सत्यमेव जयते

Report of The Working Group on Power for Twelfth Plan (2012-17)

Government of India
Ministry of Power

New Delhi
January 2012

CONTENTS

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Secretary
Government of India

सत्यमेव जयते
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PREFACE

The Planning Commission constituted the Working Group on Power to formulate the programme for development of the power sector during the 12th Plan, under the Chairmanship of Secretary (Power) with Member (Planning), CEA as its Member Secretary.

Since its constitution in March 2011, the Working Group held three meetings on 20th April, 2011, 28th July, 2011 and 26th September, 2011 respectively. During the first meeting of the Working Group, it was decided to constitute nine specialized Sub-Groups to address specific areas of the power sector and to comprehensively cover all the Terms of Reference of the Working Group. The Subgroups separately held their deliberations and their progress was regularly reviewed. This Report of the Working Group is a product of the culmination of the efforts put in by the various Subgroups.

Over the past 60 years or so, India has taken rapid strides in the development of the power sector both in terms of enhancing power generation as well as in making power available to widely distributed geographical boundaries. In order to meet the increasing demand for electricity, to fuel the economic growth of the country, large additions to the installed generating capacity and development of associated transmission and distribution network are required. However this developmental process has to be within the realms of sustainable development and environmental concerns.

During the past, the power sector was perceived to be riddled with some fundamental weaknesses, which necessitated initiation of the reform process in the Sector. Even though a number of policy initiatives have been put in place, the task of transforming the power sector is yet to be achieved. Our endeavor is to realise the stipulations of the Electricity Act 2003 as well as various policies of the Government and to ensure fructification of their intended benefits. Further, lifeline energy needs of all households must be met. Therefore, it has been the vision and the constant effort of the Government, to not only increase the generation of power in the country but also to ensure that power reaches all people with particular attention to the poor and vulnerable sections of the society.

The various Sub-Groups formed under the main Working Group deliberated on various issues as per their Terms of Reference inter alia covering Demand Projections, Generation, Transmission, Distribution including Households & Rural Electrification, Regulatory and Policy Issues, Demand Side Management & Energy Efficiency measures, Research & Development, Key Inputs, Manpower Planning & Training and Fund Requirement. The Report of the Working Group is based on the final Subgroup Reports and includes a separate chapter on development of North-Eastern Region.

The planning for the 12th Plan is in accordance with the Government's Low Carbon Growth Strategy to ensure sustainable development of the power sector. The Working Group Report has estimated a capacity addition of about 76,000 MW during the 12th Plan to meet the demand projections of the country. In our efforts to reduce GHG emissions, emphasis is being given to the development of nuclear power, hydro power as well as power from renewable sources. While planning for 12th Plan, the impact of Demand Side Management as well as Energy Efficiency measures by Bureau of Energy Efficiency have also been accounted for. However, each State needs to adopt futuristic planning and based on its estimates of requirement and availability of power from different sources, must tie-up for balance power requirement with power producers. Since need is felt to create peaking capacity in the country, the Working Group has recommended setting up of a Task Force under CERC to comprehensively address all issues related to creation of peaking and reserve capacity in the country. The Report also broadly indicates the capacity addition requirement during 13th Plan so that advance action could be initiated during the 12th Plan itself.

During the last five years we have almost fulfilled our dream of having, "One Nation One Grid". Commensurate with the generation capacity addition plans, transmission and distribution network has also been planned to facilitate power reaching the ultimate consumer. An Inter Regional transmission capacity of 37,800 MW has been planned for the 12th Plan. Transmission line additions of about 1,00,000 ckt. Kms, HVDC terminal capacity of 13,000 MW and AC transformation capacity of 2,70,000 MVA has been planned for the 12th Plan. The country need to initiate steps to evolve Smart Transmission Grid with a view to improve the reliability & efficiency of the power sector as a whole. The Report also outlines the strategy to evolve Smart Transmission Grid.

To ensure that the benefits of the increased availability of power reaches the poorest of the poor living in the rural areas, the Government has implemented the Rajiv Gandhi Grameen Vidyutikaran Yojana with vigour and determination. The Government's R-APDRP initiative aims at reducing AT&C losses through application of IT for energy auditing and accounting and through technological up gradation and strengthening of distribution infrastructure. Apart from availability and access, it is imperative to supply reliable and quality power. Reliability is manifested in the twin matrix of system availability and adequate reserves and redundancies across the value chain to cater to unforeseen situations. Since the distribution sector still remains an area of concern, major constraints being experienced and suggestions to make the distribution sector technically robust and financially viable have been covered by the Report.

The Mission of the Government is to provide quality power to all at reasonable rates. The enactment of the Electricity Act in June 2003 was a major milestone, which paved the way for development of the power sector within a competitive and liberal framework while protecting the interests of the consumers, as well as creating a conducive environment for attracting investments in the sector. The National Electricity Policy and the National Tariff Policy were finalized by the Government to steer the evolution of the power sector within the ambit of the Act. However, while traversing the developmental path, need has been felt to review certain aspects of the Electricity Act and the Government's policies. This is essential in order to make the Government's objectives achievable in accordance with the stipulated intentions, within the boundaries of the institutional and financial viability. The power sector can not deliver on its social commitments unless it is commercially and financially viable. To improve the financial health of the distribution utilities, measures are required to strengthen governance standards of DISCOMS, tariff rationalization and optimising the procurement cost of power. To cover all these issues, appropriate recommendations have been made by the Working Group in respect of legislative and policy changes required to keep the reform process on track. These need to be taken up by the Government on priority.

As a responsible nation, a two pronged strategy has been adopted whereby on one hand, continuous efforts are being made to augment the supply of clean and green power, and on the other, emphasizing the need for demand side management and energy efficiency measures. Energy Efficiency and Demand Side Management has assumed great importance in view of the need to conserve depleting energy resources as well as to minimize the carbon footprint of the power sector. Various programmes of the Bureau of Energy Efficiency have been outlined along with the likely impact and savings expected during the 12th Plan. Research and Development in the power sector is required to play an important role and therefore collaborative research in a phased manner is needed to bridge the gap between knowledge and technology. This is expected to go a long way in finding solutions for the problems existing as well as likely in the future. Areas in the power sector requiring R & D have been identified in the Report.

Timely availability of key inputs and Infrastructural support is essential for the development of the power sector. The Report highlights the requirement of various inputs, constraints being experienced in their availability and possible measures which are required to be taken. The report has identified shortage of fuel as a major challenge to the power sector. Unless adequate availability of fuel (coal & gas) is ensured for the generating plants (existing & those on the anvil) it would be very difficult to maintain the momentum of the Sector. Human resource development and capacity building demands a very pragmatic approach to attract, utilize, develop and conserve valuable human resources. A separate chapter on North Eastern Region has also been included.

The Working Group has estimated that the total fund requirement during the 12th Plan, considering each aspect of the power sector, is expected to be about Rs 14 lakh crs including Rs. 1,35,100 Cr required for renewable.

As the Indian power sector is embarking on increasing the generation and transmission capacities, key challenges lie ahead and are required to be dealt with. Power sector is poised at a crucial juncture where it is expected to meet the growing challenges of the future as well as being faced with some fundamental constraints in its path of evolution. With ambitious capacity addition plans, fuel emerges as the most significant constraint, which project developers have to grapple with and the lenders are hesitant to take the risk. Poor financial condition of State utilities due to high AT&C losses and inadequate tariff also are major constraints in the sector. Other major constraints being faced by the power sector pertain to delays in environment clearances and other key inputs such as land and water. Shortage of talent and trained manpower in the construction sector is a long term problem and is likely to continue to push up project costs and risks. Even though concerted efforts are being made to tackle these issues, it is felt that since they concern initiatives/ action to be taken by various other Ministries and Departments, intervention at the highest level is required to comprehensively work out plausible solutions.

I may mention that the capacity addition of 76,000 MW being planned for the 12th Plan comprises of about 63,000 MW coal based projects which are expected to fructify provided adequate domestic coal is available for the power projects. Import of coal to meet shortfall of domestic coal is inevitable, but related issues of increase in cost of generation and thus the tariff increasing has also to be addressed. Therefore the matter related to availability of domestic coal needs to be vigorously pursued and domestic coal production needs to be increased to meet the requirement of the 12th Plan power projects. Shortage of domestic gas will also have to be addressed on priority.

Of course the challenges before the power sector are many, but I am sure we would be able to tackle them with the support of all the stakeholders. I sincerely hope that the "Working Group Report on Power for 12th Plan" would be useful for preparation of 12th Plan documents by Planning Commission.

I acknowledge the contribution of all the members of the Working Group, the various Subgroups and the officers from Ministry of Power and Central Electricity Authority but for whose efforts this report would not have been possible.

(P. Uma Shankar)

New Delhi,
January 2012

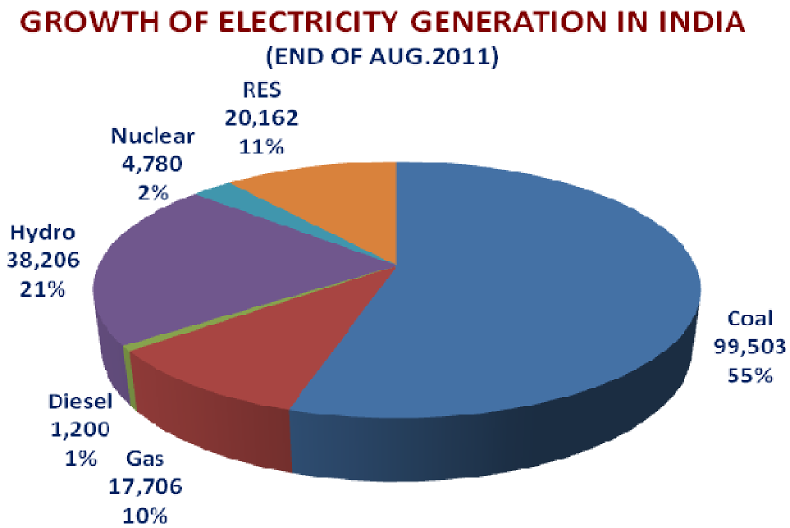
Secretary to the Government of India
Ministry of Power &
Chairman, Working Group on Power

OVERVIEW OF POWER SECTOR

Power Sector is at a crucial juncture of its evolution from a controlled environment to a competitive, market driven regime which endeavors to provide affordable, reliable and quality power at reasonable prices to all sectors of the economy. The Gross Domestic Product (GDP) of our country has been growing at the rate of about 8% for the last several years. The liberalization and globalization of the economy is leading to an increased tempo in industrial and commercial activities and this, coupled with penetration of technology and I.T. in the day-to-day life of the common man, is expected to result in a high growth in power demand. It is accordingly essential that development of the Power Sector shall be commensurate with the overall economic growth of the nation.

The Indian power sector is one of the most diversified in the world. Sources for power generation range from commercial sources like coal, lignite, natural gas, oil, hydro and nuclear power to other viable non-conventional sources like wind, solar and agriculture and domestic waste. The demand for electricity in the country has been growing at a rapid rate and is expected to grow further in the years to come. In order to meet the increasing requirement of electricity, massive addition to the installed generating capacity in the country is required. While planning the capacity addition programme, the overall objective of sustainable development has been kept in mind.

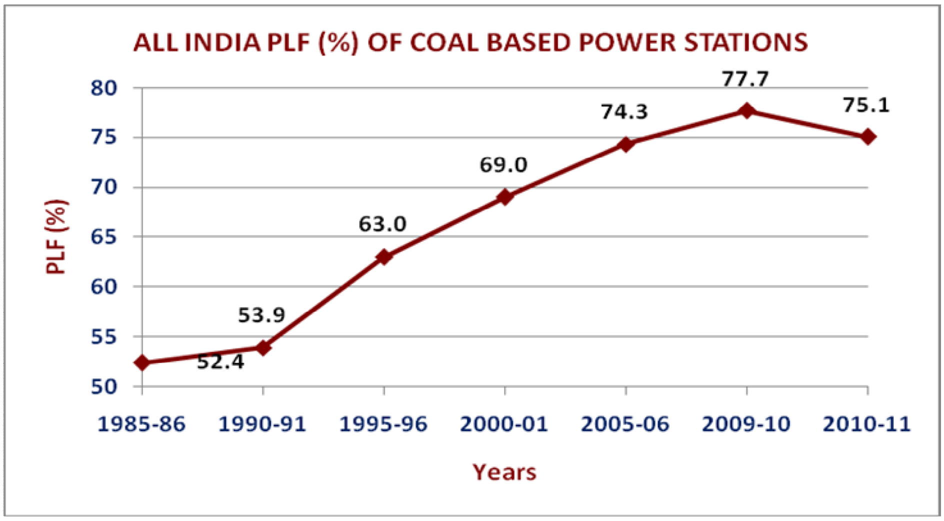
Since its structured growth post Independence, Indian power sector has made substantial progress both in terms of enhancing power generation and in making available power to widely distributed geographical boundaries. The Installed generation capacity in the Utility sector has increased to about 1,81,500 MW at the end of August 2011. The Indian power sector is largely coal based with the total Installed Capacity comprising of 99,503 MW (55 %) coal based, 17,706 MW (10%) gas based, 1200 MW (1%) diesel generation, 38,206 MW (21%) hydro, 4,780 MW (2 %) nuclear and 20,162 MW (11%) from renewable energy sources. Development of Renewable Energy Sources is being accorded special



emphasis in view of their inherent advantages. The Installed Capacity from Renewable Sources has grown to 20,162 MW in June 2011 comprising 3,226 MW in State Sector & 16,936 MW in Private Sector.

The total annual power generation has grown to about 811 BU, whereas the thermal generation has grown to 665 BU in 2011. The performance of thermal power plants in the country has steadfastly improved and the Plant Load Factor of coal based stations has increased from 52.4% during 1985-86 to 77.68 % in 2009-2010 & 75.06% during 2010-11. The Installed Capacity of captive power plants having more than or equal to 1MW capacity has grown to more than 30,000 MW at present.

Over decades, a robust inter-state and inter- regional transmission system has evolved in the country which facilitates widespread reach of power over the vast area of the country. In 1947 the maximum voltage level of transmission line was 132 kV which was subsequently increased to 220 kV in 1960 and 400 kV in 1977. To reduce Right of Way requirement for transmission lines and overcome



constraints in availability of land for substations, 765 kV transmission voltage is being increasingly adopted and Gas Insulated Stations are being provided wherever availability of land is a problem. HVDC 500 kV back to back was introduced in the year 2000.

Recognizing the need for development of National Grid, thrust was given to enhancement of the interregional capacity in a phased manner. The total Inter-regional transmission capacity by the end of 10th Plan was 14,050 MW which is now planned to grow to about 25,650 MW by 11th Plan end.

The per capita consumption of electricity in the country has increased from 15.6 units in 1950 to about 766 units during the year 2009-10. The National Electricity Policy of the Government of India stipulates that this is to be increased to over 1000 units per annum in 2012.

At the time of Independence, only about 1500 villages of the country had access to electricity. The scenario has changed significantly since then. It has been possible to extend electricity to about 5,38,296 numbers of villages out of a total of 5.93,732 as per census of 2001 villages thereby electrifying 90.8% of villages. As per rough estimates, out of this about 18,000 villages are located in remote and difficult areas and it is not possible to extend power supply to these villages through the existing power grid. Electrification of these villages, therefore, is proposed to be done through various sources of distributed generation including non-conventional sources of energy.

In spite of the massive addition in generation, transmission and distribution capacity over the last over sixty years, growth in demand for power has always exceeded the generation capacity augmentation. Although the country has achieved capacity addition of about 1,81,500 MW over the last Six decades, peak and energy shortages of varying magnitude are being experienced. During the year 2010-11, the country faced an energy shortage of 73,236 MU(8.5%) and a peak shortage of 12,031 MW (9.8%).

During the 11th Five Year Plan, a capacity addition of about 52,000 MW is expected which is over 250% of the achievement during 10th Plan and highest ever since independence. The high achievements of the 11th Plan have been facilitated due to the stringent monitoring of ongoing power projects at various levels in CEA/MOP. Other Initiatives of the Government have been the formulation of the New Hydro Policy, setting up of Ultra Mega Power Projects, enhancing the partnership of private sector in manufacture of power equipments and Bulk ordering of 11 units of 660 MW each with supercritical technology with mandatory phased indigenous manufacturing programme to promote indigenous manufacturing capability.

The Working Group on Power was constituted by the Planning Commission vide its Office Order No.1-15/1/2011-P&E dated 4th March, 2011 to formulate the power programme for 12th Plan. Secretary (Power) was the Chairman of the Working Group and Member (Planning), CEA was the Member Secretary of the Working Group. The Composition and Terms of Reference of the Working Group for Twelfth Plan are given in **Appendix-A.**

The first meeting of the Working Group was held on 20th April, 2011 under the Chairmanship of Secretary (Power). It was decided to constitute 9 specialized Sub-Groups to go into the specific areas to cover comprehensively all the Terms of Reference of the Working Group. Subsequently, review meetings of the Working Group were held in MoP on a regular basis to assess the progress of the Sub-Groups from time to time. Details of the various Sub Groups and Term of Reference are enclosed in **Appendix- B**

The Sub-Groups discussed various issues regarding Demand, Generation, Transmission & Distribution Expansion Planning, Households & Rural Electrification, Demand Side Management & Energy Efficiency Issues, Research & Development, Manpower Planning & Training and Fund Requirement. A separate chapter has also been included on development of North Eastern Region.

The report is based on 11th Plan likely capacity addition of 62,374 MW corresponding to which the 12th Plan capacity addition requirement is 75,785 MW and 13th Plan capacity addition requirement is 93,400 MW (assuming a capacity addition of 62,374 MW in 11th Plan & 75,785 MW in 12th Plan from conventional sources). However, it is felt that the likely capacity addition during the 11th Plan would be of the order of about 52,000 MW.

Various Sub-Groups submitted their Reports to the main Working Group. Based on the recommendations of these Sub-Groups the Report of the Working Group for 12th Plan has been formulated for submission to the Planning Commission.

The Power Sector is endeavoring to meet the challenge of providing adequate power needed to fuel the growing economy of the country. However, this growth of the Power Sector has to be within the realms of the principles of sustainable development. A Low carbon growth strategy has been adopted in our planning process and highest priority is accorded to development of generation based on renewable energy sources. Thrust is also accorded to maximizing efficiency in the entire electricity chain, which has the duel advantage of conserving scarce resources and minimizing the effect on the environment. It is in this context that this Report has drawn up the Plans for development of the Power Sector during the 12th Plan.

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Appendix-A

No.1-15/1/2011-P&E
Government of India
Planning Commission
(Power & Energy Division)

Yojana Bhawan
Sansad Marg,
New Delhi – 110 001.

Dated: 4th March, 2011.

ORDER

Subject:-**Constitution of a Working Group on Power for formulation of Twelfth Five Year Plan.**

It has been decided to constitute a Working Group on Power in the context of preparation of Twelfth Five Year Plan. The composition and Terms of Reference of the Group will be as follows :

A. Composition

Secretary. Ministry of Power – Chairman

Members

1. Sr. Adviser (Energy), Planning Commission
2. Chairperson, Central Electricity Authority
3. Representative of Ministry of New & Renewable Sources of Energy.
4. Representative of Department of Atomic Energy
5. Representative of Ministry of Coal
6. Representative of Ministry of Petroleum & Natural Gas
7. Representative of Ministry of Environment & Forest
8. Representative of Department of Science & Technology
9. Member (Planning), Central Electricity Authority – Member Secretary

PSUs

1. CMDs:
   National Thermal Power Corporation (NTPC)
   National Hydro Electric Power Corporation (NHPC)
   Power Grid Corporation of India Ltd. (PGCIL)
   Power Finance Corporation (PFC)
   Rural Electrification Corporation (REC)
   Nuclear Power Corporation of India Ltd.(NPCIL)
2. Chairman/CMDs
   Gujarat Urja Vikas Nigam Ltd.(GUVN)
   Haryana Vidyut Prasaran Nigam (HVPN)
   Karnataka Power Corporation Ltd. (KPCL)

Maharashtra State Electricity Distribution Co.Ltd.(MSEDC)
Grid Corporation of Orissa Ltd. (GRIDCO)

Private Sector Representatives and other non-official Members –

to be nominated separately

B. Terms of Reference

i) To review the status of various policies notified under the provisions of Electricity Act, 2003 and to identify steps needed to realize the objectives of the Electricity Act, 2003.
ii) To recommend an industry structure that would enhance the number of players, promote competition, provide a consistent and transparent pricing regime and raise conversion, transmission, distribution and end use efficiency.
iii) To review the likely achievement vis-à-vis targets during the Eleventh Plan period towards Generation, Transmission, Distribution and Renovation & Modernization (R&M). An analysis of the reasons for shortfalls, if any, may be highlighted.
iv) To review the current status of captive generation in the country, highlight issues facing this sub-sector and make recommendations for enhancing captive generation during the Twelfth Plan Period.
v) To review the effectiveness of the Twelfth Plan Schemes such as Accelerated Power Development & Reforms Programme (APDRP) and Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) and to suggest modifications and/or give its recommendations.
vi) To assess the State-wise/region wise demand for power in terms of both peak and energy requirements.
vii) To recommend the optimal mix of additional generating capacity to be created during the Twelfth Plan period in terms of hydro, thermal (coal, gas, lignite and liquid fuel) and nuclear generation on the basis of relative economics of different fuels at different locations. Advance action to be taken in the Twelfth Plan period for the Thirteenth Plan projects may also be identified.
viii) To assess the potential for improving availability of power from existing power stations through Renovation & Modernization/life extension.
ix) To review the on-going reform process undertaken by States in the power sector with special emphasis on financial health of distribution utilities.
x) To suggest Energy conservation measures through Demand Side Management (DSM) such as staggering of load, time of the day metering and pricing, reduction in the energy intensity of the large consumers etc.
xi) To develop a work plan to tackle problems in ash disposal, pollution and other environmental issues.
xii) To make recommendations regarding S&T programme to be implemented in the Twelfth Plan period and the institutional arrangements necessary therefore.
xiii) To explore avenues for purchase of power from neighboring countries through joint venture schemes.
xiv) To assess the investment requirement for the Twelfth Plan in the Power Sector.
xv) To assess the infra-structural support such as transportation, port facilities, construction and manufacturing capabilities, roads, etc. that would be required for implementation of the Twelfth and Thirteenth Five Year Plans.

3. In order to assist the Working Group in its task, separate Sub-Groups on specific aspects may be formed by the Working Group. These Sub-Groups will furnish their reports to the Working Group.
4. The Chairman of the Working Group may co-opt experts as may be considered necessary.
5. The Working Group will submit its report to the Planning Commission latest by 30th September, 2011.
6. Non-Official members shall be entitled to payment of TA/DA by the Planning Commission as per SR 190(a), Official members will be entitled to payment of TA/DA by their respective Departments/Organizations, as per the rules of entitlement applicable to them.
7. The name(s) of the Representative(s) of various organizations, as per the above composition may be communicated to the Member Secretary of the Working Group under intimation to Dr.Arbind Prasad, Senior Adviser(Energy), Planning Commission.
8. Shri Somit Dasgupta, Adviser (Power), Planning Commission, Room No.322 B, Yojana Bhawan, New Delhi – 110 001 (Telephone No.23096608), shall be the Nodal Officer for this Wroking Group.

-sd-
(R.K.Kaul)
Consultant (Power)

1. Chairman, Working Group
2. Chairperson, Central Electricity Authority
3. Member (Planning), Central Electricity Authority, Member-Secretary of the Working Group
4. All Members of the Working Group

Copy for information to :

1. PS to Deputy Chairman
2. PS to Member (Energy)
3. PS to Member Secretary
4. PS to Senior Adviser (Energy)
5. All Heads of the Division/Adviser (PC)
6. PC Division (2 copies)

- sd-

(R.K.Kaul)
Consultant (Power)

No.1-15/1/2011-P&E
Government of India
Planning Commission
(Power & Energy Division)

Yojana Bhawanm
Sansad Marg,
New Delhi – 110 001.

Dated: 16th March, 2011.

ORDER

Subject:-**Constitution of a Working Group on Power for formulation of Twelfth Five Year Plan.**

In continuation of this office order of even number dated 4th March, 2011 on the above subject, the names of the private Sector Representatives and other non-official Members are inducted as per the list given below:

Private Sector Representatives

1. CEO, Reliance Energy Company
2. Managing Director, Tata Electric Company
3. Chairman, Torrent Electric Company

Others non-official Members –

1. Dr.E.A.S.Sarma, Former Secretary, Ministry of Power
2. Shri Girish Sant, PRAYAS
3. Dr.Leena Srivastava, TERI
4. Shri Divaker Dev, Ex.CMD, REC and Ex.Chairman, UTERC
5. Shri Navroj Dubash, Centre for Policy Research
6. Prof.G.V.Siva Krishna Rao, Andhra University

A copy of the above office order dated 4th March, 2011 is also enclosed for reference to the above Members.

-sd-
(R.K.Kaul)
Consultant (Power)

1. Chairman, Working Group
2. Chairperson, Central Electricity Authority
3. Member (Planning), Central Electricity Authority, Member-Secretary of the Working Group.
4. Members of Private Sector Representatives and other non-official Members listed above.

Appendix-B

SUB-GROUP 1

DEMAND PROJECTION AND GENERATION PLANNING

Constitution

- Chairperson, CEA — Chairman of subgroup
- Chief Engineer, (IRP), CEA — Member Secretary of subgroup

Members

- Member (Thermal), CEA
- Member (Planning), CEA
- Member (Hydro), CEA
- Joint Secretary (Planning), MoP
- Representative of Planning Commission
- Representative of NTPC
- Representative of NHPC
- Representative of PFC
- Representative of NPCIL
- Chairman, Regional Power Committees
- Representative of Gujarat Urja Vikas Ligam Ltd
- Representative of Haryana Power Department
- Representative of Electricity Department of Assam
- Representative of APGENCO
- Representative of Bihar State Electricity Board
- Representative of Ministry of Coal
- Representative of Ministry of Petroleum & Natural Gas
- Representative of Ministry of Environment & Forests
- Representative of Department of Road, Transport & Highways
- Representative of Ministry of Railways
- Representative of MNRE
- Representative of BHEL
- Ministry of Heavy Industries
- Ministry of Commerce
- Representative of TERI
- Secretary, CERC.
- Dr E A S Sarma, Former Secretary (MoP)
- Representative of Reliance Power Ltd
- Representative of Tata Electric Company
- Representative of Torrent
- Representative of Essar
- Representative of CII
- Shri Girish Sant, PRAYAS (NGO)

- Chief Engineer (DMLF), CEA
- Chief Engineer (TETD), CEA

Terms of Reference of Sub-Group 1 – DEMAND PROJECTION AND GENERATION PLANNING

- To review the likely achievement viz-viz targets during 11th Plan period towards generation including non-conventional sources and R&M/LE. An analysis of the reasons for shortfalls if any may be highlighted
- Demand Assessment in terms of peak and energy requirements considering impact of DSM and Energy Conservation measures.
- Recommend optimal mix of additional Generation Capacity for 12th Plan – Listing of Projects & their phasing and advance action for 13th Plan during 12th Plan including broad identification of projects
- Suggest Policies to shift to Super-critical technologies (12th Plan to act as transitional 5 years)
- Assessment of generation capacity addition during 12th Plan from grid connected non-conventional energy sources
- Assess potential for R&M/LE and formulate plans to maximize benefit (efficiency & capacity utilization)
- Captive Plants
  - Review Status
  - Highlight issues facing this sub-sector
  - Recommendations for enhancing captive capacity during 12th Plan
- Human Resource Development plans
- Investment Requirement during 12th Plan

SUB-GROUP 2- TRANSMISSION PLANNING INCLUDING NATIONAL GRID

Constitution

- Member (PS), CEA — Chairman of subgroup
- Chief Engineer (SP&PA) CEA — Member Secretary of subgroup

Members

- Chairman Regional Power Committees – 5 Nos.
- Representative of NTPC
- Representative of POWER GRID
- Representative of PFC
- Representative of PTC
- Representative of MNRE
- Representative of UPPTCL
- Representative of WBPDC
- Representative of Tamil Nadu TRANSCO
- Representative of MSETCL
- Representative of Tripura
- Joint Secretary (Trans), Ministry of Power
- Representative of Planning Commission
- Representative of Ministry of Environment & Forests
- Representative of Reliance Power Ltd
- Representative of Tata Electric Company
- Representative of Torrent
- Chief Engineer (IRP), CEA
- CEO of POSOCO
- Representative of Power Exchanges (IEX, PXIL)
- Representative of BHEL
- Representative of Ministry of Commerce
- Representative of MEA
- Secretary CERC
- Representative of KEC International Ltd
- Representative of Adani Power

Terms of Reference of Sub-Group 2 – TRANSMISSION PLANNING INCLUDING NATIONAL GRID

- Review achievements of 11th Plan targets for Transmission & analysis of reasons for shortfall
- Integrated development of transmission system keeping in view the requirement of National Grid, open access in transmission and trading, and evacuation of renewable energy.
- Bringing in transmission planning efficiency for optimal utilization of resources.
- To explore avenues for purchase of power from neighboring countries through joint venture schemes
- Development of Transmission Plan for 12th /13th Plan considering Right of Way Issues and in accordance with stipulations of Smart Grid
- To suggest measures to facilitate ROW and provision of compensation.
- Human Resource Development plans
- Investment Requirement during 12th Plan

SUB-GROUP 3-DISTRIBUTION INCLUDING VILLAGE & HOUSEHOLD ELECTRIFICATION

Constitution

- Joint Secretary (RE), MoP — Chairman of subgroup
- Director, REC — Member Secretary of subgroup

Members

- Representative of Council of Power Utility
- Representative of State Power Discoms – **GRIDCO**, Chattisgarh, Tripura, Karnataka, UP
- Representative of Ministry of Rural Development
- Dr S.K.Chopra, Consultant, Planning Commission
- Representative of MNRE
- Representative of IREDA
- Representative of IEEMA
- Representative of PRAYAS
- Representative of Reliance Power Ltd
- Representative of Tata Electric Comapny
- Representative of Torrent
- Representative of NABARD
- Representative of TERI
- Shri Divakar Dev, Ex CMD, REC & Ex-Chairman, UTERC
- Chief Engineer (DPED), CEA

Terms of Reference of SUB-GROUP 3-DISTRIBUTION INCLUDING VILLAGE & HOUSEHOLD ELECTRIFICATION

- Review likely achievements during 11th Plan in meeting targets for Distribution and Rural Electrification. Analysis of reasons for shortfall.
- Plan for distribution system including Smart Grid, Rural Electrification and development of Non-conventional Energy Sources to meet requirement of remote areas which are not feasible or not economical to be connected to the grid.
- Measures for making available reliable and quality power to consumers at affordable rates
- Achievements and Plans regarding Non Conventional Energy Sources including decentralized distributed generation
- Review effectiveness of following 11th Plan schemes and to suggest modifications and/or give recommendations
  - R-APDRP
  - RGGVY
- Human Resource Development plans
- Investment Requirement during 12th Plan.

SUB-GROUP 4-LEGISLATIVE AND POLICY ISSUES – FORMULATION, IMPLEMENTATION & FEEDBACK

Constitution

- Additional Secretary, MoP — Chairman of subgroup
- Director, MoP (R&R) — Member Secretary of subgroup

Members

- Joint Secretary (Planning & Policy), MoP
- Chief Engineer (Legal), CEA
- Representative of MNRE
- Representative of Council of Power Utility
- Representative of State Power Utility – (**Haryana**, WB, Maharashtra, AP, Assam)
- Representative of NTPC
- Representative of NHPC
- Representative of POWER GRID
- Secretary, CERC
- Representative of Maharasthra Regulatory Commission
- Secretary of Bihar Regulatory Commission
- Representative of Forum of Regulators
- Representative of POSOCO (Shri S.K. Soonee)
- Representative of PFC
- Representative of BHEL
- Representative of CII / FICCI
- Representative of TERI
- Representative of Planning Commission
- Representative of IIM Ahmedabad
- Representative of National Council of Applied Economic Research
- Representative of Reliance Power Ltd
- Representative of Tata Electric Company
- Representative of Torrent
- Representative of PRAYAS, Pune
- Sh Navraz Dubash, Center for Policy Research
- Prof. G.V. Shiva Krishna Rao, DepartmentAndhra University

TERMS REFERENCE OF SUB-GROUP 4-LEGISLATIVE AND POLICY ISSUES – FORMULATION, IMPLEMENTATION & FEEDBACK

- Review status of various Policies notified under Electricity Act, 2003 and identify steps to realize objectives of Act
- Recommend Industry Structure to
    - Enhance number of players
    - Promote Competition
    - Provide Consistent & Transparent pricing regime and raise conversion, transmission, distribution and end use efficiency
    - Improve efficiency
- Review of ongoing Reform process undertaken by states in the Power Sector with special emphasis on financial health of distribution utilities and suggest measures for long-term viability of power sector.
- To suggest legal changes, if required, to facilitate ROW and provision of compensation

SUB-GROUP 5-DEMAND SIDE MANAGEMENT, ENERGY EFFICIENCY & ENERGY CONSERVATION

Constitution

- Director General, BEE — Chairman of subgroup
- Secretary, BEE — Member Secretary of subgroup

Members

- Advisor (Energy), Planning Commission
- Director (EC), Ministry of Power
- Representative of Ministry of Petroleum & Natural Gas
- Representative of Ministry of Coal
- Representative of Department of Road, Transport & Highways
- Representative of Ministry of Railways
- Representative of Department of Industrial Policy & Promotions
- Representative of National Productivity Council
- Representative of MNRE
- Executive Director, Petroleum Conservation Research Association
- Representative of Indian Renewable Energy Development Agency
- Representative of APTRANSCO
- Representative of State / Power Utility – 5 Nos. (Delhi, WB, Gujart, Andhra Pradesh, Sikkim)
- Representative of TERI
- Representative of Bureau of Indian Standards, New Delhi
- Representative from Indira Gandhi Institute of Development & Research, Mumbai
- Dr. Anshu Bhardwaj , Director, C-Step (Centre for Study Of Science Technology and Policy
- Representative from , IIT, Delhi
- Representative from Confederation of Indian Industry, New Delhi.
- Representative of Federation of Indian Chambers of Commerce & Industry
- Representative of IEMMA
- Representative of ELCOMA
- Representative of ESCO (Energy Service Companies)
- Representaive of POSOCO (Shri S.K. Soonee)
- Sh Girish Sant, PRAYAS, Pune
- Sh. Ajit Kapadia, Director, Centre for Fuel Studies & Research Vadodara
- Representative of Reliance Power Ltd
- Representative of Tata Electric Comapny
- Representative of Torrent
- Chief Engineer (GM), CEA
- Chief Engineer (C&E), CEA
- Chief Engineer (DPED), CEA
- Prof R. Balasubramanian , IIT , Delhi.

TERMS OF REFERENCE OF SUB-GROUP 5-DEMAND SIDE MANAGEMENT, ENERGY EFFICIENCY & ENERGY CONSERVATION

- Assess Energy Conservation measures implemented and review achievements till 11th Plan.
- Suggest Energy Conservation Measures through Demand Side Management (DSM) such as staggering of load, time of day metering and pricing, reduction in energy intensity of large consumers etc.
- Formulate DSM and Energy Efficiency Targets for 12th Plan and measures to be adopted to meet these targets, including Financial incentives and new financial instruments to finance energy efficiency projects.
- Achievements and Plans with respect to Missions of Climate change
- Human Resource Development Plans
- Investment Requirement during 12th Plan

SUB-GROUP 6-TECHNOLOGICAL ADVANCEMENT AND RESEARCH & DEVELOPMENT

Constitution

- Director General, CPRI — Chairman of subgroup
- Executive Director (R&D), NTPC — Member Secretary of subgroup

Members

- Representative of Planning Commission
- Representative of State / Power Utility – Maharashtra State Electricity Distribution Co. Tamil Nadu Electricity Board, KPTCI, Delhi Transco PSEB
- Representative of Ministry of Power
- Representative of BHEL
- Representative of L&T
- Representative of IEEMA
- Representative of ERDA, Baroda
- Representative of Department of I T
- Representative of Ministry of E&F
- Representative of CBI & P
- Representative of Bureau of Energy Efficiency
- Representative of MNRE
- Representatives of Deptt of Science & Technology (including CSIR, Fly Ash Mission, CCS)
- Prof. Bhim Singh, IIT, Delhi.
- Representative of IIT, Kanpur
- Representative of IIM, Ahmedabad
- Representative of NTPC, POWERGRID, NHPC
- Representative of TERI
- Representative of ASSOCHAM
- Prof G V Shiva Krishna Rao, Andhra University
- Chief Engineer (TETD), CEA
- Chief Engineer (TCD), CEA
- Chief Engineer (HETD), CEA
- Chief Engineer (R&D), CEA
- Chief Engineer (SETD)
- Prof. R. Balasubramanian, IIT, Delhi.

TERMS OF REFERENCE OF SUB-GROUP 6-TECHNOLOGICAL ADVANCEMENT AND RESEARCH & DEVELOPMENT

- Review of Existing R&D Facilities & Programmes in Power Sector
- Recommendations regarding Science & Technology programmes to be implemented during 12th Plan, including identification, transfer and diffusion of technology in various areas of the Power Sector such as GIS, Ultra supercritical technology, IGCC etc. Institutional arrangements to take up above programmes to be identified. Applied research in specific areas, adoption and adaptation.
- To develop work plan to tackle problems in ash disposal, pollution and other environmental issues.
- Human Resource Development Plans
- Investment requirement during 12th Plan

SUB-GROUP 7- ISSUES CONCERNING KEY INPUTS

Constitution

- Joint Secretary(Thermal), MoP — Chairman of subgroup
- Chief Engineer, (TPIA) CEA — Member Secretary of subgroup

Members

- Representative of Planning Commission
- Representative of Ministry of Power
- Representative of Ministry of Coal
- Representative of Ministry of Heavy Industry
- Representative of Ministry of Railways
- Representative of Ministry of Mines
- Representative of Ministry of Shipping & Transport
- Representative of Ministry of Steel
- Representative of Ministry of Petroleum & Natural Gas.
- Representative of Coal India Limited
- Representative of NTPC, NHPC, NJPC, POWERGRID, BHEL
- Representatives of States (One in each Region) (Rajasthan, West Bengal, MP, Karnataka, Arunachal Pradesh)
- Representative of Reliance Power Ltd
- Representative of Tata Electric Company
- Representative of Torrent
- Representative of IEEMA
- Representative of CII
- Representative of JV of L&T&MHI
- Representative of JV Alstom & Bharat Forge
- Representative of JV of Toshiba & JSW
- Representative of Inland Waterways Authority of India
- Chief Engineer (IRP), CEA
- Chief Engineer (OM), CEA
- Chief Engineer(HETD), CEA
- Chief Engineer(OM),CEA
- Chief Engineer (TETD), CEA

TERMS OF REFERENCE OF SUB-GROUP 7- ISSUES CONCERNING KEY INPUTS

- To assess infrastructural support required for 12th & 13th Plan
    - Fuel
- Land and Water requirement
- Transport (Railways, Roads, Waterways, Gas pipeline, LNG terminals)
- Port Facilities

- Construction & Manufacturing Capabilities specifically erection machinery & erection agencies including Civil & BOP contractors.
- Steel, Cement, Aluminum and other material

SUB-GROUP 8-FINANCIAL ISSUES

Constitution

- CMD, PFC — Chairman of subgroup
- MD & CEO, SBI Caps — Member Secretary of subgroup

Members

- Representative of Planning Commission
- Joint Secretary & FA, MoP
- Representatives of States (One in each Region) (HP, Bihar, Gujarat, Manipur, Tamil Nadu)
- Representative of Department of Financial Services
- Representative of IDFC
- Representative of IDBI
- Representative of Institute of Public Finance
- Representative of Torrent
- Representative of ICICI
- Representative of CRISIL
- Representative of LIC
- Representative of GIC
- Representative of Reliance Power Ltd
- Representative of Tata Electric Company
- Representative of Torrent
- Economic Advisor, CEA
- Representative of REC
- Representative of RBI
- Director (Planning) , Ministry of Power.
- Mr. Gunit Chadha, CEO – India, Deutche Bank AG.

TERMS OF REFERENCE OF SUB-GROUP 8-FINANCIAL ISSUES

- Review of Financial Issues
- To assess the investment requirement for 12th Plan in the power sector
- Policy issues concerning arrangement of funds for Power Sector

SUB-GROUP 9-HUMAN RESOURCE DEVELOPMENT & CAPACITY BUILDING

Constitution

- CMD NTPC — Chairman of subgroup
- DG, NPTI — Member Secretary of subgroup

Members

- Joint Secretary (T), MoP
- Joint Secretary (RE/APDRP/IT/PFC), MoP
- Representatives of States (One in each Region) Chhatisgarh, J&K, Kerala, West Bengal, Assam)
- Representative of BEE.
- Representative of Ministry of Labor
- Representative of BHEL
- Ministry of HRD
- Representative of IGNOU
- Representative of IIT, Delhi
- Representative of IIM, Bangalore
- Representative of MDI, Gurgaon
- Representative of Project Management Associates
- Shri S.K. Soonee, POSOCO
- Shri Sudhir Wadera, Coord. Consultant
- Representative of NTPC
- Representative of DVC
- Representative of Jindal Power
- Representative of Tata Electric Company
- Representative of TERI
- Representative of CPRI
- Representative of PGCIL
- Representative of NPC
- Prof G V Shiva Krishna Rao, Andhra University
- Chief Engineer(HRD) CEA

TERMS OF REFERENCE OF SUB-GROUP 9-HUMAN RESOURCE DEVELOPMENT & CAPACITY BUILDING

- Review existing manpower in Power Sector and training facilities / programmes and to suggest measure for training of staff in various categories.
- Review and make broad assessment of man power requirements state-wise and category-wise for construction, operation and maintenance of generation, transmission and distribution systems during 12th & 13h Plans.
- To assess the financial requirement of man power planning and training arrangement during 12th & 13th Plans.

EXECUTIVE SUMMARY

1.0 DEMAND PROJECTION AND GENERATION PLANNING

1.1 REVIEW OF CAPACITY ADDITION DURING 11TH PLAN

The Planning Commission had set a capacity addition target of 78,700 MW for 11th Plan. This comprised of 15,627 MW Hydro, 59,693 MW Thermal and 3,380 MW Nuclear. Subsequently, as per the Mid Term Appraisal of Planning Commission, a revised target of 62,374 MW was set for 11th Plan. A capacity of 34,462 MW has been commissioned during first four years of 11th Plan. Capacity addition programme during the year 2011-12 is 17,601 MW and accordingly the likely capacity addition during 11th Plan is expected to be about 52,063 MW. The total capacity commissioned during 11th Plan till 30.09.2011 is 41,617.5 MW. In addition, during the 11th Plan, a capacity totalling to 10,694 MW has already been commissioned from Renewable Energy Sources as on 31.03.2011.

1.2 DEMAND PROJECTIONS

Demand Projections form an essential input to the Generation Planning exercise. Demand in terms of Peak demand in MW, Energy Requirement in BUs and the load profile for the entire year is used as the basis for estimating the Generation Capacity addition required to meet the demand in full.

For the Generating Planning Studies, in the Base Case, demand corresponding to actual requirement in 2009-10 and thereafter 9% GDP growth rate and 0.9 & 0.8 elasticity during 12th & 13th Plans respectively has been considered to assess capacity addition requirement for 12th and 13th Plan periods. Thereafter, reduction in Peak Demand and Energy Requirement, on account of BEE's Energy Efficiency Measures and DSM programmes has also been accounted for while arriving at the final Peak Demand & Energy Requirement for the generation planning studies. A load factor of about 78% was considered while estimating the peak demand for 2016-17 & 76% for 2021-22.

Based on the above, in the Base Case, *the* demand to be adopted by 12th and 13th Plan end is as follows:

Table ES -1

DEMAND ADOPTED FOR GENERATION PLANNING STUDIES – BASE CASE

	Energy Requirement (BU)	Peak Load (MW)
	9% GDP Growth rate (0.9/ 0.8 Elasticity in 12th / 13th Plan)	9% GDP Growth rate (0.9/ 0.8 Elasticity in 12th / 13th Plan)
2016-17 (12TH Plan end)	1403	1,97,686
2021-22 (13th Plan end)	1993	2,89,667

It is pertinent to mention that the above projections by 12th Plan end are very close to the projections of the draft 18th EPS Report with peak demand of 1,99,540 MW and energy requirement 1354 BU.

Another demand scenario for the 12th Plan, with 9% GDP growth rate and an Elasticity of 1 has also been considered for capacity addition planning as a sensitivity analysis. The demand projections with 9% GDP growth rate and an Elasticity of 1 during 12th Plan are as given below:

Table ES -2
DEMAND ADOPTED FOR GENERATION PLANNING STUDIES – SENSITIVITY STUDY 12TH PLAN

	Energy Requirement (BU)	Peak Load (MW)
	9% GDP Growth rate 1.0 Elasticity in 12th Plan	9% GDP Growth rate 1.0 Elasticity in 12th Plan
2016-17 (12TH Plan end)	1489	2,09,339

1.3 PLANNING NORMS

Availability of plant, Plant Load Factor (PLF), Auxiliary Power Consumption and Heat Rate of the generating units are key performance parameters of generating station. Different types of generating units have varied operational performance and accordingly different norms have been used for thermal (coal), gas, hydro and Nuclear projects to make a fair assessment of the new generation capacity requirement. LOLP of 0.2 % and ENS of 0.05 % have been adopted for planning purposes for 12th & 13th Plan periods.

1.4 CAPACITY ADDITION REQUIREMENT FOR 12th PLAN AND 13th PLAN

Generation expansion planning studies for 12th Plan end (2012-17) have been carried out using EGEAS (Electric Generation Expansion Analysis System) software to assess the requirement of additional generating capacity during the 12th Plan period (2012-17), considering capacity addition of 62,374 MW during the 11th Plan. While carrying out studies, the requirement of 5% Spinning reserve as stipulated in the National Electricity Policy, effect of up rating of hydro power plants and expected retirement of thermal units by 2012-17 have also been considered. A capacity of about 4,000 MW each from old and inefficient thermal units has been considered for retirement during 12th and 13th Plan.

1.4.1 Base Case - Based on the above studies, the capacity addition requirement during 12th Plan works out to 75,715 MW. In accordance with the Low Carbon Growth Strategy, priority has been accorded to renewable energy sources based, hydro and nuclear generation capacity. Accordingly, a feasible hydro capacity addition of 9,204 MW and nuclear capacity addition of 2,800 MW has been taken as must run during 12th Plan while assessing generation capacity addition requirement. Gas based capacity of 1,086 MW only has been considered while carrying out studies, as gas for these projects is assured since it is tied up from local sources. Besides this, 1200 MW import from Bhutan has also been considered. The balance capacity addition to meet the demand would be from coal based capacity which is 62, 625 MW. However, against this requirement of 62,625 MW, projects totalling to, 62,695 MW have been identified to yield benefits during 12th Plan. The capacity addition planned during the 12th Plan is detailed below:

Table ES -3

CAPACITY ADDITION REQUIREMENT DURING 12th PLAN (MW)- BASE CASE

(Figures in MW)

Type of Capacity	Demand corresponding to 9% GDP GR & 0.9 Elasticity
Thermal	**63,781**
Coal	**62,695**
Gas	**1,086**
Hydro	**9,204**
Nuclear	**2,800**
Total	**75,785**

In addition, grid interactive renewable capacity addition of about 18,500 MW during 12th Plan comprising of 11,000 MW wind, 1,600 MW small hydro, 2,100 MW Biomass power, Bagasse Cogeneration and waste to energy put together and 3,800 MW Solar has been considered based on inputs provided by MNRE.

The tentative Sector-wise break-up of the capacity addition during 12th Plan is as follows:

Table ES -4

Sector-wise Break-up of 12th Plan Capacity

(Figures in MW)

Sector	Hydro	Coal	Lignite	Gas	Total Thermal	Nuclear	TOTAL
Central	5632	10600	0	826	11426	2800	**19858**
State	1456	12080	0	260	12340	0	**13796**
Private	2116	40015	0	0	40015	0	**42131**
TOTAL	**9204**	**62695**	**0**	**1086**	**63781**	**2800**	**75785**

Broad details of Coal based capacity of 62,695 MW are as follows:

(i) Technology type:
- Super Critical - 23,940 MW (38%)
- Sub-Critical - 38,755 MW (62%)

(ii) Source of Coal:
- Coal Linkage - 38,548 MW
- Coal Block - 17,825 MW
- Imported Coal - 6,292 MW
- Requiring Coal Linkage - 30 MW

(iii) Location:
- Pithead - 25,995 MW
- Load Centre - 25,160 MW
- Coastal - 11,540 MW

The estimated fund requirement during 12th Plan for generation, including renewable, works out to about Rs 6,38,600 crs including Rs 2,72,582 crs for advance action for 13th Plan projects.

1.4.2 Sensitivity Studies for 12th Plan

Sensitivity studies for 12th Plan have also been carried out based on demand projections with 9% GDP growth rate and an Elasticity of 1 and the capacity addition worked out. For sensitivity analysis two additional scenarios in capacity addition have been worked out as follows:

- **High Gas Scenario**- Additional 12,000 MW gas based capacity under construction has been considered over and above 1086 MW already taken in the Report.
- **High Gas + High Renewable Scenario** - As per revised programme of MNRE, total renewable capacity addition of 30,000 MW during 12th Plan has been taken instead of 18,500 MW considered earlier.

1.4.3 Summary of Capacity Addition in Base Case and Sensitivity Analysis:

A: Capacity addition required during 12th Plan with Demand corresponding to 9% GDP Growth Rate & 0.9 Elasticity.

Table ES -5

(Figures in MW)

Type of Capacity		Capacity addition required during 12th Plan with Demand corresponding to 9% GDP GR & 0.9 Elasticity		
		Base Case Scenario	High Gas Scenario	High Gas + Higher Renewables Scenario
Thermal		63,781	63,686	**60,486**
	Coal	62,695	50,600	**47,400**
	Gas	1,086	13,086	**13,086**
Hydro		9,204	9,204	**9,204**
Nuclear		2,800	2,800	**2,800**
Total		**75,785**	**75,690**	**72,490**
Renewables		18,500	18,500	**30,000**
Imports		1,200	1,200	**1,200**
Total with Renewables and Imports		95,485	95,390	**1,03,690**
Coal Requirement (MT)		**842**	**772**	**764**

B: Capacity addition required during 12th Plan with Demand corresponding to 9% GDP Growth Rate & 1 Elasticity

Table ES -6

(Figures in MW)

Type of Capacity		Capacity addition required during 12th Plan with Demand corresponding to 9% GDP GR & 1.0 Elasticity		
		Corresponding to Base Case Scenario with 1.0 Elasticity	High Gas	High Gas + Higher Renewables
Thermal		84,486	85,286	**82,086**
	Coal	83,400	72,200	**69,000**
	Gas	1,086	13,086	**13,086**
Hydro		9,204	9,204	**9,204**
Nuclear		2,800	2,800	**2,800**

Type of Capacity	Capacity addition required during 12th Plan with Demand corresponding to 9% GDP GR & 1.0 Elasticity		
	Corresponding to Base Case Scenario with 1.0 Elasticity	High Gas	High Gas + Higher Renewables
Total	**96,490**	**97,290**	**94,090**
Renewables	18,500	18,500	**30,000**
Imports	1,200	1,200	**1,200**
Total with Renewables and Imports	1,16,190	1,16,990	**1,25,290**
Coal Requirement (MT)	**905**	**844**	**837**

1.4.4 Capacity addition required during 13th Plan

The peak demand and energy requirement during the terminal year of 13th Plan (2021-22) is expected to be 2,89,667 MW and 1993 BU respectively. The capacity addition requirement during 13th Plan corresponding to this demand works out to 93,400 MW (assuming a capacity addition of 62,374 MW in 11th Plan & 75,785 MW in 12th Plan from conventional sources) as detailed below:

Table ES-7

CAPACITY ADDITION REQUIREMENT DURING 13th PLAN

(Figures in MW)

Type of Capacity	Demand corresponding to 9% GDP GR & 0.8 Elasticity
Thermal	**63,400**
Hydro	**12,000**
Nuclear	**18,000**
Total	**93,400**

Feasible hydro capacity addition of 12,000 MW and nuclear capacity addition of 18,000 MW has been considered as must run during 13th Plan while assessing generation capacity addition. In addition, MNRE has projected a grid interactive renewable capacity addition of about 30,500 MW during 13th Plan, comprising of 11,000 MW Wind, 1,500 MW from Small Hydro, 2,000 MW Biomass power, Bagasse Cogen and waste to energy put together and 16,000 MW Solar.

1.5 COAL DEMAND AND AVAILABILITY DURING 12TH PLAN

Availability of coal for the coal based thermal power stations is a matter of serious concern. Studies show that the likely system energy requirement that is to be met by coal based plants during the year 2016-17 would be 1095 Billion Units. Further, assuming that the estimated generation available from hydro stations to be 30% less than their design energy, the total generation, to be met by coal based plants works out to be 1155 Billons Units.

In order to meet this generation requirement, coal requirement (at SPCC 0.73 Kcal/ Kg) works out to around 842 MT. Against the requirement of 842 MT, 54 MT coal is to be imported by Thermal Power Stations designed on imported coal. SCCL has confirmed a coal availability of 35 MT and around 100 MT coal is expected to be available from captive coal blocks. Thus, 653 MT coal needs to be made available by CIL.

Scenario-I Business As Usual (BAU) - Base Case:

Against the requirement of 653 MT coal, CIL have committed to supply 415 MT which is about 75% of their total production of 556 MT in BAU scenario. The availability/shortfall of indigenous coal is detailed below:

(i)	Coal requirement during the year 2016-17		=	842 MT
(ii)	Coal availability from :			
	(a)	CIL	=	415 MT
	(b)	SCCL	=	35 MT
	(c)	Captive Blocks allocated to Power Utilities	=	100 MT
	(d)	Coal to be imported by TPSs designed imported coal	=	54 MT
		Total, coal availability	=	604 MT
(iii)	Shortfall		=	238 MT

In order to bridge the above gap between demand and coal availability, Power Utilities are expected to import around 159 MT to meet shortage in coal supply from CIL. However, such a huge quantity of imported coal for blending may not be feasible as in the existing boilers maximum 15% of blending of imported coal is possible. This quantity of imported coal would be in addition to 54 MT coal likely to be imported by Thermal Power Stations designed on imported coal. Therefore, the total quantity of coal expected to be imported is about 213 MT.

It may be noted that the availability of coal as indicated by CIL would support only about 7,500 MW of CIL linked new capacity during 12th Plan, as against 38,000 required (as per 75,785MW). Accordingly, the 12th Plan target of 76,000 would need to scaled down to about 45,000 MW. Thus, CIL is to be impressed upon for formulating exigency plan to enhance their production to meet the requirement the power stations.

Scenario-II- Optimistic Projections of CIL - Sensitivity Analysis of Coal Availability

As per the Optimistic Scenario, the total coal production of CIL in 2016-17 is expected to be 615 MT. Considering 75% availability to Power Sector, 461 MT coal shall be supplied to the Power Sector. This also implies that 80% of the additional 59 MT coal production in the Optimistic Scenario shall be supplied to the Power Sector.

In this scenario, the availability/shortfall of indigenous coal is detailed below:

(i)	Coal requirement during the year 2016-17		=	842 MT
(ii)	Coal availability from :			
	(a)	CIL	=	461 MT
	(b)	SCCL	=	35 MT
	(c)	Captive Blocks allocated to Power Utilities	=	100 MT
	(d)	Coal to be imported by TPSs designed imported coal	=	54 MT
		Total, coal availability	=	650 MT
(iii)	Shortfall in domestic coal		=	192MT

In order to bridge the above gap between demand and coal availability as referred above, Power Utilities are expected to import around 128 MT to meet shortage in coal supply from CIL. However, such a huge quantity of imported coal for blending may not be feasible as in the existing boilers maximum 15% of blending of imported coal is possible. This quantity of imported coal would be in addition to 54 MT coal likely to be imported by Thermal Power Stations designed on imported coal. Therefore, the total quantity of coal expected to be imported is about 182 MT.

It may be noted that the availability of coal as indicated by CIL would support only about 19,000 MW of CIL linked new capacity during 12th Plan, as against 38,000 required. Accordingly, the 12th Plan target of 76,000 would need to scaled down to about 57,000 MW.

Thus, CIL is to be impressed upon for formulating exigency plan to enhance their production as projected in Optimistic Scenario to meet the requirement the power stations.

As per the indications available from various Power Utilities, DISCOMS are reluctant to buy costlier power i.e. electricity generated either by TPSs designed on imported coal or Power Utilities using blending of imported coal in higher proportion.

In order to overcome the coal crisis following measures are suggested:

i) MOC/ CIL needs to be impressed upon to formulate a contingency plan to meet the coal demand of the power sector. Sanctioning of additional coal blocks from MoE&F needs to be expedited by the Government.

ii) Captive Blocks allocated to various utilities may be advised to enhance their production through some incentive oriented strategy and surplus production after meeting their own requirement may be supplied to power stations.

iii) Power Sector must be allocated 80% of total coal production by CIL.

1.6 POLICY TO INCENTIVISE RETIREMENT OF OLD PLANTS

Recommendations to incentivise generating agencies to retire the old and inefficient plants are:-

1. Regulatory frame work shall include provision that generating plants which have completed more than 30 Years of service and have operating heat rate higher than 20% of the designed value during the last five years should be retired within a fixed time frame.

2. There should be provision for incentive in terms of interest subsidy etc. for these plants to be retired and new plants to be commissioned in place of old plant.

1.7 CAPTIVE GENERATION

The Installed Capacity of Captive Power Plants (1MW and above) by the end of FY 2010-11 is about 31,000 MW. A Capacity addition of around 12,000 MW is likely during 11th Plan. A capacity addition of approximately 13,000 MW is likely during 12th Plan (April 2012 to March 2017).

1.7 MAXMISING GENERATION FROM EXISTING PLANTS

Optimization of generation from the existing generation capacity is of utmost importance in the resource crunch environment. The installation of new power projects involves large investment and long gestation period. Therefore, following options are recommended for maximizing generation from existing projects:

1. Renovation & Modernization of Power Plants

2. Energy Audits
3. Better O&M practices

1.7.1 Life Extension (LE) and R&M of Thermal Units

72 units (16,532 MW) for LE work and 23 units (4971 MW) for R&M work have been programmed during 12TH Plan. In addition to this 33 units (5147 MW) from LE works & 7 Units (1530 MW) from R&M Works are slipping from 11th Plan Target which would also be taken up during 12th Five Year Plan. Therefore Tentative programme for 12TH Five Year Plan is 105 units (21679.19 MW) from LE Works & 30 Units (6501 MW) from R&M Works.

There are 66 units (13720 MW) of 200 / 210 MW LMZ design units installed in India which are potential candidates for Energy Efficient R&M. It may be mentioned that all the 66 nos. 200/210 MW size LMZ units installed in the country would be covered for LE works starting from 11th Plan to 13th Plan.

1.7.2 Uprating, LE and R&M of Hydro Plants

Up rating, LE and R&M of hydro power plant has to be strategically planned, keeping in view all the techno-economic considerations. During the 12th Plan, 5 numbers of projects totalling to 1,390 MW and 37 projects totalling to 3,859 MW are planned to be covered for R&M and LE/Uprating respectively. The programme for LE/Uprating is expected to yield benefits totalling to 4,064 MW.

1.7.3 Energy Efficiency Improvement through Energy Audit

Energy Audit studies aim at determining the present level of performance of main power plant equipment and selected sub-systems and comparing them with design parameters. Reasons for deterioration are analysed. Techno-economic viability of introducing new efficient technologies is also included in the energy audit studies. In fact the basic objective is to reduce the consumption of various inputs (coal, oil, power, water) per unit of power generation.

It is suggested that an “Energy Efficiency Cell” shall be created at all thermal power stations. This cell shall be responsible for the following:

1. Setting up of Internal Energy Audit groups in each power plant. Capacity building of the efficiency group must be done to enable them to carry out Energy Audit tests on their own.
2. Regular audits shall also be got conducted from accredited Energy Auditors.
3. All recommendations that emerge from these audits must be implemented if these are techno-economically feasible. Short term measures can be made part of the annual plan/annual overhaul of the unit whereas long term measures can be taken up under the R&M schemes of these stations.
4. Energy Efficiency Awareness campaign shall be taken up among staff of the power plant.

1.6.4 Better O&M practices

Better O&M practice is also an effective tool to improve the performance of existing plants

1.7 NEW AND RENEWABLE ENERGY SOURCES

Generation of power from New and Renewable Energy Sources such as Wind, Small Hydro, Bio mass and Solar Energy is extremely vital in view of the fact that it is green power with minimum impact on the environment. Limited availability of fossil fuels like coal and gas & rising trend of cost & lower availability of indigenous conventional fuels, has further highlighted the importance of power from renewable energy sources. All efforts are therefore being made to tap these resources for generation of power to supplement power from Conventional Sources. Renewable sources of energy also provide a particularly attractive solution for meeting requirement of power at remote locations, where it is not feasible to extend the grid. The National Solar Mission is a major initiative of the Government of India and State Governments to promote ecologically sustainable growth while addressing India's energy security challenge.

The total estimated medium-term potential (2032) for power generation from renewable energy sources such as wind, small hydro, solar, waste to energy and biomass in the country is about 1,83,000 MW. The grid interactive Installed Capacity from renewables is likely to increase from about 3,500 MW at end of 9th Plan, 10,258 MW at the end of 10th Plan to 22,600 MW at the end of 11th Plan. As on 31.03.2011, the grid interactive Installed Capacity from renewable is 19,975 MW.

During 12th Plan renewable capacity of 18,500 MW and during 13th Plan 30,500 MW has been envisaged to be added through Wind, Biomass, Small Hydro and Solar sources.

1.8 REQUIREMENT OF PEAKING POWER AND RESERVE PLANTS

1.8.1 PEAKING PLANTS

The generation system must be designed to meet the base-load as well as the peak load of the power system with the characteristics of generating stations to respond dynamically and efficiently to the variation in demand within a short time. Since our system has vide variations in demand during peak and off peak period, there is need for peaking support with very high rampup rate. As such there is an urgent need for setting up peaking power plants during the 12th Plan with proper regulatory support.

Peaking power is ideally provided by pondage / reservoir based hydro plants. However, hydro capacity alone may not be able to meet the peaking demand. Fast response during peak hours could be provided by other suitable generation options such as gas based generation, in particular reciprocating engine based technology. Peaking plants shall be environmentally-friendly and must comply with emission norms, so as to be located close to load centres. They must be able to start up (and stop) instantaneously and ramp up quickly, and in required steps, to match the spike in load. Their efficiency curve must be high and flat at different plant loads.

Peaking Tariff

Operation of Combined Cycle Plants in peaking mode and Open Cycle Plants for peaking may result in higher heat rate and O&M costs (on account of higher repair and maintenance cost) for which the power plant will have to be compensated. Therefore, it is apparent that peaking power would be costlier as compared to off peak power. The notification for separate tariff for peak and off peak power would address this issue as well as help in flattening of Load Duration Curve and ultimately it would result in lesser capacity addition to meet the same power demand in the country.

1.8.2 RESERVE PLANTS

The Optimal power system should have adequate reserves in order to meet the contingency of outage of certain operating generation capacity.

System reserves can be classified into

i) Primary Control Reserves or Frequency Control Reserves
ii) Secondary Reserves or Spinning and Non-spinning Reserves
iii) Tertiary Reserves or Replacement Reserves

Primary reserves are those reserves that should be activated within 15 Seconds and the secondary reserves should be activated within 30 Seconds. In addition, the system should have tertiary reserves also which can take over from the secondary reserves within fifteen minutes of the disturbance and release these secondary reserves. These are generally non spinning reserves which can be brought into service at very short notice.

1.8.3 The Working Group recommends planning for at least 2000 MW gas based peaking power plants during 12th Plan, 400 MW each in five major metro cities of India with proper regulatory support. The experience gained from operation of these peaking plants would pave the way for creation of additional peaking plants in other major cities and higher peaking capacity in future plans. There is need to take measures like having separate tariff for peak and off peak power and regulations to enable fixed cost of peaking plants to be fully recovered during peak hour operation etc. to promote peaking plants. In case of future projects, gas should be allocated to power plants meant for meeting peaking and intermediate loads with proper regulatory support.

Working Group also recommends for setting up Task Force under CERC to deliberate upon the various aspects associated with setting up of peaking plants and creation of adequate system reserve.

Further, Combined Heating and Cooling (CHP) plants which have a high efficiency must be promoted. Gas allocation to such plants preferably located in urban areas should be on priority.

1.9 TECHNOLOGICAL DEVELOPMENT

Super Critical thermal units of 660 MW (steam parameters of 247 kg/cm^2 and 535/565 ^{O}) and 800 MW (Temp 565/593 ^{O}) need to be promoted aggressively.

Supercritical technology has already been introduced in the country and large numbers of supercritical units are under construction. The following Policy Options could be considered for making supercritical units mandatory beyond 12th Plan :

1. Issue of advisory by MoP/CEA for the utilities to install supercritical units only.
2. Suitable provisions to install supercritical units in the coal allocation policy for coal linkages of 13th Plan projects.
3. Suitable provision in the CEA Regulations on Technical Standards for Construction of Electric Plants And Electric Lines 2010 making supercritical units mandatory.

All Power utilities and thermal plants are to plan and implement ash utilisation targets keeping view long term strategies on sustainable basis.

1.10 CONCLUSION AND RECOMMENDATIONS (GENERATION CAPACITY)

(i) Based on capacity addition planned, there may not be power shortage in the country by the end of 12th Plan on an All-India basis; however, individual states may have power shortage. To address this problem, States/UTs must estimate their power requirement and availability of power from different sources/states and must tie up power requirement, if any, so that they do not face shortages.

(ii) As per the projected requirement and availability of coal, there will be shortage of coal for coal based power plants which will have to be met through import. In order to bridge the above gap between demand and coal availability, Power Utilities are expected to import around 159 MT to meet shortage in coal supply from CIL (in the Business as Usual Scenario). However, such a huge quantity of imported coal for blending may not be feasible as in the existing boilers maximum 15% of blending of imported coal is possible. This quantity of imported coal would be in addition to 54 MT coal likely to be imported by Thermal Power Stations designed on imported coal. Therefore, the total quantity of coal required to be imported is about 213 MT. In the Optimistic scenario, the coal required to be imported is about 182 MT.

(iii) MOC/ CIL needs to be impressed upon to formulate a contingency plan to meet the coal demand of the power sector. Sanctioning of additional coal blocks from MoE&F needs to be expedited by the Government.

(iv) Captive Blocks allocated to various utilities may be advised to enhance their production through some incentive oriented strategy and surplus production may be supplied to power station.

(v) Availability of gas for power generation is a big issue which needs to be addressed. Due to reduced availability of gas from KG D6 field and also from APM sources, existing power plants in the country are operating at low PLF. Further, gas power projects of about 13,000 MW capacity are under construction at various stages and this capacity may materialize during 11th Plan/ 12th Plan, if gas is made available.

(vi) The Working Group opines that if gas availability to projects already under construction is not ensured, it may become stranded assets and should be avoided. Some concrete policy decision towards increasing the gas availability to power plants either by increasing the production of domestic gas or increasing the share of RLNG by pooling with domestic gas is required.

(vii) To pursue with Energy Departments of all the States to identify the surplus capacity available from the captive power plants and approach State Utilities/Discoms to buy the surplus power available from the captive power plants.

(viii) The Group recommends that R&M schemes shall be continued during 12th and 13th Plans also. However it must be ensured that routine maintenance activities are not included in these schemes. Only activities which aim at increasing the efficiency of the unit, improving its availability, meeting of environmental norms or are aimed at renovating obsolete equipment are included in R & M schemes. Further, for Life Extension schemes, a cost benefit analysis should be carried out vis-à-vis installation of new unit at the same site. The Group also recommends that the AGS&P Scheme shall continue.

(ix) The Working Group recommends setting up of a Task Force under CERC to deliberate upon the various aspects associated with setting up of peaking plants and creation of adequate system reserves. The Task Force shall comprehensively address all the issues involved to facilitate a feasible and viable scenario for creation and operation of generation reserves and peaking plants in the system.

(x) The Group recommends planning for at least 2,000 MW gas based peaking power plants during 12th Plan, 400 MW each in five major metro cities of India with proper regulatory support. Further, Group recommends that in view of limited availability of gas in the country, in case of future projects gas should be allocated to power plants meant for meeting peak and intermediate load, with proper regulatory supports so that these power plants could recover their cost.

(xi) Combined Heating and Cooling (CHP) plants which have a high efficiency must be promoted.

2.0 TRANSMISSION PLANNING INCLUDING NATIONAL GRID

2.1 REVIEW OF PROGRAMME AND ACHIEVEMENTS DURING 11TH PLAN

The details of the 11th Plan programme, achievements during the first four years of the 11th Plan and anticipated additions in 11th Plan for transmission lines and substations are furnished in Tables ES-4 and ES-5 below:

Table ES-8

Transmission Lines- 11th Plan Programme & Achievement

(Figures in circuit kms)

Voltage level	11th Plan programme	Achievement up to Mar 2011 during 11th Plan	Anticipated addition during 2011-12	Anticipated addition in 11th Plan
765 kV	2773	1636	824	**2460**
± 500 kV HVDC	1600	1580	2000	**3580**
400 kV	40000	26856	12401	**39257**
220 kV	24300	19780	6567	**26347**
Total	**68673**	**49852**	**21792**	**71644**

Table ES-9

Sub Stations & HVDC Terminal capacity- 11th Plan Programme & Achievement

(Figures in MVA/MW)

Voltage level	11th Plan Programme	Achievement up to March 2011 during 11th Plan	Anticipated addition during 2011-12	Anticipated addition in 11th Plan
765 kV	24500	4500	4000	**8500**
400 kV	51960	40920	8725	**49645**
220 kV	72731	50655	14655	**65310**
Total – AC Substation capacity in MVA	**149191**	**96075**	**27380**	**123455**
± 500 kV HVDC	8500	3000	2500	**5500**
Total- HVDC terminal capacity in MW	**8500**	**3000**	**2500**	**5500**

The total inter-regional transmission capacity at the beginning of 11th Plan was 14,050 MW which is now expected to grow to about 25,650 MW by the end of 11th Plan.

The achievement of transmission line addition in the first four years of the 11th Plan has been by and large satisfactory. The shortfall in addition of transformation capacity is mainly on account substations associated with the generation projects which have now slipped to 12th Plan. It is expected that in the terminal year of 11th Plan, the transmission line target would be fully met.

2.2 TRANSMISSION PLANNING KEEPING IN VIEW OPEN ACCESS

Based on application by a generator for Long Term Open Access, the transmission system is planned for evacuation of power from generating stations. However adequate intra-state transmission system is also required to absorb power injected from ISTS. During the planning process, some design margins get created in the network generally due to long term optimisation. These margins, along with operational and reliability margins, provide sufficient additional capacity in the system for trading and for States to buy power more than their long-term PPAs.

2.2.1 PROVISIONS IN ELECTRICITY ACT AND CERC REGULATION

Enactment of the Electricity Act, 2003 has opened up hitherto constrained electricity market, which was characterized by long term PPAs and inability of Distribution Companies and consumers to have a choice of suppliers. The provision regarding availability of non-discriminatory Open Access in transmission from the very beginning and distribution in a phased manner is an important feature of the Act. This creates enabling environment for competition among generators/traders to choose their customers and vice-versa.

Access to inter-State transmission system is governed by the regulations of the Central Regulatory Commission. The Central Transmission Utility (CTU) is the nodal agency for providing medium term (3 months to 3 years) and long term (12 to 25 years) access that are typically required by a generating station or a trader on its behalf. The nodal agency for grant of short term open access (up to three months) is the Regional Load Dispatch Centre. The nodal agency for providing transmission access to the power exchanges is the National Load Dispatch Centre.

2.2.2 LONG TERM OPEN ACCESS (LTA) IN INTER-STATE TRANSMISSION

Till March 2011, CTU has received about 187 Long Term Open Access (LTA) applications for transfer of power from their generation projects of capacity about 1,77,000 MW to various target regions. Based on the progress, LTA has been granted to 135 applicants with a capacity of about 1, 17,000MW. Out of this, transmission system is already in place for about 43,500MW capacity and system strengthening identified for capacity of about 73,500MW. The progress of balance 52 applications with capacity of about 60,000MW was not up to the mark and was proposed to close/review the application based on subsequent progress.

The major challenge in processing Long Term Open Access application is that Distribution utilities are not inviting Case-1/ Case-2 bids to meet their long term requirement of power. In absence of firm beneficiaries, transmission is being developed based on target beneficiaries indicated by the generation project developers. Absence of firm beneficiaries may result into sub-optimal utilisation in one part of grid or congestion in another part. Further, the time schedule of commissioning of some of the generation projects is not certain. This puts a lot of risks on investment in transmission infrastructure and also, the time line for implementation of transmission system by CTU/ other transmission licensees becomes difficult to meet.

2.2.3 MEDIUM TERM OPEN ACCESS (MTOA)

Only two (2) applications were received for MTOA from UT DNH and UT DD in Western Region for transfer of 54MW from 500MW NSPCL generating station in Bhilai (Chhattisgarh). MTOA has been granted.

2.2.4 SHORT TERM OPEN ACCESS

The short term customers are eligible for short term open access over the surplus capacity available after use by long term customers and medium term customers due to inherent design margins available. Whenever the proposed bilateral transaction has a State utility or an intra state entity as buyer or seller, concurrence of the State Load Despatch centre shall be obtained in advance and submitted along with the application.

2.2.5 TRANSMISSION CONGESTION

Seasonal trading is done by the distribution utilities to meet their seasonal demand or sell their seasonal surplus. Short term trading on day-ahead basis is required for balancing the demand with supply. Short term trading is also required for meeting contingency requirement. However, in India the pattern of short term trading is erratic and depends on many extraneous factors particularly availability of funds with deficit Discoms etc. Sometimes a State may suddenly decide to reduce load shedding and resort to heavy short term purchase through trading. In such a situation, the drawl has to be restricted to the margins available in the planned transmission capacity. It is not possible to plan transmission system for catering to such a situation.

2.2.6 TRADING OF ELECTRICITY

Short term trading is an essential tool for optimization of resources and plays an important role in deficit scenario for harnessing additional / captive sources of generation for meeting the peak demand. Trading of electricity in India has picked up considerably after the advent of Electricity Act 2003 which recognizes trading as a distinct licensed activity. In future the quantum of electricity traded in the short term market is likely to grow considerably as the new generating capacity of many IPPs plants is not tied up in long term PPAs. The declining trend of prices in recent years is indication of more competition and increasing availability of supply.

2.2.7 POWER EXCHANGES

At present there are two power exchanges in the country, namely IEX and PXIL which separately operate Day-ahead Spot market for electricity. These two exchanges work on identical principle of price discovery as specified by CERC. The Day-ahead market operates on the principle of voluntary participation, double sided closed auctions, uniform price discovery and zonal market splitting in case of transmission constraint. The increasing volume and declining Price is indicative of improved liquidity of supply. The number of participants in the two exchanges has been growing rapidly due to the entry of bulk Open Access consumers particularly from the states of Punjab and Tamil Nadu.

2.3 12TH PLAN TRANSMISSION PROGRAMME

2.3.1 Evolving the Transmission System for 12th Plan

Identification of transmission expansion requirement for a Plan period is done based on power system studies corresponding to the generation expansion programme and forecasted demand scenario expected at the end of that Plan. The implementation programme is worked out keeping in view identification of projects, schemes and transmission elements that should be implemented matching with programme of generation capacity addition and load growth on yearly basis during the Plan.

2.3.2 Inter-Regional Transmission Capacity Programme

The Inter-regional transmission capacity of all-India grid at the end of 11th Plan is likely to be about 25,650 MW. During 12th Plan period considering about 76,000 MW capacity addition, the inter-regional transmission links of about 38,000 MW may be added during 12th Plan period. Thus inter-regional transmission capacity at the end of 12th Plan is expected to be of the order of 63,000 MW.

2.3.3 Growth in 765kV Transmission System up to 12th Plan / Early 13th Plan Period:

During 11th Plan, a number of 765kV lines and substations have been added and a few more are under-construction. A number of new 765kV lines and substations have been planned for evacuation of bulk power in the range of 3000 – 6000 MW over longer distances. The planned 765kV transmission systems are expected to be implemented during 12th Plan or early 13th Plan period.

2.3.4 Growth in HVDC Transmission System up to 12th Plan / Early 13th Plan Period:

During 11th Plan, Balia-Bhiwadi 2500 MW HVDC Bipole and upgradation of Talcher-Kolar Bipole by 500 MW has been completed. Another HVDC bipole as Dedicated Transmission line, i.e. Mundra-Mohindergarh 2500 MW is being constructed under private sector by Adani group during the 11th Plan period. Three more HVDC systems have been planned for completion during 12th Plan or early 13th Plan.

2.3.5 1200kV transmission system

The Aurangabad - Wardha 400 kV Quad D/C line which is part of the transmission system for evacuation of power from Mundra UMPP has been planned and designed in such a way that this line would be converted into a 1200kV S/C line at a later date.

2.3.6 Transmission Schemes Planned for 12th Plan Period

During 12th Plan period, a total of about 1,09,000 circuit kilometres (ckm) of transmission lines, 2,70,000 MVA of AC transformation capacity and 13,000 MW of HVDC systems are estimated to be added.

Following Tables give development of the transmission system in India in 11th Plan period and expected to be added during 12th Plan period.

Table: ES-10

Transmission Lines

(values in ckm)

Transmission Lines (AC and HVDC)	As at the end of 10th Plan	Addition during first four years of 11th Plan (2007-11)	Expected end of 11th Plan	Expected addition during 12th Plan	Expected by end of 12th Plan
HVDC Bipole lines	5872	1580	9452	**9440**	18892
765 kV	1704	1636	4164	**27000**	31164
400 kV	75722	26856	114979	**38000**	152979
220 kV	114629	19780	140976	**35000**	175976
Total Transmission Line, ckm	**197927**	**49852**	**269571**	**109440**	**379011**

Table: ES -11
Substation

(values in MVA / MW)

Substations(AC and HVDC)	As at the end of 10th Plan	Addition during first four years of 11th Plan (2007-11)	Expected at the end of 11th Plan	Expected addition during 12th Plan	Expected by end of 12th Plan
Total- HVDC Terminal Capacity, MW	8000	8500	13500	13000	26500
Total- AC Substation capacity, MVA	249439	96075	372894	270000	642894

2.3.7 Fund Requirement for development of transmission system during 12th Plan Period:

The total fund requirement for development of transmission system is estimated to be of the order of Rs 1,80,000 crore (*(Rs 1,00,000 Cr in Central Sector, Rs. 55,000 Cr in State Sector and Rs. 25,000 Cr in Private Sector).*

In the Central Sector, there is no problem of capital resources for setting up transmission facilities. However, in the State Sector some of the STUs require financial support, especially for building transmission system for renewable energy sources such as wind, solar and small hydro. It is proposed that viability gap funding may be provided on case to case basis for building intra-State transmission system for renewable generation and conventional hydro stations.

2.4 TRANSMISSION EXPANSION ASSESSMENT FOR 13TH PLAN

Transmission systems for a number of generation projects have been planned under the LTA process, majority of which are expected to materialize during 12th Plan and the rest would be implemented during 13th Plan depending upon actual progress of the generation project. Based on progress and development of generation projects and transmission system during 12th Plan, only a broad assessment of transmission capacity addition for 13th Plan can be made considering probable load growth and indicative generation capacity addition scenarios for 13th Plan. Accordingly, following assessment has been made for transmission capacity addition during 13th Plan period:

Table: ES-12
Transmission capacity addition for 13th Plan (220kV and above system)

1.	Transmission lines	130 Thousand ckm
2.	Substation (Transformation) Capacity	300 Thousand MVA
3.	Fund requirement	Rs 200,000 Crore

2.5 MEETING CHALLENGES IN TRANSMISSION SECTOR

Major challenges being faced in the transmission sector are as follows:

- *Right Of Way (ROW)*
- *Flexibility in Line Loading and Regulation of Power*
- *Improvement of Operational Efficiency*

Following measures are being implemented to meet above challenges:

- *Increase in transmission voltage*
- *Upgradation of transmission line*
- *Upgradation of HVDC Terminal*
- *High capacity 400kV multi-circuit/bundle conductor lines*
- *High Surge Impedance Loading (HSIL) Line.*
- *Compact towers.*
- *Increase in current High Temperature Low Sag (HTLS) conductor line*
- *Reduction of land for substation*
- *Regulation in Power Flow/ FACTS devices*
- *Improvement of operational efficiency with Condition Based Monitoring and Preventive Maintenance*
- *1200kV Test Station*

2.6 SMART TRANSMISSION GRID

2.6.1 Smart Transmission Grid Implementation in India

WAMS (Wide Area Measurement System) based technology is to be implemented as a part of the Smart Transmission Grid implementation. Full implementation of WAMS requires installation of Phasor Measurement Units (PMUs) at the substations and power plants in each region and reliable communication network with very high band width. Phasor data concentrators (PDC) are to be installed at National, Regional and major State Load Despatch Centre (in states having 400 kV transmission system). Availability of PMU at strategically located 400 kV/ 765kV sub-stations / power stations and a robust fiber optic communication network will facilitate situational awareness (especially dynamic state of the grid in terms of angular stability and voltage stability), control and regulation of power flow to maintain grid parameters, Remedial action scheme(RAS) and system integrated protection scheme(SIPS) and identifying corrective actions to be taken in the event of severe contingency to prevent grid disturbances.

2.6.2 Need for fibre optic based communication system:

With the restructuring & liberalization of power sector and the advent of new regulations, open access, power exchange etc, reliable voice & data communication has become critically important. The requirement of effective communication system has increased with the advent of special protection schemes, wide area measurement technology, SCADA system and remote operation. Getting real time data of various power system elements ie, substations, generating plants, HVDC links, Interstate transmission lines etc has become an essential prerequisite for successful operation of modern power system as a 'Smart Transmission Grid'. Communication requirements can be met by fiber optic based communication system.

Therefore it is considered desirable that an institutional arrangement be mandated for planning, implementation and maintenance of dedicated high band width, fiber optic communication network connecting the existing and new substations and power plants under central sector, IPPs, UMPP, Merchant Power Plants coming under the control area of Load Despatch Centres.

All new 400 kV and above substations, irrespective of ownership (state sector, private sector, central sector) and type (ISTS, dedicated, intra-state) should have optical fibre communication (OFC) facility, unless specifically exempted by CTU, as a requirement for smooth grid operation. A Standing

Committee comprising of CTU, POSOCO and CEA should be constituted to identify (i) strategic lines where OFC shall be mandated (ii) strategic locations in the grid where PMUs and PDCs need to be placed. As a first step, this committee should identify all such locations in the existing grid within six months. It should meet periodically at least once in a year to review and identify new locations. Presently, POWERGRID has built some optic fibre communication (OFC) network as part of telecom business and it is partly leased to RLDCs and NLDC for grid operation. Investment is not serviced by RLDCs. On the other hand POWERGRID has to give some normative revenue credit to its long term customers for using the RoW of transmission lines for telecom business. In future POWERGRID may be required to install optical fibre as per requirement of grid operation without assurance of telecom business. In such cases the investment should be serviced by the users/POSOCO as determined by CERC. Similar arrangements may be made for each STU/SLDC through their respective SERCs. Grid communication users should have priority over the telecom customers of POWERGRID mandated for the smart transmission grid.

2.7 TRANSMISSION PLANNING FOR RENEWABLE GENERATION

More than 80% of the renewable generation capacity is in the states of Tamil Nadu, Maharashtra, Karnataka, Gujarat and Rajasthan. As most of the renewable energy generation in terms of MW are smaller in size ranging from few MW to 25 MW or 50 MW, therefore their integration with the grid is normally done at 11kV, 22 kV, 33kV or 66 kV. The EHV transmission system beyond first connection point is either at 110 kV, 132 kV, 220 kV or 400 kV depending on the quantum of power being pooled at EHV substations. Generally the power would be absorbed within the DISCOM area or at the most within the state for meeting the states Renewable Purchase Obligation (RPO). As the RPO requirement of each state would be increasing on a yearly basis along with the increasing capacity addition of renewable energy generation, only a few Renewable Energy Sources rich states would have renewable energy additions beyond their RPO requirements. This would require augmentation of the State's transmission system and interconnection with inter-state transmission system in some cases. In case of large scale renewable generation, it is not possible to absorb the energy locally particularly during off peak hours and a transmission system is required to be planned integrating renewable generation with the state grid as well as with inter-state grid. Integrated planning approach would ensure that renewable generation does not have to back down during off peak hours and local load centres are provided with uninterrupted supply even when renewable generation is not available.

Grant needs to be made available for setting up transmission system for evacuation of power from renewable energy source.

There is a need to encourage RES rich states to build transmission over and above their RPO requirement by providing grant.

2.8 EXCHANGE OF POWER WITH NEIGHBOURING COUNTRIES

Integration of Indian Electricity Grid with countries such as Bhutan, Nepal would result in optimization of electricity resources on a large scale and provision of additional benefits and opportunities to the buying and selling countries. Cross border electricity transaction particularly with Nepal and Bhutan may be facilitated through Inter Governmental framework agreements. There is also a need to develop coordinated procedures for scheduling and dispatch of cross border power and for financial settlement of electricity transactions.

The benefits of power exchange with Nepal and Bhutan are enhanced energy security of South Asia, lesser dependence on fossile fuels, better hydro-thermal mix in generation, reduction in carbon emissions and carbon intensity and economic benefits to the countries of South Asia.

2.9 POWER SYSTEM OPERATION

2.9.1 Government of India's interventions to empower system operation

A committee headed by Shri Gireesh Pradhan was constituted by the Ministry of Power, Government of India in February 2008 to examine issues relating to manpower, certification and incentives for the personnel employed on System Operation at various levels and also for ring-fencing the load despatch centres to ensure their functional autonomy. The recommendations of the above Committee and Task Forces are being actively implemented at the Central level. A new organization, namely Power System Operation Corporation Limited (POSOCO) was formed as a 100% subsidiary of POWERGRID in March 2009 and was notified as the designated entity to operate RLDCs/NLDC wef 1st October 2010. A Forum of Load Despatchers (FOLD) has been constituted as approved by the Forum of Regulators (FOR) in January 2009 for harmonizing practices across the different LDCs. Likewise, the National Power Training Institute (NPTI) has been designated as the agency for training and certification of system operators.

2.9.2 Achievements on the market front

Empowerment of RLDCs/NLDC and their designation as nodal agency have led to the following significant developments on the electricity market front:

1. Successful implementation of Availability Based Tariff (ABT) in all the regions since 2002-03 at the inter-state level.
2. Successful implementation of inter state open access since May 2004 leading to choice for market players and promoting competition.
3. Successful operation of two Power Exchanges since June 2008 leading to a robust price discovery mechanism and investment signals.
4. Successful implementation of the Renewable Energy Certificates (REC) mechanism since October 2010 to fulfill Renewable Purchase Obligation (RPO) of DISCOMs.

2.9.3 Suggested measures to improve system operation

It is recommended that a separate Load Dispatch Centre for renewable energies shall be set up. The collated data from such sub-LDCs can be transferred to the respective SLDC and RLDC so that the grid can be operated in a secure manner as well as ensuring that the renewable generation is absorbed to the fullest extent. Such sub-LDCs may be set up in renewable energy rich States e.g Tamil Nadu, Gujarat and Rajasthan. These sub-LDCs may be set up with grant from clean energy fund. To start with such a sub-LDC may be set up in Tamil Nadu which has about 6000 MW of installed wind capacity.

2.10 ANCILLARY SERVICES

Creation of Reserve and Back Up Power in the System

The Optimal power system should have adequate reserves in order to meet the contingency of outage of certain operating generation capacity. Therefore, creation of adequate reserve and back up power in the system need to be planned along-with related evacuation networks.

Voltage Support Service

Presently there is no legal binding on the generator for providing voltage support facility and very often generators get away from this issue by citing contractual reasons for not commissioning this facility. There is an urgent need to operate large hydro plants as synchronous condensers when the water inflows are low. Operation of such generators as synchronous condensers will help in supporting the voltage and keeping the transmission system intact. It is therefore recommended that the Grid Standards for Connectivity to the grid notified by CEA may be amended to make it mandatory for hydro power stations to commission the synchronous condenser facility and test it periodically as prescribed by the system operator. CERC shall come out with guidelines/regulation for compensating the generator for the energy consumed during synchronous condenser operation, MVARh generated or absorbed by the generator and the extra Operation and Maintenance (O & M) costs associated with synchronous condenser operation.

Black-start Service: The Grid Connectivity Standards notified by CEA must make black start capability mandatory for all new hydro generating units and gas turbine units.

2.11 RELIABILITY STANDARDS

The existing Grid Codes need to be complemented by Reliability Standards. These Reliability Standards are to be adhered to by all utilities for maintaining grid security of the grid. It is recommended that POSOCO may constitute a Standing Committee for formulation of 'Reliability Standards and their approval from CERC/regulators.

2.12 NEED FOR A SEPARATE MARKET OPERATOR (MO)

There would be an explosion in number of control areas at the regional level from the level of nearly one hundred (100) control areas today to over three fold in the coming years. The number of long term, medium term, and short term and Power Exchange transactions would grow manifold. Metering and settlement system would become more complex with the above explosion in control areas. With the explosion of control areas, Fund Administration and Pool Account operations would also become more voluminous. These developments bring out the need for a Market Operator (MO) to co-ordinate all the transactions and inform the System Operator (SO) a day in advance for physical delivery. Since the work load of RLDCs has become enormous and complex, it is desirable in the interest of efficient system operation that the work of RLDC may be segregated between a 'System Operator' and a 'Market Operator'. Therefore, the following steps are suggested:

- POSOCO, in consultation with CERC, CEA and CTU shall prepare a detailed organizational proposal for segregation of 'System Operation' and 'Market Operation' functions within six (6) months.

- The proposal shall be submitted to the Government for approval and issue of enabling orders.

2.13 CONCLUSIONS AND RECOMMENDATIONS (TRANSMISSION)

(i) All new 400 kV and above substations, irrespective of ownership (state sector, private sector, central sector) and type (ISTS, dedicated, intra-state) should have optical fibre communication (OFC) facility, unless specifically exempted by CTU, as a requirement for smooth grid operation. A Standing Committee comprising of CTU, POSOCO and CEA should be constituted to identify (i) strategic lines where OFC shall be mandated (ii) strategic locations in the grid where PMUs and PDCs need to be placed. As a first step, this committee should identify all such locations in the existing grid within six months. It should meet periodically at least once in a year to review and identify new locations.

(ii) In future POWERGRID may be required to install optical fibre as per requirement of grid operation without assurance of telecom business. In such cases the investment should be serviced by the users/POSOCO as determined by CERC. Similar arrangements may be made for each STU/SLDC through their respective SERCs. Grid communication users should have priority over the telecom customers of POWERGRID mandated for the smart transmission grid.

(iii) Grant needs to be made available for setting up transmission system for evacuation of power from renewable energy source. There is a need to encourage RES rich states to build transmission over and above their RPO requirement by providing grant. It is proposed that viability gap funding may be provided on case to case basis for building intra-State transmission system for renewable generation and conventional hydro stations.

(iv) As the patch of land occupied by the transmission tower would have zero resale value, it stands to reason that compensation for diminution of value of land occupied under tower base should be the full value of the private land at prevailing market rate as determined by the revenue authorities. It is suggested that Central Government may issue a notification in this regard in consultation with the states.

(v) Transmission corridors needs to be identified and reserved in high density population areas like metros and other upcoming urban areas to meet the future growing demand.

(vi) While doing town planning for new suburban area and industrial centres, provision for laying of substation and transmission line should be kept in mind. To reduce the requirement of land for constructing substation use of Gas Insulated Substations (GIS) which requires about 30 % land compared to conventional substation is being increasingly adopted in metro, hilly and other urban areas.

(vii) It is recommended that a separate Load Dispatch Centre for renewable energies shall be set up. To start with such a sub-LDC may be set up in Tamil Nadu which has about 6,000 MW of installed wind capacity.

(viii) The Grid Standards for Connectivity to the grid notified by CEA may be amended to make it mandatory for hydro power stations to commission the synchronous condenser facility and test it periodically as prescribed by the system operator. CERC shall come out with guidelines/regulation for compensating the generator for the energy consumed during synchronous condenser operation, MVARh generated or absorbed by the generator and the extra Operation and Maintenance (O & M) costs associated with synchronous condenser operation.

(ix) POSOCO may constitute a Standing Committee for formulation of 'Reliability Standards and their approval from CERC/regulators.

(x) POSOCO, in consultation with CERC, CEA and CTU shall prepare a detailed organizational proposal for segregation of 'System Operation' and 'Market Operation' functions within six (6) months. The proposal shall be submitted to the Government for approval and issue of enabling orders.

(xi) During 12th Plan period, a total of about 1,09,000 circuit kilometres (ckm) of transmission lines, 2,70,000 MVA of AC transformation capacity and 13,000 MW of HVDC systems are estimated to be added.

(xii) The total fund requirement during 12th Plan for evacuation of power works out to about Rs.1,80,000 Cr.

3.0 DISTRIBUTION INCLUDING VILLAGE AND HOUSEHOLD ELECTRIFICATION

The Government is emphasising on an efficient and well performing distribution sector and focusing on the improvement of financial health of utilities towards providing reliable and quality power supply and universal access to power. Accessibility of Power in Rural Areas, AT&C loss reduction, financial viability of DISCOMs, Smart Grid, Demand Side Management (DSM), Private Sector Participation/Private Public Participation (PPP) etc. are also some initiatives taking centre stage today. There has been a growing concern over the financial health of Distribution Utilities. Urgent and immediate action for sustainable Distribution sector is therefore necessary.

3.1 INITIATIVES OF THE GOVERNMENT

3.1.1 Rural Electrification

The total numbers of villages electrified till July,2011 is 5,39,127 which implies that 90.8 % village electrification has been achieved.

Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) in 10th and 11th Plan

Government of India, in April 2005, launched RGGVY – A comprehensive scheme of Rural Electricity Infrastructure and Household Electrification for providing access of electricity to all rural households. There is a provision of capital subsidy of 90% of the total project cost under the scheme and balance 10% of the project cost are being provided by REC as loan.

Under the scheme, projects have been financed with capital subsidy for provision of –

A. Rural Electricity Distribution Backbone (REDB)
B. Creation of Village Electrification Infrastructure (VEI)
C. Decentralised Distributed Generation (DDG) and Supply
D. Electrification of Below Poverty Line Households

3.1.2 Restructured Accelerated Power Development & Reforms Programme (R-APDRP)

Re-structured APDRP was approved as a Central Sector Scheme on 31.07.2008 with total outlay of Rs.51,577 Cr.

State Schemes

States have come out with specific schemes for Distribution and Rural Electrification. Some of the significant schemes are as follows:

Maharashtra - *Akshay Prakash Yojana*

Maharashtra State Electricity Distribution Company Ltd.(MSEDCL) had launched the Akshay Prakash Yojana (APY) in 2004. The objective is to ensure better availability of supply and other social benefits based on collective volunteer responsibility of the inhabitants of the village.

Orissa- Biju Gram Jyoti

Biju Gram Jyoti – Govt of Orissa launched the programme in 2007 with an objective to provide access to electricity to all the habitations having population of less than 100. Altogether 10,000 habitations were covered during the 11th five year plan with budget allocation of Rs.314 Cr.

Gujarat - Jyotigram Yojana (Rural Lighting Scheme)

Gujarat Government launched the scheme in September 2003 with an objective to segregate the agriculture load from residential, industrial and commercial loads. The pilot scheme covering eight districts was completed in October 2004 and later on it was extended to cover over 18000 villages and about 9700 hamlets with an total expenditure of Rs.1,100 Cr

Best Practices Adopted by DISCOMs:

Various good practices have been adopted across the country by public and private utilities and they are detailed in Chapter 3 of the Report.

3.2 REVIEW OF 11TH PLAN PROGRESS

During the 11th Plan, emphasis was on creation of capacity in Sub-transmission & Distribution system to strengthen the Distribution sector. Emphasis has been given to Metering, Consumer Indexing, adoption of IT facilities, GIS mapping, modern payment system, HVDS, Rural franchisees etc.

3.2.1 Access to Power for Population of India

As per Census 2001, 80% of the total inhabited villages were electrified and 44% of the rural households had access to electricity. As on 31st July 2011, total of 96% of the villages of the country have access to electricity.

3.2.2 Rural Electrification – RGGVY: Review of Achievements

(a) Sanction of Projects: Under the scheme, 576 projects in 546 districts covering 1,18,499 un-electrified villages, 3,54,967 already electrified villages and 246.45 Lakh BPL households with sanctioned project cost of Rs.26,514.14 Cr have been approved.

(b) Physical Progress : As on 31.07.2011, works in 98,612 Un-electrified villages has been reported complete. However, 83,820 Un-Electrified villages have been reported energized. The gap is primarily in the states of Bihar, Jharkhand, Orissa and Assam. By the end of 11th Plan, most of the projects are expected to be completed excepting NE region and areas involving difficult terrain. The Bharat Nirman target of electrification of 1 Lakh un-electrified villages and 175 Lakh BPL households by March 2012 is expected to be surpassed.

(c) Financial Progress

Against total allocation of capital subsidy of Rs.33,000 Cr (Rs.5,000 Cr under 10th Plan and Rs.28,000 Cr under 11th Plan), capital subsidy of Rs.23,913 Cr has been released as on 31.03.2011. The subsidy allocation for FY 2011-12 is Rs.6,000 Cr and accordingly the expected cumulative achievement at the end of 11th Plan would be about Rs.29,913 Cr. Thus, there would be spill over of about Rs.3,000 Cr. in the 12th Plan.

(d) Delay in Implementation of Projects

Although there have been no shortfalls in achievement of targets for RGGVY, time overrun has been observed in implementation of RGGVY projects. Even after completion of project and energization of newly connected habitations, it has been noticed that certain regions do not get power for sufficient duration of 6-8 hours per day due to overall shortages of power. Slow progress on deployment of franchisees by the states in rural areas is also contributing to delay in energisation as well as maintaining adequate power supply due to manpower constraints.

(e) Issues and Concerns

- Coverage and Scope of the scheme
- Revenue sustainability – Deployment of Franchisees
- Notification of RE plan and its implementation by states
- Benchmark costs
- Availability of 6-8 hours Power Supply
- Monitoring
- Decentralized Distributed Generation (DDG)
- Social-economic Evaluation of RGGVY

3.2.3 R-APDRP Scheme

Part-A of R-APDRP is currently under implementation and is in a stage of advanced progress in several States. Part A of the R-APDRP is to be completed by utilities after 3 years of sanctioning. As of now, there are no projects which have completed three years of time, post sanctioning. However, it has been observed that State Procurement Policy and procedures delayed the appointment of ITIA in some States.

Financial Health of SEBs

(a) AT&C Losses:

Accelerated Power Development and Reforms Programme (APDRP) was launched in 2002-03 as an Additional Central Assistance (ACA) to finance the modernization of sub-transmission & distribution networks with the main objectives to reduce AT&C losses to 15%. AT&C loss at national level have been reduced from 38.86% in 2001-02 to 27.15% during 2009-10. While some states have shown an improvement in AT&C Loss reduction, it is pertinent to note that the absolute loss levels are still at a higher level with respect to losses and require further efforts for loss reduction.

(b) Revenue Loss (ARR and ACS gap)

As per the PFC report on "Performance of State Power Utilities" for the year 2009-10 the cash losses (revenue and subsidy realized basis) of utilities selling power directly to consumers increased from Rs.17,620 Cr. in the FY 2007-08 to Rs.42,415 Cr. in the FY 2009-10. The cumulative book losses (accrual basis) of the state utilities have increased from Rs.79,339 Cr. as on 31.03.2009 to Rs.1,06,247 Cr. at the end of year 2009-10. Gap between Average Cost of Supply and Average Revenue Realised is widening and has increased to Rs.0.73 per unit in 2009-10 from Rs.0.37 per unit in 2007-08 on subsidy realized basis. While some states have shown improvement in the financial health, others are yet to demonstrate the impact of the policy initiatives. In order to restore the commercial viability of the distribution companies it is necessary to eliminate the gap between Average Revenue realised (ARR) and Average Cost of Supply (ACS). The tariff structure needs to be designed based on Multi Year Tariff with tariff revision in a time bound manner. The National Tariff Policy mandates the SERCs to notify roadmap with a target that latest by the end of year 2010-11 the tariffs are within ± 20 % of the average cost of supply. A Panel chaired by former Comptroller and Auditor General Sh. V. K Shunglu has been formed to look into the financial health of power distribution companies and to suggest ways to improve the financial condition. Recommendations of the panel are awaited.

(c) Mounting of Debt on Utilities

The total borrowings of state DISCOMs have touched Rs.1,77,602 Cr as on 31.03.2010 and total interest charged from state utilities in year 2009-10 is Rs.15,651 Cr. RBI has taken cognizance of the difficult financial situations of DISCOMs and their attempts to bridge cash losses by short term borrowings. In order to bridge the gap between revenue and expenditure and to service interest on borrowing States resort to short-term borrowing and even divert long-term loans to bridge cash losses.

The suggested measures to improve the financial health of DISCOMs are to formulate a roadmap for reducing the gap between ACS and ARR and cash losses. Conversion of existing Government loans to DISCOMs into Government equity will help cash flow of DISCOMs because now subsidy payable by State Government is adjusted against interest on loan. Many DISCOMs have negative net-worth and conversion of loan into equity may result into positive net-worth and enable DISCOMs to attract fresh funds.

(d) Cross-subsidy

There is a significant level of cross subsidy from Industrial consumers to Agricultural consumers.

(e) Distribution Franchisee

The Government of Maharashtra had taken the initiative to introduce an input-based franchisee for distribution in selected towns. Similarly franchisee has been appointed for Agra in Uttar Pradesh. As regards, Rural Franchisee, some states have demonstrated success in rural franchisee model. The states of Uttarakhand and West Bengal have deployed Self Help Groups as rural franchisees for management of rural distribution.

3.3 REFORMS AND POLICY IMPLEMENTATION STATUS

Open Access

The Open Access at Inter-State level is fully operational. During the FY 2009-10, the total number of transactions under Open Access was 18,128 as against 778 in 2004-05. Further, Central Transmission Utility (CTU) is reported to have received 225 applications from private developers for Long Term Open Access. At State level, as per information available with Forum of Regulators secretariat, 24 SERCs have notified terms and conditions of Open Access Regulations, 21 SERCs have determined cross subsidy surcharge, 25 SERCs have allowed Open Access up to 1 MW and above, 21 SERCs have determined transmission charges and 18 SERCs have determined wheeling charges.

Tariff Rationalization

It is seen that the tariff is not appropriate to meet the cost of supply of electricity. This hinders the sustainability of distribution companies. Further, default in payment, non-metering of consumers, no proper energy accounting/ auditing, inadequate upgradation of the distribution system are issues that need to be addressed. State Governments may have to examine the possibility of increasing the tariff in respect of agriculture and domestic sector or providing adequate revenue subsidy. Comptroller and Auditor General of India (CAG) have also carried out a study of 24 utilities on issues impacting financial performance of Power Distribution Utilities in India and have mentioned the issues of cross subsidy and tariff not being rational. Unless the tariff are not made rational and higher losses are not contained, DISCOMs will reach at break down level due to financial imprudence.

3.4 PROGRAMME FOR 12TH PLAN

The key challenges to be addressed during the 12th Plan are providing access of power to all, Sustainability, Efficiency and Effectiveness of Distribution sector. Estimates of Physical and Financial programme for 12 Plan are given in Table below.

Table: ES-13

Estimates of physical & financial requirement for distribution during 12th Plan.

Sl. No.	Name of Segment	Units	Physical	Financial (Rs. Cr)
			2012-17	**2012-17**
I	**New Lines**			
(i)	33 KV O/H line	Ckt Kms	121500	9720
	33 KV U/G Cable(30%)	Ckt Kms	13500	4050
	Total 33 KV line	Ckt Kms	**135000**	
(ii)	11 KV O/H line	Ckt Kms	448000	22400
	11 KV U/G cable	Ckt Kms	112000	22400
	Total 11 KV line	Ckt Kms	**560000**	
(iii)	LV O/H	Ckt Kms	488000	24400
	LV ABC	Ckt Kms	122000	9760
	Total LV	Ckt Kms	**610000**	
II	**Installation of new S/S**			
	33/11 KV(2X10 MVA)	No	4400	22000
	No of 10 MVA Transformers	No	8800	
	Transformation capacity	MVA	**88000**	
III	**Installtion of DTs including all accessories**	MVA	**105000**	
	1000 KVA	No	10500	1260
	630 KVA	No	33500	3350
	315 KVA	No	67000	4020
	200 KVA	No	105000	5250
	100 KVA	No	210000	8400
	25 KVA	No	424000	8480
	Total No of DTs	No	**850000**	
III	**Aug of Sub-Station**			
	33/11 KV	MVA	50000	10000
	11/0.4 KV	MVA	50000	10000
IV	Capacitors	MVAR	16000	1280
V	Service Connections		50000000	25000
VI	Re conductoring of lines			
	(i) 33 KV	Ckt. Kms	100000	3000
	(ii) 11 KV	Ckt. Kms	500000	10000
	(iii) LV	Ckt. Kms	1000000	20000
	SUB TOTAL			**224770**
	Productive Load Scheme			61940
	Smart Grid			9500
	IT facilities &SCADA including HRD			10000
	R&D			25
	TOTAL			**306235**
	Say Rs 3.06 Lakh Crores			

3.5 MAJOR INITIATIVES FOR SUSTAINABLE DISTRIBUTION SECTOR DURING 12TH PLAN

Achieving the MoP's vision of "Reliable, adequate and quality power for all at reasonable prices" will require financial assistance and incentivizing investment from the Government of India. Details of the major initiatives proposed for 12th Plan along with details of outlay and Government subsidy proposed are as follows:

Table ES -14

S. No.	Scheme type	Total fund requirement (Rs. Cr.)	GoI Assistance (Subsidy) (Rs. Cr.)
1.	**R-APDRP**	**15,870**	**9,924**
1.(a)	**Additional requirement of funds for the ongoing projects sanctioned during XI Plan (Details enclosed)**	**-**	**9,900**
2.	**Smart Grid**	**9,500**	**5,000**
3.	**Research & Development (Rs. 5 Cr annually)**	**25**	**25**
4.	**RGGVY**		
	(i) For Electrification of remaining villages & habitations	**63,490**	**57,141**
	(ii) Providing LED lamps for BPL households	**1500**	**1350**
	(iii) DDG	**1000**	**900**
	Total (RGGVY)	**65990**	**59391**
5.	**Inclusion of Productive Load Scheme**	**61,940**	**30,970**
6.	**Feeder separation Scheme**	**20,000**	**10,000**
7.	**National Electricity Fund**	**22,000**	**22,000**
8.	**Human Resources Development Plan**	**150**	**150**
9.	**Scheme for Replacement of Inefficient Pump Sets by Energy Efficient Pump Sets in Agriculture Sector**	**30,000**	**15,000**
	Grand Total	***2,25,475***	***1,62,360***

3.5 CONCLUSIONS AND MAJOR RECOMMENDATIONS (DISTRIBUTION):

1. AT&C Loss reduction is a priority and is to be achieved through various administrative and technical measures.
2. Electrification of all villages and habitations for universal coverage by year 2017.
3. Payment of subsidy/outstanding dues by States shall be made upfront, as per section 65 of Electricity Act, 2003. Clearing of all the outstanding subsidies to the utilities. Release payments from the State budget directly;
4. Rationalization of tariff and timely filing of Tariff Revision Petition regularly;
5. Adoption of Multi Year Tariff with tariff revision in a time bound manner.
6. Timely finalization and computerisation of accounts;
7. Establishment of DDG projects in Grid connected areas also where adequate power supply is not available. Setting up of Decentralisaed Distribution Generation (*DDG)* projects based on Viability Gap Funding (VGF) through competitive bidding process.
8. Continuation of R-APDRP and RGGVY in 12th Plan.
9. Under National Electricity Fund assistance to be linked to sates (for interest subsidy) based on process of reforms and other eligibility criteria.
10. 100% Metering of Consumers to be ensured.
11. Distribution Franchisee as a PPP model in electricity distribution to be promoted.

12. Funding for smart grid pilot projects, training initiatives, and for Research and Development are recommended to be as grants.
13. Distribution Sector R&D to be promoted. Setting-up of a Technical Cell of CEA, which will focus on - Best practices, R&D in terms of data collection and specific projects, Technical support to States for consultancy and implementation.
14. The distribution system planned for the 12th Plan includes setting up of new lines (13,05,000 ckm), installation of new substations(88,000 MVA), augmentation of substation etc. The total fund requirement is Rs 3,06,235 crs for distribution sector.

4.0 LEGISLATIVE & POLICY ISSUES- FORMULATION, IMPLEMENTATION & FEEDBACK

Government of India's Policy of "Power for All" is in pursuance of the objective of the Electricity Act 2003 to protect the interest of consumers and supply of electricity to all areas. Several programmes have been initiated to achieve this objective. This objective has also been stated in the National Tariff Policy and National Electricity Policy and after many years of the implementation of these schemes and programmes, a need has been felt to review these policies in order to make Government's stated objectives achievable, within the boundaries of institutional and financial viability and to bring the benefits of electrification to the entire population. The suggested policy changes seek to accomplish the objective of achieving inclusive growth by providing affordable, adequate and quality power for all consumers.

A Summary of Recommendations on 'Legislative and Policy Issues – Formulation, Implementation and feedback' is as follows:

1. Strengthening of institutions at the National/ Regional/State level such as NLDC/RLDCs/SLDCs is vital to the implementation of Open Access. The management of POSOCO should be separated from the Power Grid. There is a need for functional & financial separation in operation of SLDCs for ensuring their independence. The recommendations made by the Pradhan Committee need to be implemented for ensuring empowerment of SLDCs.

2. To give a clear timeline for States to expedite reassignment of the PPAs to DISCOMs and for winding up the single buyer model as early as possible, enabling provision may be made in this regard in the Policy.

3. SERCs should provide long term trajectory for Renewable Purchase Obligation. Forum of Regulators (FOR) should conduct studies in this regard and suggest possible trajectories for different States keeping in view availability of renewable sources in the country and impact of increasing level of Renewable Purchase Obligation (RPO) on the power purchase cost of the respective distribution licensee. FOR should strive to develop homogeneity in the RPO regulations of respective states and UTs.

4. The Principles & guidelines evolved through consensus by the Forum of Regulators for the Renewable Purchase Obligation (RPO) of Obligated entities and Renewable Energy Certificate (REC) mechanism should be followed up for timely adoption by corresponding Regulations of SERCs in keeping with Government Policies. A time limit of 3 to 6 months may be prescribed under the policy for respective SERCs to issue the relevant Regulation once it is adopted by the FOR with or without modification.

5. As the present definition of cogeneration plants as provided in the Act and as interpreted by Appellate Tribunal For Electricity (APTEL) does not prescribe the source of fuel (fossil or non-fossil), it is recommended to bring clarity in this regard through legislative changes, if required, in consultation with MNRE.

6. Empowering Regulatory Commissions for suo moto revision of tariff to consumers-Section 64 of Electricity Act 2003 may be amended by incorporating an additional provision for empowering the Regulatory Commissions for suo moto revision of tariff to consumers.

7. The CGRF should be a multi-member setup with members from all stakeholders. FOR to play an important role in ensuring consonance of guidelines/regulations pertaining to CGRF & Ombudsman in respective States and UT's.

8. The office of the Ombudsman should be funded by SERCs and a separate budgetary allocation could be made in the budget of SERCs for this purpose and should be recovered from distribution licensees.

9. Consumer Advocacy Cells may be instituted by all the Commissions to provide the required legal advice, support, and assistance to Complainants for representing their case before the Ombudsman. Such a Cell could be funded by the Commission.

10. Power procurement and allocation of power to be done in line with the tariff policy and the guidelines/ Standard Bid documents (SBD) issued by Govt. of India under the Electricity Act, by the State Government. The Working Group recommends that enabling provisions may be made in the NEP in this regard.

11. A new Para in the policy may be added so that similar condition/ provision may be made on the lines of Works of Licensee Rules for conditions of construction of dedicated transmission lines and also any dispute is to be adjudicated and compensation decided by District Magistrate etc...

12. 'Independent Monitoring Group' (IMG) for oversight on important programs / schemes such as RGGVY, NEF and R-APDRP may be constituted separately. To give effect to this mechanism, provision shall be made in the plan document / National Electricity Policy.
These groups will consist of officials as well as independent experts and will review progress of policies/ programs / schemes periodically, say, every six months. IMGs will submit reports to Secretary (MoP) and these reports will be in the public domain."

13. Alternative methods of calculating cross subsidy surcharge could be worked out to ensure that neither open access is throttled nor does the host DISCOM unduly suffer.

14. SERCs may calculate Cross-Subsidy Surcharge based on the assumptions that the power available as a result of exit of open access consumer will be sold at the average revenue realization rate. This is the most practical scenario in a situation of shortage of power supply. The SERCs may assume certain percentage (say, 10%) of the total consumption by eligible open access consumers for the purpose of estimation of power available for sale at average realization rate. The wheeling charge (grossed up by the system loss at appropriate level) to be recovered from the open access consumers should also be factored into computation of surcharge. At the same time it should also be ensured that the formula incentivizes the distribution licensees to reduce their distribution losses.

15. For a situation where there is no power cut, SERCs may calculate Cross-Subsidy Surcharge based on the estimation that the DISCOM will avoid purchase of the quantum of power for which open access has been sought. This principle of avoided cost method should be adopted in areas where there are no power shortages. Other assumptions relating to quantum of power avoided and the wheeling charges could be on the same lines as above.

16. As envisaged under Sec. 61(g) of the Act, all SERCs/JERCs should specify through a regulation the roadmap for reduction of cross-subsidy between different consumer categories. The road map should also have intermediate milestones, based on the approach of a gradual reduction in cross subsidy.

17. SERCs should impose reasonable trading margin for the intra-state sale irrespective of the final destination of the electricity. SERC's should incentivize the intra-state trading in line with Act and Policy.

18. The concerned SERC should ensure automatic pass through for any increase in power purchase cost arising out of rise in cost of fuel

19. Two Power Exchanges (PX) are in operation leading to two spot prices today. Two PX, while facilitating competition, also leads to fragmentation of transmission service. It is suggested that while there could be multiple PX, a central price clearing algorithm could be adopted. A single spot price would lead to more certainty as far as investors are concerned. An alternative suggestion received was that as the Power Exchanges were still at a nascent stage, they should be allowed to mature before having a concept of a central price clearing algorithm. In the interim, there could be arbitrage opportunities between the two PX.

20. It is suggested that the ancillary active power market be developed. CERC shall come out with a framework for implementation of ancillary market.

21. The need for long term adequacy statement by DISCOMs was emphasized in order to reduce uncertainty to the end consumer. It is felt that a substantial part, say about 80-85% of the requirement needed to be sourced by DISCOMs through long/ medium term contracts so that the infrastructure is developed accordingly.

22. In view of the slow progress made by the distribution licensees for arranging long-term power purchase agreements through competitive bidding, it is recommended that a separate group may be set up to examine the impediments in this regard and suggest remedial measures required.

23. Short term procurements can be done three months in advance by the DISCOMs. Other products available in short term are First Come First Served (FCFS), day ahead and same day. A suggested model could be to source up to 98-102% of the requirements two days in advance and leaving only the last 2-3% for the day-ahead market. The day-ahead market might be taken recourse to only to account for load forecast errors and/or forced outage of some generating units.

24. The Act shall provide further clarification on the meaning of 'extraordinary circumstances' mentioned in Section 11, in case required. Further, the Appropriate Commissions might in line with the provisions of the Act clearly specify the compensation to be provided to Generating Companies whenever section 11 directive is issued to generating companies.

25. The provision under section 11 or 108 of electricity Act, 2003 should not be misused to deal with shortage of power in the State as this section was meant to be invoked in extra ordinary circumstances like security of the State, public order or a natural calamity. This position may be clarified in the National Electrical Policy

26. To make open access happen, it is also important to evolve a uniform approach to operational level issues like metering, billing and settlement etc. and various charges for open access. FOR should evolve uniform principles on all such issues through the consensus evolved and follow up for timely implementation.

27. For all 1 MW and above consumers seeking open access, Stand by charges should apply only if the distribution licensees continue to have the universal service obligation for energy supply. In case the distribution companies do not have the universal service obligation, stand by charges may be decided by mutual agreement between the open access consumers and the distribution companies.

28. In order to have two different types of distribution licensees, the power granted to Appropriate Commission, under Section 14 to grant a distribution licence, will have to be amended to the effect that it can grant two different types of distribution licences.

29. The definition of minimum area of supply may be modified and it may be left to the discretion of the SERCs to decide the area, with due consideration to the fact that the grant of second/subsequent license does not lead to “cherry picking”.

30. At the state level, DISCOMs also need to create Distribution Control Centres (DCCs) and empower them so that open access at the distribution level becomes a reality. The nodal agencies identified also need to be protected against taxation related issues with respect to single window clearance operation.

31. Single entity which takes care of wires and multiple suppliers of power which use the common network may be a vital step for operationalization of Open Access in Distribution Sector. A detailed study should be conducted by FOR in this regard based on international experience and implications should be assessed.

32. It may be desirable for the SERCs to encourage the distribution licensees to go for competitive bidding process. More clarity needs to be brought in this regard through suitable legislative changes.

33. Adequacy issues with respect to ‘carriage’ must be clearly understood and documented both at the inter-state and intra state transmission. Stakeholders must clearly understand the limitations of the network and the maximum possible power that can be transacted either way into and out of the network.

34. States may also consider setting up dedicated mobile courts and police stations for dealing with offences mentioned in Electricity Act.

35. States should ensure that the institution of Chief Electrical Inspectorate to Govt. of India (CEIG)/State Government is strengthened so that quick and timely approvals are given.

36. Taking into account the practical difficulties in view of the growing number of connections and the shortage of the staff, CEA should work out a scheme of delegation of authority of mandatory inspections, including self-certifications, which would be in consonance with liberalization of bureaucratic control without compromising system safety and suggest possible steps for strengthening of Chief Electrical Inspector institutions which may be adopted by the State Governments.

37. Suitable incentives to those states who have adopted such measures viz., Time of Day (TOD) tariff should be given.

38. TOD for LT industries and Domestic consumers should be operationalized in phases

39. Pre – paid meters shall be promoted to High value consumers and to those categories of consumers who are chronic defaulters to avoid piling up of arrears.

40. 100% Spot billing, Spot collection, Semi / fully automated meter reading and Standardization of metering protocols shall be done for extensive usage of AMR.

41. Dedicated feeders may be extended to energy intensive consumer groups at their cost.

42. The State Governments should not only clear all the outstanding dues to the Utilities, but ensure payment of subsidies as per section 65 of EA 2003 in future. FOR shall evolve principles & methodologies in this regard through consensus and further follow up the progress.

43. There is an urgent need to align power/energy policies by the States with the Tariff Policy notified under the Electricity Act.

44. Regulatory Commissions (ERCs) could consider initiating investigation under Section 128 to investigate on any action with respect to procurement and/ or disposal of power by State Government in its capacity as a deemed licensee u/s 14 and give appropriate direction. ERCs could issue directions u/s 60 to State Govt (in its capacity as a deemed licensee u/s 14) to not force generating company to export surplus power only through SEB and thereby examine whether unfair conditions are being imposed on account of violation of Section 10(2) and / or whether unlawful actions are being taken by contravention of the Tariff Policy. ERCs could also take action if they feel that their tariff fixation powers are being encroached upon or being vitiate on account of the State Government policies.

45. Renewable purchase obligation for these sources have to be fixed in line with the expected generating capacities and for which the corresponding action plan/mission of on the lines of National Solar Mission which will look into all related steps like corresponding transmission evacuation capacity, the technical and commercial issues associated with it are considered in consultation with all stakeholders. Thereafter, RPOs should be distributed among the states in line with the targets set under the National Action Plan on Climate Change to be done through amendment in Electricity Act 2003 and/ or Tariff Policy.

46. Each state to have 5-10 years RPO for different renewable resources.

47. All states should take Renewable Purchase Obligation (RPO) in all renewable power resources. Percentage share of each resource may depend upon availability of resource in the state, e.g. Bihar with higher biomass resources may take higher PO for biomass and remaining from others-this will create market for each renewable resource.

48. All Generators who set up Power plants may be encouraged to set up corresponding renewable source power generation through suitable incentives by MNRE.

49. Long term procurement of power by the distribution licensee to be done through competitive bidding process (CBP) and Power Purchase Agreements (PPA). To start with, the provisions in the Tariff Policy may be amended suitably for phase-wise introduction of competition for the different sources of renewable energy. Renewable Power procuring state will have the following procurement options:-

1. Long term procurement through competitive bidding.
2. Short term procurement through Purchase of REC or at preferential tariffs.

50. For the procurement of renewable power individual demands of more than one distribution licensees/ States may be pooled at the regional level and procured through competitive bidding route under Section 63 (A) of EA 2003/ National Tariff Policy .

51. Spinning reserves need to be facilitated for grid stability at the regional level to accommodate the infirm renewable energy injection into the grid.

52. Suitable incentive for low cost transmission system linking the renewable energy generation sources, development of Smart Grid for evacuation and transmission of renewable power , creation of Spinning Reserves managed by the Regional Load Dispatch Centre needs to be developed may be done through the National Clean Energy Fund .

58. Through suitable legislative changes it is recommended that a Multi-disciplinary body shall be constituted comprising of representatives from Centre and States to review the performance of the Regulatory Commissions periodically on the basis of a performance evaluation matrix and report to the appropriate Government for necessary corrective action.

59. Through suitable legislative changes, to entrust CERC with the additional function of regulating coal prices and its transportation charges.

5.0 DEMAND SIDE MANAGEMENT ENERGY EFFICIENCY & ENERGY CONSERVATION

5.1 11TH FIVE YEAR PLAN – TARGETS & ACHIEVEMENTS

In the 11th Five Year Plan (2007–12), it was proposed to achieve energy saving of 5% of the anticipated energy consumption level in the beginning of the 11th Five Year Plan.

Various activities under different schemes of BEE and MoP have resulted in savings in avoided power capacity of 7415 MW (verified; till Dec 2010) and 250 MW (unverified for 4th Quarter of year 2010 – 11) and 3409 MW avoided power capacity savings is projected during the last year of the 11th Five Year Plan (2011-12).

5.2 UTILITY BASED DEMAND SIDE MANAGEMENT IN THE 12TH PLAN

BEE would provide the technical assistance for establishment of DSM cells in the DISCOMs and capacity building of personnel of DSM cells for enabling them to undertake the following strategies and schemes of DSM in 12th Five Year plan:

(i) Load Survey
(ii) Load Strategies

- Demand Response
- Load Management Programmes
- Dynamic/Real Time Pricing
- Time-of-Use Rates
- Automated/Smart Metering
- Web-based/Communication System

(iii) Demonstration Studies
(iv) Advanced Metering
(v) DSM Financing

The total funds required for providing technical assistance for capacity building of DSM cells established by DISCOMs under 12th Five Year Plan is Rs. 300 crore.

5.3 ENERGY CONSERVATION STRATEGY IN THE 12TH PLAN

It is necessary to carry forward the existing schemes as well as further strengthen the activities to accelerate the process of implementation of energy efficiency measures to achieve the desired energy savings. The target of energy saving which may be achieved in the terminal year 2016-17 of 12th Five year Plan as a consequence of Demand Side Management (DSM), Energy Efficiency and Energy Conservation schemes as proposed in the plan is expected to be 44.85 BU (at consumer side) which is equivalent to 60.17 BU at the Bus bar side. Details of the various Schemes are as follows:

5.3.1 Strengthening State Designated Agencies (SDA)

The thrust of the SDA program during the 12th Plan will be on strengthening the 32 SDAs which would enable them to implement various programs and activities initiated by BEE or SDAs themselves.

In the 11th Plan, BEE supported State designated agencies (SDAs) in preparation of action plan, building institutional capacity of SDAs, to perform their regulatory, developmental and promotional functions in their respective states, by way of technical assistance, guidance and funding etc. Each SDA has been supported to develop a five year Energy Conservation Action Plan, customized to local needs aiming at and delivery of the EC act mandates. The proposed activities for the 12th Plan include sector specific interventions in areas like municipality (drinking water and sewage treatment), agriculture sector (pumping), street lighting, commercial buildings, government buildings and waste heat recovery in SMEs including demonstration projects.

The total funds requirement for proposed activities is Rs. 140 crore.

5.3.2 State Energy Conservation Funds (SECF)

The State Energy Conservation Funds (SECF) as mandated under the Energy Conservation Act, 2001, have already been constituted in 22 states and funds have been released to 20 states during the 11th Plan to operationalize the SECF for various energy efficiency initiatives. The state governments of Andhra Pradesh, Rajasthan, Chhattisgarh, Karnataka, Haryana, Gujarat and Mizoram have also contributed a matching grant to the SECF.

In the 12th Plan, it is proposed to set up the SECF in all the states and

- Pursue with SDAs for constitution of SECF in the states and matching contribution by the state governments to the SECF.
- Coordinate with SDAs to implement various energy conservation activities and utilization of fund under SECF.

Contribution of Rs. 70 crore to state energy conservation fund is proposed under the 12th Plan.

Total fund required for strengthening of SDAs and SECF is Rs. 210 crore.

5.3.3 Industrial Sector

The total commercial energy consumed by the industries and SMEs together stands at about 40-50% of the total commercial energy consumption in the country. In view of continuing growth of industry sector, the proportion of commercial energy consumed by industry is envisaged to be around 40-45% in the next five-year plan also.

(a) Large Industries (Designated Consumers)

The projected energy saving potential in the 12th Plan is 11.43 mtoe which consists of a saving of 6.2 mtoe from the seven energy intensive industries (DCs) and 5.23 mtoe from thermal power stations sector. The total energy saving per year during 2011-12 to2016-17 for 7 DC sectors is calculated on the basis of 1.2% p.a. and at 1% p.a. for the Thermal Power Plant sector during 2015-16.

The instruments to achieve the projected savings in 12th Plan in DCs and other industries are:

- **Continuation of on-going Schemes/Programs by Bureau of Energy Efficiency and Ministry of Power**
    - National Energy Conservation Award
    - Notification of Energy Intensive Sectors as Designated Consumers (DC)
    - Enhanced Capacity Building of Energy Management Professionals (National Certification Examination for EA/EM)
    - Implementation of Perform, Achieve & Trade (PAT) Scheme

The following points describe the vision for PAT scheme during 2012-2017.

- Implementation of 1st Cycle of PAT to achieve the set target of 6.6 mtoe by 2014-15
- Widening and Deepening the Scope of PAT during the 2nd Cycle of PAT
- Accelerate the Implementation of ISO 50001 to promote benchmarking of Energy Management system in Industries and facilities
- Implementation of Frame work for Energy Efferent Economic Development
- Getting support from National Clean Energy Fund (NCEF
- Facilitation for Need for R&D in NMEEE / PAT

(b) Small & Medium Enterprises

The MSME sector plays a significant role in energy consumption which is about 5% of the total energy consumption by industrial sector. In the 12th Five Year Plan, BEE would target the SME sector for reduction in energy consumption by 6% of the energy used in the energy intensive manufacturing SMEs which is equivalent to 1.75 mtoe. The targeted goal is proposed to be achieved by introducing innovative business models and financial instruments (like Venture Capital Fund/Revolving Fund, Partial Risk Guarantee Fund). The proposed schemes/activities to be undertaken in 12th Plan are as mentioned below:

- Sector specific approach for energy efficiency and technology upgradation through facilitation of implementation of DPRs
- Energy mapping of the targeted SME Sector on all India basis
- Undertaking of Innovative Financial Schemes for adoption of EE Technologies in the SMEs
- Technical assistance and capacity building
- SMEs Product Labelling Promotion Scheme

5.3.4 Equipment and Appliances

(a) Standard & Labeling (S&L) Programme:

The proposed activities in 12th Five Year Plan under S&L for equipments and appliances include:

- Inclusion of 5 new equipment and appliances
- Awareness creation among all the stakeholders,
- Undertaking of check testing, monitoring, market impact assessment of appliances/ equipments covered under S&L

- Up-gradation of energy performance standards for equipment/ appliances covered during 11th Plan.

S&L for Transport Sector

There are total 13.3 million passenger cars (2010 – 11) in India which consume about 9 mtoe. The average annual sales of new passenger cars in the country are about 1.1 million. Under the labeling scheme, the following activities are proposed

- Introduction of fuel economy norms effective from 1st year of 12th Plan,
- Technical study for 2 & 3 wheelers and commercial vehicles (Truck & Buses) to finalise S&L programme

The targeted energy saving by the end of the 12th Five Year Plan is 4.3 mtoe.

(b) Super Efficient Equipment Program (SEEP)

SEEP is a part of Market Transformation for Energy Efficiency (MTEE) initiative, one of the four initiatives of the National Mission on Enhanced Energy Efficiency (NMEEE). The primary objective of MTEE is to accelerate the shift to energy efficient appliances through innovative measures to make the products more affordable. NMEEE seeks to achieve annual savings of 19,598 MW of power and 23 million tonnes of fuel and greenhouse gas emissions reduction of 98.55 million tonnes. is the mission implementing agency for NMEEE.

5.3.5 Commercial Sector

a) Energy Conservation Building Code & Energy Efficiency in Existing Buildings

The projected energy saving at the end of the 12th Five Year Plan is 10.77 BU with the financial budget requirements of Rs. 65 crore.

b) Residential Sector

Bachat Lamp Yojana

The projected electricity saving at the end of 12th Plan is about 10 BU with the financial budget requirement of Rs. 6 crore.

c) Agriculture Sector

Agriculture DSM (Ag DSM)

The projected electricity saving at the end of 12th Plan is about 0.7 BU with the financial budget requirement of Rs. 393 crore.

d) Municipal and Public Utility Sector

Municipal DSM (Mu DSM)

- Energy Efficiency in ULBs
- Energy Efficiency in Water pumping

The projected electricity saving at the end of 12th Plan is about 0.47 BU with the financial budget requirement of Rs. 45 crore.

5.3.6 Energy conservation awareness, awards and painting competition

It is proposed to strengthen all ongoing activities during the 12th Plan and introduce the following specific activities:

- Creation of data base and its analysis for EC Award participating units
- Compilation and dissemination of best-practices in industry and building sector
- Continuation of EC Awards and paintings competition on energy conservation
- Awareness creation on energy conservation through print, electronic and other media for general public

The projected saving at the end of 12th Plan is about 6.83 BU of electrical energy and 5 mtoe of thermal fuel saving with the financial budget requirement of Rs. 100 crore.

5.3.7 Human Resource Development Programmes

In addition to the HRD activities undertaken in each of the scheme of BEE and MoP, the following initiatives are also proposed to be undertaken in the 12th Five Year Plan:

- Student awareness programs
- Training, skill up gradation and refresher training of energy managers and energy auditors
- Training, skill upgradation and refresher training of operators handling fuel fired furnaces and boilers.
- Inter-institutional networking in energy efficiency training
- Training of Power plant personals

The HRD plan is developed for general public awareness and student groups as well as through special training packages for sector specific energy efficiency of operators, energy auditors and managers. It meets the need of most of the sectors such as the power sector, SME, North East, agricultural, buildings, etc.

The total budget proposed is Rs. 288 crores in the 12th Plan.

5.4 CONCLUSION & RECOMMENDATION

Following recommendations/new initiatives are suggested for 12th Plan.

- Continuation of on-going Schemes/Programs by Bureau of Energy Efficiency and Ministry of Power

- The target of energy saving which may be achieved in the terminal year 2016-17 of 12th Five year Plan as a consequence of Demand Side Management (DSM), Energy Efficiency and Energy Conservation schemes as proposed in the plan is expected to be 44.85 BU (at consumer side) which is equivalent to 60.17 BU at the Bus bar side.

- State designated agencies (SDAs) in different states need to play a very important role in terms of carrying forward various energy efficiency initiatives at the state level. The thrust of the SDA program during the 12th Plan will be on strengthening the 32 SDAs which would enable them to implement various programs and activities initiated by BEE or SDAs themselves.

- In the 12th Plan, it is proposed to set up State Energy Conservation Fund (SECF) in all the States and pursue with SDAs for constitution of SECF in the states to implement various energy conservation activities and utilization of fund under SECF. Matching contribution may be made by the state governments to the SECF.

The proposed activities in 12th Five Year Plan under Standard & Labelling Programme (S&L) for equipments and appliances include:

- Inclusion of at least 5 selected new equipment and appliances. Standby power loss reduction in few of the electrical appliances will also be focussed in the 12th Plan.
- Awareness creation among all the stakeholders,

- Undertaking of check testing, label verification, market impact assessment for appliances/ equipments covered under S&L scheme and
- Up-gradation of energy performance standards for equipment/ appliances covered during 11th Plan.

Under the labelling scheme, the following activities are proposed

- Introduction of fuel economy norms effective from 1st year of 12th Plan,
- Technical study for 2 & 3 wheelers and commercial vehicles (Truck & Buses) to finalise S&L programme

6.0 RESEARCH AND DEVELOPMENT

6.1 REVIEW OF R&D ACTIVITIES DURING 11th PLAN

i. Details of R&D activities by NTPC are in the following areas:

Development of IGCC Technology, Solar Thermal Platform & Solar Photovoltaic Research set ups, Waste heat recovery from flue gas for air conditioning, Development of aqueous-ammonia technology, Establishment of integrated biodiesel pilot plant, Development of robotic based inspection systems for boiler tubes, Set up of Solar thermal based HVAC system, Development of Water & Waste Treatment Technology, Set up of Pressure Swing Adsorption (PSA) based pilot plant for CO_2 capture, Studies on fixation of CO_2 through Microalgae, Studies on aqueous mineralization of fly ash by flue gases, Feasibility studies on Extraction of moisture from flue gas, Development of PDC-RVM instrument and expert system for moisture measurement in insulating papers of transformers, Retrofitting of VFD drives in existing cooling tower fans, Development & installation of artificial intelligence based software for plant performance improvement, Development & installation of online boiler water chemistry monitoring & advisory software, CFD modeling of flue gas ducts to improve temperature & velocity imbalances, etc

Scientific & technical support provided to all NTPC stations as well as many outside stations by NETRA plays a definite role in increasing the availability & reliability of stations in terms of failure investigations, corrosion analysis & control, water & waste water treatment, condition monitoring, health assessment, etc.

ii. Research projects taken up by BHEL during 11th plan under transmission sector are as follows:

a) 2.5 MVAr STATCOM: This project has been taken up jointly with CPRI and the system was developed and successfully commissioned at BHILAI steel plant.
b) Development of IEC 61850 Compliant Substation Automation System. Under this project IEC 61850 client has been developed. Bay Control Unit (BCU) has been developed. Based on this, a 132 kV substation of AP TRANSCO at Chintal has been provided with BHEL developed SAS under a field trial project.
c) Based on the development of 33kV Phase Shifting Transformer (PST) with Thyristor controlled static tap changer, BHEL has made efforts to develop and manufacture PST suitable for transmission applications. In this regard, with the help of CEA and APGENCO, system studies were made and a proposal for the design, manufacture and commissioning of 400kV, 315 MVA +/- 15 degree PST was proposed at KTPS stage VI .

Based on the proposal, APGENCO has awarded a commercial order on BHEL. The project is under advanced stage of execution.

d) BHEL is working on the development of 400kV GIS and all the systems have cleared required dielectric tests and the efforts for field trial of the developed GIS is proposed in 2012. The field trail may spill over to 12th plan.

e) BHEL has developed IEC 61850 Process Bus requirements. In this regard, A Merging Unit (MU) has been developed and successfully tested at KEMA in the beginning of 2011. Field trail of full scale SAS along with process bus is contemplated in 2012 and the same is likely to come up in 12th plan.

iii. National Perspective Plan (NPP) –Initiative of MoP in R&D

R&D projects are executed through National Perspective Plan (NPP) Scheme of MoP in a collaborative mode. During the 11th plan period, thrust was given to new technologies such as: High temperature superconducting (HTS) systems, National Effort to Develop Custom Power Devices, Development of materials to address Silt erosion, Grid integration issues with renewable generation such as wind. These are addressed in a project mode.

The total fund spent so far in 11th Plan R&D works is 352 Crore only. Thus, MoP has initiated R&D Plan in new and emerging technologies, which need to be continued during the 12th plan.

6.2 PROPOSED R&D PLAN FOR 12TH PLAN

In the present scenario it is proposed to categorize the R&D initiatives into four different conventional sectors, viz. Generation, Transmission, Distribution and Environment. Under each Sector different technologies have been identified for development of prototypes and pilot plant demonstration. The different areas in these sectors are as below:

a. **Generation Sector:** Thermal, Hydro Fuel, Renewable Energy and Distributed Generation
b. **Transmission sector:** Design and development of equipment, real time simulators and controllers, Creation of data-bank, Automation, Pilot plant/Demonstration, Development of alternative materials, Equipment performance, Biological effects, Concept proving / Exploratory studies
c. **Distribution sector:** Smart Grid, Distributed generation
d. **Environment:** Clean Development Mechanism, Bulk utilization of fly ash, SOx, NOx, and mercury control.

The details of proposed R&D works are given in Chapter 6 of the Report.

6.3 ATTRACTING AND RETAINING OF YOUNG TALENT FOR R&D IN POWER SECTOR

First of all the young engineers should be trained in all aspects of Power Engineering. Training shall include:

- Field exposure
- System simulation for carrying out system studies
- Any other specialized areas in which they are supposed to work
- The problems faced in the Power sector shall be obtained from utilities Specific areas for R&D should be identified by experts; young talent can be used to solve the problems under the guidance of experts

- o Incentives should be given for good R&D work.

(a)To retain engineers/ young talent they should be allowed to pursue higher studies such that the research work they are carrying out becomes their project work for their masters or doctoral work.

(b)Institute should go for campus interviews in IIT's /NITs/Universities, explain to them the importance of R&D, the facilities and avenues for research, so that they make a proper choice of their future work.

(c) The problems faced in power sector should be made known to the researchers so that they can appreciate and take up such research work.

(d) More job opportunities should be created to absorb engineers for a job placement who are successful/excel in R&D.

(g) Researchers should be rewarded suitably, and if the research works ends up in patent he should also be eligible for the royalty, awards and citations etc.

(h) Researchers should be sent to training programs on advanced topics for research.

(i) Curriculum at degree level should be revamped to make students to realize the importance of R&D in power sector, so that they can pursue R&D

(j) Educational institutions should provide motivation to students to take up research work.

(k) R&D jobs should be paid on par with IT professionals else there is every chance that power engineers also take up IT related work and there is no brain drain.

(l) There should be an increased emphasis on induction level and advanced training focusing on career development of individuals and organization.

The educational institutions in the order of IIT/NIT/ Universities where the staff of Electrical Engineering Department is active should be identified for carrying advanced research and identifying as centres of excellence in specific fields.

6.4 Institutional and funding framework for R&D

Government should fund the R&D programmes through various schemes such as National Perspective Plan (NPP), Research Scheme on Power (RSoP). Some of them can be in collaborative mode with participation from CPSU's, Industry and academic institutes and utilities.

With a view to take up R&D projects under major thrust areas, and to establish new facilities and augment existing facilities fund requirement amounting to Rs 2,668 crores is proposed. The financial requirements to execute the projects outlined through NPP R&D scheme of MoP are to the tune of Rs 1,500 Crores. Thus, total requirement of fund during 12th Plan for R&D works out to Rs. 4168 Crore.

Out of the Rs 1,500 crores proposed for R&D, direct government grant should be to the tune of Rs 750 crores and balance can be through participation from CPSUs, Utilities and industry.

Details of R&D projects proposed are given in Chapter 6.

6.5 PROMOTION OF R&D IN POWER SECTOR

The Standing Committee on Research and Development (SCRD), which is presently managing NPP R&D, should be strengthened and empowered to make policy document on R&D for the power sector and prioritize problems of National importance having short, medium and long term impact. This should be the apex committee for R&D of power sector. This committee should be well represented by senior executives of central R&D institutions, CPSUs, Utilities and industry.

(a) Utilities should have collaboration with research institutes so that the problems faced by them can be taken up as research work and will also have immediate application.

(b) Manufacturers should also participate and sponsor the research program relevant to power sector.

(c) The successful R&D projects should be given a wide publicity within the power sector

(d) The power sector should have joint collaboration with similar research institutes abroad to have exchange of know-how and latest methods.

The proposed 'POWER – ACADEMY' should be entrusted with complete research need of country, and shall work in coordination with SCRD. All the manufacturing firms, utilities and all concerned even remotely with power sector should be reporting their problems, R & D requirement to this academy.

The recommendations can be implemented by R&D institutions which are financially and administratively autonomous. Such institutions can draw road map for R&D for the next decade.

6.6 CONCLUSION AND RECOMMENDATIONS

1. Power Sector, being highly technology intensive, there is need to promote extensive Research and Development (R&D) in the country, especially while considering introduction of new and advanced
2. Collaborative Research in a phased manner is needed to bridge the knowledge and technology gaps, build expertise, to find solutions for the problems existing in the system and also for problems that may arise in the future.
3. Technologies such as FACTS and HVDC transmission have played a crucial role in alleviating transmission system constraints. More R&D in these area need to be promoted.
4. Special attention is needed for the development of the eight States of the NE Region of the country through a separate R&D Programme on renewable energy.
5. It is proposed to institute Scholarship schemes in some of the Engineering colleges in North East, institute Cash incentive schemes for students and encourage students to take up Masters and Doctoral Programmes in Engineering.
6. Human Resource and Competence building Development for R&D in power sector would require creating a separate cadre for research in taking up application oriented research. The success of the R&D projects will largely depend upon quality of manpower, freedom for research and continuity. Keeping this in view, special schemes such as: attractive fellowships, provision to improve qualification and exposure will be introduced, for attracting young talent and to retain them in power sector.
7. With a view to strengthen the multi disciplinary collaborative research activity amongst CPSUs, utilities, industry and academic institutions, ***Centres of Excellence (CoE)*** need to be

created to take up application oriented research projects in strengthening the performance of power sector.

8. There is a need to establish ***'Power – Academy'*** in line with the 'CSIR-Academy', ISRO – Indian Institute of space science and Technology, to attract young engineers, and provide scope to build professional carrier in R&D.
9. With a view to take up R&D projects under major thrust areas, and to establish new facilities and augment existing facilities fund requirement amounting to Rs 2,668 crores is proposed. The financial requirements to execute the projects outlined through NPP R&D scheme of MoP are to the tune of Rs 1,500 Crores. Thus, total requirement of fund during 12th Plan for R&D works out to Rs. 4168 Crore.

7.0 KEY INPUTS

Timely availability of key inputs such as equipment, material, fuel, land and water transplant etc., is crucial for the timely completion of power projects. Infrastructural support such as Port facility, construction & manufacturing capabilities specifically erection machinery and erection agencies including civil and BOP contractors are also of utmost importance.

7.1 COAL

Coal-based generation is expected to continue to be the predominant source of electricity in the 12th plan period and beyond. Out of the total capacity addition of 75,785 MW envisaged during the 12th plan, coal-based capacity addition is expected to be about 62,695 MW i.e., about 82.73%. Hydro, Nuclear and Gas based generation is expected to constitute about 12.14%, 3.70% and 1.43%. The estimated coal requirement is 842 MT at the end of 12th Plan and 1040 MT at the end of 13th Plan.

Strategies for Mitigation of demand supply gap of coal are Import of coal, Coal price pooling, Demand side management of Coal and Coal Linkages to be reviewed.

7.1.1 Concerns Regarding New Coal Distribution Policy (NCDP)

- Coal India Limited is pursuing Power Utilities for signing of FSA for new units commissioned in year 2009-10 & after, with trigger value of 50% of ACQ quantities in stead of existing trigger value of 90% of ACQ. In this condition, the Fixed Cost Component of generation cost will increase with 50% coal availability and with the operation of units at lower PLF the Station Heat Rate & auxiliary power consumption will also increase. This will also increase the variable cost of generation. If the imported coal is used to maintain the PLF as specified by Regulatory Commission to recover 100% Fixed Cost, the Variable Cost of generation will be very high. The net impact in either case will be of the order of 60-70 paisa per KWH.

- ACQ level be determined at 90% PLF level for all power plants.

- Given the supply deficit scenario and monopolistic nature of domestic coal market, it is essential that CIL treats all the projects on the same platform, irrespective of vintage of the plant or ownership structure, while determining ACQ levels and agreeing on trigger levels for penalty for short-supply.
- Efficiency norms to be used for all plants and such norms to be reviewed by an independent expert body (CEA or CERC).

- New linkages to be given only to higher operating efficiency project- with super critical/ ultra super critical technology. It is recommended that during the 13th Plan, new power plant based on sub-critical technology should be an exception.
- Coal India has specified number of milestones for execution of the power projects for commencement of coal supply. The Coal India should restrict to the major milestone of commissioning of the unit on oil firing. The Coal India should also bind themselves with their milestones to give confidence to the power developer that they will get the assured supply of coal immediately after synchronization of their unit on oil to secure their investments.
- Difficulties in submission of documentary proof for achievement of milestones :
  - ***Forest Clearance***: Coal Companies insist for NOC from State Forest Authority even when no forest land is involved for the project.
  - ***Commitment of Equity Investment:*** In some organisations, projects are financed in the equity: debt ratio of 30:70. No separate proposal for the equity investment is approved by the board, only investment decision is approved. Coal companies are not accepting extract of the annexure from the agenda.
  - ***Financial Closure***: In some companies, the loans are tied up on the strength of balance sheet; project specific loans are not tied up. As such there is no financial closure of individual project, which is not acceptable to coal companies.
  - ***Land Acquisition:*** Coal companies accept only Land Registration/ Transfer Deed/ Land Lease Agreement as documentary proof for completion of Land acquisition milestone. The list of documents as proof for land acquisition must also include possession Certificates/ "dhekal dhakani" forms/ "khatoni"/final compensation award letters.
- The Coal India should delete the clause of operation of Commitment Guarantees in case the power developer fails to achieve milestones. If Coal India desires to retain the clause for encashment, then they should encash the Bank Guarantees of power developer only when Coal India is having sufficient coal with them. If Coal India is short of coal supply then they should not operate the Guarantee.
- No material changes should be made to the FSAs that existed at the time of announcement of NCDP. While there can be changes in the operational aspects, there cannot be changes in key risk parameters such as quantity, period of the agreement, quality, price, etc.
- A statement of cumulative contractual obligation of CIL, SCCL and their subsidiaries may be prepared. A framework may be developed for recommending issuance of a LoA. An essential input in this framework should be the existing cumulative contractual obligation of coal companies.
- FSA provisions may be revised in terms of:
  - Quantity Obligation: Minimum quantity obligation to be close to ~90% of the ACQ. Compensation for short supply/failure to lift the coal should be increased to 50% (from current 10%) of the base price of the coal.
  - Term: Term of FSA should be minimum 15 years, commensurate with typical project finance debt tenure.
- Consistent with stipulations of NCDP, subject to agreement by the buyer, CIL should import coal and meet its responsibility under FSAs.

7.2 GAS

As domestic gas is on the decline and international gas prices remain high and volatile, financial viability of gas-based power projects is a matter of concern. A gas-based power plant becomes unviable if the gas prices rise above US$ 10-US$ 12.

Need For Capacity addition through Gas based stations is on account of their suitability to function as peaking stations, Shorter construction periods, Lesser strain on resources such as land and water, considerable environmental benefits relative to coal-based power and Diversification of fuel supply /energy security risks.

7.3 LAND

Optimum utilization of land has gained significance and challenges are to be encountered in land usage practices.

As most of the 12th Plan Thermal Power Projects (62695 MW out of total 75785 MW) are already under construction, land has already been acquired and only about 1300 acres is still left. For Hydro Projects also, no serious issue is understood to have been raised by developers. Tentatively, land requirement for the 13th Plan projects is expected to be nearly 64000 acres.

Major Issues of concern regarding land are Lack of land Records, Issues related to compensation, Lack of clarity about the status of occupiers who are not owners, Right of way (ROW) for Ash/Water pipelines, coal conveyors and transmission lines, Resistance from local people, MOEF clearance and acquisition of forest land and Resettlement and rehabilitation of the project affected people (PAP).

7.4 WATER

Water is one of the key inputs to thermal power generation and off-late the availability of water has also become scarce. As much of the new generation capacity is envisaged near pit-head, difficulties are being faced in selection of suitable sites due to non-availability of water, particularly in coal bearing states such as Orissa, Jharkhand and Chhattisgarh. The Report highlights various technical measures for reducing water consumption including inter alia use of dry ash disposal/ high concentration disposal system, use of efficient cooling towers, dry cooling, water optimization during plant operation as well as additional measures for conserving water and mitigating water shortage for power plants. It is recommended that Ministry of Water Resource must take incentive for creation of new reservoir/dams on the potential rivers so as to tie-over the water shortage.

7.5 TRANSPORT

Transport sector plays a vital role in the growth of Power Sector. The development of different transport sectors like Railways, Highways & Roads, Ports, Inland Waterways and Gas pipelines are key to achieve the capacity addition targets in the 12th five year plan. On account of increase in Unit sizes to 660 MW, 800 MW and plus 1000 MW during 12th plan and beyond, Heavy Over Dimensional Consignments (ODC) will need to be transported from Ports (for imported equipment) and from sites of Indigenous Manufacturers to Project sites. This calls for bold initiatives, policy changes as well as adopting basic changes in load and handling specifications in Roads, Railways and Port sectors.

7.6 CONCLUSION AND RECOMMENDATIONS

FUEL

Since coal is our major source of energy and would remain the mainstay of future energy requirement, domestic coal production needs a boost as also acceleration of exploration activities for finding out new coal reserves in our country.

Domestic Coal Supplies:

1. To sustain the capacity addition proposed in the 12th Plan, coal availability to power sector must be increased by domestic coal companies to 688 million tons by the end of 12th Plan.
2. As per present projections of CIL/SCCL and expected coal production from captive coal blocks, the domestic coal availability is likely to be 550 million tonnes, thus indicating a huge gap in demand & supply. CIL/SCCL will need to step up its production as also to take action to arrange imported coal as per New Coal Distribution Policy of Ministry of Coal.
3. Coal sector needs to be immediately opened up for private sector investment
4. Coal Regulator needs to be in place to ensure higher coal productivity at least cost.
5. Need to upgrade coal mining equipment and practices in the already working mines for better productivity.
6. Concerns of developers regarding Fuel Supply Agreement (FSA) need to be addressed urgently. Coal companies need to guarantee 100% of the normative requirement and FSA for 90% of ACQ to be signed .
7. Coal crushing capacity to be augmented at mines.
8. MoEF has proposed an amendment to notification for mandatory use of beneficiated/ blended coal with less than 34% ash for projects located beyond 500 km from mines (presently it is beyond 1000 km). CIL to ensure adequate number of washeries to meet this stipulation before it is implemented.
9. The cost of washed coal should be on the basis of actual cost of washing instead of import price parity. Issue of coal rejects utilization also needs to be addressed sooner.
10. Coal should be sold through e-auction only after meeting the full demand of power sector. The issue of rail connectivity to such mines from where coal for e-auction is sourced should be taken up immediately.
11. Coal Price Pooling may be considered to optimize coal transportation and also to encourage acceptance of imported coal.

Captive Coal Blocks:

1. Coal blocks still falling in Category 'A' need to be immediately brought under Category 'B' including coal blocks in Hasdeo Arand coal field for UMPP and other ongoing power projects.
2. New captive coal mines need to be allocated for competitive bidding by state utilities at lowest price of power (Case-II) instead of auctioning proposed by Ministry of Coal.
3. Allocation as well as De-allocation of captive coal blocks should be by the Inter-Ministerial Committee as for coal linkages.
4. The issues of additional benefits requested by coal bearing states need to be addressed on urgent basis as some of the captive coal block developers are facing problems including, interalia, land acquisition.
5. The time lines prescribed for captive coal block development to be made more realistic.
6. In the draft Mines and Minerals (Development and Regulation) Bill 2011, the sharing of profits by local populace from the coal mines has been proposed. However in case of captive coal mines, since there is no sale of coal but only of power produced, the profit sharing should be linked to royalty payable which could be adjusted from the pretax profits as any other revenue expenditure.

Lignite

1. Lignite reserves in the country have been estimated at around 40.9 billion tonnes, out of which about 82 % are located in the State of Tamil Nadu & Pondicherry. At present only a small percentage of the total reserves of lignite have been exploited. Immediate steps needed to augment lignite production considering large reserves of lignite in the country. The technology issues for efficient utilization of lignite resources need to be addressed.

Gas

- There is need for promotion of new gas based capacity in the country (at least 20,000 MW during 12th Plan) due to inherent advantages of gas power plants and also to reduce our carbon footprints.
- Presently gas based projects totaling to about 13,000 MW are already under construction. These projects can be commissioned during 11th Plan/early 12th Plan, if gas is made available.
- Gas supply to be made available for at least 20,000 MW new Capacity in the 12th Plan.

Policy changes to be adopted to encourage gas based capacity addition

1. Policy initiatives to incentivize gas based plants including Combined Heating & Cooling plants having high efficiency.
2. Priority for gas allocation to CCHP plants.
3. Constitution of Task force under CERC to address issues related to setting up of Peaking and Reserve Plants.
4. Standard Bidding Documents (SBDs)– need to be adapted for gas-based power.
5. Duration of PPA in case of gas based projects, which at present is 25 years, needs to be brought down to 15-18 years, keeping in mind economic life of gas-based power plants. Further, normally gas is allocated for 5 Year period, as such signing of PPA need to be facilitated for 5 year period, to be reviewed from time to time in line with extension of gas allocation period upto the economic life cycle of 15-18 year of the plant.
6. Fuel risks pass-through: Current domestic and international market environment for natural gas suggests that there are far too many uncertainties with regard to availability and/or price of natural gas. Developers are not ideally placed to take those risks. Therefore fuel availability and price risks need to be borne by the procurers.
7. Take-or-Pay risk pass-through: Gas supply contracts are characterized by high level of Take-or-Pay obligations on fuel buyer. PPA needs to be suitably amended to alter current level (relatively low) of minimum off-take guarantees to suitably higher levels. It also needs to be ensured that gas-based plants do not face dispatch risks during their intended hours of operation (peak/ intermediate load).
8. Capital cost and heat rate under competitive bidding scope: Bidding would therefore be primarily on competitively discovering capacity charges and conversion (net heat rate) efficiencies.
9. Gas based peaking power if integrated into the total electricity generation system can lead to carbon reduction efficiencies even higher than renewables like wind or solar power. Hence it is suggested to extend the fiscal benefits to gas based peaking power projects at par with the renewable energy projects or Ultra Mega Projects. Specifically, zero customs duties & taxes and interest rate subsidy.

LAND & WATER

Land

The Working Group recommends the following for Land use and acquisition:

1. Land to be acquired with a view of not only project development but also the livelihood issues of the original land owners.
2. Minimizing land requirement pressure for new projects by use of spare land within existing plants.
3. Review of MoEF procedures for expeditious project clearances.
4. Higher capacity units in place of older small size units
5. Adoption of higher size units.
6. Shelf of sites for projects i.e. land bank needs to be created.
7. New technology options to be adopted for minimizing land requirement.
8. CEA may undertake another exercise in consultation with various stakeholders to further optimize land requirement for Power projects.
9. Land acquisition by States need to be done expeditiously in a time bound manner, considering that a large percentage of Power is allocated / committed to the Home State from the Power project.

Water

Major recommendations regarding Water Requirement are as follows:

1. Technical measures for reducing water consumption may be adopted.
2. Creation of large reservoirs/ dams on potential rivers to retain flood waters.
3. Coastal power plants to be encouraged.

TRANSPORT

The development of Transport infrastructure in different transport sectors like Railways, Highways & Roads, Inland Waterways and Gas Pipelines is essential to achieve the capacity addition targets in 12th five year plan and beyond. The main recommendations on Transport sector are:

1. Railways to augment their capacity to evacuate coal from major coal fields namely North Karampura, Ib Valley, Talcher and Mand Raigarh.
2. For smooth and faster evacuation of coal, coal conveyors should be used to transport coal from mine to rail head with automatic loading in wagons.
3. Railway to expedite proposed Dedicated Freight Corridors to segregate freight and passenger traffic.
4. Railways to ensure rail connectivity to all ports having coal unloading facilities.
5. NTPC and Inland Water Ways Authority of India (IWAI) would be signing an agreement for transportation of 3 MT of imported coal to Farakka TPS. Other thermal projects located on the banks of Ganges in West Bengal and Bihar should also explore the same.
6. Roads and Highways need to be augmented for transportation of Over Dimensioned Consignments (ODC) for higher size units.
7. Amendment in Motor Vehicle Act to accommodate heavy consignments above 49 MT and inclusion of hydraulic axle trailers.
8. Review of load classification for Roads & Bridges by IRC/ MoRTH to accommodate ODCs beyond 100 MT.
9. Single window clearance and one time payment for ODC movement.
10. Proper design of Toll Plazas built on highways.

11. Changes in Road design in North Eastern & Hill states to minimise sharp curves/gradients in roads and have sufficient vertical clearance in underpasses.
12. Proper Approach Roads to be provided for Hydro Projects.

PORTS

Major recommendations for augmenting Ports and related infrastructure are:

1. Adequate coal unloading arrangement at Ports to be ensured to handle imported and domestic coal required for power stations .
2. On the East Coast, coal handling facilities to be augmented at Paradip and Vizag Ports. This will be necessary to evacuate coal from mines in Orissa as rail routes are congested.
3. All major and important minor ports should be mechanised by augmenting crane capacities, silos, conveyors & wagon tipplers.
4. Draft at various ports to be increased to handle Panamax or Capsize vessels.
5. RO-RO berths should be created at least in two major ports namely Kandla on the west coast and Paradip on the east coast for unloading ODCs.
6. Road connectivity to ports to handle ODCs has to be ensured

MANUFACTURING CAPACITY AND CONSTRUCTION AGENCIES

Adequate manufacturing capacity of Main Plan Equipment including that for large super-critical thermal set shall be available indigenously to meet the capacity addition requirement of the Country during 12th Plan. As regards Balance of Plants (BOP), Construction Agencies and Construction equipment/ Construction techniques, the capacities and capabilities have to be further developed and enhanced.

Main Plant Equipment

1. An implementation mechanism for meeting the technical standards as notified by CEA needs to be devised for adherence by the Manufacturing agencies.
2. Standardization of technical specifications to the extent possible will enable batch production of equipments expediting their delivery.
3. Adequate Logistics & Road Connectivity
4. 12th Plan capacity addition proposes large size super critical sets. Therefore provision needs to be made for movement of heavy/ ODC consignments on domestic roads and bridges. The development of the project should also involve development of the roads/ bridges up to project site.
5. In order to reduce the transportation time and timely delivery at site, single window concept for clearances of consignments and hassle free movement of the goods at National/ State/ District/ Tehsil check nakas is recommended to be provided.
6. Government should encourage indigenous manufacturing of critical raw materials such as Special steels like CRGO & CRNGO, thicker boiler quality steel plates and high pressure tubes and pipes by providing incentives and policy support.

Balance of Plants (BOP)

1. Standardization

The variation in engineering practices delays the finalization of design of equipment and result in serious financial implications. Standardization of engineering / design practice in plant layout and equipment rating / selection is expected to reduce delays in project execution.

2. **Faster Document Approval for BOP engineering**
The delay in the finalization of engineering document and approval procedures in a BOP package has been affecting delivery schedules. The concept of e-documentation may be adopted using latest IT tools for speedier approval.
3. **Ensure Availability / Development of skilled manpower**
Both the developer and the contractor(s) have to jointly make efforts for providing training and necessary skill sets to local people to improve their employability.
4. **Timely ordering for BOP packages -** to minimize the delays in BOP supplies.
5. **Review of Qualification Requirements**
Qualification requirements for the BOP vendors may be reviewed from time to time, in order to align with the industry situations. This will ensure quality vendors and a larger vendor base for a faster execution of projects.
6. **Concept of Functional Specification**
The concept of functional specification to the extent feasible (say in respect of major components) may be adopted, keeping in view the commitment of vendor by way of guaranteed performance and liquidated damages clauses provided in the contract.
7. **Ensuring clarity of inputs to vendors**
Ambiguity in site inputs to the vendor delays the process of engineering and placement of orders. It is emphasized that clear site inputs / fronts shall be made available to the developers.
8. **Adoption of latest techniques in project execution**
Latest methods of civil construction with mechanized equipment and manpower mobilization needs to be adopted.

9. **Technological up gradation of BOP**
New design changes and materials may be adopted for an optimal functioning and reduced redundancies for a cost effective solution.
10. **Mechanism for capacity assessment of BOP suppliers**
There has been a bunching of orders with a few suppliers, with a result of delayed deliveries due to their limited capacities. There is an urgent need to develop mechanism for capacity assessment of BOP vendors.
11. **Following EPC approach**
EPC contracts have merits over the multiple package contracts. Multiple package poses problems of micro level monitoring and interfacing issues resulting in delays. The EPC packages are priced slightly higher, but the cost is compensated by the timely completion.
12. **Proper interface between various vendors and consultants**
The interface between various vendors has to be ensured to have proper matching equipment design and sequential supplies

Construction Agencies and Equipment

1. Latest methods of civil construction with mechanized equipment and manpower mobilization needs to be adopted. Vendors should be encouraged to adopt new erection technologies to reduce the erection and commissioning cycle.
2. New tools and tackles may be adopted for optimum functioning and reduce redundancies for a cost effective solution.
3. Industry is facing severe shortage of skilled manpower like welders (especially High Pressure welders), fitters, turners, masons, carpenters etc. Following is recommended:

- Creation of adequate number of new modern technical training institutions under government sector and facilitation in creation of the same under private sector.
- PPE manufacturers and Developers to take a lead in Training and skill enhancement of manpower through encouragement and facilitation of plant visits, live projects, internship, guest lectures and other means of industry interaction with students and faculty of technical institutions.
- An institutional mechanism for setting up Regional Skill Development Centers by pooling resources from Power Developers, Manufacturers and Contractors to enable a substantial increase in the availability of trained and skilled manpower.

MATERIALS

There is no shortage of key materials except CRGO Steel, higher grade CRNGO and thick boiler steel plates. The following measures should be taken:

- Need to set up plant for producing CRGO.
- Indigenous capacity for tubes and pipes to be augmented.
- Need to create short circuit testing facility for transformers.
- Indigenous manufacturing facility for gas insulated substation to be augmented.
- Indigenous capacity for thicker boiler quality plates needs to be created.
- Mandatory BIS Certification requirement may result in supply constraints of CRGO and thicker Boiler quality plates. This issue needs to be addressed.

8.0 FINANCIAL ISSUES IN POWER SECTOR FINANCING

8.1 FINANCIAL PERFORMANCE OF POWER SECTOR DURING 11TH PLAN

The 11th Plan fund requirement for the power sector was Rs. 10,31,600 crore. The All India Expenditure in Power for 11th Plan was Rs. 707,278crore as mentioned in Table below.

Table: ES-15

Projected fund requirement v/s likely expenditure during 11th Plan

S. No.	Segment	Fund Requirement (Rs. crore)	Likely Expenditure (Rs. crore)*	Achievement (%)
1.	Generation (including Nuclear#, NCES, Merchant and Captive)	566,396	479,620	84.68%
2.	Transmission	140,000	122,991	87.85%
3.	Distribution (including DDG)	307,000	100,000	32.57%
4.	R&M	15,875	3,564	22.45%
5.	HRD	462	83	17.97%
6.	R&D	1,214	352	29.00%
7.	DSM	653	668	102.30%
	Total	**1,031,600**	**707,278**	**68.56%**

Source: CEA & Working Group report of 11th Plan
#Source: Department of Atomic Energy Annual Accounts
**Generation includes nuclear, NCES, merchant and captive power projects*
** Transmission includes 33 kV and above inter and intra state transmission lines*
** Distribution is inclusive of sub-transmission lines upto 33 kV levels and DDG*

*includes actual and projected expenditure up to FY 2011-12

8.2 FUND REQUIREMENT FOR 12TH PLAN

The fund requirement for 12th Plan has been estimated to be Rs. 12,37,480 as mentioned in Table below:

Table: ES 16

Capacity Addition & Fund Requirement for 12th Plan projects

S. No.	Capacity Addition	Allocation of cost towards 12th Plan (Rs. Crore)			
		Centre	State	Private	Total
1.	**11th Plan (2011-12)**				
a)	Generation –capacity addition	5,174	1,485	5,100	11,759
A	**Sub-Total 11th Plan**	**5,174**	**1,485**	**5,100**	**11,759**
2.	**Generation – 12th Plan capacity addition**				
a)	Thermal	48,650	55,734	1,73,117	2,77,500
b)	Hydro	35,183	8,024	6,952	50,159
c)	Nuclear	26,600	-	-	26,600
B	**Sub-Total 12th Plan**	**1,10,433**	**63,758**	**1,80,069**	**3,54,260**
3.	**Advance action for 13th Plan**				
a)	Thermal	40,440	14,805	80,577	1,35,822
b)	Hydro	28,132	612	11,216	39,960
c)	Nuclear	96,800	-	-	96,800
C	**Sub-Total 13th Plan**	**1,65,372**	**15,417**	**91,793**	**2,72,582**
4.	**Sub-Total generation (A+B+C)**	**2,80,979**	**80,660**	**2,76,961**	**6,38,600**
5.	**Captive Power Projects**			65,000	**65,000**
6.	**R&M of Power Plants**	19,847	12,040		**31,887**
7.	**Transmission**	1,00,000	55,000	25,000	**1,80,000**
8.	**Distribution**	48,191	2,38,082	19,963	**3,06,235**
9.	**Research & Development**	4,168			**4,168**
10.	**DSM & EE**	7,482			**7,482**
11.	**Human Resources Development (Training Infrastructure)**	4,108			**4,108**
	Fund Outlay (4 to 11)	**4,64,774**	**3,85,782**	**3,86,924**	**12,37,480**

Fund requirement Renewable Energy (RE) projects in 12th Plan have been computed on the basis of per MW cost of different types of RE projects which are based on the FY 2011-12 price. The total fund requirement for RE projects in 12th Plan is as below:

Table ES 17

Fund requirement for RE projects in 12th Plan

S. No.	Type	Total cost (Rs. crore)
1.	Biomass	10,500
2.	SHP	8,000
3.	Solar	49,400
4.	Wind	67,200
	Total	**1,35,100**

Hence, the total fund outlay for 12th Plan has been calculated as below:

Table: ES 18

Particulars	Total cost (Rs. crore)
Total fund outlay except RE projects	12,37,480
Fund outlay for RE projects	1,35,100
Total fund outlay for 12th Plan	**13,72,580**

The year wise fund requirement during 12th Plan is given in the table below:

Table: ES 19

Year wise fund requirement during 12th Plan

(Figures in Rs. Crore)

Financial Year	2012-13	2013-14	2014-15	2015-16	2016-17	Total
Fund requirement	2,36,996	2,42,335	2,72,042	3,02,770	3,18,436	**13,72,580**

8.3 FUND AVAILABILITY

Debt: Equity (D/E) ratios for central, state and private sector have been taken based on the current lending norms for funding of power sector. The details are as given below:

Table: ES 20

Debt equity ratios

Sector	Debt	Equity
Centre	70%	30%
State	80%	20%
Private	75%	25%

The possible sources of funding are commercial banks, public financial institutions, dedicated infrastructure/power finance institutions, insurance companies, overseas markets, bilateral/ multilateral credit, bond markets and equity markets.

8.3.1 Estimated Funds Mobilization

The details of the major sources of financing and estimated quantum of funds are mentioned in subsequent sections.

Table: ES 21

Major sources of financing and funds mobilization

(Figures in Rs. Crore)

Sources of Funds	12th Plan estimations
Equity	
By promoters for IPPs, IPTCs	80,481
By promoters for NCES & Captive	56,780
Internal Resources	126,226
Total Sources of Equity (A)	**263,487**
Debt	
Scheduled Commercial Banks (SCBs)	270,455
PFC	178,259
REC	175,950
Other IFC	36,427
Bonds/Debentures	140,541
Multilateral/Bilateral Credits/ECBs	90,755
Insurance companies	28,899
Total Sources of Debt (B)	**921,286**
Total Sources of Debt and Equity (C=A+B)	**1,184,773**

8.4 SOURCES OF EQUITY

8.4.1 Internal Resources

Internal resource, mobilization by Public Sector Enterprises (PSEs) in 12th Plan have been estimated at Rs.1,26,226 crore. The estimate has been made on the basis of the Internal & Extra Budgetary Resources (I&EBR) data. For IPPs, IPTCs, NCES and Captive power projects it has been assumed that the required equity has been/ will be tied up to the satisfaction of lenders as these projects will achieve Financial Closure on non-recourse basis.

8.4.2 Gross Budgetary Support (GBS)

GBS to Central Sector power PSEs has been estimated at Rs. 2,473.26 crore during 12th Plan. In addition fund infusion through GBS under planned schemes has been estimated at Rs. 177,368 crore.

Funds under NEF scheme amounting to around Rs. 22,000 crore will be provided as interest subsidy and thus have been excluded for estimation of fund availability.

8.5 SOURCES OF DEBT

8.5.1 Banks

The funds available from banks during 12th Plan have been estimated at Rs. 2,70,455 crore.

8.5.2 PFC

The funds available from PFC for 12th Plan have been estimated at Rs. 1,78,259 crore.

8.5.3 REC

The funds available from REC for 12th Plan have been estimated to be Rs. 1,75,950 crore.

8.5.4 Other IFC

The major IFCs other than PFC and REC are Infrastructure Development Finance Company Limited (IDFC), Larsen and Tubro Finance and PTC India Financial Services Ltd. The projected funding by IDFC for 12th Plan power projects is Rs. 30,000 crore which is about 80% of its incremental loan book in 12th Plan. Assuming similar ratios for the other two companies, the total funds available from the IFCs for 12th Plan power projects has been calculated as Rs. 36,427 crore.

8.5.5 Bonds/Debentures

Bond and Non-Convertible Debenture (NCD) issuances grew at a CAGR of 18% from Rs. 99,222 crore in FY 2007 to Rs. 1,94,948 crore in FY 2011. During the same period, bond issuances by Power sector companies (excluding IFC) increased at a CAGR of 38% from Rs. 5,275 crores to Rs. 19,025 crores. While the year on year growth rates for bond issuances has been volatile due to the impact of economic crisis, the percentage of bond issuances by Power sector companies to the overall bond issuances has been in the range of 7-10%.

Going forward, the growth rate of bond and NCD issuances during 12th Plan has been assumed at a conservative rate of 9% p.a., while the growth rate of bond issuances by Power sector companies is expected to moderate to around 10% p.a. Based on these assumptions, the total bond and NCD issuances in the terminal year of 12th Plan are expected to be around Rs. 3,27,000 crore with bond issuances by Power sector companies at around Rs. 33,704 crore i.e. around 10% of total bond and NCD issuances. The funds available from Bond issuances during 12th Plan have been estimated at around Rs. 1,40,541 crore..

8.5.6 Multilateral/ Bilateral Credits/ ECBs

The total outstanding amount of multilateral credits, bilateral credits and ECBs increased from Rs. 303,800 crore in March 2004 to Rs 412,076crore in March 2007 (*Source: RBI*).The CAGR of the same has been computed as 10.7%. Assuming the same trend to continue, the total inflow of funds through these routes has been calculated to be Rs. 4,53,777 crore.

Based on the industry reports (Source: McKinsey), 24% of the total external borrowings have been assumed to be channelled towards infrastructure investments, out of which, 20% (83% of external borrowing to infrastructure) are assumed to be channelized to power sector. Hence, the total funds available through these routes have been calculated to be Rs. 90,755 crore.

8.5.7 Insurance companies

The following assumptions have been used to estimate fund availability from life and non-life insurance companies

- **Life insurance companies:**
    - The total investments of life insurance companies grew from Rs. 743,602 crore in March 2009 to Rs. 873,536 crore in March 2010 which is a growth of about 17.5%. The growth rate of these investments has been assumed to be 15% per annum till FY 2017.
    - In FY 2009 and FY 2010, about 9% of total investments of life insurance companies have been in housing and infrastructure sector. The same trend has been assumed to continue till FY 2017
    - 25% of the total investments of housing and infrastructure sector have been assumed to be allocated to power sector
- **Non-life insurance companies:**
    - The total investments of non-life insurance companies grew from 58,893in March 2009 to 66,372in March 2010 which is a growth of about 12.7%. The growth rate of these investments has been assumed to be 12.5% per annum till FY 2017.
    - In FY 2009 and FY 2010, about 15.5% of total investments of non-life insurance companies have been in housing and infrastructure sector. The same trend has been assumed to continue till FY 2017
    - 25% of the total investments of housing and infrastructure sector have been assumed to be allocated to power sector

On the basis of the above assumption, fund availability for power sector during 12th plan from life and non-life insurance companies has been estimated at rs. 28,899 crore.

8.6 ADEQUACY OF FUNDS

On the basis of the fund requirement and availability estimated in previous sections, the debt shortfall has been computed at around Rs. 97,444 crore and the equity shortfall has been computed at around Rs. 90,363 crore, implying a total funding shortfall of Rs. 1,87,807 crore.

After incorporating funds available from GBS and special schemes, the total funding available is detailed below:

Table: ES 22

Assessment of adequacy of funds during 12th Plan

(Figures in Rs. crore)

Particulars	Amount
Funds Required	**13,72,580**

Particulars	Amount
Equity Required	3,53,850
Total sources of Equity	2,63,487
Equity available /(shortfall) (A)	**(90,363)**
Debt Required	10,18,730
Total sources of Debt	9,21,286
Debt available /(shortfall) (B)	**(97,444)**
Total Funds available /(shortfall) before considering impact of Special Schemes (A+B)	**(187,807)**
Funding by GBS	
GBS to CPSEs	**2,473**
GBS to plan schemes	**155,368***
Sub-Total (C)	**1,57,841**
Funding from other Sources	
Credit Enhancement Scheme	10,000
Infrastructure Debt Fund	25,000
Sub-Total (D)	**35,000**
Total funds available /(shortfall) (E=A+B+C+D)	**5,034**

** Funds under NEF scheme amounting to around Rs. 22,000 crore will be provided as interest subsidy and thus have been excluded for estimation of fund availability.*

8.7 POLICY INTERVENTIONS & FINANCIAL MEASURES FOR REDUCING FUNDING GAP

8.7.1 Tax incentives on investments

A higher economic growth can only be sustained through investment in the infrastructure sector. For garnering additional funds for the sector, there is a need to introduce additional investment limit of Rs. 50,000 per year for infrastructure bonds under Section 80C of the Income Tax Act, 1961 over and above existing limit of Rs. 1,00,000. Assuming a subscriber base of 13 million (approx. 33% of the total tax payer base of 40 million), the amount mobilized is estimated as Rs. 39,000 crore p.a. Assuming a 50% flow to the power sector out of the above, the mobilization over 5 years is estimated at Rs. 97,500 crore. The loss of tax revenue from this step would be compensated by higher tax revenue in future due to higher GDP growth rate. Such a step can be supported at this junction as we expect higher tax collection as a result of a growing economy.

8.7.2 Institutional / Regulatory Interventions

- Payment security mechanism
    a. Commitment of escrow upfront as in case of successful UMPPs to be provided
    b. Alternatively, to provide access to large industrial consumers on payment of wheeling charges, in case of default, as adequate security in lieu of ESCROW.

- Uniform rules for cross subsidy and additional surcharges to be levied by SEB on sale of power by an IPP in that state to a third party

- In line with the National Electricity Policy, states should be encouraged to follow Intra – State ABT regime such that they are eligible for 14% return on equity. This would encourage better discipline even within the states and shall enhance internal resources for deployment in R&M/capacity expansion.

8.7.3 Fiscal and other Measures to enable cheaper power

- The effective tax rate for the business of lending to infrastructure sector after the likely advent of Direct tax code from FY12 is projected to go up from about 27% to 30% due to withdrawal of exemptions under 36(1)(viii) and 36(1)(viia)(c) of Income Tax, 1961. Hence infrastructure lending would be subjected to maximum tax rate. Though concessions for developers in infrastructure space would continue, all benefits for infrastructure lending are proposed to be removed. This would force lenders to pass this additional tax burden in the lending rates which would enhance the cost of borrowing for infrastructure projects.

  Since the need of the hour is to arrange low-cost funds for infrastructure sector, there is a strong case for levying MAT for infra lending rather than the normal corporate tax or to restore the tax concession already available to these financial institutions.

- Excise duty on power generation, transmission & distribution equipment (which is currently at 14%) should be reduced and gradually phased out for generation projects with an installed capacity of more than 1,000 MW and for inter-state transmission lines. This is required, as power sector has no advantage of "cenvat" credit as there is no excise on power, which increases the cost of power.

- The import duty relaxation presently available for generation equipments may also be extended to include all equipment related to power transmission, distribution metering and energy conservation so that the supply of equipments at reasonable cost is available to continue with Distribution reforms which are being supported by schemes like APDRP etc.

- Existing Income tax exemption for power sector projects under section 80IA expiring in March 2012 to be extended till March 2017, i.e. end of 12th Plan period.

- Additional depreciation of 20% (WDV) under IT Act is available for investments in plant and machinery in industries other than power. Same depreciation should be made available to power industry also.

- Technology transfer for developing and enhancing existing manufacturing facilities in India needs to incorporate in equipment procurement contracts. As a first step, the domestic manufacturing obligations on the line of bulk-tendering carried out by NTPC for 800 MW and 660 MW sets could be stipulated for the power projects being awarded for the benefit of

13th Plan. Such a step will ensure that indigenous vendor development is facilitated for high-tech supplies in future.

8.7.4 National Electricity Fund (NEF)

The poor state of distribution sector requires investment for replacement of obsolete equipment and technology upgradation. During budget speech of 2008-09, Government of India (GoI) had announced the creation of NEF. Under this scheme, it was proposed that interest subsidy would be extended to the Distribution Utilities which would be linked to reforms. This is expected to reduce the burden of servicing the interest on the utilities.

The proposed scheme is envisaged to provide interest subsidy for over 15 years with an estimated outlay of Rs. 63,750 crore. The amount of Rs. 22,000 crore has been estimated for 12th Plan under NEF, assuming an average interest subsidy of 5% per annum which is expected to be provided from the funds allocated for distribution.

8.7.5 Dedicated fund for financing Power projects in NE sector

Power projects in NE sector could be financed through a dedicated NE fund. Since the benefits of optimal utilization of mineral and water resources of NE would accrue to the whole country, establishing such a fund could channelize the funds collected from the country as a whole and release capital resources of banks/ GoI grants for community level developmental work in NE region.

Further, project developers could be further incentivised to set up projects in the NER through fiscal incentives like waiver on Minimum Alternate Tax (MAT). It may be emphasised that MAT credits are utilized by a project developer between 5th and 10th year of the project cycle. Hence, MAT waiver would not impact the total tax payments but would only increase upfront equity returns to the project developer.

8.8 CONCLUSION & RECOMMENDATIONS

1. On the basis of envisaged capacity mix, proposed capacity addition schedule and associated project cost, the total funds required during 12th Plan have been estimated at Rs. 13,72,580 crores with a Debt requirement of Rs. 10,18,730 crore and Equity requirement of Rs. 3,53,850 crore.
2. The availability of Debt and Equity during the same period have been estimated at Rs. 9,21,286 crores and 2,63,487 crores respectively implying a total funding shortfall of Rs. 1,87,807 crore.
3. After incorporating funds available from GBS and special schemes, the shortfall in availability of funds in low economic growth scenario has been computed to be Rs, 140,528 crore vis.a.vis fund surplus of 5,034 crore in the base case scenario.
4. While most of the 12th Plan power projects have achieved financial closure, fuel related issues viz. lack of binding FSA, high cost of imported coal and delays in according statutory

clearances to captive coal blocks are expected to impact financial closure of 13th Plan power projects.

5. Further, appropriate steps are required to be taken to curtail the financial losses of the utilities and improve the investment climate in the power sector.
6. Due to the above reasons, mobilization of debt to power sector projects will continue to be challenge that needs to be addressed with suitable measures.
7. Further various policy measures like Hydro Power viability fund, measures for financing RE projects and take-out financing for ECB lenders have been suggested so as to improve fund availability for the sector.

9.0 HUMAN RESOURCE DEVELOPMENT (HRD)

The HRD/Training needs of Technical, Non-Technical and Supporting Staff should be addressed keeping in view the National Training Policy for the Power Sector.

9.1 REVIEW OF HRD PROGRAMME & ACHIEVEMENTS DURING 11th PLAN

Some of the major achievements pertaining to capacity building during 11th Plan are:

(a) Distance Learning Certificate Programs on Power Distribution Management for JEs/ AEs level
(b) Certificate of Competency in Power Distribution (CCPD)
(c) Adoption of 69 ITIs by CPSUs/Private organizations
(d) Training under Distribution Reforms, Upgrades and Management (DRUM)
(e) C&D Employees Training
(f) Franchisee Training
(g) Training under R-APDRP etc.

9.2 ASSESSMENT OF REQUIREMENT OF MANPOWER

9.2.1 Manpower requirement in 12th Plan & 13th Plans

For a capacity addition of 94,215 MW(including renewable) in the 12th Plan, the additional manpower requirement shall be of the order of 407.67 thousands out of which 312.92 thousands will be technical and 94.75 thousands will be non-technical. The total manpower by the end of 12th Plan shall be 1425.79 thousands, out of which 1083.88 thousands (76%) will be technical and 341.91 thousands (24%) will be non-technical.

For a capacity addition of 1,23,900 MW(including renewable) in the 13th Plan, the additional manpower requirement shall be of the order of 547.78 thousands out of which 419.04 thousands will be technical and 128.74 thousands will be non-technical. The total manpower by the end of 13th Plan shall be 1795.34 thousands, out of which 1367.43 thousands (76%) will be technical and 427.91 thousands (24%) will be non-technical.

A summary of likely manpower at the end of 11th, 12th & 13th Plan is furnished in the following table.

Table: ES 23
Manpower under various Plans

Capacity in MW and Man Power in Thousands

S No	Plan	Capacity at the beginning of Plan	Capacity addition during Plan*	Capacity at the end of Plan	Manpower at the beginning of Plan	Reduced Manpower due to retirement etc.	Manpower required for Capacity addition of Plan	Manpower at the end of Plan	Man/MW at the end of Plan
C 1	C 2	C 3	C 4	C 5 = C 3 + C 4	C 6	C 7 = 87.5%* C 6	C 8	C 9 = C 7 + C 8	C 10
1	11th	132330	74374	206704	950.47	831.66	331.90	1163.56	5.63
2	12th	206704	94215	300919	1163.56	1018.12	407.67	1425.79	4.74
3	13th	300919	123900	424819	1425.79	1247.56	547.78	1795.34	4.23

**** Includes Capacity addition from Renewable Energy***

Man/MW ratio

The Man/MW ratio during various plans, based on above projections of capacity addition and corresponding requirement of manpower during 11th, 12th & 13th Plan is given below:

Table: ES 24
Man/MW Ratio at the end of various Plan Periods

End of Plan Period	Thermal	Hydro	Nuclear	Transmission & Distribution	Overall
9th	1.78	2.20	3.97	7.50	9.42
10th	1.44	1.95	2.96	5.41	7.00
11th	1.08	1.74	2.27	4.37	5.63
12th	0.85	1.56	1.87	3.73	4.74
13th	0.72	1.43	1.59	3.34	4.23

9.2.2 Manpower Availability

On the basis of the total number of technical institutions operational, it can be seen that at all the three levels i.e. Graduation, diploma and ITI, there are sufficient number of students passing out each year. However the skill set required for the power sector in few areas does not match the needs of the industry. Our ITIs and other vocational training institutions have to be augmented for providing certain skill sets like High Pressure Welders, Fabricators, Fitters, Binders, Drillers, Plumbers, Electricians, Linemen, Heavy Machine Operators, Operators-Crane, Dozer, Dumper, Excavation, Bar Benders, Piling Rig Operators etc. who would be required in huge number for the Erection & Commissioning Activities for the Thermal, Hydro, Nuclear Plants and Transmission & Distribution areas. The quality and range of their training will keep pace with the changing needs of the economy and opportunities for self-development.

9.3 TRAINING NEED ASSESSMENT

9.3.1 Training Strategy

To fulfil the above needs, training to the power sector personnel is provided in the following categories:

i) O&M Training to all existing employees engaged in O&M of generating projects and Transmission & Distribution System as per statutory requirements under the Gazette Notification of September 2010 issued by CEA ranging from 4 Weeks to 30 Weeks.
ii) Induction level training for new recruits for 1 month (Technical & Non-Technical) is considered a must in the power sector
iii) Refresher/Advanced training of 5 Days in a year to all existing personnel of varying degrees in various specializations in line with National Training Policy for Power Sector.
iv) Management training of 5 Days in a year to the senior Executives/Managers in India/Abroad in line with National Training Policy for Power Sector.

9.4 TRAINING FACILITIES

9.4.1 Training Institutes Recognized by CEA

During the 10th Plan, there were, 51 training institutes recognized by CEA under various power utilities. About 20 new institutes were recognized by CEA during the 11th Plan. A total of 72 training institutes under various power utilities have been recognised by CEA.

Various Organizations which have provided training in 11th Plan in Power Sector are:

(i) National Power Training Institute
(ii) Power Management Institutes (PMI) & Various training Institutes of NTPC
(iii) Various training Institutes of NHPC, SJVNL, THDC etc.
(iv) Various training Institutes of Power Grid
(v) Various training Institutes of State/Private Generating Utilities
(vi) Various training Institutes of State Transmission Utilities
(vii) Various training Institutes of State/Private Distribution Utilities

Various Schemes under the 11th Plan towards Training were operative like Training under Distribution Reforms, Upgrades and Management (DRUM), C&D Employees Training, Franchisee Training, Training under R-APDRP etc. Short-term programs with multiple program themes Course Curriculum centrally developed under DRUM were delivered through institutional spread of 20 Training Institutions. Structured Training for C&D Level Distribution employees and Franchise development programs were initiated under RGGVY.

9.4.2 National Power Training Institute

NPTI has trained over 1,80,000 Power Professionals in regular Programs over the last 4 decades. NPTI operates on an all India basis through its nine Institutes in different zones of the country. NPTI conducts various Manpower Training and Academic Programs. NPTI has one 500 MW Thermal Training Simulator, Two Nos of 210 MW Thermal training Simulators, one 430 MW (2x143 MW Gas Turbine and 1 x 144 MW Steam Turbine) Combined Cycle Gas Turbine Simulator, one No of Hydel Simulator and one No of Load Dispatch Simulator. NPTI has a Training Infrastructure to provide Training of 29,356 Man-Months per Year.

9.4.3 Power Management Institute (PMI) & other training institutes of NTPC

The Power Management Institute (PMI), NTPC's apex training and development centre has been imparting training in the fields of management development, construction and O&M of power plants and information technology . NTPC has 11 No of training institutes at its Project Sites spread all across the country. NTPC has a Training Infrastructure to provide Training of 18,856 Man-Months per Year.

9.4.4.Training Institutes of NHPC

NHPC has Training Institutes at its Project Sites with a training infrastructure to provide training of 720 Man-Months per Year.

9.4.5 Training Institutes of PowerGrid

PowerGrid has Training Institutes at its Regional locations/Project Sites. They have a training infrastructure to provide training of 1917 Man-Months per Year.

9.4.6 Neyveli Lignite Corporation

Neyveli Lignite Corporation has a Training Institute at Neyveli. They have a Training Infrastructure to provide Training of 2407 Man-Months per Year.

9.4.7 Other Training Institutes

Names of some other leading Training Institutes which are providing training in Power Sector are Reliance Energy Management Institute, Mumbai, Jindal Institute of Power Technology, Raigarh, Chattisgarh, Evonik (Steag), Noida, Gujarat Energy Training & Research Institute, Vadodara

9.4.8 Distance Learning Certificate Programs on Power Distribution Management for JEs/ AEs level

Advanced Certificate in Power Distribution Management (ACPDM) - Course was developed by IGNOU in association with NPTI and delivered by IGNOU through multiple regional centres spread across the country. The course is meant for Graduate Engineers/Diploma holders, or Science/Commerce/Art Graduates or Equivalent with two years experience in Power Utilities or the Electricity Sector.

9.4.9 Certificate of Competency in Power Distribution (CCPD)

The course is meant for Technicians/Equivalent Trade or manpower working in Power Sector (sponsored candidates) or General Candidates or Private electricians at least 8th Pass (non-sponsored). The course started in August, 2009 and is presently being conducted at Durgapur, Nagpur & Guwahati Institutes of NPTI.

9.4.10 Adoption of ITIs

During the Power Sector conclave held during July 2007, the recommendations were included are Adoption of ITIs by Power Industry and Integration of ITIs by power industry to enhance the basic skills of workforce

9.5 CAPACITY BUILDING DURING 12TH PLAN

Training may be given to personnel in the power sector as detailed below:

- O&M Training
- On-job Training Facility
- Induction Training
- Refresher/Advanced Training

- Management Training
- Simulator Training
- Training in Renewable Sources of Energy
- Training in Demand Side Management, Energy Efficiency and Energy Conservation
- Power System Operators Training & Certification
- Capacity Building under R-APDRP
- National Training Program for Electricity Distribution Franchisee and C&D Employees under RGGVY
- HRD and Technical Competence Building due to Technology Advancement and R &D
- Introduction of Training on Attitudinal Changes / Behavioural Sciences
- Training in Information Technology
- Opportunities for Higher Studies
- Training of Non-Technical Officers and Staff
- HRD and Capacity Building for Power Generating Stations
- Training for Nuclear Power Personnel
- Training Abroad
- Hot Line Maintenance Training
- Vocational Training for Youths & Project Affected Persons (PAPs) near Project sites
- Training through Distance learning education & Web based Training

9.5.1 Training Infrastructure Requirements vis-à-vis Availability during 12th Plan.

Overall training load during 12th Plan is estimated as 2473.41 thousand man-weeks/year. The available training infrastructure is 1945.69 thousand man-weeks/year. Thus, there is a deficit of training infrastructure for 527.72 thousand man-weeks/years.

9.5.2 Conclusion & Recommendations

It is proposed that all Central Sector Utilities, all state Sector Utilities and all IPPs should create sufficient Training Infrastructure for providing O&M training as per the norms stipulated in notification of September 2010 issued by CEA. Additional training Infrastructure should also be created by Organizations like NPTI & Training Institutes of other Utilities and they should also augment their existing Training Institutes for meeting the increased training requirements of the Power Sector. It is also proposed that all existing nine Institutes of NPTI should be augmented for which estimated cost for augmentation per Institute is Rs. 50.00 crore and for nine institutes it works out to Rs. 450 crore, for which necessary Plan funding may be provided by Ministry of Power.

The following options are available for meeting the funding arrangements

i) As per National Training Policy each organization should allocate training budget between 1.5% to 5% of annual salary budget.
ii) Each utility engaged in generation and transmission could set aside 0.25% of profit annually for meeting the training expenses.
iii) Training infrastructure for distribution could be funded through R-APDRP.
iv) Funds could be sought under the National Skill Development Program of Ministry of Human Resource Development for meeting the Training requirements.

10.0 DEVELOPMENT OF POWER SECTOR IN NORTH-EASTERN REGION

Major recommendations towards development of the North eastern Region are as follows:

i) A clear, coherent and sustainable power policy may be made specially for the NER which will take into account the special characteristics and needs of the Region. High capacity hydro & thermal power projects with associated transmission lines should be developed in the NE region for - First meeting the demand of the North-Eastern Region, and thereafter for other parts of the country.

ii) CIL should take up development of new coal mines particularly in Assam and Meghalaya to meet the coal requirement for new thermal power projects being proposed in the NE region.

i) The issue of gas availability and pricing may be appropriately addressed for exploiting the substantial gas reserves in the Region for power generation.

iv) In planning road networks particular attention should be given to roads, bridges and underpasses with adequate design capacity considering transportation of heavy ODCs to power projects.

v) More attention should be given to inland water routes as a method of connectivity within the region, the existing potential of which is largely untapped.

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Chapter-1

DEMAND FOR POWER AND GENERATION PLANNING

1.0 REVIEW OF CAPACITY ADDITION DURING 11TH PLAN

During the 11th Plan, significant achievements in capacity addition have taken place as compared to any previous Plan period. The total capacity addition during the 11th Plan has been the highest so far as compared to any previous Plan period. The capacity addition of 12,160 MW during 2010-11 has also been the highest during any previous single year. Thus, 11th Plan may be considered as a transitional Plan to achieve higher generation capacity additions in the country in the future.

The total Installed Capacity at the beginning of the 11th Plan i.e. 1.4.2007 was 1,32,330 MW comprising 34,654 MW Hydro, 86,015 MW Thermal (including Gas and Diesel), 3,900 MW Nuclear and 7,761 MW from Renewable Energy Sources. With this Installed capacity, the country faced peak shortages of 13,897 MW (13.8%) and energy shortage of 66,092 MU or 66 BU (9.6%) at the beginning of 11th Plan.

With a view to plan the future capacity addition requirement to meet the forecasted demand, planning studies were carried out to assess the additional capacity required to meet the demand in full by the end of the 11th Plan. It was assessed that a capacity addition of about 82,000 MW would be required during the 11th Plan including creating a spinning reserve of 5% in the system. Based on the Report of the Working Group on Power for the 11th Plan submitted to the Planning Commission, and taking into account the resources available, the target for capacity addition during 11th Plan was set at 78,700 MW comprising 15,627 MW Hydro, 59,693 MW Thermal and 3,380 MW Nuclear. The sector wise, type wise Summary of this capacity addition target is given in Table 1.1 below:

Table 1.1

11TH PLAN CAPACITY ADDITION TARGET-SECTOR WISE

(Figures in MW)

SOURCE	Central	State	Private	TOTAL
Hydro	8,654	3,482	3,491	15,627
Thermal	24,840	23,301	11,552	59,693
Nuclear	3,380	-	-	3,380
Total	36,874	26,783	15,043	78,700

Region wise/ Sector wise Summary of this capacity addition target of 78,700 MW is furnished in **Appendix 1.1**.

The goal of capacity addition of 78,700 MW during the 11th Plan was a great challenge to the central, state and private sector generating companies. MOP and CEA formulated a strategy for achieving the planned target of capacity addition during the 11th Plan and carried out rigorous monitoring of the progress of construction of the various projects. The efforts of CEA and MOP have yielded good results. Critical projects not making satisfactory progress were identified and focused efforts were made to resolve the constraints being faced in their implementation. However, in spite of best efforts by Project Authorities, MOP and CEA, few projects are still likely to slip from the 11th Plan target. At the same time, action has also been taken to add new additional capacity which was not initially included in the target for the 11th plan. This was done to supplement the capacity addition as some of the plants included in the target are likely to slip.

1.1 Mid Term Appraisal Target for 11th Plan

The target set for capacity addition during the 11th Plan was 78,700 MW. As per Mid Term Appraisal (MTA) of Planning Commission, certain projects totalling to 21,802 MW were likely to slip from 11th Plan on account of various reasons viz. delay in placement of order for main plant, slow progress of civil work, poor geology etc. Further, certain additional projects which were originally not included in the 11th Plan target were identified for benefits during 11th Plan by expediting the process of project implementation and compression of the construction schedule. This has been possible through sustained efforts made by Ministry of Power & CEA in pursuing the developers and other Stake holders. These additional projects total to 5,156 MW.

Based on the above, capacity addition likely during 11th plan as per Mid Term Appraisal (MTA) was fixed as 62,374 MW. A Summary of the likely slippages and additional projects identified is given in Table 1.2 below:

Table 1.2

SUMMARY OF CAPACITY SLIPPING / ADDITIONAL CAPACITY FOR LIKELY BENEFITS DURING 11TH PLAN

(Figures in MW)

11th Plan Capacity Addition Target (A)		**78,700**
Slipped From Target (B)		**21,802**
Balance Capacity (C)		**56,898**
Change in Capacity of projects as included in Target (D)		**320**
Increase in capacity of Anpara C	**200**	
Increase in capacity of Sugen CCGT	**20**	
Increase in capacity of Mettur Ext	**100**	
Additional Capacity Likely during 11th Plan Outside Target (E)		**5,156**
Total Capacity (F) = (C+D+E)		**62,374**

Thus capacity addition likely during 11th Plan as per Mid Term Appraisal (MTA) is 62,374 MW. A Sector wise Summary of this capacity addition target of 62,374 MW is furnished in **Appendix 1.2** and consolidated Project-wise list of projects for 78,700 MW, 62,374 MW and likely addition is furnished in **Appendix 1.3.** Reasons for projects slipping from 78,700 MW target viz-a-viz

62,374 MW totaling to 21,802 MW are furnished in **Appendix 1.4.** List of additional projects (i.e. outside target) totaling to 5,156 MW is furnished in **Appendix 1.5**.

1.2 Actual Capacity Addition and Power Supply Position during 11th Plan

Year-wise Target and Actual Capacity Addition during 2007-08, 2008-09, 2009-10, 2010-11

A capacity addition of 34,462 MW has been achieved during the first four years of the 11th Plan. Year wise details of the targeted and actual capacity addition during 11th Plan up to 31.03.2011 is given in Table 1.3 below and the project wise details are given in **Appendix 1.6**:

Table 1.3

ALL INDIA TARGET AND ACTUAL CAPACITY ADDITION DURING 11TH PLAN UPTO 31.3.2011

(Figures in MW)

Year (MW)	Type	Target	Actual Achievement
2007-08	Hydro	2,372	2,423
	Thermal	9,007	6,620
	Coal	7,880	5,620
	Lignite	0	0
	Gas	1,127	1,000
	Nuclear	660	220
	Total	12,039	9,263
2008-09	Hydro	1,097	969
	Thermal	5,773	2,485
	Coal	3,820	2,010
	Lignite	200	0
	Gas	1,753	475
	Nuclear	660	0
	Total	7,530	3,454
2009-10	Hydro	845	39
	Thermal	13,002	9,106
	Coal	9,105	6,655
	Lignite	1375	335
	Gas	2,522	2,116
	Nuclear	660	440
	Total	14,507	9,585
2010-11	Hydro	1,346	690
	Thermal	17,793	11,251
	Coal	14,000	9,725
	Lignite	1,185	635
	Gas	2,608	891
	Nuclear	1,220	220
	Total	20,359	12161
Grand Total (Up to 31st March 2011)			34,462

Year-wise Actual Power Supply position during 2007-08, 2008-09, 2009-10 & 2010-11 of 11th plan is given in Table 1.4 below:

Table 1.4
ACTUAL POWER SUPPLY POSITION (ALL INDIA BASIS)

Year	Peak (MW)				Energy (MU)			
	Peak Demand (MW)	Peak Met (MW)	Peak Deficit/ Surplus (MW)	Peak Deficit/ Surplus (%)	Energy Requi-rment (MU)	Energy Avail-ability (MU)	Energy Deficit/ Surplus (MU)	Energy Deficit/ Surplus (%)
10TH PLAN END	**100715**	**86818**	**-13897**	**-13.8**	**690587**	**624495**	**-66092**	**-9.6**
2007-08	108866	90793	-18073	-16.6	739343	666007	-73336	**-9.9**
2008-09	109809	96785	-13024	-11.9	777039	691038	-86001	**-11.1**
2009-10	119,166	104,009	-15,157	-12.7	830,594	746,644	-83,950	**-10.1**
2010-11	**125,077**	**112,167**	**-12,910**	**-10.3**	**862,125**	**789,013**	**-73,112**	**-8.5**

1.3 Installed Capacity as on 31.3.2011

The total Installed Capacity as on 31.3.2011 was 1,73,626 MW comprising 37,567 MW Hydro, 1,12,824 MW Thermal including gas & diesel, 4,780 MW nuclear based power plants and 18,455 MW from renewable energy sources including wind. The sector– wise details of installed capacity is given in Table 1.5 below:

Table 1.5
SUMMARY OF INSTALLED CAPACITY AS ON 31.03.2011
(Figures in MW)

Sector	Hydro	Thermal				Nuclear	R.E.S@	. Total
		Coal	Gas	Diesel	Total			
STATE	**27,257.00**	**47,257.00**	**4,327.12**	**602.61**	**52,186.73**	**0.00**	**3,008.85**	**82,452.58**
PRIVATE	**1,425.00**	**12,616.38**	**6,677.00**	**597.14**	**19,890.52**	**0.00**	**15,445.67**	**36,761.19**
CENTRAL	**8,885.40**	**34,045.00**	**6,702.23**	**0.00**	**40,747.23**	**4,780.00**	**0.00**	**54,412.63**
TOTAL	**37,567.40**	**93,918.38**	**17,706.35**	**1,199.75**	**1,12,824.48**	**4,780.00**	**18,454.52@**	**1,73,626.40**

Source: DMLF Division, CEA
@ R.E.S. = Renewable Energy Sources includes Small Hydro Project(SHP), Biomass Gas (BG), Biomass Power (BP) Urban and Industrial waste power (U&I), Wind Energy and Solar Power.

Power supply position during 2007-08, 2008-09, 2009-10 and 2010-11 of 11th plan shows peak deficit ranging from 10 to 17% and energy deficits ranging from 8 to 11%.

1.4 Actual/ Likely Capacity Addition during Eleventh Plan

A capacity of 34,462 MW has been commissioned during first four years of 11th Plan. Capacity addition programme during the year 2011-12 is 17,601 MW. The details of these projects are given in **Appendix-1.7** . With the addition of new projects and dropping of the projects likely to slip from the 11th Plan, even though stringent monitoring of projects has been done, the likely capacity addition during 11th Plan would be about 52,063 MW out of which 34,462 MW has already been commissioned during 11th Plan as on 31.03.2011 and 7155.5 MW capacity has already been commissioned till 30.09.2011 during the year 2011-12 as detailed in **Appendix-1.8**. Thus the total capacity commissioned during 11th Plan till 30.09.2011 is 41,617.5 MW. In addition, during the 11th Plan, a capacity totalling to 10,694 MW has already been commissioned from Renewable Energy Sources as on 31.03.2011.

Gas based projects with shorter gestation period have also been initiated during 11th Plan in order to augment likely capacity addition during the Plan. Of these three projects (not included in 11th Plan target) with a total capacity of 1,763 MW (Vemagiri Exp CCGT 768 MW, LANCO Kondapalli Exp. CCGT 770 MW, & Sravanthi Ph-I CCGT 225 MW) are likely to be commissioned during 11th Plan, if gas is made available.

1.5 Likely Installed Capacity at the end of 11th Plan i.e. as on 31.03.2012

The installed capacity as on 31.3.2011 is 1,73,626 MW (including renewables) and the likely capacity addition from conventional sources during 2011-12 is 17,601 MW. Therefore likely Installed Capacity at the end of 11th Plan i.e. as on 31.03.2012 would be of the order of 1,91,227 MW. This does not include additional capacity likely from projects being advanced to 11th Plan and capacity addition from renewables during 2011-12.

1.6 Analysis of Reasons for 11th Plan Slippages

The target of 78,700 MW capacity additions during 11th Plan was revised to 62,374 MW as per the Mid Term Appraisal (MTA) of Planning Commission. The major reasons for slippage of power projects from the capacity addition target of 78,700 MW are as follows:

➢ Delay in placement of orders for Main plant	: 6,660 MW
➢ Delay in placement of orders for Civil works	: 1,860 MW
➢ Slow progress of Civil works	: 900 MW
➢ Poor Geology	: 4,432 MW
➢ Contractual dispute between project developer and contractor and their sub-vendors / sub-contractor	: 4,760 MW
➢ Delay in Land Acquisition	: 810 MW
➢ Environmental Concerns	: 1100 MW
➢ Law and Order Problem/Local Issues	: 580 MW
➢ E&M work critical	: 600 MW
➢ Difficult area and accessibility	: 100 MW
Total	**21802 MW**

As per the latest assessment, capacity addition likely during 11th Plan is 52,063 MW. Projects totalling to about 12,977 MW are likely to slip from the 62,374 MW capacity additions as per MTA. In addition projects totalling to 2,666 MW (some of this capacity has already been commissioned) not included in the capacity addition of 62,374 MW (i.e. capacity outside the MTA target) are likely to yield benefits during 11th Plan.

The main reasons for slippage of power plants from the likely capacity addition of 62,374 MW during 11th Plan, as per the Mid Term Appraisal of Planning Commission, to the 12th Five Year Plan are as follows:

- Slow progress of Civil works
- Poor Geology
- Flash Flood
- Local agitation
- R&R issues
- Law and Order problem
- Shortage of Manpower and difficult site conditions

2.0 DEMAND PROJECTIONS

Demand Projections form an essential input to the Generation Planning exercise. Demand in terms of Peak demand in MW, Energy Requirement in BUs and the load profile for the entire year is used as the basis for estimating the Generation Capacity addition required to meet the demand in full. Since electricity demand is dependant on a large number of factors and since the correlation with some of these factors is not easy to define, accurate demand assessment is a challenging task.

Deliberations were held on the demand to be adopted for planning generation capacity addition for the 12th & tentative 13th Plan periods. It was decided that different demand Scenarios may be worked out based on actual requirement during 2009-10 and the GDP growth rate and likely values of elasticity. Also, the impact of DSM and Energy Conservation Measures during the 12th and 13th Plans on the demand of the country may also be suitably taken into account while finalizing the demand.

The projections of capacity addition are based on All India studies (since the National Grid is expected to be in place and free power flows from one Region to another are likely) while considering the All India demand figures.

The 18th EPS Committee has been constituted and its Report is under finalisation.

2.1 Impact of DSM and Energy Conservation Measures on Demand Projections

Demand Side Management and Energy Efficiency programmes initiated by Bureau of Energy Efficiency are also expected to result in reduction of Peak Demand and Energy Requirement of the country. Various Schemes initiated by BEE choosing base year as 2011-12 for Demand Side Management and Energy Conservation are as follows:

Standard & Labeling (S & L)

This scheme is the star rating system of different appliances and the savings on account of this Scheme has been estimated considering the following:

- Higher penetration of S & L scheme
- Introduction of more number of appliances
- Moving from voluntary to mandatory participation

The projections in savings by 12th Plan end have been worked out considering actual savings achieved between 2007-08 to 2010-11 and based on these figures, a regression equation has been established with Logarithmic scale using base year as 2011-12.

National Energy Conservation Award (NECA)

This is a scheme introduced by Government of India to award every participating unit. Savings on account of this Scheme has been estimated considering the following:

- Participation from bigger industries will stabilize
- Reported savings would decrease as industries will move towards energy efficiency
- There may be more participation from SME sector
- Regression equation follows Logarithmic scale

State Designated Agency (SDA)

This is the extended arm of BEE in various states and they initiate conservation schemes. Savings on account of this Scheme has been estimated considering the following:

- More involvement of state Governments in implementing energy efficiency projects (More demonstration projects)
- Replication of already demonstrated projects
- Implementation of inspection system in designated consumers for compliance
- Regression equation is Logarithmic.

Energy Conservation Building Code (ECBC)

Savings on account of this Scheme has been estimated considering the following:

- Mandatory implementation of ECBC in Govt. buildings, new establishments

As no past data is available to have a Regression equation, yearly savings of 10 MW have been assumed.

Bachat Lamp Yojana (BLY)

Savings on account of this Scheme have been estimated considering the following:

- The scheme is expected to stabilize by 2013-14because adoption of the scheme by major States
- The regulations of UNFCC may also influence further implementation
- Logarithmic growth followed upto 2013-14, then stabilized

Perform, Achieve & Trade (PAT)

462 no. of Industries in 8 sectors are currently participating in this scheme. Savings on account of this Scheme has been estimated considering the following:

- Involvement of energy intensive sectors in this mandatory scheme
- PAT scheme will focus on reduction of all forms of energy consumption with respect to product output (Electrical + Solid fuel like Coal, Lignite + Liquid fuel + Gaseous fuel)
- The savings would be in terms of Million Tons of Oil equivalent (Mtoe) or avoided generation capacity in MW
- The national target saving of 6.5 Million Tons of Oil equivalent (Mtoe) has been considered for first PAT Cycle (i.e. about 3000 MW of avoided generation capacity)
- Increase of 1000 MW/year has been considered upto 2016-17
- More no. of industries as well as sectors be taken into this umbrella during 2013-14 to 2016-17

All the reported savings are achieved / to be achieved in that year only. However, a cumulative figure is also estimated based on base year 2011-12.

On account of the above Schemes of BEE, it is envisaged that there would be additional savings in terms of energy on account of Energy Efficiency measures and reduction in peak demand on account of Energy Efficiency and DSM measures. It has been estimated by BEE that the net savings in terms of energy in the year 2016-17 would be about 60 BU. Considering about 50% of these energy savings during peak hours (about 4 hours per day), it would be reasonable to assume that this energy savings during peak hours would contribute to reduction in peak demand to an extent of about 12,350 MW in 2016-17. Considering DSM measures which are going to continue during 13th Plan, the savings in terms of Peak reduction by 13th Plan end i.e. 2021-22 would be of the order of about 15,000 MW.

2.2 Demand to be adopted for Assessment of Generation Capacity Addition Programme for 12th & 13th Plan

A number of demand scenarios were worked out corresponding to actual requirement up till 2009-2010 and 9% GDP growth rate & varying values of elasticity (of GDP vs Energy Requirement).

For the Generation Planning Studies, demand corresponding to actual requirement in 2009-10 and thereafter 9% GDP growth rate and 0.9 & 0.8 elasticity during 12th & 13th Plans respectively has been considered to assess capacity addition requirement for 12th and 13th plan periods. Thereafter, reduction in Peak Demand and Energy Requirement, as indicated above, on account of BEE's Energy Efficiency Measures and DSM programmes has also been accounted for while arriving at the final Peak Demand & Energy Requirement for the generation planning studies.

The actual load factor in 2009-10 was 79.5 %. The Load factor assumed in the 17th EPS in 2011-12 & 2016-17 is 72.4% and 72.8% respectively. In the past, the demand has not grown as anticipated and due to various other reasons the decreasing trend of load factor as anticipated has not taken place. It was therefore considered prudent to assume a modest decline in load factor, rather then that assumed by the 17th EPS, and a load factor of about 78% was considered while estimating the peak demand for 2016-17 & 76% up to 2021-22.

Based on the above, the demand to be adopted by 12th and 13th Plan end considering impact of DSM & Energy conservation measures for the purpose of Generation Planning Exercise is as follows:

Table 1.6
DEMAND ADOPTED FOR GENERATION PLANNING STUDIES

	Energy Requirement (BU)	Peak Load (MW)
	9% GDP Growth rate (0.9/ 0.8 Elasticity in 12th / 13th Plan)	9% GDP Growth rate (0.9/ 0.8 Elasticity in 12th / 13th Plan)
2016-17 (12TH Plan end)	**1403**	**1,97,686**
2021-22 (13th Plan end)	**1993**	**2,89,667**

It is pertinent to mention that the above projections by 12th Plan end are close to the projections of the draft 18th EPS Report with peak demand of 1,99,540 MW and energy requirement 1354 BU.

Another demand scenario with 9% GDP growth rate with an Elasticity of 1 has also been considered for capacity addition planning as a sensitivity analysis. The demand projections with 9% GDP growth rate and an Elasticity of 1 are as given below:

Table 1.7
DEMAND ADOPTED FOR SENSITIVITY STUDIES

	Energy Requirement (BU)	Peak Load (MW)
	9% GDP Growth rate 1.0 Elasticity in 12th Plan	9% GDP Growth rate 1.0 Elasticity in 12th Plan
2016-17 (12TH Plan end)	1489	2,09,339

3.0 PLANNING NORMS

3.1 Objective of Planning Norms

The Indian Power Sector comprises of units of different type of power plants i.e. hydro, coal, lignite, gas based, DG Sets and nuclear power plants. The unit size of coal based plants has also been steadily increasing over the years from 30 to 50 to 67.5 MW during the 70's to 500 MW at present. During the 12th & 13th Plan periods supercritical units of 660 MW and 800 MW have also been planned. In respect of nuclear plants, 200-220 MW unit size plants are in operation and 540 MWe reactors have recently been put in operation during the 10th Plan. 1000 MW units are also under construction by the Nuclear Power Corporation. In the

Planning exercise, generation norms are used as representative performance parameters of various types of generation sources to estimate the availability of peaking power and energy from each generating unit. These norms are then used to assess the availability of energy from each source of generation and thus assess generation capacity addition required to meet the stipulated demand.

The planning studies require accurate performance parameters of various type of generating units to assess their availability and energy generation capabilities. Availability and generation capacity are important parameters for meeting the projected demand in the country and also in various regions. Therefore, Availability, PLF, Auxiliary Power Consumption and Heat Rate of the generating units are key performance parameters. Different types of generating units have varied operational performance and accordingly different norms have been used for thermal (coal), gas, hydro and Nuclear projects to make a fair assessment of the new generation capacity requirement.

The planning Norms are in accordance with the norms stipulated by CERC.

3.2 Parameters covered by Norms

Norms for thermal, hydro and nuclear stations have been evolved as all India average figures. The parameters covered under Norms are as follows.

(a) Availability
(b) Auxiliary Power Consumption
(c) Unit Heat Rate
(d) Plant Load Factor

Availability

The Availability (gross) of the various types of generating units is given in Table 1.8 below:

Table 1.8
AVAILABILITY

PEAKING AVAILABILITY (GROSS) in % OF THERMAL/ NUCLEAR/ HYDRO POWER STATIONS			
	Unit Size	Existing Units	Future Units
Thermal (Coal)	800/660 MW	-	88
	500/250/210/200 MW	85	85
	Below 200 MW	75	85
	Below 200 MW operating below 20 % PLF at present	50	-
Gas Based	OCGT all sizes	90	90
	CCGT all sizes	88	88
DG Sets	All sizes	75	75
Lignite Based	All sizes	80	80
Nuclear	All sizes	68	68
Hydro	All sizes	87.5	87.5

Auxiliary Power Consumption (APC)

The auxiliary consumption of the various types of generating units considered is given in Table below:

Table 1.9
AUXILLIARY POWER CONSUMPTION

I	**Coal Based Power stations**	
1.	800/ 660 MW class units	7.5%
2.	500 MW class units	7.5%
3.	250/210/200 MW class units	8.5%
4	Below 200 MW units	12.0
5	Lignite based units	12 % for <200 MW 9 % for >200 MW
II	**Gas Based Power Stations**	
1	Combined cycle	3.0%
2	Open cycle	1.0%
3	DG sets	1.0%
III	**Hydro Power Stations**	**0.7%**
IV	**Nuclear Power Stations**	
	160 MW BWR	10%
	200/220 MW PHWR	12.5%
	1000 MW LWR	7.8%
	220/ 540 MW PHWR	12.5%
	500 MW FBR	6.0%

Unit Heat Rate

The Unit heat rates (Gross) used for planning studies for thermal units of various capacities as arrived at by the past average data are given in Table below.

Table 1.10
UNIT HEAT RATES

Unit Size	Gross Heat rate (Kcal/kWh)
800 MW	2300
660 MW	2300
500 MW	2425
200/210/250 MW KWU	2460
200/210/250 MW LMZ	2500
250/210/125 MW (lignite)	2750
100 MW	2750
50 MW class of units	3000
30 MW class of units	3300
Combined cycle Gas turbine	2000
Open cycle Gas turbine/DG Sets	2900

Plant Load Factor

The Plant Load Factor (PLF) to be adopted for thermal units of various capacities and as agreed by group are furnished in Table below.

Table 1.11
PLANT LOAD FACTOR

PLANT LOAD FACTORS OF THERMAL/ NUCLEAR POWER STATIONS		
Units	PLF (%)	Remarks
Thermal		
Coal Based		
800/660 MW	**82.5**	**Future Units**
500/250/210/200 MW	**82.5**	**Existing and Future Units**
Below 100/110 MW	**60**	**80% for future units**
	40	**Units in ER and NER operating Below 20% PLF.**
Lignite Based 125/ 200/250 MW	**75**	
Gas Based		
CCGT	**68.5**	
OCGT	**33**	
Nuclear Units		
All sizes	**68**	**Normative Capacity Factor**

For hydro units it was the energy generation shall be taken as the designed energy generation in a 90 % dependable year.

3.3 Norms adopted for Reliability Criteria

The Power System is planned to meet the forecasted demand and ensure an expected level of reliability. Reliability is a measure of the ability of a system to perform its designated function under the designed conditions. In our Studies, Loss of Load Probability (LOLP) is the criteria adopted to reflect the capacity of the system to meet the peak load and Energy Not Served (ENS) to reflect the Energy Requirement not met in the System. LOLP is the probability that a system will fail to meet its peak load under the specified operating conditions. It is the proportion of days per year or hours per year when the available generating capacity is insufficient to serve the peak demand. This index is dimensionless and can also be expressed as a percentage.

ENS is the expected amount of energy which the system will be unable to supply to the consumers as a fraction of the total energy requirement. This index again is dimensionless and can also be expressed as a percentage. In other words these indicate as to how many units of energy requirement in a year are not met and correspondingly how many hours in a year the power demand is not met.

In the Generation Planning Studies carried out while formulating the earlier Report of the Working Group on 11th Plan, an LOLP of 1% and ENS of 0.15 % was considered. However, in keeping with the trend worldwide more stringent reliability parameters in terms of LOLP and ENS have now been considered while planning for 12th and 13th Plan periods. USA adopts an LOLP of 0.03 % which appears to be reasonable for a developed economy. LOLP standard adopted by some developing countries is 0.27%. It is therefore proposed that an LOLP of 0.2 % and ENS of 0.05 % shall be adopted for planning purposes.

3.4 Norms for Cost and heat value of GAS/ LNG

Table 1.12

Fuel	Cost (Rs./th.cum)	Calorific value (Kcal /cum)
LNG	8,000	9,800
Gas (HBJ)	4,400	9,500
Gas (Reliance)	5,760	9,500
Gas (NER)	3,000	9,500

Financial Parameters

Financial parameters have been considered as per CERC guidelines.

4.0 CAPACITY ADDITION REQUIREMENT FOR 12th PLAN AND 13th PLAN

Generation expansion planning studies for 12th plan end (2012-17) have been carried out using EGEAS (Electric Generation Expansion Analysis System) software to assess the requirement of additional generating capacity during the 12th plan period (2012-17), considering capacity addition of 62,374 MW during the 11th Plan. The study has been carried out for the demand estimates based on actual energy requirement during the year 2009-10 and 9% GDP growth, with elasticity of 0.9 during 12th Plan and 0.8 during the 13th Plan, as detailed in Clause 2. Sensitivity Study has also been carried out to assess the capacity addition requirement corresponding to elasticity of 1.0 during 12th Plan. While carrying out the studies, the requirement of 5% Spinning reserve as stipulated in the Electricity Policy, effect of uprating of hydro power plants and expected retirement of thermal units by 2012-17 are also considered. A capacity of about 4,000 MW from old and inefficient thermal units has been retired during 12th Plan.

4.1 Capacity Addition required during 12th Plan

Base Case Scenario:

The capacity addition requirement during 12th Plan corresponding to demand as per 9% GDP growth and elasticity of 0.9 during 12th Plan works out to 75,715 MW. In accordance with the

Low Carbon Growth Strategy, priority has been accorded to renewable energy sources, hydro and nuclear generation capacity. Accordingly, a feasible hydro capacity addition of 9,204 MW and nuclear capacity addition of 2,800 MW has been taken as must run during 12th Plan while assessing generation capacity addition requirement. Gas based capacity of 1,086 MW only has been considered while carrying out studies, as gas for these projects is assured since it is tied up from local sources. Besides 1200 MW import from Bhutan has also been considered. Based on Studies, balance capacity addition to meet the demand would be from coal based capacity which is 62, 625 MW. However, against this requirement of 62,625 MW, projects totalling to, 62,695 MW have been identified as most likely projects to yield benefits during 12th Plan. Details of the projects are furnished in **Appendix 1.9(a).**

The capacity addition planned during the 12th Plan is detailed below:

Table 1.13
CAPACITY ADDITION PLANNED DURING 12th PLAN
(Figures in MW)

Type of Capacity	Demand corresponding to 9% GDP GR & 0.9 Elasticity
Thermal	**63,781**
Coal	**62,695**
Gas	**1,086**
Hydro	**9,204**
Nuclear	**2,800**
Total	**75,785**

The above capacity addition requirement during 12th Plan is based on the likely capacity addition of 62,374 MW during 11th plan.

In addition, a grid interactive renewable capacity addition of about 18,500 MW during 12th Plan comprising of 11,000 MW wind, 1,600 MW small hydro, 2,100 MW Biomass power, Bagasse Cogen and waste to energy put together and 3,800 MW Solar has been considered for the generation planning studies.

Generation planning has been carried out considering 5% capacity as spinning reserve as stipulated by the National Electricity Policy.

The gestation period of hydro and nuclear projects is about 6-7 years. Hence, only those hydro and nuclear projects which are under construction at present are expected to yield benefits during 12th Plan period. In view of uncertainty of gas availability for 12th Plan projects, only those projects totalling to 1086 MW have been considered which have tied up gas linkage from local sources. This comprises of 826 MW in central Sector, and 260 MW in State Sector. It may also be mentioned that presently an additional gas based capacity of about 13,000 MW is under construction in the country and this capacity can be commissioned during 11th Plan/12th Plan, if gas is made available for testing /commissioning and commercial operation of these projects.

List of hydro, nuclear and gas projects for likely benefits during 12th Plan is given at **Appendix 1.9 (b)**.

Projects totalling to 62,695 MW coal based capacity have been identified as most likely projects yielding benefits during 12th Plan. The coal based capacity of 62,695 MW is expected to have 10,600 MW in Central sector and 12,080 MW in State Sector and 40,015 MW in private sector. The sector wise breakup of under construction hydro projects of 9,204 MW is 5,632 in Central sector, 1,456 MW in State Sector and 2,116 MW in private sector and nuclear capacity addition of 2,800 MW is in Central sector. Thus the tentative sector-wise breakup of the 75,785 MW capacity addition required during 12th Plan would be 19,858 MW in Central Sector, 13,796 MW in State Sector and 42,131 MW in Private Sector.

Out of the most likely coal based projects totalling to 62,695 MW; 23,940 MW is based on supercritical technology and 38,755 MW is based on sub-critical technology. Also out of 62,695 MW coal based capacity, 38,548 MW capacity is based on coal linkage, 17,825 MW is coal block based, 6,292 MW is imported coal based and capacity totalling to 30 MW requires coal linkage on account of change in capacity of some of the projects. 25,955 MW of this capacity is located at Pithead, 25,160 MW at load centre and 11,540 MW in Coastal belt.

Sector-wise Summary of the capacity addition is given in Table below:

Table 1.14
Sector-wise Break-up of 12th Plan Capacity
(Figures in MW)

Sector	Hydro	Coal	Lignite	Gas	Total Thermal	Nuclear	TOTAL
Central	5632	10600	0	826	11426	2800	**19858**
State	1456	12080	0	260	12340	0	**13796**
Private	2116	40015	0	0	40015	0	**42131**
TOTAL	**9204**	**62695**	**0**	**1086**	**63781**	**2800**	**75785**

Likely status of coal tie up of the capacity totalling to 62,695 MW is as follows:

Table 1.15-A

Coal tie up status	MW
Coal linkage	38548
Coal Block	17825
Imported coal	6292
Coal Linkage to be tied up	30
Total	**62695**

Table 1.15-B

Location-wise Break up	MW
Pit head	25,995
Load Centre	25,160
Coastal	11,540
Total	**62695**

A capacity of about 4000 MW is from coastal plants based on imported coal.

4.1.1 Sensitivity Studies for 12th Plan

Sensitivity studies for 12th Plan have also been carried out based on demand projections with 9% GDP growth rate and an Elasticity of 1 and the capacity addition in various scenarios worked out. For sensitivity analysis two additional scenarios in capacity addition have been worked out as follows:

- **High Gas Scenario**- Additional 12,000 MW gas based capacity under construction has been considered over and above 1086 MW already taken in the Report.
- **High Gas + High Renewable Scenario** - As per revised programme of MNRE, total renewable capacity addition of 30,000 MW during 12th Plan has been taken instead of 18,500 MW considered earlier.

A Summary of above study results is as given below:

A: Capacity addition required during 12th Plan with Demand corresponding to 9% GDP Growth Rate & 0.9 Elasticity

Table 1.16

(Figures in MW)

Type of Capacity	Capacity addition required during 12th Plan with Demand corresponding to 9% GDP GR & 0.9 Elasticity		
	Base Case Scenario	High Gas Scenario	High Gas + Higher Renewables Scenario
Thermal	63,781	63,686	60,486
Coal	62,695	50,600	47,400
Gas	1,086	13,086	13,086
Hydro	9,204	9,204	9,204
Nuclear	2,800	2,800	2,800
Total	75,785	75,690	72,490
Renewables	18,500	18,500	30,000
Imports	1,200	1,200	1,200
Total with Renewables and Imports	95,485	95,390	1,03,690
Coal Requirement (MT)	842	772	764

B: Capacity addition required during 12th Plan with Demand corresponding to 9% GDP Growth Rate & 1 Elasticity

Table 1.17

(Figures in MW)

Type of Capacity	Capacity addition required during 12th Plan with Demand corresponding to 9% GDP GR & 1.0 Elasticity		
	Corresponding to Base Case Scenario with 1.0 Elasticity	High Gas	High Gas + Higher Renewables
Thermal	84,486	85,286	82,086
Coal	83,400	72,200	69,000
Gas	1,086	13,086	13,086
Hydro	9,204	9,204	9,204
Nuclear	2,800	2,800	2,800
Total	96,490	97,290	94,090
Renewables	18,500	18,500	30,000
Imports	1,200	1,200	1,200
Total with Renewables and Imports	1,16,190	1,16,990	1,25,290
Coal Requirement (MT)	905	844	837

4.2 Coal demand and availability during 12th plan

Availability of coal for the coal based thermal power stations is a matter of serious concern. Although thrust is being accorded to maximize generation from other conventional and non-conventional sources, coal based generation is likely to be the main stay of electricity generation for 12th and 13th Plan to support the targeted GDP growth envisaged by the Government. The coal based capacity addition programme is worked out after taking into account the electricity generation availability from other sources i.e. Hydro, Nuclear, Gas, Lignite and renewable sources. Studies show that the likely system energy requirement that is to be met by coal based plants during the year 2016-17 would be 1095 Billion Units. Further, assuming that the estimated generation available from hydro stations to be 30% less than their design energy, the total generation, to be met by coal based plants works out to be 1155 Billons Units.

In order to meet this generation requirement, coal requirement (at SPCC 0.73 Kcal/ Kg) works out to around 842 MT. Against the requirement of 842 MT, 54 MT coal is to be imported by Thermal Power Stations designed on imported coal. SCCL has confirmed a coal availability of 35 MT and around 100 MT coal is expected to be available from captive coal blocks. Thus, 653 MT coal needs to be made available by CIL .

Scenario-I Business As Usual (BAU) - Base Case:

Against the requirement of 653 MT coal, CIL have committed to supply 415 MT which is about 75% of their total production of 556 MT in BAU scenario. The availability/shortfall of indigenous coal is detailed below:

(i)Coal requirement during the year 2016-17	=	842 MT
(ii)Coal availability from:		
(a)CIL	=	415 MT
(b)SCCL	=	35 MT
(c)Captive Blocks allocated to Power Utilities	=	100 MT
(d)Coal to be imported by TPSs designed imported coal	=	54 MT
Total, coal availability	=	604 MT
(iii)Shortfall	=	238 MT

In order to bridge the above gap between demand and coal availability as referred above, Power Utilities are expected to import around 159 MT to meet shortage in coal supply from CIL. However, such a huge quantity of imported coal for blending may not be feasible as in the existing boilers maximum 15% of blending of imported coal is possible. This quantity of imported coal would be in addition to 54 MT coal likely to be imported by Thermal Power Stations designed on imported coal. Therefore, the total quantity of coal expected to be imported is about 213 MT.

It may be noted that the availability of coal as indicated by CIL would support only about 7,500 MW of CIL linked new capacity during 12th Plan, as against 38,000 required (as per 75,785 MW). Accordingly, the 12th Plan target of 76,000 would need to scaled down to about 45,000 MW. Thus, CIL is to be impressed upon for formulating exigency plan to enhance their production to meet the requirement the power stations.

Scenario-II- Optimistic Projections of CIL - Sensitivity Analysis of Coal Availability

As per the Optimistic Scenario, the total coal production of CIL in 2016-17 is expected to be 615 MT. Considering 75% availability to Power Sector, 461 MT coal shall be supplied to the Power Sector. This also implies that 80% of the additional 59 MT coal production in the Optimistic Scenario shall be supplied to the Power Sector.

In this scenario, the availability/shortfall of indigenous coal is detailed below:

(i)	Coal requirement during the year 2016-17	=	842 MT
(ii)	Coal availability from :		
	(a) CIL	=	461 MT
	(b) SCCL	=	35 MT
	(c) Captive Blocks allocated to Power Utilities	=	100 MT

	(d) Coal to be imported by TPSs designed imported coal	=	54 MT
	Total, coal availability	=	650 MT
(iii)	Shortfall in domestic coal	=	192MT

In order to bridge the above gap between demand and coal availability as referred above, Power Utilities are expected to import around 128 MT to meet shortage in coal supply from CIL. However, such a huge quantity of imported coal for blending may not be feasible as in the existing boilers maximum 15% of blending of imported coal is possible. This quantity of imported coal would be in addition to 54 MT coal likely to be imported by Thermal Power Stations designed on imported coal. Therefore, the total quantity of coal expected to be imported is about 182 MT.

It may be noted that the availability of coal as indicated by CIL would support only about 19,000 MW of CIL linked new capacity during 12th Plan, as against 38,000 required. Accordingly, the 12th Plan target of 76,000 would need to scaled down to about 57,000 MW.

Thus, CIL is to be impressed upon for formulating exigency plan to enhance their production as projected in Optimistic Scenario to meet the requirement the power stations.

As per the indications available from various Power Utilities, DISCOMS are reluctant to buy costlier power i.e. electricity generated either by TPSs designed on imported coal or Power Utilities using blending of imported coal in higher proportion.

In order to overcome the coal crisis following measures are suggested:

i) MOC/ CIL needs to be impressed upon to formulate a contingency plan to meet the coal demand of the power sector. After assessing the potential of existing coal blocks, sanctioning of additional coal blocks from MoE&F needs to be expedited by the Government.

ii) Captive Blocks allocated to various utilities may be advised to enhance their production through some incentive oriented strategy and surplus production after meeting their coal requirement may be supplied to power station.

iii) Power Sector must be allocated 80% of total coal production by CIL.

4.3 Efficient use of coal in sub critical plants

Severe constraints in availability of adequate coal for power plants are being experienced at present and the same is expected to continue in future as well. Even through CIL is being pursued to increase production of coal; efforts are being made for most efficient use of coal in sub critical plants. Steps being taken in this regard are as follows:

1. Retirement of old and inefficient coal based plants – about 4,000 MW of capacity shall be retired during the 12th plan.
2. Renovation and Modernization of plants with a view to improve its efficiency and performance. This would facilitate efficient use of coal in existing sub critical plants.

3. Energy audits and better O&M Practices
4. Initiatives by Bureau of Energy Efficiency (BEE) to introduce Energy Efficiency measures through their various schemes. These have been dealt with in detail in Chapter 5.

4.3.1 Policy On How to Incentivise the Retirement of Old Power Plants

Experience has revealed that the Agencies/Organizations owning the generating plants are reluctant to retire old power plants mainly because of following:-

- Due to poor power availability position
- Due to loss of generation asset in the absence of new generating plants likely to be commissioned in the near future.

As a result, the generating agencies/organizations are continuing to use old and inefficient generating plants. There should be incentive for the generating agencies to retire the old plants so that they are willing to phase out old and inefficient power plants which would also result in lower specific green house gases in case of Thermal Power Plants. Some of the recommendations are:-

1. That in the regulatory frame work, there should be provision to the effect that the generating plants which have completed more than 30 Years of service and have operating heat rate higher than 20% of the designed value during the last five years should be retired within a fixed time frame.

2. There should be incentive in terms of interest subsidy etc. for these plants to be retired and new plants to be commissioned in place of old plant. It has been observed that the old plants have adequate infrastructure in terms of land, water so that building up of new plants in the same area will not be a problem and would be feasible.

4.4 Fund requirement for generation projects during 12th Plan:

A capacity addition of about 1,07,000 MW (comprising 75,785 MW Conventional, 13,000 MW Captive and 18,500 MW Renewables) is envisaged during 12th Plan, corresponding to the demand projection based on the actual energy requirement during the year 2009-10 and 9% GDP growth, with elasticity of 0.9 during 12th Plan as indicated. The estimated requirement of funds during 12th Plan works out to about Rs. 6,38,600 Crore for the Generation projects (including Rs. 2,72,582 Cr for advance action for 13th Plan projects).

Assumption for funds requirements calculation for Generation projects:
Conventional: (Coal-Rs 5 Cr/MW; Hydro-ROR-Rs 5.50 Cr/MW; Hydro-Storage-Rs 6.50 Cr/MW; Gas-Rs 3.75 Cr/MW; Nuclear-Rs 7 Cr/MW); Captive-Rs 5 Cr/MW; Solar-Rs 13 Cr/MW; RES-Rs 4 Cr/MW

4.5 Capacity addition required during 13th Plan

The peak demand and energy requirement during the terminal year of 13th Plan (2021-22) would be 2,89,667 MW and 1993 BU respectively. The capacity addition requirement during

13th Plan to meet this demand is estimated to be 93,400 MW (assuming a capacity addition of 62,374 MW in 11th Plan & 75,785 MW in 12th Plan from conventional sources) as detailed below:

Table 1.18

CAPACITY ADDITION REQUIREMENT DURING 13th PLAN

(Figures in MW)

Type of Capacity	Demand corresponding to 9% GDP GR & 0.8 Elasticity
Thermal	**63,400**
Hydro	**12,000**
Nuclear	**18,000**
Total	**93,400**

Feasible hydro capacity addition of 12,000 MW and nuclear capacity addition of 18,000 MW as intimated by Nuclear Power Corporation has been considered as must run during 13th Plan while assessing generation capacity addition. A capacity of about 4,000 MW has been retired for 13th Plan studies.

In addition, MNRE has projected a grid interactive renewable capacity addition of about 30,500 MW during 13th Plan, comprising of 11,000 MW Wind, 1,500 MW from Small Hydro, 2,000 MW Biomass power, Bagasse Cogen and waste to energy put together and 16,000 MW Solar.

4.6 CO_2 emission from power generation at the end of 12th /13th Plan

The estimated CO_2 emission from power generation at the end of 12th Plan and 13th Plan, based on the projected capacity addition of 75,785 MW during 12th Plan and 93,400 MW during 13th Plan is given below.

Table 1.19

CO_2 emission from Power Generation

CO_2 emission	Thermal Gross Generation (Coal + Lignite + Gas) MU	Total CO_2 emission in Million Tonne	Average Emission factor from thermal generation kg/kwh	Total Gross Generation (including generation from Renewables) MU	Average Emission factor from total generation kg/kWh
Anticipated at the end of 12th Plan	1211848	1078	0.889	1493011	0.722
Anticipated at the end of 13th Plan	1625343	1421	0.874	2119897	0.670

5.0 CAPTIVE POWER PLANTS

Large number of captive plants including co-generation power plants of varied type and sizes exist in the country which are either utilized in process industry or used for in-house power consumption. A number of industries have set up their own captive plants so as to get reliable and quality power. Some Captive plants are also installed as stand-by units for operation only during emergencies when the grid supply is not available. The installed capacity of CPPs has increased from 588 MW in 1950 to about 22,235 MW by the end of 10th Plan. The same has increased to about 30,000 MW in March 2011. Captive plants including co-generation power plants could, therefore, play a supplementary role in meeting the country's power demand.

After the enactment of Electricity Act 2003, there is a renewed interest in captive generation. Surplus power, if any, from captive power plants is being fed into the grid as the Electricity Act 2003 provides for open access, in non-discriminatory way.

Around 12,000 MW of addition of Captive Capacity is likely during 11th Plan, out of which about 9250 MW has been commissioned during the first 4 years of 11th Plan. A capacity addition of approximately 13,000 MW is likely to be commissioned during 12th Plan (April 2012 to March 2017).

It is estimated that about 20% of the likely capacity addition during 11th Plan shall be surplus and can be fed to the grid. However, to harness surplus capacity from captive power plants it is essential that various bottlenecks being faced are addressed and technical and commercial issues are resolved to make the export arrangements attractive and commercially viable.

6.0 MAXMISING GENERATION FROM EXISTING PLANTS

Optimization of generation from the existing generation capacity is of utmost importance in the resource crunch environment. The installation of new power projects involves large investment and long gestation period. Therefore, following options are recommended for maximizing generation from existing projects:

1. Renovation & Modernization of Power Plants
2. Energy Audits
3. Better O&M practices

6.1 Renovation & Modernisation and Life Extension(R&M and LE) of Thermal Power Plants

The coal based thermal plants are the backbone of Indian power sector. Most of the old smaller size non-reheat type units are on the verge of retirement. Though the 200 MW and above size units, barring a few, are performing at the national average PLF, however, some of these units have crossed their economic life of 25 years and are also having high specific fuel consumption. It is of prime importance to improve their performance level in terms of efficiency in order to not only save fuel but also to reduce environmental impact. Such units provide a good opportunity for capacity uprating and extended period of operation. Renovation and Modernisation (R&M) and Life Extension (LE) of existing old power plants is therefore, considered as an economical option to supplement the capacity addition programme for increased power availability.

The R&M programme is primarily aimed at generation sustenance and overcoming problems arising due to generic defects, design deficiencies/ modifications, obsolescence of equipments/ systems, inadequacies due to poor quality of coal, change in terminal parameters w.r.t. design, stringent environmental conditions and safety requirements.

The life extension (LE) programme on the other hand focuses on plant operation beyond their original design life after carrying out specific life assessment studies of critical components. After about 20 years of life or 1,60,000 hours of operation, a detailed condition assessment along with performance evaluation of various systems/ sub-systems is carried out to identify the modifications/ replacements required to enable plant operation for a longer period.

The old and small size units of early post-independence period were based on technology as available at that time having a very low efficiency. These units are therefore near obsolescence. The LMZ Russian design larger size units (200/210MW) and initial KWU design machines are now at the fag end of their economic life. Further, though there has been gradual improvement in plant load factor over the years, there exists a lot of scope for further improvement. There exists a potential for enhancing their rated capacity by 4 – 8 % and efficiency by 8 to 10% in various 200/210 MW LMZ machines. Few such units have been taken up as pilot projects under Energy Efficient R&M (EE R&M) programme through funding support from World Bank and KfW, Germany.

6.1.1 Review of R&M programme in the country

R&M Programme in a structured manner was initiated in 1984 as a centrally sponsored programme during 7th Plan and the programme continued during the two Annual plans 1990-91 & 1991-92. The momentum for undertaking R&M works continued during the 8th & 9th Plan periods. However, the same could not be sustained during the 10th Plan. The Plan-wise details are given below:

Table 1.20

Sl. No.	5-Year Plan	Year	No. of TPS / No. of Units	Capacity (MW)	Additional Generation Achieved MU/ Annum	Equivalent MW**
1	7th Plan & 2 Annual Plans	85-86 to 89-90 & 90-91, 91-92	**34 / 163**	**13570**	10000	**2000**
2	8th Plan (R&M) (LEP)	92-93 to 96-97	**44 / 198** 43/(194) 1 (4)	**20869** (20569) (300)	5085	**763**
3	9th Plan (R&M) (LEP)	97-98 to 2001-02	**37 / 152** 30/ (127) 7/ (25)	**18991** (17306) (1685)	14500	**2200**
4	**10th Plan (R&M) (LEP)**	**2002-03 to 2006-07**	**9/25 (14 units out of 57 planned) (11 units out of 106 *)**	**3445 (2460) (985)**	**2000**	**300**

*Out of 106, 23 units were considered under PIE programme and 45 units were found techno-economically unviable.

** Equivalent MW has been worked out considering PLF during the respective plan period.

6.1.2 Formulation of R&M / LE programme & Achievement during 11th Plan

Based on the discussions held with Ministry of Power, various utilities, PFC and BHEL, CEA prepared a 'National Perspective Plan for R&M and Life Extension & Uprating (LE&U) for 11th Plan. 53 units (7318 MW) for LE works and 76 units (18965 MW) for R&M works were programmed for 11th Plan, out of which works relating to 18 units (1931 MW) for LE and 69 units (17435 MW) for R&M have been completed during 11th Plan. A Summary of Programme & tentative Achievement during 11th Plan is given in Table 1.21.

TABLE 1.21

LE/R&M Programme-Tentative Achievement during 11th Plan (2007 – 2012)

Sl No.	Particular	State Sector		Central Sector		Total (State sector + Central Sector)	
		No. of units	Capacity (MW)	No. of units	Capacity (MW)	No. of units	**Capacity (MW)**
1.	LE works (Programme)	33	4524	20	2794	53	**7318**
	(Tentative Achievement)	15	1664	3	267	18	**1931**
2.	R&M works (Programme)	27	6015	49	12950	76	**18965**
	(Tentative Achievement)	20	4485	49	12950	69	**17435**
	Total (Programme)	**60**	**10539**	**69**	**15744**	**129**	**26283**
	(Tentative Achievement)	**35**	**6149**	**52**	**13217**	**87**	**19366**

6.1.3. 12TH Plan Tentative Programme Including Units Slipping From LE/R&M

72 units (16532 MW) for LE work and 23 units (4971 MW) for R&M work have been programmed during 12TH Plan. In addition to this 33 units (5147 MW) from LE works & 7 Units (1530 MW) from R&M Works are Slipping from 11th Plan Target which would also be taken up during 12th Five Year Plan. Therefore Tentative programme for 12TH Five Year Plan is 105 units (21679.19 MW) from LE Works & 30 Units (6501 MW) from R&M Works aggregating to 135 units (28180.19 MW) would be taken up during 12th Five Year Plan. A Summary of R&M/LE programme for 12th Plan is given in Table below:

TABLE 1.22

R&M/ LE Programme of Thermal Units during 12th Plan (2012 – 2017) including Units Slipping From 11th Plan.

Sl No.	Particular	State Sector		Central Sector		Total (State sector + Central Sector)	
		No. of units	Capacity (MW)	No. of units	Capacity (MW)	No. of units	Capacity (MW)
1.	**LE works** (Programmed) (Slipping From 11th Plan) Sub-Total	30 16 46	5860 2620 8480	42 17 59	10672.19 2527 13199.19	72 33 105	**16532.19** **5147** **21679.19**
2.	**R&M works** (Programmed) (Slipping From 11th Plan) Sub-Total	03 07 10	630 1530 2160	20 - 20	4341 - 4341	23 07 30	**4971** **1530** **6501**
	Total (Programmed) (Slipping From 11th Plan)	**33** **23**	**6490** **4150**	**62** **17**	**15013.19** **2527**	**95** **40**	**21503.19** **6677**
	Grand Total Of LE/R&M	**56**	**10640**	**79**	**17540.19**	**135**	**28180.19**

The details of progamme of units taken up for LE/R&M during 12th Five Year Plan are given in **Appendix 1.10 & 1.11.** There are 66 units (13720 MW) of 200 / 210 MW LMZ design units installed in India which are potential candidates for Energy Efficient R&M.

6.1.4 Potential candidate units for LE and R&M works during 13th Plan (2017-2022)

The Summary of 13th Plan R&M/LE programme is given in Table below:

Table 1.23
13TH PLAN R&M/LE PROGRAMME (POTENTIAL CANDIDATE UNITS)

Name of the Programme	State Sector		Central Sector		Total identified units (State + Central Sector) during 13th Plan	
	No. of Units	Capacity (MW)	No. of Units	Capacity (MW)	No. of Units	Capacity (MW)
LE						
Coal	55	12130	16	3940	71	**16070**
Gas	6	672	5	765.71	11	**1438**
Sub Total	**61**	**12802**	**21**	**4706**	**82**	**17508**
R&M						
Coal	16	3560	6	2420	22	**5980**
Gas			6	1172	6	**1172**
Sub Total	**16**	**3560**	**12**	**3592**	**28**	**7152**
Grand Total	**77**	**16362**	**33**	**8298**	**110**	**24660**

It may be mentioned that all the 66 nos. 200/210 MW size LMZ units installed in the country would be covered for LE works starting from 11th Plan to 13th Plan.

6.2 R&M of Hydro Plants

The normal life expectancy of a hydroelectric power plant is 30 to 35 years after which it needs life extension. Many of the existing hydro power stations could be modernized to generate reliable and higher yield by minor modifications. By adopting modern equipment like static excitation, micro-processor based controls, electronic-micro processor based governors, high speed static/Numerical relays, data logger, optical instruments for monitoring vibrations, air gaps, silt content in water etc. availability of hydro power stations could be improved and outages minimized.

In situations like run-of-the river schemes in Himalayan and Sub-Himalayan region, excessive silt contained in the inflows causes enormous damage to the under water parts of turbines, requiring rehabilitation almost every year.

Upgrading / Uprating of hydro plants calls for a systematic approach in view of a number of influencing parameters pertaining to the prime mover besides its repercussions on the total hydro electric development which itself may be a sub system of an integrated power development. A number of hydraulic, mechanical, electrical and above all economic factors play a vital role in deciding the course of action and the modalities of an upgrading / uprating programme. Uprating of hydro power plant cannot thus be considered in isolation. It has to be strategically planned, may be in certain steps, keeping in view all the techno-economic considerations.

6.2.1 11TH Plan Review of Programme of R&M, Life Extension & Uprating – Hydro

A Summary of the projects planned, completed and on which work is ongoing in the 11th Plan is as furnished in **Table below:**

Table 1.24

SUMMARY OF R&M, LIFE EXTENSION & UPRATING PROGRAMME AND ACHIEVEMENTS FOR 11TH PLAN - HYDRO

Description	R&M	LE & Uprating
No. of Projects Covered	15	5
Capacity (MW)	4883.50	935.00
Estimated Cost (Rs. Crores)	512.87	
Expenditure incurred (Rs. Crores) till 31.03.2011	354.76	
Targeted Benefits (MW)	-	491
Actual Benefits achieved	-	380

6.2.2 Programme for 12th Plan – Hydro

A Summary of the 12th Plan programme for hydro R&M, Life Extension & Uprating Schemes and of the projects planned, completed and on which work is ongoing in the 12th Plan is as furnished in **Table below.**

Table 1.25
SUMMARY OF R&M AND LIFE EXTENSION PROGRAMME AND ACHIEVEMENTS FOR 12TH PLAN - HYDRO

Description	R&M	LE & Uprating
No. of projects Covered	5	**37**
Capacity (MW)	1390.00	**3858.80**
Estimated Cost (Rs. Crores)	**3887.55**	
Expenditure incurred (Rs. Crores) till 31.03.2011	**674.70**	
Targeted Benefits (MW)	-	**4063.45**
Actual Benefits achieved	**-**	**-**

Project-wise details of Hydro R&M, Life Extension & Uprating Schemes for completion during the 12th Plan are furnished in **Appendix 1.12.**

6.3 Energy Efficiency Improvement through Energy Audit

As per Energy Conservation Act 2001, Energy audit means the verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption. Also under the provision of Energy Conservation Act 2001, all designated consumers declared by the Government would have to undertake mandatory Energy Audit studies by accredited Energy Auditors.

Energy Audit studies aim at determining the present level of performance of main power plant equipment and selected sub-systems and comparing them with design parameters. Reasons for deterioration are analysed. Techno-economic viability of introducing new efficient technologies is also included in the energy audit studies. In fact the basic objective is to reduce the consumption of various inputs (coal, oil, power, water) per unit of power generation.

It is suggested that an “Energy Efficiency Cell” shall be created at all thermal power stations. This cell shall be responsible for the following:

1. Setting up of Internal Energy Audit groups in each power plant. Capacity building of the efficiency group must be done to enable them to carry out Energy Audit tests on their own.
2. Regular audits shall also be got conducted from accredited Energy Auditors.
3. All recommendations that emerge from these audits must be implemented if these are techno-economically feasible. Short term measures can be made part of the

annual plan/annual overhaul of the unit whereas long term measures can be taken up under the R&M schemes of these stations.

4. Energy Efficiency Awareness campaign shall be taken up among staff of the power plant.

6.3.1 Better O&M practices

Better O&M practice is also an effective tool to improve the performance of existing plants

7.0 NEW AND RENEWABLE ENERGY SOURCES

Generation of power from New and Renewable Energy Sources such as Wind, Small Hydro, Bio mass and Solar Energy is extremely vital in view of the fact that it is green power with minimum impact on the environment. Limited availability of fossil fuels like coal and gas & rising trend of cost & lower availability of indigenous conventional fuels, has further highlighted the importance of power from renewable energy sources. All efforts are therefore being made to tap these resources for generation of power to supplement power from Conventional Sources. Renewable sources of energy provide a particularly attractive solution for meeting requirement of power at remote locations, in case of which it is not feasible to extend the grid. The National Solar Mission is a major initiative of the Government of India and State Governments to promote ecologically sustainable growth while addressing India's energy security challenge. It will also constitute a major contribution by India to the global effort to meet the challenges of climate change.

The total estimated medium-term potential (2032) for power generation from renewable energy sources such as wind, small hydro, solar, waste to energy and biomass in the country is about 1,83,000 MW. The grid interactive installed capacity from renewable is likely to increase from about 3,500 MW at end of 9th Plan, 10,258 MW at the end of 10th Plan to 22,600 MW at the end of 11th Plan. The grid interactive Installed Capacity as on 31.03.2011 is **19,975 MW**.

Table 1.26

CUMULATIVE POTENTIAL AND ACHIEVEMENTS FOR GRID INTERACTIVE RENEWABLE POWER AS ON 31.03.2011

(Figures in MW)

Sources / Systems	Estimated mid-Term (2032) Potential	Cumulative Installed Capacity (As on 31.03.2011)
Wind Power	45,000	14,157
Bio- Power(Agro residues & Plantations)	61,000	2,737*
Co-generation Baggasse	5,000	-
Small Hydro (up to 25 MW)	15,000	3,043
Waste to Energy	7,000	-
Solar Photovoltaic	50,000	38
TOTAL	1,83,000	19,975

***** *Includes Biomass power, bagasse cogeneration, urban and industrial waste to energy.* ***Source MNRE***

7.1 Review of Eleventh Plan – Target and Achievement

A target of 12,230 MW was set by MNRE for the 11th Plan in respect of grid interactive renewable power against which an achievement of 9,717 MW has been made during the 1st four years of the 11th Plan and balance capacity is expected to realize during terminal year of the plan i.e 2011-12.

TWELFTH PLAN PROGRAMME

Details of 12th Plan Programme of Grid Interactive renewable power as considered in the Generation Planning studies are furnished in Table below:

Table 1.27

12TH PLAN TENTATIVE PROGRAMME FOR GRID INTERACTIVE RENEWABLE POWER

(Figures in MW)

Sources / Systems	Programme for 12th plan
Wind Power	11,000
Biomass Power, Baggasse Co-generation, Biomass Gasifiers	2,100
Small Hydro (up to 25 MW)	1,600
Solar Power	3800
TOTAL	**18,500**

THIRTEEN PLAN PROGRAMME

Details of 13th Plan programme of Grid Interactive renewable power as considered in the Generation Planning studies are furnished in Table below:

Table 1.28

13TH PLAN TENTATIVE PROGRAMME FOR GRID INTERACTIVE RENEWABLE POWER

(Figures in MW)

Sources / Systems	Programme for 13th plan
Wind Power	11,000
Biomass Power, Baggasse Co-generation, Biomass Gasifiers	2,000
Small Hydro (up to 25 MW)	1,500
Solar Power	16,000
TOTAL	**30,500**

SUMMARY OF INSTALLED CAPACITY FROM RENEWABLE ENERGY SOURCES (likely by the end of 12th Plan)

Considering the 11th Plan and tentative 12th Plan capacity addition as detailed above, Summary of Installed Capacity is furnished below**:**

Installed capacity by the end of 10th Plan (As on 31.3.2007)	10,258 MW
Installed capacity by the end of 2010-11 (As on 31.3.2011)	19,975 MW
Programme for 2011-12	2,513 MW
12th Plan programme for 2012-17	18,500 MW
Total Installed Capacity by the end of 12th plan	40,988 MW
Say	**41,000 MW**

Extension programmes of the MNRE are largely implemented through the State Renewable Energy Development Agencies. These agencies, in turn, mobilize participation of the State level machinery, local institutions, Non- Governmental Organizations (NGOs) and village level organizations for implementation of these programmes. MNRE has set up a Solar Energy Centre near Delhi with the state-of-art facilities for testing of solar thermal and solar photovoltaic materials, devices and systems which will soon become an apex Centre of Excellence. A Centre for Wind Energy Technology has been set up in Chennai for providing technical support to the Ministry in the implementation of its wind energy programmes. Research and Development programmes are sponsored in research institutions, national laboratories and in industries, both public and private sectors. For market development and financing of renewable energy projects, a separate financing institution called the Indian Renewable Energy Development Agency (IREDA) has been set up as a public sector undertaking.

8.0 REQUIREMENT OF PEAKING POWER AND RESERVE PLANTS

The generation system must be designed to meet the base-load as well as the peak load of the power system with the characteristics to respond dynamically or efficiently to the variation in demand within a short time. Apart from variation in demand, there is expected to be wide variation in generation as well, when the installed base of renewable energy plants increases as a result of pressure on DISCOMs to source their requirement from renewable energy sources (to meet Renewable Purchase Obligation- RPO). Since system stability requires matching of generation with the demand at all instances of time, a certain degree of flexibility and ability of the generators to respond rapidly to the changing demand/availability for renewable energy sources must be introduced into the system through appropriate generation plants.

It is expected that although in next 5 yrs or so our country may become base load power surplus but peak power deficits will still prevail. In this scenario necessary measures for improving the peaking power requirements of our system need to be taken to ensure desired and targeted benefits to the economy.

Since our system has vide variations in demand during peak and off peak period due to our typical load duration curve, there is need for peaking support with very high ramping rate. Peaking power can ideally be provided by pondage / reservoir based hydro plants. However, hydro capacity alone may not be able to meet the peaking demand. Fast response during peak hours could be provided by other suitable generation options such as the gas based generation, in particular engine based technology, because of excellent peaking support capability.

8.1 Requirement of Reserve Plants

The Optimal power system should have adequate reserves in order to meet the contingency of outage of certain operating generation capacity.

System reserves can be classified into:

i) Primary Control Reserves or Frequency Control Reserves
ii) Secondary Reserves or Spinning and Non-spinning Reserves
iii) Tertiary Reserves or Replacement Reserves

The deployment of the primary control reserves is from 0 to 30 seconds. The primary frequency control systems are activated if the frequency deviation is more than the dead band of the controller. Half of the primary control reserves should be in operation in 15 seconds, and all reserves should be in full power in 30 seconds. In the Indian context, frequency reserves can be built, in such a way that at least half of these reserves are in operation within a time span of 15 seconds and remaining reserves are put in service within 30 seconds. In addition to the standard frequency control reserves, Secondary Reserves are also to be created. The reserves should be activated within a period of 30 seconds and should give full output within the next 15 minutes, with a view to release the primary control reserves. In addition, the system should have tertiary reserves also which can take over from the secondary reserves within fifteen minutes of the disturbance and release these secondary reserves. These are generally non spinning reserves which can be brought into service at very short notice.

8.2 Option for Peaking Power Generation

The peaking power demand could be supplemented by storage type hydro generating station including pumped storage schemes, open cycle gas turbine station, and gas based reciprocating engines. Peaking plants shall be environmentally-friendly and must comply with emission norms, so as to be located close to load centres. They must be able to start up (and stop) instantaneously and ramp up quickly, and in required steps, to match the spike in load. Their efficiency curve must be high and flat at different plant loads. They must be 'all-season' plants and use a fuel which is available throughout the year.

8.3 Peaking Tariff

Operation of Combined Cycle Plants in peaking mode as suggested above and Open Cycle Plants for peaking may result in higher heat rate and O&M costs (on account of higher repair and maintenance cost) for which the power plant will have to be compensated. Therefore, it is apparent that peaking power would be costlier as compared to off peak power. The notification for separate tariff for peak and off peak power would address this issue as well as help in flattening of Load Duration Curve and ultimately it would result in lesser capacity addition to meet the same power demand in the country.

Further, the Working Group recommends planning for at least 2000 MW gas based peaking power plants during 12th Plan, 400 MW each in five major metro cities of India with proper regulatory support. The experience gained from operation of these peaking plants would pave the way for creation of additional peaking plants in other major cities and higher capacity in future plans. There is need to take measures like having separate tariff for peak and off peak power and regulations to enable fixed cost of peaking plants to be fully recovered during peak hour operation etc. to promote peaking plants. In case of future projects gas should be allocated to power plants meant for meeting peak and intermediate load, with proper regulatory supports so that these power plants could recover their cost.

Working Group also recommends for setting up Task Force under CERC to deliberate upon the various aspects associated with setting up of peaking plants and creation of adequate system reserve. Further, the subject of Ancillary Services has already been covered in Chapter 4 of the Report and recommended suitably.

Combined Heating and Cooling (CHP) plants which have a high efficiency must be promoted. Gas allocation to such plants preferably located in urban areas should be on priority.

9.0 TECHNOLOGICAL DEVELOPMENT, ENVIRONMENTAL ASPECTS, POLLUTION AND ASH DISPOSAL, R&R ISSUES OF HYDRO PROJECTS

Technology development plays an important role in the evolution of the power sector. Improved technology implies increased efficiency, lesser consumption of fuel and ensures reasonable cost of power to all with high reliability. With increasing development leading to high pollution, environmental aspects are also of major concern sustainable development implies development while at the same time conserving the environment for future generations.

9.1 Technology Development in Thermal Power Generation

The present technologies used for thermal power generation are latest and mature technologies duly adapted for Indian conditions. As such no major technology gaps are foreseen during the next plan period. Thus fuel consumption and environmental emissions would invite greater attention. The advanced technologies now commercially available can be broadly categorized as follows:

For Efficiency Improvement

1 Supercritical and Ultra supercritical Technology
2 Advanced Gas Turbines

Policy Initiatives Required for Super Critical Technologies

Supercritical technology has already been introduced in the country and large numbers of supercritical units are under construction. The following policy options could be considered for making supercritical units mandatory beyond 12th Plan :

i. Issue of advisory by MoP/CEA for the utilities to install supercritical units only.

ii. Suitable provisions to install supercritical units in the coal allocation policy for coal linkages of 13th Plan projects.

iii. Suitable provision in the CEA Regulations on Technical Standards for Construction of Electric Plants And Electric Lines 2010 making supercritical units mandatory.

Provisions mandating supercritical technology in the coal allocation policy may still lead to installation of sub-critical units for the stations based on imported coal. Also, the CEA Regulations for construction of Electric Lines and Electric plants are presently applicable to all unit sizes and accordingly provide minimum efficiency criteria for units of various sizes. Thus, mandating supercritical technology through this route may require amendments to these Regulations and vetting by Ministry of Law.

Concerning Environmental considerations

1. Flue Gas Desulphurisation System
2. No_x control
3. Fluidized Bed Combustion (FBC)
4. Use of washed coal

Combined Efficiency Improvement and Environmental Aspects

1 Integrated Gasification Combined Cycle (IGCC)
2 Pressurized Fluidized Bed Combustion System (PFBC)

9.2 Technology for Hydro Power Generation

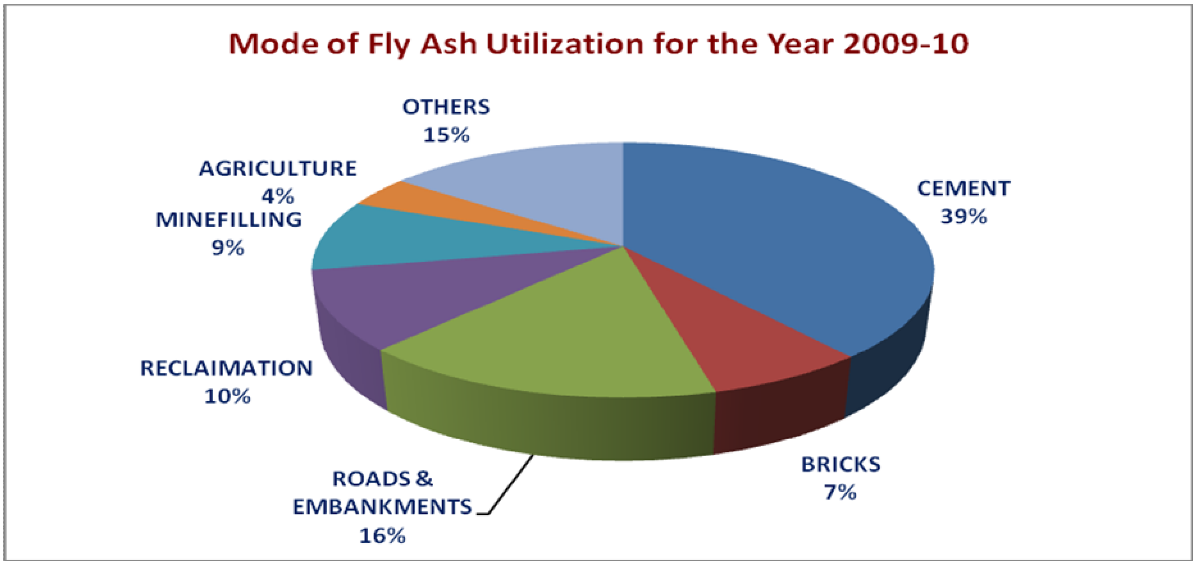
On a global base there have been a lot of technical developments for hydropower plants, these developments along with the site specific developments made to suit Indian conditions are fully incorporated in upcoming hydro power plants. With these developments increases in efficiency, output and performance have been achieved. R&D has also contributed breakthroughs in the fields of greaseless turbine components, generator components, variable speed technologies and double-stage adjustable Pump turbines.

9.3 Pollution and Ash Utilization

Central Electricity Authority is monitoring the ash generation at coal/lignite based thermal power stations and its utilization. The data on annual basis is obtained from thermal power stations to serve as a basic data for driving various outputs that are required from time to time. The power stations are also submitting annual compilation report to MoEF.

As per data available in CEA, the ash utilization has increased from 9.63% in 1996-97 to 62.60% in 2009-10. The quantity wise ash utilization was 6.64 mtpa (million tones per annum) during the year 1996-97 against the generation of 86.95 mtpa. The ash utilization during the year 2009-10 has gone up to 77.34 mtpa against the ash generation of 123.54 mtpa. There are 21 thermal power stations in the country which have achieved 100% or more ash utilization during 2009-10.

The pie chart showing the mode of fly ash utilization during the year 2009-10 is given below:-



It is seen from above utilization pattern that about 45% of fly ash is being utilized as a raw material in the manufacturing of pozzolana cement, bricks, blocks and pavement tiles etc.

It is estimated that by the end of 11th Plan i.e. in 2011-12, the ash generation by coal/lignite based thermal power stations would increase to 160 million ton per year and by the end of 12th Plan i.e. 2016-17, the quantity of ash generation is estimated to reach 300 million tones per year

The need to increase ash utilization and various measures required to achieve this objective has been deliberated at various different forum and at all levels, the Central, States Governments, power utilities, thermal power plants and all concerned users group agencies etc. All power utilities and thermal power plants are to plan & implement ash utilization targets keeping in view long term strategies on sustainable basis. The ash utilization is a priority.

10.0 CONCLUSION AND RECOMMENDATIONS

The Group deliberated upon various aspects of “Demand Projections and Generation Planning”. Major Conclusions and Recommendations made by Working Group are summarized as below:

(i) The Mid Term Appraisal target for 11th Plan is 62,374 MW. Against this, the likely capacity addition during the 11th Plan is about 52,000 MW. The historic achievement of capacity addition during 11th Plan viz-a viz the 10th Plan is noteworthy. It has been estimated that the likely capacity addition during the 11th Plan shall be about two and a half times the capacity addition during the 10th Plan. The reasons for slippages of projects from the 11th Plan target were also analysed, in order to avoid such slippages while planning for capacity addition during 12th Plan. Working Group recommends that to meet the demand projections for the 12th Plan only those projects should be considered where all clearances have been obtained, fuel linkages tied up and the project is under construction. Also while setting the 12th Plan target, adequate availability of coal must be ensured.

(ii) The likely demand by the end of 12th & 13th Plan has been worked out considering various scenarios and also considering reduction in demand due to DSM and Energy Efficiency and various measures being taken by BEE. The demand to be adopted by 12th and 13th Plan end for the purpose of Generation Planning Exercise is as following:

Table 1.29
DEMAND ADOPTED FOR GENERATION PLANNING STUDIES

	Energy Requirement (BU)	**Peak Load (MW)**
	9% GDP GR **0.9/ 0.8 Elasticity in 12th / 13th Plan**	9% GDP GR **0.9/ 0.8 Elasticity in 12th / 13th Plan**
2016-17 (12TH Plan end)	1403	197686
2021-22 (13th Plan end)	1992	289667

(iii) The likely effect of BEE’s various programmes of Energy Efficiency & DSM have been considered to effect a reduction in Peak Demand of about 12,000 MW in 2016-17 and peak reduction of 15,000 MW in 2021-22.

(iv) The requirement of generation capacity addition during 12th and 13th Plan has been worked out based on projected demand indicated above. Accordingly, Working Group recommends following capacity addition for 12th and 13th Plan.

Table 1.30

CAPACITY ADDITION REQUIREMENT DURING 12th PLAN

(Figures in MW)

Type of Capacity	Capacity Addition (As per Demand corresponding to 9% GDP GR & 0.9 Elasticity)
Thermal	63,781
Coal	62,695
Gas	1,086
Hydro	9,204
Nuclear	2,800
Total	75,785

(v) The capacity addition requirement during 12th Plan is based on the capacity addition target of 62,374 MW during 11th Plan as per MTA. About 12,977 MW capacity is likely to slip from 62,374 MW to 12th Plan. The estimated requirement of funds during 12th Plan works out to about Rs. 6,38,600 Crore for the Generation projects (including Rs. 2,72,582 Cr for advance action for 13th Plan projects).

(vi) In addition, based on inputs received from MNRE, grid interactive renewable capacity addition of about 18,500 MW has been considered for planning studies during 12th Plan comprising of 11,000 MW wind, 1,600 MW small hydro, 2,100 MW Biomass power, Bagasse Cogen and waste to energy put together and 3,800 MW Solar.

(vii) The capacity addition requirement during 13th Plan is as follows:

Table 1.31

CAPACITY ADDITION REQUIREMENT DURING 13th PLAN

(Figures in MW)

Type of Capacity	Capacity Addition (As per Demand corresponding to 9% GDP GR & 0.8 Elasticity)
Thermal	63,400
Hydro	12,000
Nuclear	18,000
Total	93,400

(viii) In addition, MNRE has projected a grid interactive renewable capacity addition of about 30,500 MW during 13th Plan, comprising of 11,000 MW Wind, 1,500 MW from Small Hydro, 2,000 MW Biomass power, Bagasse Cogen and waste to energy put together and 16,000 MW Solar.

(ix) Based on above capacity addition, there may not be power shortage in the country by the end of 12th Plan on an All-India basis; however, individual states may have power shortage. To address this problem, States/UTs must estimate their power requirement and availability of power from different sources/states and must tie up power requirement, if any, so that they do not face shortages.

(x) Availability of coal for the coal based thermal power stations is a matter of serious concern As per the projected requirement and availability of coal, there will be shortage of coal for coal based power plants which will have to be met through import. In order to bridge the above gap between demand and coal availability, Power Utilities are expected to import around 159 MT to meet shortage in coal supply from CIL. However, such a huge quantity of imported coal for blending may not be feasible as in the existing boilers maximum 15% of blending of imported coal is possible. This quantity of imported coal would be in addition to 54 MT coal likely to be imported by Thermal Power Stations designed on imported coal. Therefore, the total quantity of coal required to be imported is about 213 MT.

(xi) MOC/ CIL needs to be impressed upon to formulate a contingency plan to meet the coal demand of the power sector. After assessing the potential of existing coal blocks, sanctioning of additional coal blocks from MoE&F needs to be expedited by the Government.

(xii) Captive Blocks allocated to various utilities may be advised to enhance their production through some incentive oriented strategy and surplus production after meeting their coal requirement may be supplied to power station.

(xiii) Availability of gas for power generation is a big issue which needs to be addressed due to reduced availability of gas from KG D6 field and also from APM sources, existing power plants in the country are operating at low PLF. In addition, gas is yet to be allocated for power plants under construction for commissioning during 11th Plan. Further, gas power projects of about 13,000 MW capacity are under construction at various stages and this capacity may materialize during 11th Plan/12th Plan, if gas is made available.

(xiv) The Working Group opines that if gas availability to projects already under construction is not ensured, it may become stranded assets and should be avoided. Some concrete policy decision towards increasing the gas availability to power plants either by increasing the production of domestic gas or increasing the share of RLNG by pooling with domestic gas is required.

(xv) To pursue with Energy Departments of all the States to identify the surplus capacity available from the captive power plants and approach State Utilities/Discoms to buy the surplus power available from the captive power plants.

(xvi) The Group recommends that R&M schemes shall be continued during 11th and 12th Plan also. However it must be ensured that routine maintenance activities are not included in these schemes. Only activities which aim at increasing the efficiency of the unit or improve the availability or are required to meet environmental norms or are aimed at renovating obsolete equipment- Controls and Instrumentation are included in R & M schemes. Further for Life Extension schemes, a cost benefit analysis should be carried out vis-à-vis installation of new unit at the same site. The Group also recommends that the AGS&P Scheme shall continue.

(xvii) The programme for capacity addition from Renewable Energy Sources during the 12th & 13th Plan has been included as per information furnished by MNRE. The Group recommends that all efforts shall be made towards implementation of this Programme. However, the detailed programme and fund requirement are expected to be finalized by the Working group for 12th Plan for Non- Conventional Energy Sources

(xviii) The Working Group recommends setting up of a Task Force under CERC to deliberate upon the various aspects associated with setting up of peaking plants and creation of adequate system reserves. The Task Force shall comprehensively address all the issues involved to facilitate a feasible and viable scenario for creation and operation of generation reserves and peaking plants in the system.

(xix) The Group recommends planning for at least 2,000 MW gas based peaking power plants during 12th Plan, 400 MW each in five major metro cities of India with proper regulatory support. The experience gained from operation of these peaking plants would pave the way for creation of additional peaking plants in other major cities and higher capacity in future plans. Further, Group recommends that in view of limited availability of gas in the country, in case of future projects gas should be allocated to power plants meant for meeting peak and intermediate load, with proper regulatory supports so that these power plants could recover their cost.

(xx) Combined Heating and Cooling (CHP) plants which have a high efficiency must be promoted. Gas allocation to such plants preferably located in urban areas should be on priority.

(xxi) In view of successful operation of Super Critical units in developed countries and commissioning of few units based on super critical technology in the country, it is felt that Super Critical units of 660 MW (steam parameters of 247 kg/cm^2 and 535/565 ^{O}) and 800 MW (Temp 565/593 ^{O}) need to be promoted aggressively.

(xxii) Supercritical technology has already been introduced in the country and large numbers of supercritical units are under construction. The following policy options could be considered for making supercritical units mandatory beyond 12th Plan :

1. Issue of advisory by MoP/CEA for the utilities to install supercritical units only.
2. Suitable provisions to install supercritical units in the coal allocation policy for coal linkages of 13th Plan projects.
3. Suitable provision in the CEA Regulations on Technical Standards for Construction of Electric Plants And Electric Lines 2010 making supercritical units mandatory.

(xxiii) Working Group recommends that all project developers should meet the stringent requirement of environmental norms for setting up thermal power plants to minimize the air and water pollutions.

(xxiv) There is a greater stress on utilization of ash being generated in coal/lignite based Thermal Power Stations and MOEF has issued various notifications for achieving 100% utilization of fly ash within a prescribed time frame. With greater utilization of fly ash, the quantity of ash which has to be disposed off in ash ponds has reduced significantly and it has helped in addressing the problem of air pollution to some extent. The Working Group recommends that all utilities should make all out efforts to increase percentage utilization of ash generated by their plants to meet the environmental requirement.

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Appendix –1.1

SUMMARY STATEMENT OF ORIGINAL TARGET DURING THE 11TH PLAN (REGION WISE, SECTOR WISE AND TYPE WISE)

(Figures in MW)

Sl. No.	REGION	Hydro	Thermal				Nuclear	Grand Total
			Coal	Lignite	Gas	Total		
1	NORTHERN	7488	9825	1455	1720	13000	440	20928
2	WESTERN	1170	16550	325	3335	20210	0	21380
3	SOUTHERN	1094	9385	500	1001	10886	2940	14920
4	EASTERN	3151	14060	0	0	14060	0	17211
5	NORTH EASTERN	2724	750	0	787	1537	0	4261
	TOTAL (ALL INDIA)	**15627**	**50570**	**2280**	**6843**	**59693**	**3380**	**78700**

Sl. No.	SECTOR	Hydro	Thermal				Nuclear	Grand Total
			Coal	Lignite	Gas	Total		
a	CENTRAL	8654	22600	750	1490	24840	3380	36874
b	STATE	3482	19535	450	3316	23301	0	26783
c	PRIVATE	3491	8435	1080	2037	11552	0	15043
	TOTAL (ALL INDIA)	**15627**	**50570**	**2280**	**6843**	**59693**	**3380**	**78700**

Appendix –1.2

SUMMARY STATEMENT OF MID TERM APPRAISAL TARGET AND LIKELY CAPACITY ADDITION DURING THE 11TH PLAN (SECTOR WISE AND TYPE WISE)

(Figs in MW)

	HYDRO	TOTAL THERMAL	THERMAL BREAKUP			NUCLEAR	TOTAL
			Coal	Lignite	Gas/ LNG		
CENTRAL SECTOR	**2922**	**14920**	13430	750	740	**3380**	**21222**
STATE SECTOR	**2854**	**18501**	14735	450	3316	**0**	**21355**
PRIVATE SECTOR	**2461**	**17336**	13725	1080	2531	**0**	**19797**
ALL-INDIA	**8237**	**50757**	41890	2280	6587	**3380**	**62374**

SUMMARY OF LIKELY CAPACITY ADDITION DURING 11TH PLAN

	Hydro	Thermal				Nuclear	Total
		Lignite	Gas	Coal	Total		
CENTRAL SECTOR	2005	500	740	10050	11290	2880	16175
STATE SECTOR	2744	450	2098	11945	14493	0	17237
PRIVATE SECTOR	1362	405	2494	14390	17289	0	18651
ALL-INDIA	**6111**	1355	5332	36385	**43072**	**2880**	**52063**

Appendix-1.3

LIST OF PROJECTS COMMISSIONED/ BEING MONITORED FOR LIKELY BENEFITS DURING 11TH PLAN

Sl.No.	Plant Name	State	Agency	Status	Fuel Type	Capacity (MW)	Capacity as per 78,700 MW	Capacity as per 62,374 MW	Capacity as per 52,063 MW
	CENTRAL SECTOR								
1	Chandrapura U-7,8	Jharknd	DVC	Comnd	Coal	500	500	500	500
2	Mejia U-6	WB	DVC	Comnd	Coal	250	250	250	250
3	Mejia Ph II U7,8	WB	DVC	Comnd	Coal	1000	1000	1000	1000
4	Kodarma U1	Jharknd	DVC	Comnd	Coal	500	500	500	500
5	Kodarma U2	Jharknd	DVC	UC	Coal	500	500	500	
6	Durgapur Steel U1	WB	DVC	Comnd	Coal	500	500	500	500
7	Durgapur Steel U2	WB	DVC	UC	Coal	500	500	500	
8	Raghunathpur Ph-I U1,2	WB	DVC	UC	Coal	1200	1200	1200	
9	Bokaro Expansion	Jharknd	DVC	UC	Coal	500	500		
10	Maithan RBC JV U1*	Jharknd	IPP	Comnd	Coal	525	525	0	0
11	Maithan RBC JV U2*	Jharknd	IPP	UC	Coal	525	525	0	0
12	Kameng HEP	Ar.Pr	NEEPCO	UC	Hydro	600	600		
13	Omkareshwar HEP	MP	NHDC	Comnd	Hydro	520	520	520	520
14	Teesta V U 1,2,3 HEP	Sikkim	NHPC	Comnd	Hydro	510	510	510	510
15	Sewa-II U1,3,2 HEP	J&K	NHPC	Comnd	Hydro	120	120	120	120
16	Chamera-III HEP	HP	NHPC	UC	Hydro	231	231	231	231
17	Parbati - II HEP	HP	NHPC	UC	Hydro	800	800		
18	Parbati - III HEP	HP	NHPC	UC	Hydro	520	520	520	
19	Uri-II HEP	J&K	NHPC	UC	Hydro	240	240	240	180
20	Nimoo Bazgo HEP	J&K	NHPC	UC	Hydro	45	45	45	
21	Chutak HEP	J&K	NHPC	UC	Hydro	44	44	44	44
22	Teesta Low Dam-III HEP	WB	NHPC	UC	Hydro	132	132	132	
23	Teesta Low Dam-IV HEP	WB	NHPC	UC	Hydro	160	160	160	
24	Subansiri Lower HEP	Ar.Pr	NHPC	UC	Hydro	2000	2000		
25	Barsingsar Lig U1,2	Rajas	NLC	Comnd	Lignite	250	250	250	250
26	Neyveli - II Lig	TN	NLC	UC	Lignite	500	500	500	250
27	Tuticorin JV	TN	NLC	UC	Coal	1000	1000		
28	Kaiga U-3,4	Karntk	NPC	Comnd	Nuclear	440	440	440	440
29	RAPP U-5,6	Rajas	NPC	Comnd	Nuclear	440	440	440	440
30	Kudankulam U 1,2	TN	NPC	UC	Nuclear	2000	2000	2000	2000
31	PFBR(Kalapakkam)	TN	NPC	UC	Nuclear	500	500	500	
32	Ratnagiri (Dhabol) JV	Maha	NTPC	Comnd	Gas/LNG	740	740	740	740
33	Sipat-II U4,5	Chattis	NTPC	Comnd	Coal	1000	1000	1000	1000
34	Sipat-I U1	Chattis	NTPC	Comnd	Coal	660	660		660
35	Sipat I U2-3	Chattis	NTPC	UC	Coal	1320	1320		660
36	Bhilai JV U 1,2	Chattis	NTPC	Comnd	Coal	500	500	500	500
37	Korba III U-7	Chattis	NTPC	Comnd	Coal	500	500	500	500
38	Kahalgaon II U6,7	Bihar	NTPC	Comnd	Coal	1000	1000	1000	1000
39	Dadri Ext U-5,6	Up	NTPC	Comnd	Coal	980	980	980	980
40	Indira Gandhi TPP (Jhajjar) JV U1	Haryana	NTPC	Comnd	Coal	500	500	500	500
41	Indira Gandhi TPP (Jhajjar) JV U2,3	Haryana	NTPC	UC	Coal	1000	1000	1000	500
42	Farakka Stage-III U6	WB	NTPC	Comnd	Coal	500	500	500	500
43	Simhadri-Ext U-3	AP	NTPC	Comnd	Coal	500	500	500	500
44	Simhadri-Ext U-4	AP	NTPC	UC	Coal	500	500	500	
45	Bongaigaon TPP U 1-3	Assam	NTPC	UC	Coal	750	750	500	
46	Lohari Nagpala HEP	Ut.Khand	NTPC	UC	Hydro	600	600		
47	Tapovan Vishnugarh HEP	Ut.Khand		UC	Hydro	520	520		

Sl.No.	Plant Name	State	Agency	Status	Fuel Type	Capacity (MW)	Capacity as per 78,700 MW	Capacity as per 62,374 MW	Capacity as per 52,063 MW
48	Koldam HEP	HP		UC	Hydro	800	800		
49	Mauda TPP U1,2	Maha		UC	Coal	1000	1000		
50	Barh I U 1,2,3	Bihar		UC	Coal	1980	1980		
51	Barh II U1	Bihar		UC	Coal	660	660		
52	Nabinagar JV U-1,2,3	Bihar		UC	Coal	750	750		
53	Vallur (Ennore) JV U1,2	TN		UC	Coal	1000	1000	1000	
54	Tripura Gas ILFS JV	Tripura		UC	Gas/LNG	726	750		
55	Rampur HEP	HP		UC	Hydro	412	412		
56	Koteshwar U 1,2 HEP	Ut.Khand		Comnd	Hydro	200	200	200	200
57	Koteshwar U3-4 HEP	Ut.Khand		UC	Hydro	200	200	200	200
	Sub Total (Central Sector)						**36874**	**21222**	**16175**
	State Sector								
1	Jurala Priya U 1-6	AP		Comnd	Hydro	234	234	234	234
2	Rayalseema U4,5	AP		Comnd	Coal	420	420	420	420
3	Vijaywada TPP St-IV, U1	AP		Comnd	Coal	500	500	500	500
4	Kakatiya TPP	AP		Comnd	Coal	500	500	500	500
5	Kothagudem St-VI	AP		Comnd	Coal	500	500	500	500
6	Nagarjuna Sagar TR	AP		UC	Hydro	50	50	50	
7	Lower Jurala U1-6 HEP	AP		UC	Hydro	240	240		
8	Pulichintala HEP	AP		UC	Hydro	120	120		
9	Kakatiya Ext U1	AP		UC	Coal	500	500		
10	Lakwa Wh	Assam		UC	Gas/LNG	37.2	37.2	37.2	
11	Korba East Ext U2	Chattis		Comnd	Coal	250	250	250	250
12	Marwah TPP U 1,2	Chattis		UC	Coal	1000	1000		
13	Korba West Ext PH III	Chattis		UC	Coal	500	500		
14	Pragati-III (Bawana) GT-1,2	Delhi		Comnd	Gas/LNG	500	500	500	500
15	Pragati-III (Bawana) GT-3,4 & St-1,2	Delhi		UC	Gas/LNG	1000	1000	1000	500
16	Kutch Lign TPS	Gujarat		Comnd	Lignite	75	75	75	75
17	Dhuvran St	Gujarat		Comnd	Gas/LNG	40	40	40	40
18	Utran CCPP-GT+ST	Gujarat		Comnd	Gas/LNG	374	374	374	374
19	Surat Lignite Ext U3,4	Gujarat		Comnd	Lignite	250	250	250	250
20	Ukai Ext U6	Gujarat		UC	Coal	490	490	490	
21	GSEG Hazira Ext	Gujarat		UC	Gas/LNG	351	351	351	351
22	Pipavav JV Ccgt	Gujarat		UC	Gas/LNG	702	702	702	
23	Sikka TPP Ext	Gujarat		UC	Coal	500	500		
24	Yamuna Nagar U1,2	Haryana		Comnd	Coal	600	600	600	600
25	Rajiv Gandhi TPS (Hissar) U1,2	Haryana		Comnd	Coal	1200	1200	1200	1200
26	Uhl - III HEP	HP	HPJVVNL	UC	Hydro	100	100		
27	Sawara Kuddu HEP	HP	PVC	UC	Hydro	110	110		
28	Baglihar-I U1,2,3 HEP	J&K	JKPDC	Comnd	Hydro	450	450	450	450
29	Varahi Ext U1,2 HEP	Karntk	KPCL	Comnd	Hydro	230	230	230	230
30	Bellary TPP U 1	Karntk	KPCL	Comnd	Coal	500	500	500	500
31	Bellary TPP U 2	Karntk	KPCL	UC	Coal	500	500	500	500
32	Raichur U 8	Karntk	KPCL	Comnd	Coal	250	250	250	250
33	Kutiyadi Ext U1,2 HEP	Kerala	KSEB	Comnd	Hydro	100	100	100	100
34	Pallivasal HEP	Kerala	KSEB	UC	Hydro	60	60		
35	Ghatghar Pss U1,2	Maha	GOMID	Comnd	Hydro	250	250	250	250
36	Paras Ext U1,2	Maha	MSPGCL	Comnd	Coal	500	500	500	500
37	New Parli Ext U-2	Maha	MSPGCL	Comnd	Coal	250	250	250	250
38	Khaper Kheda Ext	Maha	MSPGCL	Comnd	Coal	500	500	500	500
39	Bhusawal TPP U4,5	Maha	MSPGCL	UC	Coal	1000	1000	1000	1000
40	Myntdu St-I HEP	Meghal	MESEB	UC	Hydro	84	84	84	84
41	Myntdu St-I Addl Unit	Meghal	MESEB	UC	Hydro	42		42	42
42	New Umtru HEP	Meghal	MESEB	UC	Hydro	40	40		
43	Birsinghpur Ext	MP	MPPGCL	Comnd	Coal	500	500	500	500

Sl.No.	Plant Name	State	Agency	Status	Fuel Type	Capacity (MW)	Capacity as per 78,700 MW	Capacity as per 62,374 MW	Capacity as per 52,063 MW
44	Amarkantak U-5	MP	MPGENCO	Comnd	Coal	210	210	210	210
45	Malwa TPP U1,2	MP	MPGENCO	UC	Coal	1000	1000		
46	Satpura Ext U-1,2	MP	MPPGCL	UC	Coal	500	500		
47	Balimela HEP St-II U7,8	Orissa	OHPC	Comnd	Hydro	150	150	150	150
48	GhTPP-II U-3,4	Punjab	PSEB	Comnd	Coal	500	500	500	500
49	Giral Lignite U-2	Rajas	RRVUNL	Comnd	Lignite	125	125	125	125
50	Chhabra TPS U-1,2	Rajas	RRVUNL	Comnd	Coal	500	500	500	500
51	Kota TPP U7	Rajas	RRVUNL	Comnd	Coal	195	195	195	195
52	Suratgarh Ext U6	Rajas	RRVUNL	Comnd	Coal	250	250	250	250
53	Dholpur GT2+ST	Rajas	RRVUNL	Comnd	Gas/LNG	220	220	220	220
54	Kalisindh TPS U1	Rajas	RRVUNL	UC	Coal	600	500		
55	Valuthur Ext	TN	TNEB	Comnd	Gas/LNG	92.2	92.2	92.2	92.2
56	Bhawani Barrage II & III	TN	TNEB	UC	Hydro	60	60	60	
57	Mettur Ext U1	TN	TNEB	UC	Coal	600	500	600	
58	North Chennai Ext U1,2	TN	TNEB	UC	Coal	1200	600	1200	
59	Baramura Gt	Tri		Comnd	Gas/LNG	21			21
60	Maneri Bhali HEP	Ut.Khand	UJVNL	Comnd	Hydro	304	304	304	304
61	Parichha Ext U-5,6	Up	UPRVUNL	UC	Coal	500	500	500	
62	Harduaganj Ext U-8	Up	UPRVUNL	Comnd	Coal	250	250	250	250
63	Harduaganj Ext U-9	Up	UPRVUNL	UC	Coal	250	250	250	250
64	Anpara-D U1,2	Up	UPRVUNL	UC	Coal	1000	1000		
65	Purlia Pss	WB	WBSEB	Comnd	Hydro	900	900	900	900
66	Sagardighi U 1,2	WB	WBPDCL	Comnd	Coal	600	600	600	600
67	Santaldih U5	WB	WBPDCL	Comnd	Coal	250	250	250	250
68	Santaldih Ext-U 6	WB	WBPDCL	Comnd	Coal	250	250	250	250
69	Bakreshwar U 4,5	WB	WBPDCL	Comnd	Coal	420	420	420	420
70	Durgapur Ext U 7	WB	DPL	Comnd	Coal	300	300	300	300
	Sub Total (State Sector)						**26783**	**21355**	**17237**
	Private Sector								
1	Konaseema Gt+St	AP	Konaseema Power	Comnd	Gas/LNG	445	445	445	445
2	Gautami	AP	Gautami Power	Comnd	Gas/LNG	464	464	464	464
3	Kondapalli CCPP Ph-II Gt+St	AP	LANCO	Comnd	Gas/LNG	366		366	366
4	Raigarh TPP Ph-I, U-1, 2; Ph II U 3,4	Chattis	Jindal Power	Comnd	Coal	1000	1000	1000	1000
5	Lanco Amarkantak U1,2	Chattis	LANCO	Comnd	Coal	600	600	600	600
6	Rithala CCPP (Gt1+Gt2+St)	Delhi	NDPL	Comnd	Gas/LNG	108.0		108.0	71.5
7	Sugen Torrent Block I, II & III	Gujarat	Torrent	Comnd	Gas/LNG	1147.5	1128	1147.5	1147.5
8	Mundra TPP Ph-I, U 1-4	Gujarat	Adani Power	Comnd	Coal	1320	1320	1320	1320
9	Mundra TPP Ph-II U1,2	Gujarat	Adani Power	Comnd	Coal	1320		1320	1320
10	Mundra TPP Ph-III U-1	Gujarat	Adani Power	UC	Coal	660		660	
11	Ultra Mega Mundra U1	Gujarat	Tata Power	UC	Coal	800		800	800
12	Allain Duhangan U1,2	HP	Adhpl	Comnd	Hydro	192	192	192	192
13	Karcham Wangtoo U1-4	HP	Jpkhcl	Comnd	Hydro	1000	1000	1000	1000
14	Malana HEP II U1,2	HP	Evrest Power	Comnd	Hydro	100	100	100	100
15	Budhil HEP	HP	LANCO	UC	Hydro	70	70	70	70
16	Sorang HEP	HP	Himachal Sorang Power	UC	Hydro	100	100		
17	Maithan RBC JV U1**	Jharknd	IPP	Comnd	Coal	525	0	525	525
18	Maithan RBC JV U2**	Jharknd	IPP	UC	Coal	525	0	525	525
19	Torangallu U1,2	Karntk	JSW Energy	Comnd	Coal	600	600	600	600
20	Udupi TPP (LANCO Nagarjuna) U1,2	Karntk	NPCL	Comnd	Coal	1200	1015	1015	1200

Sl.No.	Plant Name	State	Agency	Status	Fuel Type	Capacity (MW)	Capacity as per 78,700 MW	Capacity as per 62,374 MW	Capacity as per 52,063 MW
21	Trombay TPS	Maha	Tata Power	Comnd	Coal	250	250	250	250
22	JSW Energy, RaTNagiri U1-3	Maha	JSW	Comnd	Coal	900	900	900	900
23	JSW Energy, RaTNagiri U4	Maha	JSW	UC	Coal	300	300	300	300
24	TPS At Warora U1,2,3,4	Maha	Wardha Powerco	Comnd	Coal	540			540
25	Tiroda TPP Ph-I U1	Maha	Adani Power	UC	Coal	660		660	660
26	Maheshwar 1-10	MP	SMHPCL	UC	Hydro	400	400	400	
27	Sterlite TPP U 2,1	Orissa	Sterlite Energy	Comnd	Coal	1200	600	1200	1200
28	Sterlite TPP U3	Orissa	Sterlite Energy	Comnd	Coal	600			600
29	Jallipa Lignite U 1,2	Rajas	Raj West Power	Comnd	Lignite	270	270	270	270
30	Jallipa Lignite U 3-8	Rajas	Raj West Power	UC	Lignite	810	810	810	135
31	Teesta III	Sikkim	Teesta Urja	UC	Hydro	1200	1200	600	
32	Chujachen	Sikkim	GATI	UC	Hydro	99	99	99	
33	Srinagar	Ut.Khand	GVK	UC	Hydro	330	330		
34	Rosa St-I U1,2	UP	Reliance Power	Comnd	Coal	600	600	600	600
35	Anpara-C U1,2	UP	LANCO	UC	Coal	1200	1000	1200	1200
36	Budge-Budge Ext	WB	CESC	Comnd	Coal	250	250	250	250
	Sub Total (Private Sector)						**15043**	**19797**	**18651**
	Total (11th Plan)						**78700**	**62374**	**52063**

Note - UC: Under Construction

*considered in Private sector in 62,374 MW & 52,063 MW

******considered in Central sector in 78,700 MW

Appendix 1.4
Sheet 1/4

LIST OF PROJECTS SLIPPING FROM 78,700 MW viz-a-viz 62,374 MW

Sl.No.	PLANT NAME	STATE	AGENCY	CAPACITY (MW)	REASONS FOR SLIPPAGE
	HYDRO				
	CENTRAL SECTOR				
1	PARBATI - II	HP	NHPC	800	Slow progress of Head Race Tunnel works because of bad geology.
2	SUBANSIRI LOWER	AR.PR.	NHPC	2000	Poor geology and consequent change in design of surge shaft arrangement. Local issues.
3	RAMPUR	HP	SJVNL	412	Slow progress of Head Race Tunnel works because of bad geology.
4	KAMENG	AR.PR.	NEEPCO	600	Adverse geology resulting in slow progress in HRT. Flash flood.
5	LOHARI NAGPALA	UKND	NTPC	600	Work held up due to environmental concern.
6	TAPOVAN VISHNUGARH	UKND	NTPC	520	Slow progress in power house due to poor rock strata.
7	KOLDAM	HP	NTPC	800	Slow progress of work. Contractual issues.
	Sub-total (Central)			**5732**	
	STATE SECTOR				
8	LOWER JURALA U1-6	AP	APGENCO	240	Slow progress of civil work.
9	PULICHINTALA	AP	APID	120	Delay in civil works.
10	UHL - III	HP	HPJVVNL	100	Poor geology in HRT. Re-award of contract for HRT & Neri Khad works due to slow progress.
11	SAWARA KUDDU	HP	PVC	110	Initial delay due to MoEF clearance. Delay in award of civil and E&M package.
12	NEW UMTRU	MEGHALAYA	MeSEB	40	Slow progress of civil works.
13	PALLIVASAL	KERL	KSEB	60	Delay in land acquisition. Slow progress of civil works.
	Sub-total (State)			**670**	
14	SORANG	HP	HIMACHAL SORANG POWER	100	Difficult area, weather conditions & accessibility.
15	SRINAGAR	UKND	GVK	330	Concreting of dam. Local issues
16	TEESTA III	SIKKIM	TEESTA URJA	600	E&M works are critical.
	Sub-total (Private)			**1030**	
	SUB TOTAL (HYDRO)			**7432**	

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Sl.No.	PLANT NAME	STATE	AGENCY	CAPACITY (MW)	REASONS FOR SLIPPAGE
	THERMAL				
	CENTRAL SECTOR				
1	MAUDA TPP U1,2	MAH	NTPC	1000	Delay in placement of main plant order.
2	BARH I U 1,2,3	BIH	NTPC	1980	Contractual issues.
3	BARH II U1	BIH	NTPC	660	Delay in placement of main plant order.
4	SIPAT I U 1-3	CHG	NTPC	1980	Contractual issues.
5	NABINAGAR JV U-1,2,3	BIH	NTPC	750	Land to be acquired.
6	BONGAIGAON U3	ASSAM	NTPC	250	Law & order problem.
7	TUTICORIN JV	TN	NLC	1000	Delay in placement of main plant order.
8	BOKARO EXPANSION	JHAR	DVC	500	Delay in dismantling of CW channel for start of work of boiler foundation.
9	TRIPURA GAS ILFS JV	TRI	ONGC	750	Order for main plant civil works and logistics to be placed by BHEL. Forest clearance from MoEF for erection of transmission lines awaited.
	Sub-total (Central)			**8870**	
	STATE SECTOR				
10	KALISINDH TPS U1	RAJ	RRVUNL	500	Delay in placement of orders for main plant.Orders for BoPs to be placed.
11	MARWAH TPP U 1,2	CHG	CSEB	1000	Delay in placement of main plant order.
12	MALWA TPP U1,2	MP	MPGENCO	1000	Delay in placement of orders for main plant.Orders for BoPs to be placed.
13	SATPURA EXT U-1,2	MP	MPPGCL	500	Delay in placement of orders for main plant.Orders for BoPs to be placed.
14	SIKKA EXT	GUJ	GSECL	500	Environmental clearance by MoEF. Orders for BoPs to be placed.
15	KAKATIYA EXT U1	AP	APGENCO	500	Delay in placement of main plant order.
16	ANPARA-D U1,2	UP	UPRVUNL	1000	Delay in award of civil works.
17	KORBA WEST EXT PH III	CHG	CSEB	500	Delay in placement of main plant order.
	Sub-total (State)			**5500**	
	SUB TOTAL (THERMAL)			**14370**	
	TOTAL SLIPPAGE			**21802**	
	CENTRAL SECTOR			*14602*	
	STATE SECTOR			*6170*	
	PRIVATE SECTOR			*1030*	

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BREAK UP OF SLIPPED CAPACITY (REASON-WISE)

Delay in placement of orders for Main plant: 6,660 MW

Sl. No.	Plant Name	State	Agency	Capacity (MW)
1	MAUDA TPP U1,2	MAHARASHTRA	NTPC	1000
2	BARH II U1	BIHAR	NTPC	660
3	TUTICORIN JV	TN	NLC	1000
4	KALISINDH TPS U1	RAJASTHAN	RRVUNL	500
5	MARWAH TPP U 1,2	CHHATTISGARH	CSEB	1000
6	MALWA TPP U1,2	MP	MPGENCO	1000
7	SATPURA EXT U1,2	MP	MPPGCL	500
8	KAKATIYA EXT U1	AP	APGENCO	500
9	KORBA WEST EXT PH III	CHHATTISGARH	CSEB	500
	Total			**6660**

Delay in placement of orders for Civil works: 1,860 MW

Sl. No.	Plant Name	State	Agency	Capacity (MW)
1	TRIPURA GAS ILFS JV	TRIPURA	ONGC	750
2	ANPARA-D U1,2	UP	UPRVUNL	1000
3	SAWARA KUDDU	HP	PVC	110
	Total			**1860**

Slow progress of Civil works: 900 MW

Sl. No.	Plant Name	State	Agency	Capacity (MW)
1	LOWER JURALA U1-6	AP	APGENCO	240
2	NEW UMTRU	MEGHALAYA	MeSEB	40
4	PULICHINTALA	AP	APID	120
5	BOKARO EXPANSION	JHARKHAND	DVC	500
	Total			**900**

Poor Geology: 4,432 MW

Sl. No.	Plant Name	State	Agency	Capacity (MW)
1	PARBATI - II	HP	NHPC	800
2	SUBANSIRI LOWER	ARUNACHAL PRADESH	NHPC	2000
3	RAMPUR	HP	SJVNL	412
4	KAMENG	ARUNACHAL PRADESH	NEEPCO	600
5	TAPOVAN VISHNUGARH	UTTARAKHAND	NTPC	520
6	UHL - III	HP	HPJVVNL	100
	Total			**4432**

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Contractual dispute between project developer and contractor and their sub-vendors / sub-contractor: 4,760 MW

Sl. No.	Plant Name	State	Agency	Capacity (MW)
1	BARH I U 1,2,3	BIHAR	NTPC	1980
2	SIPAT I U 1-3	CHHATTISGARH	NTPC	1980
3	KOLDAM	HP	NTPC	800
	Total			**4760**

Delay in Land Acquisition: 810 MW

Sl. No.	Plant Name	State	Agency	Capacity (MW)
1	PALLIVASAL	KERALA	KSEB	60
2	NABINAGAR JV U-1,2,3	BIHAR	NTPC	750
	Total			**810**

Environmental Concern: 1100 MW

Sl. No.	Plant Name	State	Agency	Capacity (MW)
1	LOHARI NAGPALA	UTTARAKHAND	NTPC	600
2	SIKKA EXT	GUJARAT	GSECL	500
	Total			**1100**

Law and Order Problem/Local Issues: 580 MW

Sl. No.	Plant Name	State	Agency	Capacity (MW)
1	BONGAIGAON U3	ASSAM	NTPC	250
2	SRINAGAR	UTTARAKHAND	GVK	330
	Total			**580**

E&M work critical: 600 MW

Sl. No.	Plant Name	State	Agency	Capacity (MW)
1	TEESTA III	SIKKIM	TEESTA URJA	600
	Total			**600**

Difficult area and accessibility: 100 MW

Sl. No.	Plant Name	State	Agency	Capacity (MW)
1	SORANG	HP	HIMACHAL SORANG POWER	100
	Total			**100**
	Total Capacity Slipping from 78,700 MW			**21802**

Appendix 1.5

LIST OF ADDITIONAL PROJECTS FOR BENEFITS DURING 11TH PLAN

Sl.No.	PLANT NAME	STATE	AGENCY	ULTIMATE CAPACITY (MW)	TYPE	BENEFITS 11TH PLAN (2007-12)
	STATE SECTOR					
1	MYNTDU St-I ADDL UNIT	MEGH	MeSEB	42	HYDRO	42
2	NORTH CHENNAI EXT U2	TN	TNEB	600	COAL	600
	SUB TOTAL					**642**
	PRIVATE SECTOR					
3	RITHALA CCPP	DELHI	NDPL	108	GAS/LNG	108
4	KONDAPALLI CCPP PH-II	AP	LANCO Kondapalli Power	366	GAS/LNG	366
5	TIRODA TPP PH-I, U1	MAH	Adani Power	660	660	660
6	MUNDRA TPP PH-II U1,2	GUJ	Adani Power	1320	COAL	1320
7	MUNDRA TPP PH-III U1	GUJ	Adani Power	660	COAL	660
8	STERLITE TPP U2	ORS	Sterlite Energy	2400	COAL	600
9	ULTRA MEGA MUNDRA U1	GUJ	TATA Power	800	COAL	800
	SUB TOTAL					**4514**
	TOTAL					**5156**

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LIST OF PROJECTS COMMISSIONED DURING 2007-08 (11th PLAN)

PROJECT NAME	Capacity (COMMISSIONING DATE/MONTH/ YEAR)	REGION	SECTOR	STATE	TYPE	TOTAL CAPACITY (MW)
THERMAL PROJECTS						
SIPAT-II UNIT-4	500 (27/05/2007)	WR	C.S.	CHAT	COAL	500.00
PARAS UNIT-1	250 (31/05/2007)	WR	S.S.	MAHA	COAL	250.00
DHOLPUR CCGT GT -2	110 (16/06/2007)	NR	S.S.	RAJ.	GAS	110.00
BIRSINGPUR UNIT-5	500 (18/06/2007)	WR	S.S.	M.P.	COAL	500.00
DHUVRAN ST	40 (13/08/2007)	WR	S.S.	GUJ.	GAS	40.00
RAIGARH (JINDAL) U-I	250 (02/09/2007)	WR	P.S.	CHAT	COAL	250.00
MEJIA UNIT-6	250 (01/10/2007)	ER	C.S.	DVC	COAL	250.00
RATNAGIRI GAS	740 (28/10/2007)	WR	C.S.	MAHA	GAS	740.00
YAMUNA NAGAR U-I	300 (01/11/2007)	NR	S.S.	HAR.	COAL	300.00
SANTALDIH UNIT-5	250 (07/11/2007)	ER	S.S.	W.B.	COAL	250.00
RAYALSEEMA U-4	210 (20/11/2007)	SR	S.S.	A.P.	COAL	210.00
DURGAPUR DPL U-7	300 (24/11/2007)	ER	S.S.	W.B.	COAL	300.00
BELLARY UNIT-I	500 (03/12/2007)	SR	S.S.	KAR.	COAL	500.00
KORBA EAST EXT. U-2	250 (11/12/2007)	WR	S.S.	CHAT	COAL	250.00
SAGARDIGHI U-1	300 (21/12/2007)	ER	S.S.	W.B.	COAL	300.00
BAKRESHWAR U-4	210 (24/12/2007)	ER	S.S.	W.B.	COAL	210.00
DHOLPUR ST	110 (27/12/2007)	NR	S.S.	RAJ.	GAS	110.00
GHGTPS-II (LEH MOH)	250 (03/01/2008)	NR	S.S.	PUN.	COAL	250.00
RAIGARH (JINDAL) U-3	250 (10/02/2008)	WR	P.S.	CHAT	COAL	250.00
RAIGARH (JINDAL) U-2	250 (06/03/2008)	WR	P.S.	CHAT	COAL	250.00
KAHALGAON UNIT-6	500 (16/03/2008)	ER	C.S.	BIH.	COAL	500.00
YAMUNA NAGAR U-2	300 (29/03/2008)	NR	S.S.	HAR.	COAL	300.00
SUB-TOTAL(THERMAL)						**6620.00**
HYDRO PROJECTS						
PURLIA PSS UNIT-4 (JV)	225 (18/07/2007)	ER	S.S.	W.B.	HYDRO	900.00
PURLIA PSS UNIT-3 (JV)	225 (27/08/2007)					
PURLIA PSS UNIT-2 (JV)	225 (23/11/2007)					
PURLIA PSS UNIT-1 (JV)	225 (20/01/2008)					
		WR	C.S.	M.P.	HYDRO	520.00
OMKARESWAR UNIT-1	65 (21/07/2007)					
OMKARESWAR UNIT-2	65 (09/08/2007)					
OMKARESWAR UNIT-3	65 (29/08/2007)					
OMKARESWAR UNIT-4	65 (13/09/2007)					
OMKARESWAR UNIT-5	65 (27/09/2007)					
OMKARESWAR UNIT-6	65 (18/10/2007)					
OMKARESWAR UNIT-7	65 (27/10/2007)					
OMKARESWAR UNIT-8	65 (04/11/2007)					
BALIMELA UNIT-7	75 (05/01/2008)	ER	S.S.	ORI.	HYDRO	150.00
BALIMELA UNIT-8	75 (27/03/2008)					
MANERI BHALI U-4	76 (16/01/2008)	NR	S.S.	UTTA	HYDRO	304.00
MANERI BHALI U-1	76 (21/01/2008)					
MANERI BHALI U-3	76 (25/01/2008)					
MANERI BHALI U-2	76 (10/03/2008)					

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PROJECT NAME	Capacity (COMMISSIONING DATE/MONTH/ YEAR)	REGION	SECTOR	STATE	TYPE	TOTAL CAPACITY (MW)
TEESTA -V UNIT - 2	170 (06/02/2008)	ER	C.S	SIKK	HYDRO	510.00
TEESTA -V UNIT – 3	170 (20/03/2008)					
TEESTA -V UNIT - 1	170 (28/03/2008)					
JURALA PRIYA U-1	39 (28/03/2008)	SR	S.S.	A.P.	HYDRO	39.00
SUB-TOTAL(HYDRO)						**2423.00**
NUCLEAR PROJECT						
KAIGA UNIT-3	220 (11/04/2007)	SR	C.S.	KAR.	NUCLEAR	220.00
SUB-TOTAL(NUCLEAR)						**220.00**
TOTAL(THERMAL+HYDRO+NUCLEAR):-(2007-2008)						**9263.00**

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LIST OF PROJECTS COMMISSIONED DURING 2008-2009 (11th PLAN)

PROJECT NAME	Capacity (COMMISSIONING DATE/MONTH/ YEAR)	REGION	SECTOR	STATE	TYPE	TOTAL CAPACITY (MW)
THERMAL PROJECTS						
BHILAIEXN.TPPUNIT-1	250 (20/04/2008)	WR	C.S.	CHAT	COAL	250.00
VALUTHUR PH-II GTPP	59.8 (6/02/2009)	SR	S.S.	TAM.	GAS	59.8
AMARKANTAK U-5	210 (15/06/2008)	WR	S.S.	M.P.	COAL	210.00
RAIGARH (JINDAL) U-4	250 (17/06/2008)	WR	P.S.	CHAT	COAL	250.00
SAGARDIGHI U-2	300 (20/07/2008)	ER	S.S.	W.B.	COAL	300.00
GHGTPP-II,LEHAR MOB.	250 (31/07/2008)	NR	S.S.	PUN.	COAL	250.00
SIPAT ST-II U-5	500 (13/08/2008	WR	C.S.	CHAT	COAL	500
VALUTHUR PH-II ST	32.4 (17/02//2009)	SR	S.S.	TAM.	GAS	32.4
SUGEN CCPP	382.5 (4/02/2009)	WR	P.S.	GUJ	GAS	382.5
TROMBAY Extn.	250 (26.03.2009)	WR	P.S.	MAH	COAL	250
SUB-TOTAL(THERMAL)						**2484.7**
HYDRO PROJECTS						
GHATGHAR PSS	125 (13/05/2008)	WR	S.S.	MAHA	HYDRO	125.00
GHATGHAR PSS	125 (01/07/2008)	WR	S.S.	MAHA	HYDRO	125.00
JURALA PRIYA U-2	39 (31/08/2008)	SR	S.S.	A.P.	HYDRO	39.00
BAGLIHAR UNIT-1	150 (19/09/2008)	NR	S.S.	J&K	HYDRO	150.00
BAGLIHAR UNIT-2	150 (26/10/2008)	NR	S.S.	J&K	HYDRO	150.00
BAGLIHAR UNIT-3	150 (14/11/2008)	NR	S.S.	J&K	HYDRO	150.00
VARAHI EXT.UNIT 1	115 (11/1/2009	SR	S.S.	KAR	HYDRO	115.00
VARAHI EXT.UNIT 2	115 (09/2/2009	SR	S.S.	KAR	HYDRO	115.00
SUB-TOTAL(HYDRO)						**969.00**
NUCLEAR PROJECT						
SUB-TOTAL(NUCLEAR)						**0.00**
TOTAL(THERMAL+HYDRO+NUCLEAR):-(2008-2009)						**3453.7**

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LIST OF PROJECTS COMMISSIONED DURING 2009-2010 (11TH PLAN)

PROJECT NAME	CAPACITY (COMMISSIONING DATE/MONTH/ YEAR)	REGION	SECTOR	STATE	TYPE	TOTAL CAPACITY (MW)
TORANGALLU U-1	(23.4.2009)	SR	P.S.	KAR	COAL	300
SUGEN –BLOCK-2	(7.5.2009)	WR	P.S.	GUJ	GAS	382.5
GAUTAMI	(3.5.2009)	SR	P.S	A.P.	GAS	464
KONASEEMA GT	(3.5.2009)	SR	P.S.	A.P.	GAS	280
SUGEN BLOCK-3	(8.6.2009)	WR	P.S.	GUJ	GAS	382.5
LANCO AMARKANTAK U-1	(4.6.2009)	WR	P.S.	CHATT	COAL	300
BAKRESHWAR U-5	(7.6.2009)	ER	S.S	WB	COAL	210
BHILAI U-2	(12.07.2009)	WR	C.S	CHATT	COAL	250
KAHALGAON-II U-7	(31.07.2009)	ER	C.S	BIHAR	COAL	500
MUNDRA PH-I, U-I	(4.8.2009)	WR	P.S.	GUJ	COAL	330
UTRAN GT	(8.8.2009)	WR	S.S.	GUJ	GAS	240
TORANGALLU U-2	(24.8.2009)	SR	P.S.	KAR	COAL	300
SURATGARH U-6	(29.8.2009)	NR	S.S.	RAJ	COAL	250
KOTA U-7	(30.8.2009)	NR	S.S.	RAJ	COAL	195
BUDGE-BUDGE-EX	(29.9.2009)	ER	P.S.	WB	COAL	250
KUTCH LIGNITE U-4	(1.10.2009)	WR	S.S.	GUJ	LIGNITE	75
VIJAYWADA ST.IV U-I	(8.10.2009)	SR	S.S	A.P.	COAL	500
UTRAN CCPP-II ST	(10.10.2009)	WR	S.S.	GUJ	GAS	134
JALIPA LIGNITE U-I	(16.10.2009)	NR	P.S.	RAJ	LIGNITE	135
CHABRA U-I	(30.10.2009)	NR	S.S	RAJ	COAL	250
CHANDRAPUR U-7	(4.11.2009)	ER	C.S.	DVC	COAL	250
Lanco Kondapalli St-II GT	(5.12.2009)	SR	P.S.	A.P.	GAS	233
NCTPP DADRI UNIT 5	(29.01.2010)	NR	C.S.	UP	COAL	490
NEW PARLI EXT U2	(10.2.2010)	WR	S.S.	MAHA	COAL	250
ROSA ST-I U1	(10.2.2010)	NR	P.S.	UP	COAL	300
MUNDRA TPP ,PH-I,U-2	(17.03.2010)	WR	P.S.	GUJ	COAL	330
LANCO AMARKANTAK TPS U-2	(25.03.2010)	WR	P.S.	CHAT	COAL	300
PARAS TPS EXT. U2	(27.03.2010)	WR	S.S.	MAHA	COAL	250
CHANDRUPURA U-8	(31.03.2010)	ER	C.S.	DVC	COAL	250
RAJIV GANDHI (HISSAR) U-1	(31.03.2010)	NR	S.S.	HAR	COAL	600
GIRAL LIGNITE U-2		NR	S.S.	RAJ	LIGNITE	125
TOTAL THERMAL						**9106**
HYDRO PROJECTS						
JURALA PRIYA U-3	(27.06.2009)	SR	S.S.	A.P.	HYDRO	39.0
TOTAL HYDRO						**39.0**
NUCLEAR PROJECT						
RAPP U-5	(4.02.2010)	NR	C.S.	RAJ	NUCLEAR	220
RAPP U-6	(31.03.2010)	NR	C.S.	RAJ	NUCLEAR	220
TOTAL NUCLEAR						**440**
TOTAL (THERMAL+HYDRO+NUCLEAR)(2009-10)						**9585**

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LIST OF PROJECTS COMMISSIONED DURING 2010-2011 (11th PLAN)

PROJECT NAME	COMMISSIONING DATE	REGION	SECTOR	STATE	TYPE	TOTAL (MW)
SURAT LIGNITE EXP TPP U3	12.04.2010	NR	S.S	GUJ	LIGNITE	125
SURAT LIGNITE EXP TPP 4	12.04.2010	NR	S.S	GUJ	LIGNITE	125
CHHABRA TPS U-2	04.05.2010	NR	S.S.	RAJ.	COAL	250
KAKATIYA ST-I U-1	27.05.2010	SR	S.S.	A.P.	COAL	500
ROSA PH-I U-2	26.06.2010	NR	P.S.	U.P.	COAL	300
BARSINGSAR LIG. U-1	28.06.2010	NR	C.S.	RAJ.	LIGNITE	125
WARDHA WARORA TPP U-I	05.06.2010	WR	P.S.	MAHA.	COAL	135
RAICHUR TPS EXTN. U-8	26.06.2010	SR	S.S.	KARNATAKA	COAL	250
KONASEEMA ST	30.06.2010	SR	P.S.	A.P.	GAS/LNG	165
LANCO KONDAPALLI St-II ST	19.07.2010	SR	P.S.	AP	GAS	133
UDUPI U I	23.07.2010	SR	P.S.	KARNATAKA	COAL	600
DADRI U-6	30.07.2010	NR	C.S	U.P.	COAL	490
JALIPA LIGNITE U -2	8.07.2010	NR	P.S.	RAJ	LIGNITE	135
MUNDRA TPP PH-I,U-3	2.08.2010	WR	P.S.	GUJ	COAL	330
BARAMURA GT EXTN.	3.08.2010	NER	S.S	TRI	GAS	21
JSW ENERGY RATNAGIRI U-1	24.08.2010	WR	P.S.	MAHA	COAL	300
MEJIA PH II , U-7	30.09.2010	ER	C.S.	DVC	COAL	500
RAJIV GANDHI(HISSAR) U-2	1.10.2010	NR	S.S	HAR	COAL	600
STERLITE (JHARSUGUDA) U-2	14.10. 2010	ER	P.S.	ORI	COAL	600
WARDHA WARORA TPP U-2	10.10.2010	WR	P.S.	MAHA.	COAL	135
PRAGATI (BAWANA) ST-III GT-I	24.10.2010	NR	S.S	DEL	GAS	250
INDRA GANDHI (JHAJJAR) U-I	31.10.2010	NR	C.S.	HAR	COAL	500
JSW ENERGY RATNAGIRI U-2	09.12.2010	WR	P.S.	MAH	COAL	300
MUNDRA TPP PH-I,U-4	20.12.2010	WR	P.S.	GUJ	COAL	330
KORBA STPP ST III U-7	26.12.2010	WR	C.S.	CHATT	COAL	500
MUNDRA TPP PH-II U-I	26.12.2010	WR	P.S	GUJ	COAL	660
RAYALSEEMA TPP ST.III U5	31.01.2011	SR	S.S.	AP	COAL	210
STERLITE (JHARSUGUDA) U1	29.12.210	ER	P.S.	ORI	COAL	600
RITHALA CCPP GT-1	9.12.2010	NR	P.S.	DEL	GAS	35.75
RITHALA CCPP GT-2	4.10.2010	NR	P.S.	DEL	GAS	35.75
WARDHA WARORA TPP U-3	21.01.2011	WR	P.S.	MAHA.	COAL	135
BARSINGHSAR LIGNITE U-2	25.01.2011	NR	C.S.	RAJ	LIGNITE	125
PRAGATI (BAWANA) ST-IIIGT-2	16.02.2011	NR	S.S	DEL	GAS	250
FARAKKA ST III ,U-6	23.03.2011	ER	C.S.	W.B.	COAL	500
SIMHADRI U-3	31.03.2011	SR	C.S	A.P	COAL	500
MEJIA TPS ,PH II U-8	26.03.2011	ER	C.S.	DVC	COAL	500
TOTAL THERMAL						***11250.5***
HYDRO PROJECTS						
KUTTIYADI EXTN. H.E. U-1	*25.05.2010*	*SR*	*S.S.*	*KERALA*	*HYDRO*	*50*
SEWA II U-1	*22.06.2010*	*NR*	*C.S.*	*J&K*	*HYDRO*	*40*
SEWA II U-2	*23.07.2010*	*NR*	*C.S.*	*J&K*	*HYDRO*	*40*
SEWA-II U-3	*23.07.2010*	*NR*	*C.S.*	*J&K*	*HYDRO*	*40*
JURALA PRIYA U-4	*28.08.2010*	*SR*	*S.S*	*A.P.*	*HYDRO*	*39*
ALLAIN DUHANGAN U-I	*16.09.2010*	*NR*	*P.S.*	*H.P.*	*HYDRO*	*96*
ALLAIN DUHANGAN U-2	*18.09.2010*	*NR*	*P.S.*	*H.P.*	*HYDRO*	*96*
KUTIYADI EXT.H.E. U-2	*23.09.2010*	*SR*	*S.S.*	*KERALA*	*HYDRO*	*50*
JURALA PRIYA U-5	*09.11.2010*	*SR*	*S.S*	*A.P*	*HYDRO*	*39*
KOTESHWAR ,U-1,2	*28 & 31.03.2011*	*NR*	*C.S.*	*UTTA*	*HYDRO*	*200*
TOTAL HYDRO						***690***
NUCLEAR PROJECTS						
KAIGA U-4	*19.01.2011*	*SR*	*C.S.*	*KARNATAKA*	*NUCLEAR*	*220*
TOTAL NUCLEAR						***220***
TOTAL (THERMAL+HYDRO+NUCLEAR)(2010-11)						***12160.5***

Appendix 1.7
Sheet (1/2)

SUMMARY OF CAPACITY ADDITION TARGET DURING 2011-12

	Hydro	Thermal				Nuclear	Total
		Coal	Gas	Lignite	Total		
CENTRAL SECTOR	655	2820	0	250	3070	2000	5725
STATE SECTOR	165	3250	851	0	4101	0	4266
PRIVATE SECTOR	1170	6305	0	135	6440	0	7610
ALL-INDIA	1990	12375	851	385	13611	2000	17601

LIST OF PROJECTS (CAPACITY ADDITION TARGET) DURING 2011-12

Sl. No.	PLANT NAME	STATE	DEVELOPER	SECTOR	CATEGORY	FUEL	CAPACITY (MW)
	HYDRO						
1	CHUTAK	J&K	NHPC	C	UC	HYDRO	44
2	CHAMERA-III	HP	NHPC	C	UC	HYDRO	231
3	URI-II U1,2,3	J&K	NHPC	C	UC	HYDRO	180
4	KOTESHWAR U3-4	UKND	THDC	C	UC	HYDRO	200
5	JURALA PRIYA U 6	AP	APGENCO	S	COMND	HYDRO	39
6	MYNTDU St-I ADDL UNIT	MEGH	MeSEB	S	UC	HYDRO	84
7	MYNTDU St-I	MEGH	MeSEB	S	UC	HYDRO	42
8	MALANA II U1,2	HP	EVREST POWER	P	COMND	HYDRO	100
9	KARCHAM WANGTOO	HP	JPKHCL	P	COMND	HYDRO	1000
10	BUDHIL	HP	LANCO	P	UC	HYDRO	70
	TOTAL (HYDRO)						**1990**
	THERMAL						
1	KODARMA U1	JHAR	DVC	C	COMND	COAL	500
2	DURGAPUR STEEL U1	WB	DVC	C	COMND	COAL	500
3	INDIRA GANDHI TPP (JHAJJAR) JV U2	HAR	NTPC	C	UC	COAL	500
4	SIPAT-I U1	CHG	NTPC	C	COMND	COAL	660
4	SIPAT-I U2	CHG	NTPC	C	UC	COAL	660
5	NEYVELI - II LIG U1	TN	NLC	C	UC	LIGNITE	250
6	KOTHAGUDEM ST-VI	AP	APGENCO	S	COMND	COAL	500
7	BELLARY TPP U 2	KAR	KPCL	S	UC	COAL	500
8	KHAPER KHEDA EXT	MAH	MSPGCL	S	COMND	COAL	500
9	BHUSAWAL TPP U4,5	MAH	MSPGCL	S	UC	COAL	1000

Appendix 1.7
Sheet (2/2)

Sl. No.	PLANT NAME	STATE	DEVELOPER	SECTOR	CATEGORY	FUEL	CAPACITY (MW)
10	HARDUAGANJ EXT U-8,9	UP	UPRVUNL	S	UC	COAL	500
11	SANTALDIH EXT-U 6	WB	WBPDCL	S	COMND	COAL	250
12	PRAGATI-III (BAWANA) GT-3, ST-1	DELHI	PPCL	S	UC	GAS/LNG	500
13	GSEG HAZIRA EXT	GUJ	GSECL	S	UC	GAS/LNG	351
14	MUNDRA TPP PH-II U 2	GUJ	ADANI POWER	P	COMND	COAL	660
15	ULTRA MEGA MUNDRA U1	GUJ	TATA POWER	P	UC	COAL	800
16	MAITHAN RBC JV U1	JHAR	IPP	P	COMND	COAL	525
16	MAITHAN RBC JV U2	JHAR	IPP	P	UC	COAL	525
17	UDUPI TPP (LANCO NAGARJUNA) U2	KAR	LANCO	P	COMND	COAL	600
18	TIRODA TPP PH-I, U1	MAH	ADANI POWER	P	UC	COAL	660
19	JSW ENERGY, RATNAGIRI U3	MAH	JSW ENERGY	P	COMND	COAL	300
20	JSW ENERGY, RATNAGIRI U4	MAH	JSW ENERGY	P	UC	COAL	300
21	TPS AT WARORA U4	MAH	WARDHA POWER CO.	P	COMND	COAL	135
22	STERLITE TPP U3	ORS	STERLITE ENERGY	P	COMND	COAL	600
23	ANPARA-C U1,2	UP	LANCO	P	UC	COAL	1200
24	JALIPA LIGNITE U 3	RAJ	RAJ WEST POWER	P	UC	LIGNITE	135
	TOTAL (THERMAL)						**13611**
	NUCLEAR						
1	KUDANKULAM U 1	TN	NPC	C	UC	NUCLEAR	2000
	TOTAL (NUCLEAR)						**2000**
	TOTAL						**17601**
	Capacity Commissioned during 2011-12 (till 30.09.2011)						**7155.5**

Appendix 1.8

DETAILS OF CAPACITY COMMISSIONED DURING 2011-12 UPTO 30.9.2011

	Hydro	Thermal				Nuclear	Total
		Coal	Gas	Lignite	Total		
CENTRAL SECTOR	0	1660	0	0	1660	0	1660
STATE SECTOR	39	1500	0	0	1500	0	1539
PRIVATE SECTOR	1100	2820	36.5	0	2856.5	0	3956.5
ALL-INDIA	1139	5980	36.5	0	6016.5	0	7155.5

LIST OF PROJECTS COMMISSIONED IN 2011-12 UPTO 30.9.2011

Sl. No.	PLANT NAME	STATE	DEVELOPER	SECTOR	FUEL	CAPACITY (MW)
	HYDRO					
1	Jurala Priya U 6	AP	APGENCO	S	HYDRO	39
2	Malana II U1,2	HP	EVREST POWER	P	HYDRO	100
3	Karcham Wangtoo	HP	JPKHCL	P	HYDRO	1000
	TOTAL (HYDRO)					**1139**
	THERMAL					
1	Kodarma U1	JHAR	DVC	C	COAL	500
2	Durgapur Steel U1	WB	DVC	C	COAL	500
3	Sipat-I U1	CHG	NTPC	C	COAL	660
4	Kothagudem St-VI	AP	APGENCO	S	COAL	500
5	Khaper Kheda Ext	MAH	MSPGCL	S	COAL	500
6	Santaldih Ext-U 6	WB	WBPDCL	S	COAL	250
7	Harduaganj U8	UP	UPPCL	S	COAL	250
8	Mundra TPP Ph-II U 2	GUJ	ADANI POWER	P	COAL	660
9	Maithan RBC JV U1	JHAR	IPP	P	COAL	525
10	Udupi TPP (Lanco Nagarjuna) U2	KAR	LANCO	P	COAL	600
11	JSW Energy, Ratnagiri U3	MAH	JSW ENERGY	P	COAL	300
12	TPS At Warora U4	MAH	WARDHA POWER CO.	P	COAL	135
13	Sterlite TPP U3	ORS	STERLITE ENERGY	P	COAL	600
14	Rithala ST (Not included in the capacity addition target of 17,601 MW during 2011-12)	Delhi	NDPL	P	GAS	36.5
	TOTAL (THERMAL)					**6016.5**
	TOTAL COMMISSIONED TILL 30.09.2011					**7155.5**

Appendix 1.9(a)

LIST OF PLANNED/ MOST FEASIBLE THERMAL PROJECTS FOR LIKELY BENEFITS DURING 12TH PLAN

Sl. No.	Project Name	State	Developer	Sector	Capacity (MW)
	Coal Based Projects				
1	Bongaigaon TPP U 3	Assam	NTPC	C	250
2	Muzaffarpur Ext. TPP U 1,2	Bihar	NTPC JV	C	390
3	Barh TPP-I U1-3	Bihar	NTPC	C	1980
4	Barh TPP-II U1-2	Bihar	NTPC	C	1320
5	Nabinagar TPP U 1-4	Bihar	NTPV JV	C	1000
6	Sipat TPP-I U 3	Chhattisgarh	NTPC	C	660
7	Bokaro TPP 'A' Exp U 1	Jharkhand	DVC	C	500
8	Vindhyachal TPP-IV U 11,12	MP	NTPC	C	1000
9	Mauda TPP U 1,2	Maharashtra	NTPC	C	1000
10	Vallur TPP -II U 3	TN	NTECL (NTPC/TNEB JV)	C	500
11	Tuticorin JV TPP U1,2	TN	NPTL (NLC JV)	C	1000
12	Rihand TPP-III U 5,6	UP	NTPC	C	1000
13	Kakatiya TPP Ext U 1	AP	APGENCO	S	600
14	Sri Damodaram Sanjeevaiah TPP (Krishnapattam TPP), U 1,2	AP	APPDCL	S	1600
15	Korba West TPP- III U5	Chhattisgarh	CSEB	S	500
16	Marwa TPP U 1,2	Chhattisgarh	CSEB	S	1000
17	Sikka TPP Ext. U 3,4	Gujarat	GSECL	S	500
18	Satpura TPP Ext U-10,11	MP	MPPGCL	S	500
19	Shree Singati (Malwa) TPP U 1,2	MP	MPGENCO	S	1200
20	Chandrapur TPP Ext U 8, 9	Maharashtra	MSPGCL	S	1000
21	Koradi TPP Ext U 8-10	Maharashtra	MSPGCL	S	1980
22	Parli TPP Ext U 8	Maharashtra	MSPGCL	S	250
23	Kalisindh TPP U 1,2	Rajasthan	RRVUNL	S	1200
24	Chhabra TPP Ext U 3,4	Rajasthan	RRVUNL	S	500
25	Anpara-D U 1,2	UP	UPRVUNL	S	1000
26	Durgapur TPS Ext U 8	WB	DPL	S	250
27	Thamminapatnam TPP -II U 3,4	AP	Meenakshi Energy Ltd.	P	600
28	Painampuram TPP U 1,2	AP	Thermal Powertech Corporation Ltd.	P	1320

Sl. No.	Project Name	State	Developer	Sector	Capacity (MW)
29	Simhapuri TPP-II U 3,4	AP	Madhucon Projects Ltd. (Simhapuri Energy Ltd)	P	300
30	Vandana Vidyut TPP U 2	Chhatisgarh	Vandana Vidyut	P	135
31	Darrampura TPP U 1-3	Chhatisgarh	SKS Power Generation (Chattisgarh) Ltd	P	900
32	Avantha Bhandar TPP U 1	Chhattisgarh	Korba West Power Company Ltd.	P	600
33	Maurti Clean Coal & Power TPP U 1	Chhattisgarh	Maurti Clean Coal & Power Ltd.	P	300
34	Lanco Amarkantak TPP- II U 3, 4	Chhattisgarh	LAP Pvt. Ltd.	P	1320
35	Uchpinda TPP U 1-3	Chhattisgarh	R.K.M. POWERGEN Pvt. Ltd.	P	1080
36	Akaltara (Nariyara) TPP U 1-4	Chhattisgarh	Wardha PCL (KSK)	P	2400
37	Mundra TPP- III U 2,3	Gujarat	Adani Power Ltd.	P	1320
38	Mundra UMPP U 2-5	Gujarat	Tata Power Company	P	3200
39	Jhajjar TPP (Mahatma Gandhi TPP) U 2	Haryana	CLPower India Pvt Ltd	P	660
40	Corporate Power Ltd (Maitrishi Usha)- I U 1,2	Jharkhand	Corporate Power Ltd.	P	540
41	Adhunik Power TPP U 1,2	Jharkhand	Adhunik Power & Natural Resources Ltd.	P	540
42	Anoppur TPP -I U 1,2	MP	MB Power (M P) Ltd.	P	1200
43	Bina TPP U 2	MP	Bina Power Supply Co. Ltd.	P	250
44	Sasan UMPP U 1-4	MP	Reliance Power Ltd.	P	2640
45	Nigri TPP U 1	MP	JP Power Ventures Ltd.	P	660
46	Mahan TPP U 1,2	MP	Essar Power MP Ltd.	P	1200
47	Amravati TPP -I U 1-5	Maharashtra	India Bulls	P	1350
48	Amravati TPP -II U 1-5	Maharashtra	India Bulls	P	1350
49	Nasik TPP-I U 1-5	Maharashtra	India Bulls	P	1350
50	Nasik TPP- II U 1-5	Maharashtra	India Bulls	P	1350
51	Dhariwal Infrastructure TPP U 1,2	Maharashtra	Dhariwal Infrastructure (P) Ltd.	P	600
52	EMCO Warora TPP U 1,2	Maharashtra	EMCO Energy Ltd. (GMR)	P	600
53	Butibori TPP -II U-1	Maharashtra	Vidarbha Industries Power Ltd	P	300
54	Lanco Vidarbha TPP U 1,2	Maharashtra	Lanco Vidarbha	P	1320

Sl. No.	Project Name	State	Developer	Sector	Capacity (MW)
55	Tiroda TPP -I U 2	Maharashtra	Adani Power Ltd.	P	660
56	Tiroda TPP- II U 1	Maharashtra	Adani Power Ltd.	P	660
57	Derang TPP U 1,2	Orissa	Jindal India Thermal Power Ltd	P	1200
58	Ind Bharat TPP U 1,2	Orissa	Ind. Bharat Power (Utkal) Ltd.	P	700
59	Lanco Babandh TPP U 1	Orissa	Lanco Babandh Power Ltd.	P	600
60	K.V.K. Nilanchal TPP U 1,2	Orissa	K.V.K. Nilanchal Power	P	1050
61	Kamalanga TPP U 1-3	Orissa	GMR Energy	P	1050
62	Talwandi Sabo TPP U 1,2	Punjab	Vedanta (Sterlite)	P	1320
63	Goindwal Sahib TPP U 1	Punjab	GVK Power	P	270
64	Melamaruthur TPP U 1,2	TN	Coastal Energen Pvt. Ltd.	P	1200
65	Bara TPP U 1,2	UP	Jaypee Power Ltd.	P	1320
66	Rosa TPP -II U 3.4	UP	Reliance Power Ltd.	P	600
	TOTAL (COAL BASED)				**62695**

Appendix 1.9 (b)
Sheet(1/2)

LIST OF UNDER CONSTRUCTION HYDRO PROJECTS FOR LIKELY BENEFITS DURING 12TH PLAN

Sl. No.	Project Name	State	Developer	Sector	Capacity (MW)	E&M equipment supplier
1	Pare	Ar. Pradesh	NEEPCO	C	110	Andritz
2	Kameng	Ar. Pradesh	NEEPCO	C	600	BHEL
3	Subansiri Lower	Ar. Pradesh	NHPC	C	2000	Alstom India
4	Parbati-II	H.P.	NHPC	C	800	BHEL
5	Rampur	H.P.	SJVNL	C	412	BHEL
6	Kol Dam	H.P.	NTPC	C	800	BHEL
7	Kishan Ganga	J & K	NHPC	C	330	BHEL
8	Tuirial	Mizoram	NEEPCO	C	60	BHEL
9	Tapovan Vishnugad	Uttarakhand	NTPC	C	520	BHEL
10	Lower Jurala	A.P.	APGENCO	S	240	Alstom India
11	Pulichintala	A.P.	APGENCO	S	120	BHEL
12	Kashang - I	H.P.	HPPCL	S	65	Andritz
13	Uhl-III	H.P.	BVPC	S	100	BHEL
14	Sawara Kuddu	H.P.	HPPCL	S	111	Andritz
15	Kashang II & III	H.P.	HPPCL	S	130	Andritz
16	Sainj	H.P.	HPPCL	S	100	
17	Baglihar-II	J & K	J&K State PDC	S	450	
18	Thottiar	Kerala	KSEB	S	40	M/s Chonging
19	Pallivasal	Kerala	KSEB	S	60	DEC China
20	New Umtru	Meghalaya	MeECL	S	40	Andritz
21	Tidong-I	H.P.	N S L Tidong Power Gen. Ltd	P	100	Alstom India
22	Sorang	H.P.	Himachal Sorang Power Pvt. Ltd	P	100	Voith Siemans
23	Tangnu Romai-I	H.P.	Tangnu Romai Power Gen.Ltd	P	44	
24	Bhasmey	Sikkim	Gati Infrastructure Ltd.	P	51	Voith Hydro
25	Jorethang Loop	Sikkim	DANS Pvt. Ltd	P	96	Alstom India
26	Rangit-IV	Sikkim	Jal Power Corp. Ltd.	P	120	Andritz
27	Teesta-VI	Sikkim	Lanco Energy Pvt. Ltd.	P	500	Alstom India
28	Teesta-III	Sikkim	Teesta Urja	P	600	VATech Hydro
29	Singoli Bhatwari	Uttarakhand	L & T	P	99	
30	Phata Byung	Uttarakhand	Lanco Energy Pvt. Ltd.	P	76	
31	Srinagar	Uttarakhand	AHP Co. Ltd. (GVK)	P	330	BHEL
	TOTAL (HYDRO)				**9204**	

Appendix 1.9 (b)
Sheet (2/2)

LIST OF UNDER CONSTRUCTION NUCLEAR PROJECTS FOR LIKELY BENEFITS DURING 12TH PLAN

Sl.No.	PLANT NAME	STATE	AGENCY	SECTOR	FUEL TYPE	CAPACITY (MW)
1	RAPP U 7 & 8	RAJ	NPC	C	NUCLEAR	1400
2	KAPP U-3 & 4	GUJARAT	NPC	C	NUCLEAR	1400
	TOTAL (NUCLEAR)					**2800**

LIST OF GAS BASED STATIONS FOR WHICH GAS HAS BEEN TIED UP FROM LOCAL SOURCES

S.No.	Name of Power Station / Agency	Capacity (MW)	Located in State
	STATE SECTOR		
1	Ramgarh CCGT	160	Rajasthan
2	Namrup CCGT	100	Assam
	Sub Total (S.S.)	**260**	
	CENTRAL SECTOR		
1	Tripura Gas	726	Tripura
2	Monarchak	100	Tripura
	Sub Total (C.S.)	826	
	Total (All India)	**1086**	

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STATE WISE LIST OF HYDRO R&M, LIFE EXTENSION & UPRATING SCHEMES PROGRAMMED FOR COMPLETION DURING THE 12TH PLAN

As on 31.03.2011

S. No	Project, Agency	CS/ SS	Installed Capacity (MW)	Estimated Cost	Actual Expenditure	Benefits (MW)	Category	Year of Completion
				(Rs. in Crs.)				
Ongoing Schemes – Under implementation								
Himachal Pradesh								
1	Bhakra LB, BBMB	CS	5x108	489.77	170.92 (as on 31.12.10)	540.00 (LE) + 90.00 (U)	RMU&LE	2012-13
Jammu & Kashmir								
2	Chenani, J&KPDC	SS	5x4.66	39.14	3.49 (as on 31.12.10)	23.30 (LE)	RM&LE	2012-13
3	Sumbal Sindh, J&KPDC	SS	2x11.3	25.60	13.10 (as on 31.12.10)	-	R&M	2012-13
4	Lower Jhelum, J&KPDC	SS	3x35	101.30	68.45 (as on 31.12.10)	15.00 (Res.)	R&M+ Res.	2012-13
Uttar Pradesh								
5	Obra, UPJVNL	SS	3x33	31.70	11.454 (as on 31.12.10)	99.00 (LE)	RM&LE	2013-14
6	Rihand, UPJVNL	SS	6x50	132.20	46.325 (as on 31.12.10)	300.00 (LE)	RM&LE	2012-13
Uttarakhand								
7	Pathri, UJVNL	SS	3x6.8	71.59	-	20.40 (LE)	RM&LE	2013-14
Andhra Pradesh								
8	Srisailam RB, APGENCO	SS	7x110	16.70	13.36 (as on 28.02.10)	-	R&M	2012-13
Kerala								
9	Sabirigiri, KSEB	SS	6x50	104.36	96.95 (as on 31.12.10)	300.00 (LE) + 35.00(U)	RMU&LE	2012-13
10	Idamalayar, KSEB	SS	2x37.5	11.70	5.45 (as on 31.12.10)	-	R&M	2012-13
Tamil Nadu								
11	Periyar,TNEB	SS	4x35	161.18	82.43 (as on 28.02.11)	140.00 (LE) + 28.00(U)	RMU&LE	2013-14
West Bengal								
12	Maithon, U-1&3, DVC	CS	2x20	49.05	3.76 (as on 31.03.10)	40.00 (LE)	RM&LE	2013-14

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S. No	Project, Agency	CS/ SS	Installed Capacity (MW)	Estimated Cost	Actual Expenditure	Benefits (MW)	Category	Year of Completion
				(Rs. in Crs.)				
13	Jaldhaka St.I, WBSEB	SS	3x9	88.62	59.80 (as on 31.12.10)	27.00(LE)	RM&LE	2012-13
Maharashtra								
14	Koyna St.III, MSPGCL	SS	4x80	16.65	5.79 (as on 30.6.10)	320 (LE)	RM&LE	2012-13
Orissa								
15	Rengali OHPC	SS	1x50	47.50	3.40 (as on 31.12.10)	50(LE)	RM&LE	2012-13
16	Hirakud-II, OHPC	SS	3x24	125.52	58.73 (as on 31.03.10)	72.00 (LE)	RM&LE	2013-14
Assam								
17	Kopili, NEEPCO	CS	2x50 + 2x50	66.42	0.218 (as on 30.09.10)	-	R&M & Refurbishment of Units 1 & 2	2013-14
18	Khandong, NEEPCO	CS	2x25	20.57	0.213 (as on 30.09.10)	50.00 (LE)	RM&LE	2013-14
Meghalaya								
19	UmiumSt.II , MeSEB	SS	2x9	90.46	19.00 (as on 31.12.10)	2(U)+ 18.00 (LE)	RM&LE	2012-13
	Sub Total(A)		**3172.30**	**1690.03**	**662.84**	**2169.70**		
Ongoing Schemes – Under Tendering								
Jammu & Kashmir								
20	Ganderbal, J&KPDC	SS	2x3+ 2x4.5	39.30	6.24 (as on 31.12.10)	15.00 (LE)	RM&LE	XII Plan
Uttar Pradesh								
21	Matatila, UPJVNL	SS	3x10.2	10.29	1.00 (as on 31.12.10)	30.6 (LE)	RM&LE	XII Plan
Uttarakhand								
22	Khatima, UJVNL	SS	3x13.8	140.24	-	41.40 (LE)	RM&LE	XII Plan
23	Chilla(Ph-B), UJVNL	SS	4x36	472.00	-	22(U) + 144(LE)	RMU&LE	XII Plan
24	Dhakrani, UJVNL	SS	3x11.25	70.00	-	33.75 (LE)	RM&LE	XII Plan

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S. No	Project, Agency	CS/ SS	Installed Capacity (MW)	Estimated Cost	Actual Expenditure	Benefits (MW)	Category	Year of Completion
				(Rs. in Crs.)				
25	Dhalipur, UJVNL	SS	3x17	101.25	-	51.00 (LE)	RM&LE	XII Plan
26	Tiloth, UJVNL	SS	3x30	163.75	-	90 (LE)	RM&LE	XII Plan
27	Kulhal, UJVNL	SS	3x10	38.75	-	30(LE)	RM&LE	XII Plan
28	Chibro, UJVNL	SS	4x60	201.25	-	240(LE)	RM&LE	XII Plan
29	Khodri(Ph-B), UJVNL	SS	4x30	120.00	-	120(LE)	RM&LE	XII Plan
Tamil Nadu								
30	Sholayar-I, TNEB	SS	2x35	40.681	-	14.00(U) + 70.00(LE)	RMU&LE	XII Plan
Kerala								
31	Poringal-kuthu,KSEB	SS	4x8	9.55	2.34 (as on 31.12.10)	32.00 (LE)	RM&LE	XII Plan
Jharkhand								
32	Panchet, U-1, DVC	CS	1x40	58.22	1.99 (as on 31.03.10)	40.00 (LE)	RM&LE	XII Plan
Orissa								
33	Hirakud-I U5&6, OHPC	SS	2x37.5	92.37	0.25 (as on 31.12.10)	75.00 (LE)	RM&LE	XII Plan
34	Balimela, OHPC	SS	6x60	160	-	360(LE)	RM&LE	XII Plan
	Sub Total(B)		**1372.75**	**1717.65**	**11.82**	**1408.75**		
Ongoing Schemes – Under DPR Preparation/Finalisation								
Himachal Pradesh								
35	Giri, HPSEB	SS	2x30	48.48	-	60.00 (LE)	RM&LE	XII Plan
Andhra Pradesh								
36	Machkund , APGENCO	SS	3x17 (St.I) & 3x21.25 (St.II)	124.45	-	15.25 (U) + 114.75 (LE)	RMU&LE	XII Plan
Kerala								
37	Sholayar, KSEB	SS	3x18	54.00	0.044 (as on 31.12.10)	54.00 (LE)	RM&LE	XII Plan
38	Kuttiadi, KSEB	SS	3x25	25.00	-	75.00 (LE)	RM&LE	XII Plan

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S. No	Project, Agency	CS/ SS	Installed Capacity (MW)	Estimated Cost	Actual Expenditure	Benefits (MW)	Category	Year of Completion
				(Rs. in Crs.)				
Meghalaya								
39	Kyrdemkulai, MeSEB	SS	2x30	168.00	-	60.00 (LE) 6.00 (U)	RMU & LE	XII Plan
	Sub Total(C)		**363.75**	**419.93**	**0.044**	**385.00**		
Ongoing Schemes – Under RLA Studies								
Andhra Pradesh								
40	Upper Sileru, APGENCO	SS	4x60	10.00	-	-	R&M	XII Plan
Tamil Nadu								
41	Kodayar Ph.I, TNEB	SS	1x60	30.00	-	60.00 (LE)	RM&LE	XII Plan
42	Kodayar PH-II, TNEB	SS	1x40	19.94	-	40.0(LE)	RM&LE	XII Plan
	Sub Total(D)		**340.00**	**59.94**	**-**	**100.00**		
	Total (A+B+C+D)		**5248.80**	**3887.55**	**674.70**	**4063.45 [212.25(U) + 3836.20(LE) + 15.0 (Res.)]**		

Abbreviations:
R&M – Renovation & Modernisation;
RM&U – Renovation, Modernisation & Uprating,
RM&LE – Renovation, Modernisation & Life Extension
RMU&LE – Renovation, Modernisation, Uprating & Life Extension;
R&M+Res.-Renovation & Modernisation + Restoration;
RM&LE+Res.- Renovation, Modernisation & Life Extension + Restoration;
RM&U+Res. – Renovation, Modernisation & Uprating + Restoration.
MW – Mega Watt; Res – Restoration; U – Uprating; LE – Life Extension

LIST OF THERMAL UNITS PROGRAMMED FOR LIFE EXTENSION WORKS DURING 12TH PLAN

Appendix 1.10
(Sheet 1 of 5)

1. STATE SECTOR

Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		LMZ / KWU	Remarks
							Boiler	TG		
Northern Region										
1	U.P.	UPRVUNL	Obra	11	1977	200	BHEL	BHEL	LMZ	Slip from 11th Plan
2	U.P.	UPRVUNL	Obra	12	1981	200	BHEL	BHEL	LMZ	Slip from 11th Plan
3	U.P.	UPRVUNL	Obra	12	1982	200	BHEL	BHEL	LMZ	Slip from 11th Plan
4	U.P.	UPRVUNL	Parichha	1	1984	110	BHEL	BHEL		Slip from 11th Plan
5	U.P.	UPRVUNL	Parichha	2	1985	110	BHEL	BHEL		Slip from 11th Plan
6	U.P.	UPRVUNL	Panki	3	1976	105	BHEL	BHEL		Slip from 11th Plan
7	U.P.	UPRVUNL	Panki	4	1977	105	BHEL	BHEL		Slip from 11th Plan
8	U.P.	UPRVUNL	Anpara"A"	1	1986	210	BHEL	BHEL	KWU	Slip from 11th Plan
9	U.P.	UPRVUNL	Anpara"A"	2	1986	210	BHEL	BHEL	KWU	Slip from 11th Plan
10	U.P.	UPRVUNL	Anpara"A"	3	1988	210	BHEL	BHEL	KWU	Slip from 11th Plan
	Sub Total			10		1660				
11	Punjab	PSPCL	Ropar	1	1984	210	BHEL	BHEL	KWU	Slip from 11th Plan
12	Punjab	PSPCL	Ropar	2	1985	210	BHEL	BHEL	KWU	Slip from 11th Plan
13	Punjab	PSPCL	Bathinda	4	1979	110	BHEL	BHEL		Slip from 11th Plan
	Sub Total			3		530				
14	Haryana	HPGCL	Panipat	3	1985	110	BHEL	BHEL		Being taken up under W.Bank EE R&M programme
15	Haryana	HPGCL	Panipat	4	1985	110	BHEL	BHEL		
	Sub Total			2		220				
							Boiler	TG		
16	Rajasthan	RRVUNL	Kota	1	1983	110	BHEL	BHEL		
17	Rajasthan	RRVUNL	Kota	2	1983	110	BHEL	BHEL		
	Sub Total			2		220				
	Sub Total Northern Region			**17**		**2630**				
Western Region										
18	Gujarat	GSECL	Ukai	3	1979	200	BHEL	BHEL	LMZ	
19	Gujarat	GSECL	Ukai	4	1979	200	BHEL	BHEL	LMZ	
20	Gujarat	GSECL	Wanakbori	1	1982	210	BHEL	BHEL	KWU	
21	Gujarat	GSECL	Wanakbori	2	1983	210	BHEL	BHEL	KWU	
	Sub Total			4		820				
22	Maharashtra	MAHAGENCO	Nashik	3	1979	210	BHEL	BHEL	LMZ	Taken up under KfW funded EER&M programme. Feasibility study report / DPR under preparation
23	Maharashtra	MAHAGENCO	Nashik	4	1980	210	BHEL	BHEL	LMZ	

Appendix 1.10
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Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		LMZ / KWU	Remarks
							Boiler	TG		
24	Maharashtra	MAHAGENCO	Koradi	5	1978	210	BHEL	BHEL	LMZ	
25	Maharashtra	MAHAGENCO	Koradi	6	1982	200	BHEL	BHEL	LMZ	Being taken up under W.Bank EE R&M programme.
26	Maharashtra	MAHAGENCO	Bhusawal	2	1979	210	BHEL	BHEL	LMZ	
27	Maharashtra	MAHAGENCO	Bhusawal	3	1982	210	BHEL	BHEL	LMZ	
28	Maharashtra	MAHAGENCO	Chandrapur	1	1983	210	BHEL	BHEL	LMZ	
29	Maharashtra	MAHAGENCO	Chandrapur	2	1984	210	BHEL	BHEL	LMZ	
30	Maharashtra	MAHAGENCO	Parli	3	1980	210	BHEL	BHEL	LMZ	
	Sub Total			9		1880				
31	Chattisgarh	CSEB	Korba (West)	1	1983	210	BHEL	BHEL	KWU	
32	Chattisgarh	CSEB	Korba (West)	2	1984	210	BHEL	BHEL	KWU	
	Sub Total			2		420				
33	Madhya Pradesh	MPPGCL	Satpura	6	1979	200	BHEL	BHEL	LMZ	
34	Madhya Pradesh	MPPGCL	Satpura	7	1979	210	BHEL	BHEL	LMZ	
	Sub Total			2		410				
	Sub Total Western Region			**17**		**3530**				
Southern Region										
35	Tamil Nadu	TNEB	Tuticorin	1	1979	210	BHEL	BHEL	LMZ	
36	Tamil Nadu	TNEB	Tuticorin	2	1980	210	BHEL	BHEL	LMZ	
	Sub Total			2		420				
37	Andhra Pradesh	APGENCO	Dr. N.T. TPS (Vijaywada)	1	1979	210	BHEL	BHEL	LMZ	
38	Andhra Pradesh	APGENCO	Dr. N.T. TPS (Vijaywada)	2	1980	210	BHEL	BHEL	LMZ	
	Sub Total			2		420				
39	Karnataka	KPCL	Raichur	1	1985	210	BHEL	BHEL	KWU	
40	Karnataka	KPCL	Raichur	2	1986	210	BHEL	BHEL	KWU	
	Sub Total			2		420				
	Sub Total Southern Region			**6**		**1260**				
Eastern Region										
41	West Bengal	WBPDCL	Kolaghat	1	1990	210	AVB	BHEL	LMZ	
42	West Bengal	WBPDCL	Kolaghat	2	1985	210	AVB	BHEL	LMZ	
43	West Bengal	WBPDCL	Kolaghat	3	1984	210	AVB	BHEL	LMZ	Taken up under KfW funded EER&M programme.
44	West Bengal	WBPDCL	Bandel	5	1982	210	AVB	BHEL	LMZ	Slip from 11th Plan
	Sub Total			4		840				
45	Bihar	BSEB	Barauni	6	1983	110	BHEL	BHEL		Slip from 11th Plan
46	Bihar	KBUNL	Muzaffarpur	2	1986	110	BHEL	BHEL		Slip from 11th Plan
	Sub Total			2		220				
	Sub Total Eastern Region			**6**		**1060**				
	SUB TOTAL STATE SECTOR			**46**		**8480**				

Appendix 1.10
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2. CENTRAL SECTOR

Sl. No.	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		LMZ / KWU	Remarks
						Boiler	TG		
1	NLC	Neyveli M/C	1	1988	210	TE	FT	KWU	
2	NLC	Neyveli M/C	2	1987	210	TE	FT	KWU	
3	NLC	Neyveli M/C	3	1986	210	TE	FT	KWU	
	Sub Total		**3**		**630**				
4	DVC	Bokaro 'B'	1	1986	210	ABL	BHEL	LMZ	Taken up under KfW funded EER&M programme. Feasibility study report / DPR under preparation
5	DVC	Bokaro 'B'	2	1990	210	ABL	BHEL	LMZ	
6	DVC	Bokaro 'B'	3	1993	210	ABL	BHEL	LMZ	
7	DVC	Durgapur	4	1982	210	BHEL	BHEL	LMZ	
	Sub Total		**4**		**840**				
8	NTPC	Badarpur	4	1978	210	BHEL	BHEL	LMZ	Slip from 11th Plan
9	NTPC	Badarpur	5	1981	210	BHEL	BHEL	LMZ	Slip from 11th Plan
10	NTPC	Singrauli STPS	1	1982	200	BHEL	BHEL	LMZ	Slip from 11th Plan
11	NTPC	Singrauli STPS	2	1982	200	BHEL	BHEL	LMZ	Slip from 11th Plan
12	NTPC	Singrauli STPS	3	1983	200	BHEL	BHEL	LMZ	
13	NTPC	Singrauli STPS	4	1983	200	BHEL	BHEL	LMZ	
14	NTPC	Singrauli STPS	5	1984	200	BHEL	BHEL	LMZ	
15	NTPC	Singrauli STPS	6	1986	500	BHEL	BHEL	KWU	
16	NTPC	Singrauli STPS	7	1987	500	BHEL	BHEL	KWU	
17	NTPC	Korba STPS	1	1983	200	BHEL	BHEL	KWU	Slip from 11th Plan
18	NTPC	Korba STPS	2	1983	200	BHEL	BHEL	KWU	
19	NTPC	Korba STPS	3	1984	200	BHEL	BHEL	KWU	

Appendix 1.10
(Sheet 4 of 5)

Sl. No.	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		LMZ / KWU	Remarks
						Boiler	TG		
20	NTPC	Korba STPS	4	1987	500	BHEL	BHEL	KWU	
21	NTPC	Korba STPS	5	1988	500	BHEL	BHEL	KWU	
22	NTPC	Korba STPS	6	1989	500	BHEL	BHEL	KWU	
23	NTPC	Ramagundam STPS	1	1984	200	Ansaldo	Ansaldo	KWU	Slip from 11th Plan
24	NTPC	Ramagundam STPS	2	1984	200	Ansaldo	Ansaldo	KWU	
25	NTPC	Ramagundam STPS	3	1984	200	Ansaldo	Ansaldo	KWU	
26	NTPC	Ramagundam STPS	4	1988	500	BHEL	BHEL	KWU	
27	NTPC	Ramagundam STPS	5	1989	500	BHEL	BHEL	KWU	
28	NTPC	Ramagundam STPS	6	1989	500	BHEL	BHEL	KWU	
29	NTPC	Farakka Stage-I	1	1986	200	BHEL	BHEL	KWU	
30	NTPC	Farakka Stage-I	2	1986	200	BHEL	BHEL	KWU	
31	NTPC	Farakka Stage-I	3	1987	200	BHEL	BHEL	KWU	
32	NTPC	Vindhyachal	1	1987	210	USSR	USSR	LMZ	
33	NTPC	Vindhyachal	2	1988	210	USSR	USSR	LMZ	
34	NTPC	Vindhyachal	4	1990	210	USSR	USSR	LMZ	
35	NTPC	Vindhyachal	5	1990	210	USSR	USSR	LMZ	
36	NTPC	Rihand	1	1988	500	ICL (UK)	GEC(UK)	KWU	
37	NTPC	Rihand	2	1989	500	ICL (UK)	GEC(UK)	KWU	

Appendix 1.10
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Sl. No.	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		LMZ / KWU	Remarks
						Boiler	TG		
38	NTPC	Dadri GT	GT-1	1992	131	SIEMENS			Slip from 11th Plan
39	NTPC	Dadri GT	GT-2	1992	131	SIEMENS			Slip from 11th Plan
40	NTPC	Dadri GT	GT-3	1992	131	SIEMENS			Slip from 11th Plan
41	NTPC	Dadri GT	GT-4	1992	131	SIEMENS			
42	NTPC	Auraiya GT	GT-1	1989	111.19	MHI, Japan			Slip from 11th Plan
43	NTPC	Auraiya GT	GT-2	1989	111.19	MHI, Japan			Slip from 11th Plan
44	NTPC	Auraiya GT	GT-3	1989	111.19	MHI, Japan			Slip from 11th Plan
45	NTPC	Auraiya GT	GT-4	1989	111.19	MHI, Japan			
46	NTPC	Kawas GT	GT-1	1992	106	GE			Slip from 11th Plan
47	NTPC	Kawas GT	GT-2	1992	106	GE			Slip from 11th Plan
48	NTPC	Kawas GT	GT-3	1992	106	GE			Slip from 11th Plan
49	NTPC	Kawas GT	GT-4	1992	106	GE			
50	NTPC	Gandhar GT	GT-1	1994	131	ABB			Slip from 11th Plan
51	NTPC	Gandhar GT	GT-2	1994	131	ABB			Slip from 11th Plan
52	NTPC	Gandhar GT	GT-3	1994	131	ABB			
53	NTPC	Faridabad CCPS	GT-1	1999	143	Siemens			
54	NTPC	Faridabad CCPS	GT-2	1999	143	BHEL			
55	NTPC	Rajiv Gandhi CCPS	GT-1	1998	115	GE			
56	NTPC	Rajiv Gandhi CCPS	GT-2	1999	115	BHEL			
57	NTPC	Anta GTPS	ST-1	1990	149	ABB			
58	NTPC	Auraiya CCPS	ST-1	1989	109	MHI, Japan			
59	NTPC	Auraiya CCPS	ST-2	1990	109	MHI, Japan			
	Sub Total		**52**		**11728.76**				
	SUB TOTAL CENTRAL SECTOR		**59**		**13198.76**				

TOTAL OF 12TH PLAN (LE) :

NUMBER OF UNITS : **105**
CAPACITY (MW) : **21679**

LIST OF THERMAL UNITS PROGRAMMED FOR R&M WORKS DURING 12TH PLAN.

Appendix 1.11
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1. STATE SECTOR

Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make	
							Boiler	TG
Northern Region								
1	U.P.	UPRVUNL	Anpara 'B'	4*	1993	500	BHEL	BHEL
2	U.P.	UPRVUNL	Obra	5*	1994	500	BHEL	BHEL
3	U.P.	UPRVUNL	Obra	7*	1974	100	BHEL	BHEL
4	U.P.	UPRVUNL	Obra	8*	1975	100	BHEL	BHEL
	Sub Total			4		1200		
5	Punjab	PSEB	Ropar	5	1992	210	BHEL	BHEL
6	Punjab	PSEB	Ropar	6	1993	210	BHEL	BHEL
	Sub total			2		420		
7	Haryana	HPGCL	Panipat	6	2001	210	BHEL	BHEL
Total Northern Region				**7**		**1830**		
Eastern Region								
8	Jharkhand	JSEB	Patratu	9*	1984	110	BHEL	BHEL
9	Jharkhand	JSEB	Patratu	10*	1986	110	BHEL	BHEL
	Sub-Total			2		220		
10	West Bengal	DPL	Durgapur	6*	1985	110	AVB	BHEL
Total Eaatern Region				**3**		**330**		
TOTAL STATE SECTOR				**10**		**2160**		
2. CENTRAL SECTOR								
1	NTPC		Unchahar	3	1999	210	BHEL	BHEL
2	NTPC		Unchahar	4	1999	210	BHEL	BHEL
3	NTPC		Vindhyachal	7	1999	210	BHEL	BHEL
4	NTPC		Vindhyachal	8	2000	210	BHEL	BHEL
5	NTPC		Simhadri	1	2002	500	BHEL	BHEL
6	NTPC		Simhadri	2	2002	500	BHEL	BHEL
7	NTPC		Kahalgaon	4	1996	210	BHEL	BHEL
8	NTPC		Talcher STPS	1	1995	500	BHEL	BHEL
9	NTPC		Talcher STPS	2	1996	500	BHEL	BHEL
10	NTPC		Talcher STPS	3	2003	500	BHEL	BHEL
11	NTPC		Talcher STPS	4	2003	500	BHEL	BHEL
	Sub Total			**11**		**4050**		

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Sl. No.	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make
12	NEEPCO	Kathalguri CCGT	GT-1	1995	33.50	Mitsubishi, Japan
13	NEEPCO	Kathalguri CCGT	GT-2	1995	33.50	Mitsubishi, Japan
14	NEEPCO	Kathalguri CCGT	GT-3	1995	33.50	Mitsubishi, Japan
15	NEEPCO	Kathalguri CCGT	GT-4	1995	33.50	Mitsubishi, Japan
16	NEEPCO	Kathalguri CCGT	GT-5	1996	33.50	Mitsubishi, Japan
17	NEEPCO	Kathalguri CCGT	GT-6	1996	33.50	Mitsubishi, Japan
18	NEEPCO	Kathalguri CCGT	ST-1	1998	30.00	BHEL
19	NEEPCO	Kathalguri CCGT	ST-2	1998	30.00	BHEL
20	NEEPCO	Kathalguri CCGT	ST-3	1998	30.00	BHEL
	Sub Total		**9**		**291.00**	
TOTAL CENTRAL SECTOR			**20**		**4341.00**	

Notre:* Slip from 11th Plan
TOTAL OF 12TH PLAN (R&M) :
NUMBER OF UNITS : 30
CAPACITY (MW) : 6501
Total of 12th Plan (LE+R&M) 135

Capacity (MW) 28180

CHAPTER – 2

TRANSMISSION PLANNING

2.0 INTRODUCTION

The transmission systems in the country consist of Inter-State and Intra State Transmission System. Over decades a robust inter-state and inter-regional transmission system has evolved in the country. Inter State (and Inter-regional) transmission system is mainly owned by POWERGRID. In future, Inter-State Transmission System (ISTS) schemes would also be built through competitive bidding by private sector entities. Already, a number of such schemes by the private sector or joint venture between private sector and POWERGRID are under construction. Planning and developing inter-state transmission system for IPP projects is a challenging task because there is greater uncertainty about their actual materialization, commissioning schedule and their beneficiaries are most often not known at the time of transmission planning. The process of transmission planning and development has become very dynamic in the market driven scenario. To reduce Right Of Way(ROW) requirements for transmission lines and overcome constraints in availability of land for substations, 765 kV transmission voltage is being increasingly adopted and GIS substations are being provided wherever availability of land is a problem. Massive expansion of inter-state transmission system is under way to cater to the transmission requirement of new generation projects.

2.1 GROWTH OF TRANSMISSION SYSTEM

At the time of Independence, power systems in the country were essentially isolated systems developed in and around urban and industrial areas and the highest transmission voltage was 132 kV. The state-sector network grew at voltage level up to 132 kV during the 50s and 60s and then to 220 kV during 60s and 70s. Subsequently, in many states (U.P., Maharashtra, M.P., Gujarat, Orissa, A.P., and Karnataka) substantial 400kV network was also added as large quantum of power was to be transmitted over long distances.

To supplement the efforts of the states in increasing generation capacities, Central Sector generation utilities viz. National Hydroelectric Power Corporation (NHPC) and National Thermal Power Corporation (NTPC) were created in 1975. These corporations established large generating stations for the benefit of States in a region. These corporations also undertook development of associated transmission lines, for evacuation of power and delivery of power to the beneficiary States transcending state boundaries. By the end of 1980s, strong regional networks came into existence and in 1989, transmission wings of Central generating companies were separated to set up Power Grid Corporation of India (POWERGRID). Power grid was set up to give thrust to implementation of transmission system associated with Central generating stations and inter-Regional transmission programme based on perspective planning done by Central Electricity Authority (CEA).

Considering the operational regime of the various Regional Grids, it was decided around 1990s to establish initially asynchronous connection between the Regional Grids to enable them to exchange large regulated quantum of power. Accordingly, a 500 MW asynchronous HVDC back-to-back link between the NR - WR at Vindhyachal was established. Subsequently, similar links between WR – SR (1000 MW capacity at Bhadrawati), between ER – SR (1000 MW capacity at Gazuwaka) and between ER – NR (500 MW capacity at Sasaram), were established. In 1992 the Eastern Region and the North-Eastern Region were synchronously interconnected through a Birpara-Salakati 220kV double circuit transmission line and subsequently by a 400 kV D/C Bongaigaon -Malda line. Western Region was interconnected to ER-NER system synchronously through 400kV Rourkela-Raipur D/C line in 2003 and thus the Central India system consisting of ER-NER-WR came in to operation. In 2006 with commissioning of Muzaffarpur-Gorakhpur 400kV D/C line, the Northern region also got interconnected to this system making an upper India system (‘NEW’ grid) having the NR-WR-ER-NER system.

Recognizing the need for development of National grid, thrust was given to enhance the capacity of inter-regional links in a phased manner. Total inter-regional transmission capacity at the end of 9th Plan was 5,750 MW. During 10th Plan i.e. 2002-07, a total of 8300 MW of inter-regional capacities were added. Total inter-regional transmission capacity at the end of 10th Plan was 14,050 MW. In order to facilitate evacuation of power from various hydro power projects in the country, CEA has evolved river basin wise transmission plans in consultation with the State Transmission Utilities. An Integrated transmission system for evacuation of power from hydro generating projects proposed in river basins of Uttarakhand, Himachal Pradesh, Arunachal Pradesh and Sikkim has been evolved.

2.2 REVIEW OF ACHIEVEMENTS DURING 11TH PLAN

2.2.1 Programme and achievements during 11th plan

A programme for construction of 88,515 ckm transmission lines for evacuation of power from generating stations as well as for strengthening of transmission network was envisaged at the beginning of the 11th Plan corresponding to generation capacity addition programme of 78,700 MW. Subsequently, during the mid-term appraisal by the Planning Commission, generating capacity target for the 11th plan was scaled down to 62,374 MW. Accordingly, 68,673 ckm of transmission line addition in the 11th plan was anticipated during Mid-Term appraisal of the Planning Commission. This comprises 2,773 ckm of 765 kV lines, 40,000 ckm of 400 kV lines, 24,300 ckm for 230/220 kV lines and 1600 ckm for HVDC lines. Against this programme, actual addition of transmission lines during first four years of 11th Plan is 49,852 ckm comprising of 1,636 ckm of 765 kV lines, 1580 ckm of HVDC lines, 26,856 ckm of 400 kV lines and 19,780 ckm of 230/220 kV lines .

A programme of 1,57,691 MVA of transformation capacity corresponding to generation capacity addition programme of 78,700 MW was envisaged at the beginning of the 11th Plan. During the mid-term appraisal by the Planning Commission, no revision in transformation capacity addition programme was indicated. Against the original programme of 1,57,691 MVA at the beginning of 11th plan, the actual achievement of transformation capacity addition during the first four years of 11th Plan is 99,075 MVA comprising of 4,500 MVA of 765 kV, 3,000 MW for HVDC, 40,920 MVA for 400 kV and 50,655 MVA for 230/220 kV.

For the terminal year of 11th Plan period i.e. 2011-12, a programme of transmission line addition of 21,792 Ckm and transformation capacity addition of 27,380 MVA has been made. In the event of full achievement of these targets for 2011-12, the total achievements during 11th Plan would be 71,644 ckm for transmission line addition, 1,23,455 MVA AC transformation capacity additions and 5,500 MW of HVDC terminal capacity addition. The following table indicates the programme, achievements during the first four years of the 11th Plan and anticipated additions in 11th Plan for transmission lines and substations.

Table 2.1

Transmission Lines- 11th Plan Programme & Achievement

(All figures in circuit kms)

Voltage level	XI plan programme	Achievement up to Mar 2011 during XI Plan	Anticipated addition during 2011-12	Anticipated addition in 11th Plan
765 kV	2773	1636	824	**2460**
± 500 kV HVDC	1600	1580	2000	**3580**
400 kV	40000	26856	12401	**39257**
220 kV	24300	19780	6567	**26347**
Total	**68673**	**49852**	**21792**	**71644**

Table: 2.2

Sub Stations & HVDC Terminal capacity- 11th Plan Programme & Achievement

(Figures in MVA/MW)

Voltage level	XI plan Programme	Achievement up to March 2011 during XI plan	Anticipated addition during 2011-12	Anticipated addition in 11th Plan
765 kV	24500	4500	4000	**8500**
400 kV	51960	40920	8725	**49645**
220 kV	72731	50655	14655	**65310**
Total – AC Substation capacity in MVA	**149191**	**96075**	**27380**	**123455**
± 500 kV HVDC	8500	3000	2500	**5500**
Total- HVDC terminal capacity in MW	**8500**	**3000**	**2500**	**5500**

The following table gives the cumulative growth in transmission lines and substation capacity at the end of various Plan periods.

Table 2.3

CUMULATIVE GROWTH IN TRANSMISSION LINES					
	Unit	At the end of 8th Plan i.e. March 1997	At the end of 9th Plan i.e. March 2002	At the end of 10th Plan i.e. March 2007	Anticipated at the end of 11th Plan i.e. March 2012
Transmission Lines					
765 kV	Ckm	0	1160	2184	**4644**
HVDC	Ckm	1634	4738	5872	**9452 ***
400 kV	Ckm	36142	49378	75722	**114979**
230/220 kV	Ckm	79600	96993	114629	**140976**
Total	Ckm	117376	152269	198407	**270051**
CUMULATIVE GROWTH IN SUBSTATION CAPACITY					
Substations					
765 kV	MVA	0	0	0	**8500**
HVDC	MW	0	5200	8200	**13500****
400 kV	MVA	40865	60380	92942	**142587**
230/220 kV	MVA	84177	116363	156497	**221807**
Total	MVA/ MW	125042	181943	257639	**386394**

Note: Growth figures upto the end of 10th plan as given above for transmission lines are for achievement of stringing. It is assumed that length of transmission line commissioned upto the end of 10th Plan is same as the length of transmission line strung upto the end of the 10th Plan. The anticipated transmission line addition during 11th Plan is added to the length of the line strung upto end of the 10th Plan to arrive at the growth figures at the end of 11th Plan.

*** including 2500 MW, 1000 km by Adani Power**
**** The 200 MW HVDC Monopole between Bursur- L.Sileru is not in operation.**

2.2.2 Inter-regional capacity addition during 11th Plan

The total inter-regional transmission capacity at the beginning of 11th Plan was 14,050 MW. During Mid Term Review of 11th Plan, additional inter-regional transmission systems of 18,600 MW capacities were anticipated, taking the expected inter-regional capacity to 32,650 MW by end of 11th Plan. Out of the programme for 11th Plan, 2400 MW capacity was added during 2007-08, 3300 MW during 2008-09, 1000 MW during 2009-10 and no addition during 2010-11. Thus a capacity addition of 6700 MW has already been added in 11th Plan up to 31-03-2011. With these additions the total transmission capacity of inter-regional transmission system, as on 31-03-2011 is 20,750 MW. The Barh – Balia 400kV Quad D/C line of 1600 MW transmission capacity has been completed but this line is yet to be commissioned as the associated Barh generation project is getting delayed. In addition, two more inter-regional links i.e. Gaya–Balia 765kV S/C (2100 MW) and Rourkela- Raigarh 400kV

D/C line with series compensation (1400 MW) lines are under construction and likely to be completed within 11th Plan period. With these links, total inter-regional capacity, on all India basis is anticipated to be 25,850 MW by end of 11th Five Year Plan. Thus there would be shortfall of 6800 MW in inter-regional transmission capacity addition during 11th Plan. This is on account of Ranchi – WR (Bilaspur) Pooling Point 765kV S/C (2100 MW), Sasaram-Fathepur 765 kV S/C (2100 MW) and 400 kV D/C Bongaigaon-Siliguri 400 kV D/ C Quad (1600 MW) which have slipped to 12th Plan. The 1000 MW Narendra – Kolhapur HVDC back-to-back has been dropped. The delay in Sasaram-Fatehpur 765 kV S/c line is on account of delay in commissioning of DVC generation projects with which this line is associated. The transmission service provider for Bongaigaon-Siliguri line has been selected through tariff based competitive bidding in 2010 and as per the terms of the award this line is now expected in early 12th Plan.

2.2.3 Fund Requirement and actual utilization during 11th Plan

Total Fund requirement for transmission system development and related schemes as estimated at the beginning of XI plan was Rs 1,40,000 Crore(Central Sector- Rs 75,000 Crore, and State Sector- Rs 65,000 Crore). Against this estimated funds requirement, the total utilization during XI Plan is anticipated to be of the order of Rs. 1,22,800 Crore.

2.2.4 Analysis and Reasons for shortfall in targets

The achievement of transmission line addition in the first four years of the 11th plan has been by and large satisfactory. The shortfall in addition of transformation capacity is mainly on account of substations associated with the generation projects which have now slipped to 12th Plan. It is expected that in the terminal year of 11th plan, the transmission line target would be fully met.

2.3 OPEN ACCESS IN TRANSMISSION AND TRADING OF ELECTRICITY

2.3.1 Transmission Planning keeping in view Open Access

Based on application by a generator for Long Term Open Access, the transmission system is planned for evacuation of power from generating stations. The system planning studies are carried out considering projected demand in accordance with load forecasts. The loads of various States are assumed irrespective of any PPAs. However adequate intra-state transmission system is also required to absorb power injected from ISTS. During the planning process, some design margins get created in the network generally due to long term optimisation. These margins, along with operational and reliability margins which are variable in nature and depend upon system conditions and load flow pattern at that time provide sufficient additional capacity in the system for trading and States to buy power more than their long-term PPAs. However, these margins can be utilized only up to a limit and may result into congestion if States start buying Power much in excess of their forecasted requirements.

2.3.2 Provisions in Electricity Act and CERC Regulation

Enactment of the Electricity Act, 2003 has opened up hitherto constrained electricity market which was characterized by long term PPAs and inability of Distribution Companies and consumers to have a choice of suppliers. Besides, de-licensing generation and removing controls on captive generation, the provision regarding availability of non-discriminatory open access in transmission from the very beginning and open access in distribution in a phased manner are important features of the Act. This creates an enabling environment for competition among generators/traders to choose their customers and vice-versa.

Access to inter-State transmission system is governed by the regulations of the Central Electricity Regulatory Commission. The Central Transmission Utility (CTU) is the nodal agency for providing medium term (3 months to 3 years) and long term (12 to 25 years) access that is typically required by a generating station or a trader on its behalf. The nodal agency for grant of short term open access (up to three months) is the Regional Load Dispatch Centre. The nodal agency for providing transmission access to the power exchanges is the National Load Dispatch Centre.

2.3.3 Long term Open access in inter-state transmission

2.3.3.1 The nodal agency for providing long term open access in inter-state transmission is the CTU. Up till March 2011, CTU has received about 187 Long Term Access(LTA) applications for transfer of power from their generation projects of capacity of about 1,77,000 MW to various target regions. The applications were processed by CTU and progress of each generation project in terms of land acquisition, fuel tie-up, environment and forest clearance, water linkage, EPC award, financial closure etc. was reviewed by CTU and CEA. Based on the progress, LTA has been granted to 135 applicants with capacity of about 1,17,000 MW. Out of this, transmission system is already in place for a capacity of about 43,500 MW and system strengthening identified for a capacity of about 73,500MW. The progress of balance 52 applications with capacity of about 60,000MW was not up to the mark and was proposed to close/review the application based on subsequent progress.

2.3.3.2 The grant of Long Term Access generally involves evolution or strengthening of the ISTS to accommodate desired transaction of power and is akin to transmission planning. The primary inputs required for transmission planning include (i) generation plant capacity, (ii) its location, (iii) time frame of materialization, (iv) beneficiaries to whom the power shall be delivered etc. However, in the present circumstances, none of these inputs are available with certainty. Under such a situation where the basic inputs required for evolving a transmission Plan are not available readily, it is prudent that transmission planners follow some innovative strategies to ensure fulfillment of broad objectives including ensuring that (i) transmission development takes place to cater to the transmission requirement, (ii) bottling up of the power is avoided, (iii) mismatch of generation and transmission system is avoided, (iv) congestion if observed in some part of grid should be removed at the earliest etc. In view of above it is a challenge to evolve optimal transmission system and once the plan is in place it is equally challenging to plan its implementation so as to avoid mismatch between development of generation project and transmission system.

2.3.3.3 Most of the generation projects for which additional system strengthening has been identified are mainly located in Orissa, Chhattisgarh, Sikkim, Jharkhand, Madhya Pradesh, coastal Andhra Pradesh and Tamil Nadu. While processing these applications, readiness of generation projects in terms of above parameters was examined in association with the beneficiaries of concerned regions and CEA. For the generation projects having no firm beneficiaries, transmission system requirement has been worked out on the basis of target beneficiaries/regions. Based on the information furnished by the applicants, group of generation projects who have made progress on ground were prioritized and considered for grant of Long Term Access. For this, system strengthening has been identified which includes 11 nos. High Capacity Power Transmission Corridors catering to about 58,000 MW generation capacity and also comprises of latest technologies like 765kV AC / ±800kV HVDC. The High Capacity Power Transmission Corridors include:

- Transmission System Associated with Phase-I Generation Projects in Orissa
- Transmission System Associated with IPP projects in Jharkhand
- Transmission System Associated with IPP projects in Sikkim
- Transmission System Associated with IPP projects in Bilaspur complex, Chattisgarh & IPPs in Madhya Pradesh
- Transmission System Associated with IPP projects in Chattisgarh
- Transmission System Associated with IPP projects in Krishnapatnam Area, Andhra Pradesh
- Transmission System Associated with IPP projects in Tuticorin Area, Tamil Nadu
- Transmission System Associated with IPP projects in Srikakulam Area, Andhra Pradesh
- Transmission System Associated with IPP projects in Southern Region for transfer of power to other regions
- Transmission System Associated with IPP projects in Vemagiri area in SR for power transfer to other regions
- Transmission System Associated with IPP projects in Nagapattinam / Cuddalore area in SR for power transfer to other regions

The transmission corridors shall be commissioned progressively matching with commissioning of IPP generation projects.

2.3.3.4 Challenges in processing LTA

Distribution utilities, to meet their long term requirement of power, are not inviting Case-1/ Case-2 bids. In absence of firm beneficiaries, transmission is being developed based on target beneficiaries indicated by the generation project developers. Absence of firm beneficiaries may result into sub-optimal utilisation in one part of grid or congestion in another part. Further, the time schedule of commissioning of some of the generation projects is not certain. This puts a lot of risk on investment in transmission infrastructure and also, the time line for implementation of transmission system by CTU/ other transmission licensees becomes difficult to meet.

2.3.4 Medium term Open Access (MTOA)

Only two (2) applications were received for MTOA from UT Dadar and Nagar Haveli and UT Daman & Diu in Western Region for transfer of 54MW from 500MW NSPCL generating station in Bhilai (Chhattisgarh). MTOA has been granted.

2.3.5 Short Term Open Access

Short term Customer or the power exchange on behalf of buyers and sellers intending to avail short term access makes an application to the nodal agency. The short term customers are eligible for short term open access over the surplus capacity available after use by long term customers and medium term customers due to inherent design margins available. The application for bilateral transaction contains details such as name and location of the supplier and buyer, contracted power (MW) to be scheduled, point of injection, point of drawal, starting time block and date etc. Whenever the proposed bilateral transaction has a State utility or an intra state entity as buyer or seller, concurrence of the State Load Despatch centre shall be obtained in advance and submitted along with the application. A Summary of the short term transactions bilateral and collective processed is as under:

Table 2.4
Summary of Open Access short term transactions

Year	No. of transactions			Approved Energy in MUs		
Year	Bilateral	Collective	Total	Bilateral	Collective	Total
2004-05	778	-	778	16441	-	**16441**
2005-06	3938	-	3938	22526	-	**22526**
2006-07	5933	-	5933	23598	-	**23598**
2007-08	9560	-	9560	29831	-	**29831**
2008-09	11781	3633	15414	27756	2765	**30521**
2009-10	8154	9974	18128	32371	7086	**39457**
2010-11	6154	13729	19883	41693	13539	**55232**
Total	**46298**	**27336**	**73634**	**194216**	**23390**	**217606**

2.3.6 Transmission Congestion

As self dispatched entities, seasonal trading is done by the distribution utilities to meet their seasonal demand or sell their seasonal surplus. Short term trading on day-ahead basis is required for balancing the demand with supply. Short term trading is also required for meeting contingency requirement. Normally, there should be regular pattern of short term trading which may vary depending on uncertain factors like weather. However, in India the pattern of short term trading is erratic and depends on many extraneous factors particularly availability of funds with deficit Discoms etc. Sometimes a State may suddenly decide to reduce load shedding and resort to heavy short term purchase through trading. In such a situation, the drawal has to be restricted to the margins available in the planned transmission capacity. It is not possible to plan transmission system for catering to such a situation. In the Northern Region the congestion has often occurred due to heavy reactive power drawal during agricultural season and dry weather by some States like Haryana and Punjab.

2.3.7 Trading of Electricity

Short term trading is an essential tool for optimization of resources and plays an important role in a deficit scenario for harnessing additional / captive sources of generation for meeting the peak demand. Trading of electricity in India has picked up considerably after the advent of Electricity Act 2003 which recognizes trading as a distinct licensed activity. In future the quantum of electricity traded in the short term market is likely to grow considerably as the new generating capacity of many IPP's plants is not tied up in long term PPAs. The volume of electricity traded and its average price are depicted in the Table 2.5 below. The declining trend of prices in later years is an indication of increased competition and increasing availability of supply.

Table 2.5

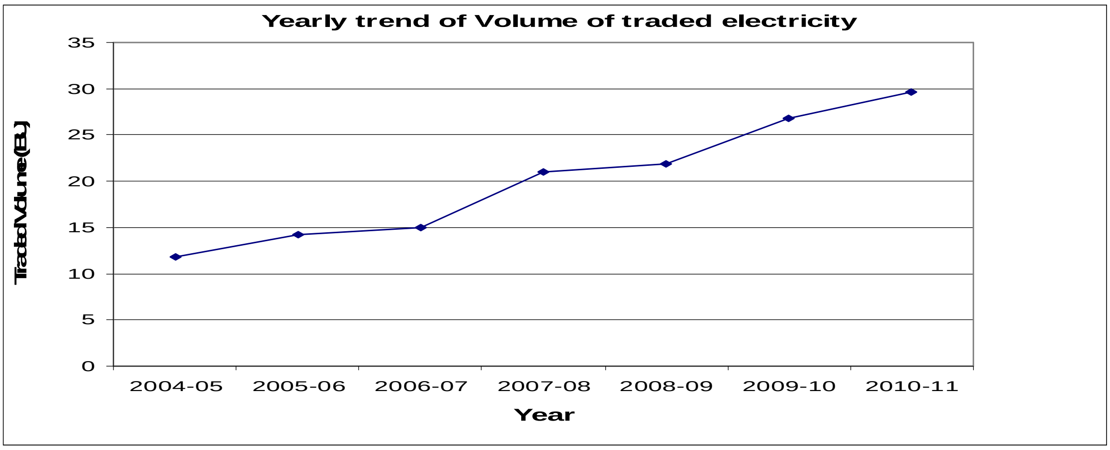
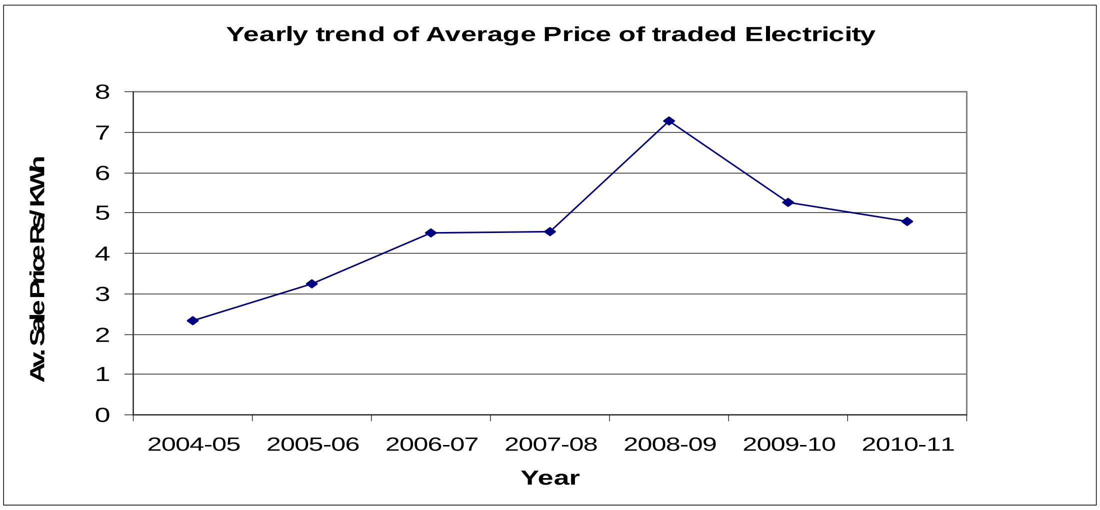


Table 2.6



2.3.8 Power Exchanges

At present there are two power exchanges in the country, namely IEX and PXIL which separately operate Day-ahead Spot market for electricity. These two exchanges work on identical principle of price discovery as specified by CERC. The Day-ahead market operates on the principle of voluntary participation, double sided closed auctions, uniform price discovery and zonal market splitting in case of transmission constraint. The yearly volume and average price of electricity of the two power exchanges is indicated in the table below:

Table 2.7

Volume and Price of Electricity Transacted through Power Exchanges in Day Ahead Market				
Period	Volume (Million Units)		Average Sale Price(Rs)	
	IEX	PXIL	IEX	PXIL
2008-09	2623.22	149.36	7.48	7.6
2009-10	6170.93	915.3	4.98	4.79
2010-11	11800.58	1740.18	3.38	3.87

The increasing volume and declining price is indicative of improved liquidity of supply. The number of participants in the two exchanges has been growing rapidly due to the entry of bulk Open Access consumers particularly from the states of Punjab and Tamil Nadu. The average number of active participants in the two exchanges was more than 600 during June 2011, which is a clear trend of bulk industrial consumers sourcing reliable or cheaper supply through power exchanges.

In addition to above, two power exchanges also separately operate term-ahead market. Each exchange follows its own market rules for the same. Term-ahead market particularly for 'one month' and 'one year' contracts has great potential in the future with the entry of merchant plants into the fray.

2.4 12TH PLAN TRANSMISSION PROGRAMME

2.4.1 Evolving the Transmission System for 12th Plan

Identification of transmission expansion requirement for a Plan period is done based on power system studies corresponding to the generation expansion programme and forecasted demand scenario expected at the end of that Plan. The implementation programme is worked out keeping in view identification of projects, schemes and transmission elements that should be implemented matching with programme of generation capacity addition and load growth on yearly basis during the Plan. Timely development of transmission network requires firming-up of the specific transmission schemes corresponding to specific generation projects, which, particularly in respect of inter-state transmission system, need to be done 3 to 5 years ahead of the target date of completion. Meeting this requirement, most of the 12th Plan schemes have already been identified, discussed in the Regional Standing Committees on Power System Planning, finalized, scheme formulated and process of implementation initiated. Of the identified schemes, many are under construction, particularly those which are required to be completed during first half of the 12th Plan.

2.4.2 Inter-Regional Transmission Capacity Programme

2.4.2.1 The Bursur- Lower Sileru HVDC monopole, which was included upto 10th Plan in the list of Inter-regional (IR) capacity, is currently not in operation; as such this link of 200 MW between WR-SR would not be available by the end of 11th Plan. Thus, the Inter-regional transmission capacity of All-India grid at the end of 11th Plan is expected to be 25,650 MW. During 12th Plan period a number of inter regional transmission links either associated with generation projects or as system strengthening schemes have been planned. These links would be implemented depending upon the progress of associated generating stations. Considering a capacity addition of about 76,000 MW during 12th Plan over & above 62,374 MW target for 11th Plan, the inter-regional transmission links of about 38,000 MW may be added during 12th Plan period. Details are given in Table-2.8 below. Thus inter-regional transmission capacity at the end of 12th Plan is expected to be of the order of 63,000 MW.

Table 2.8

(All figures are in MW)

Name of System	Existing as on 31.03.2011	Balance program for 11th Plan	Expected at the end of 11th Plan i.e. 31.03.2012	12th plan Additions	Expected at the end of 12th Plan
ER – SR :					
Gazuwaka HVDC back to back	1000		1000		1000
Balimela-Upper Sileru 220kV S/C	130		130		130
Talcher-Kolar HVDC Bipole	2000		2000		2000
Upgradation of Talcher–Kolar HVDC bipole **(not to be included since 11th Plan)**	500		500		500
ER-SR total	**3630**	**0**	**3630**	**0**	**3630**
ER –NR :					
Muzaffarpur - Gorakhpur 400kV D/C (Quad Moose) with TCSC	2000		2000		2000
Dehri-Sahupuri 220kV S/C	130		130		130
Patna-Balia 400kV D/C quad	1600		1600		1600
Biharshariff-Balia 400kV D/C quad	1600		1600		1600
Barh-Balia 400kV D/C quad #	1600		1600		1600
Gaya–Balia 765kV S/C (LILOed at Varanasi in 12th Plan)		2100	2100		2100

Name of System	Existing as on 31.03.2011	Balance program for 11th Plan	Expected at the end of 11th Plan i.e. 31.03.2012	12th plan Additions	Expected at the end of 12th Plan
Sasaram-Allahabad/Varanasi 400kV D/C line (Sasaram HVDC back to back has been bypassed)	1000		1000		1000
Gaya-Varanasi 765kV S/C				2100	2100
Sasaram-Fatehpur 765kV S/C				2100	2100
Barh-Gorakhpur 400kV D/C quad				1600	1600
ER-NR total	**7930**	**2100**	**10030**	**5800**	**15830**
ER - WR :					
Rourkela-Raipur 400kV D/C	1000		1000		1000
TCSC on Rourkela-Raipur 400kV D/C	400		400		400
Budhipara-Korba220kV D/C+S/C	390		390		390
Ranchi-Sipat 400kV D/C (40% SC)	1200		1200		1200
Ranchi-Rourkela-Raigarh-Raipur 400kV D/C with fixed series capacitor, TCSC in parallel line		1400	1400		1400
Ranchi – WR(Bilaspur)Sipat Pooling Point 765kV S/C via Dharamjaigarh during 12th plan				2100	2100
Ranchi- Dharamjaigarh 765kV S/C				2100	2100
Jharsuguda -Dharamjaigarh- 765kV D/C				4200	4200
ER-WR total	**2990**	**1400**	**4390**	**8400**	**12790**
ER - NER :					
Birpara -Salakati 220kV D/C	260		260		260
Malda-Bongaigaon 400kV D/C	1000		1000		1000
Bongaigaon-Siliguri 400kV D/C Quad to be LILOed at Alipurduar in 12th/13th plan				1600	1600
ER-NER total	**1260**	**0**	**1260**	**1600**	**2860**
NR - WR :					
Vindhyachal HVDC back to back	500		500		500
Auria-Malanpur 220kV D/C	260		260		260
Kota-Ujjain 220kV D/C	260		260		260
Agra-Gwalior 765kV S/C line-1 at 765 kV(earlier at 400kV)	1100		1100	1000	2100
Agra-Gwalior 765kV S/C line-2 at 765kV(earlier at 400kV)	1100		1100	1000	2100
Kankroli-Zerda 400kV D/C	1000		1000		1000
Gwalior-Jaipur 765kV S/C#1				2100	2100

Name of System	Existing as on 31.03.2011	Balance program for 11th Plan	Expected at the end of 11th Plan i.e. 31.03.2012	12th plan Additions	Expected at the end of 12th Plan
Gwalior-Jaipur 765kV S/C#2				2100	2100
RAPP C&D-Nagda 400kV D/C				1000	1000
Champa-Kurukshetra +/-800kV 6000MW HVDC bipole line, Phase-I				3000	3000
NR-WR total	**4220**	**0**	**4220**	**10200**	**14420**
WR-SR :					
Chandrapur HVDC back to back	1000		1000		1000
Bursur –L. Sileru 200kV HVDC mono pole @	200	(-200)	200		--
Kolhapur-Belgaum 220kV D/C	260		260		260
Ponda – Nagajhari 220kV D/C	260		260		260
Narendra (GIS) – Kolhapur (new) 765kV D/C line (initially charged at 400 kV)				2200	2200
Raichur-Sholapur 765kVS/C #1				2100	2100
Raichur-Sholapur 765kV S/C #2				2100	2100
WR-SR total	**1720**	**(-200)**	**1520**	**6400**	**7920**
NER/ER-NR/WR :					
Bishwanath Chariyali – Agra $\pm$800 kV, 3000 MW HVDC bipole.				3000	3000
LILO of $\pm$ 800kV Bishwanath Chariyali – Agra HVDC Bipole at new pooling station in Alipurduar and addition of second 3000 MW HVDC				3000	3000
NER/ER-NR/WR total	**0**	**0**	**0**	**6000**	**6000**
TOTAL ALL INDIA (220kV & above)	**21750**	**3300**	**25050**	**38400**	**63450**
132kV/110kV Inter-Regional links $ (not to be included in 12th Plan)	600	0	600	(-600)	----
TOTAL ALL INDIA	**22350**	**3300**	**25650**	**37800**	**63450**

Note:
@ - 200 MW HVDC Monopole is currently not in operation.
$ - 132/110kV lines are operated in radial mode from time to time. (not to be included for 12th plan period)
# - Barh-Balia line has been completed but is yet to be commissioned.

2.4.2.2 Transmission Capacity of Inter-Regional links v/s Transfer Capability between two regions:

The National Grid constitutes the complete transmission network, including transmission system for evacuation of power from generating stations, the inter-regional links and complete Inter State transmission system and right upto Intra-State transmission of STU with DISCOMs. In view of this, development of national grid is an evolutionary process. The summation of the transmission capacities of inter-Regional links is a figurative representation of the bonds between the regions. These aggregate numbers do not indicate actual power transfer capability across different regions/States. The power transfer capability between any two points in a grid depends upon a number of variable factors, such as - load flow pattern, voltage stability, angular stability, loop flows and line loading of weakest link in the grid. For instance, present aggregate inter-regional transmission capacity of Northern Region is 9320 MW (6330 MW with ER and 2990 MW with WR), whereas, simultaneous transfer import capability of NR may work out to about 5000 - 6000 MW depending upon operational conditions. The system operator has to assess the transfer capability between two points of the grid from time to time and restrict the power flow accordingly.

2.4.3 Growth in 765kV Transmission System up to 12th Plan / Early 13th Plan Period:

During 11th Plan, a number of 765kV lines and substations have been added and a few more are under-construction. The trend of increasing 765kV system in the grid is going to continue in the 12th Plan as well. A number of new 765kV lines and substations have been planned for evacuation of bulk power in the range of 3000 – 6000 MW to longer distances. Their actual realization would depend upon progress of associated generation projects. The planned 765kV transmission systems are expected to be implemented during 12th Plan or early 13th Plan period. Some of the planned 765 kV systems would be initially operated at 400 kV. Their 765 kV operation depends upon associated generation projects, which could be in 12th plan or beyond.

2.4.4 Growth in HVDC Transmission System up to 12th Plan / Early 13th Plan Period:

During 11th Plan, Balia-Bhiwadi 2500 MW HVDC Bipole and upgradation of Talcher-Kolar Bipole by 500 MW has been completed. Another HVDC bipole as Dedicated Transmission line, i.e. Mundra-Mohindergarh 2500 MW is being constructed under private sector by Adani group. This line is expected to be completed within 11th Plan period. Three more HVDC systems have been planned for completion during 12th Plan or early 13th Plan. These are Biswanath Chariyali -Alipurduar-Agra 6000 MW, Champa-Kurukshetra Phase-I 3000 MW and Raigarh-Dhule 4000 MW. Details of HVDC system in India and its plan are given in the following Table:

Table 2.9
HVDC Capacity (bipole / back-to-back) Existing and Planned
(values in MW)

HVDC	Type	Agency	As at the end of 10th Plan	Expected at the end of 11th Plan	Planned for 12th / early 13th Plan	Expected at the end of 12th/early 13th Plan
Chandrapur-Padghe	bipole	MSEB	1500	1500		1500
Rihand-Dadri	bipole	PGCIL	1500	1500		1500
Talcher-Kolar	bipole	PGCIL	2000	2500		2500
Balia-Bhiwadi	bipole	PGCIL		2500		2500
Biswanath-Agra	bipole	PGCIL			3000	3000
Champa– Kurukshetra	bipole	PGCIL			3000	3000
Raigarh(Kotra)-Dulhe	bipole	PGCIL			4000	4000
LILO of Bishwanath– Agra at Alipurduar	bipole	PGCIL			3000	3000
Mundra - Mohindergarh	bipole	Adani		2500		2500
Sub-total (bipole)			**5000**	**10500**	**13000**	**23500**
Vindhyachal	b-to-b	PGCIL	500	500		500
Chandrapur	b-to-b	PGCIL	1000	1000		1000
Gazuwaka	b-to-b	PGCIL	1000	1000		1000
Sasaram	b-to-b	PGCIL	500	500		500
Sub-total (b-to-b)			**3000**	**3000**	**0**	**3000**
TOTAL – HVDC Terminal Capacity, MW			**8000**	**13500**	**13000**	**26500**

2.4.5 1200kV transmission system: The Aurangabad - Wardha 400 kV Quad D/C line which is part of the transmission system for evacuation of power from Mundra UMPP has been planned and designed in such a way that this line would be converted into a 1200kV S/C line at a later date.

2.4.6 Transmission Schemes Planned for 12th Plan Period

CEA, in coordination with all the stake-holders i.e. Central Transmission Utility, State Transmission Utilities and Central Sector Generation Companies, have planned transmission systems required for evacuation of power from various generation projects which are in the pipeline and likely to yield benefit during 12th Plan period or early 13th Plan period, and also the transmission systems required for strengthening of regional and inter-regional transmission networks. Most of these schemes have been firmed up, however these also include some schemes, which are yet to be firmed up depending upon progress of associated generation project.
A few transmission schemes, particularly those required for generation projects coming up towards the last years of the 12th Plan and having common transmission system, could be altered depending upon progress of generation capacity linking to a common pooling point. Transmission systems for some of the 12th Plan generation capacities under the State sector

(or private sector but giving benefit to only home State) have also been tentatively considered for integrated system planning process, however, these transmission schemes are required to be firmed up by the respective State Transmission Utilities.

2.4.7 Assessment of transmission system addition during 12th Plan Period: During 12th Plan period, a total of about 1,09,000 circuit kilometers(ckm) of transmission lines, 2,70,000 MVA of AC transformation capacity and 13,000 MW of HVDC systems are estimated to be added. Highlights of this transmission expansion are addition of three new HVDC Bipole systems of 13,000 MW capacity and quantum jump in 765kV transmission systems. During 12th Plan about 27,000 ckm of 765kV lines and 1,49,000 MVA transformation capacity addition is expected. This huge increase in the 765kV system is due to a number of pooling and de-pooling 765/400kV stations that have been planned to evacuate power from cluster of generation projects mainly in pit-head and coastal areas and transfer their power through long distance transmission lines up to load centers in the country. In addition to above, 400kV lines of 38,000 ckm, 220kV lines of 35,000 ckm and transformation capacity of 45,000 MVA and 76,000 MVA, respectively is estimated to be added during 12th Plan period.

Following Tables give development of the transmission system in India in 11th Plan period and expected to be added during 12th Plan period. These estimates are considering about 76 GW generation capacity addition for 12th Plan over and about 63 GW capacity addition target for 11th Plan:

Table: 2.10
Transmission Lines

Transmission Lines (both AC and HVDC systems) for 11th Plan and expected in 12th Plan (values in ckm)	As at the end of 10th Plan	Addition during first four years of 11th Plan (2007-11)	Expected at the end of 11th Plan	Expected addition during 12th Plan	Expected by end of 12th Plan
HVDC Bipole lines	5872	1580	9452	**9440**	18892
765 kV	1704	1636	4164	**27000**	31164
400 kV	75722	26856	114979	**38000**	152979
220 kV	114629	19780	140976	**35000**	175976
Total Transmission Line, ckm	**197927**	**49852**	**269571**	**109440**	**379011**

Table 2.11
Substations

Substations(AC) and HVDC Terminals for 11th Plan and expected in 12th Plan (values in MVA / MW)	As at the end of 10th Plan	Addition during first four years of 11th Plan (2007-11)	Expected at the end of 11th Plan	Expected addition during 12th Plan	Expected by end of 12th Plan
HVDC Terminals:					
HVDC back-to-back	3000	3000	3000	**0**	3000
HVDC Bipole terminals	5000	5500	10500	**13000**	23500
Total- HVDC Terminal Capacity, MW	**8000**	**8500**	**13500**	**13000**	**26500**
AC Substations					
765 kV	0	4500	8500	**149000**	157500
400 kV	92942	40920	142587	**45000**	187387
220 kV	156497	50655	221807	**76000**	297807
Total- AC Substation capacity, MVA	**249439**	**96075**	**372894**	**270000**	**642894**

2.4.8 Fund Requirement for development of transmission system during 12th Plan Period:

Considering 76 GW generation capacity addition for 12th Plan over and about 63 GW target (the Mid-term assessment for 11th plan by Planning commission) for 11th Plan, total fund requirement for development of transmission system is estimated to be of the order of Rs 1,80,000 crore (Rs 1,00,000 Cr in Central Sector, Rs. 55,000 Cr in State Sector and Rs. 25,000 Cr in Private Sector).

In the Central Sector, there is no problem of capital resources for setting up transmission facilities. However, in the State Sector some of the STUs require financial support, especially for building transmission system for renewable energy sources such as wind, solar and small hydro. In case of conventional hydro and renewable generation, the plant load factor is low and as a result the cost of transmission per kWh becomes high. Therefore, it is proposed that viability gap funding may be provided on case to case basis for building intra-State transmission system for renewable generation and conventional hydro stations.

2.4.9 Investment through Private Sector participation in development of transmission system during 12th Plan Period:

It may be noted that transmission schemes for the projects identified for 12th Plan have been mostly planned, firmed up in the Standing Committees for Power System Planning and the transmission agreements (BPTA) have been signed with the CTU as the nodal agency for Long Term Transmission Access to ISTS prior to the cut-off date of 5th January 2011. As such most of the ISTS schemes would be implemented by POWERGRID as central sector schemes. In addition Dedicated Transmission Lines from the inter-State Generating Stations would mostly be built by the generation developers as private sector lines. Some schemes, under the direction of the Empowered Committee for developing ISTS through competitive bidding have been identified and are in the various stages of implementation. These would materialize during 12th Plan period. Further, barring a few exceptions, new transmission schemes required for system strengthening, drawl of power by the states and for power evacuation to be identified in future would be implemented through competitive bidding process as far as possible. POWERGRID would also participate in the competitive bidding. Similarly in the State sector also it is likely that majority of the schemes during 12th Plan period would be implemented by the STUs.

2.5 TRANSMISSION EXPANSION ASSESSMENT FOR 13TH PLAN

As explained above, transmission system for a number of generation projects have been planned under the LTA process, majority of which are expected to materialize during 12th Plan and the rest would be implemented during 13th Plan depending upon actual progress of the generation project. Based on progress and development of generation projects and transmission system during 12th Plan, some of the already planned transmission systems would have to be reviewed. This review would be carried out alongwith planning for new transmission requirements for specific generation projects coming in 13th Plan. Under such scenario, only a broad assessment of transmission capacity addition for 13th Plan can be made considering probable load growth and indicative generation capacity addition scenarios for 13th Plan. Accordingly, following assessment has been made for transmission capacity addition during 13th Plan period:

Transmission capacity addition for 13th Plan (220kV and above system):		
1.	Transmission lines	130 Thousand ckm
2.	Substation (Transformation) Capacity	300 Thousand MVA
3.	Fund requirement	Rs 200,000 Crore

2.6 MEETING CHALLENGES IN TRANSMISSION SECTOR

2.6.1 In order to meet the growing power demand of various regions, power transfer capacity of the grid is being enhanced continuously. This expansion poses few challenges that need to be met through planning and adoption of new technologies. Following are some of the challenges:

- **Right Of Way (ROW):** It is the most notable challenge that the transmission sector is facing today. The need is to develop high intensity transmission corridor (MW per meter ROW) in an environmental friendly manner.

- **Flexibility in Line Loading and Regulation of Power:** Due to wide variation in demand on a daily as well as seasonal basis there is increased need to regulate power flow on the transmission network for grid security and optimization.

- **Improvement of Operational Efficiency:** Power system is required to be operated at the rated capacity with security, reliability and high availability. This can only be achieved through reliability based on-line condition monitoring, repair and maintenance in advance and making forced outage as zero.

2.6.2 Following measures are being implemented to meet above challenges:

- **Increase in transmission voltage:** Power density of transmission corridors (MW per meter ROW) is being enhanced by increasing the voltage level. It is 3 MW/m for 132kV and 45 MW/m for 765kV. Transmission voltage upto 765kV level are already in operation. A ±800 kV, 6000 MW HVDC system as a part of evacuation of bulk power from North Eastern Region (NER) to Northern Region (NR) over a distance of around 2000 km is under implementation. In addition, increasing the AC voltage level at 1200kV level has been planned. Research work for 1000kV HVDC system has also been commenced.

- **Upgradation of transmission line:** Upgradation of 220kV D/C Kishenpur- Kishtwar line in J&K to 400 kV S/c, which was first time in India, has resulted in increase of power transfer capacity of the exist transmission corridor with marginal increase in ROW (from 35m to 37m).

- **Upgradation of HVDC Terminal: Upgradation of Talcher(ER) –** Kolar(SR) ±500kV HVDC terminal from 2000MW to 2500MW has been achieved seamlessly without changing of any equipment. That has been achieved with enhanced cooling of transformer and smoothing reactor with meager cost.

- **High capacity 400kV multi-circuit/bundle conductor lines:** POWERGRID has designed & developed multi circuit towers (4 Circuits on one tower with twin conductors) in-house and the same are implemented in many transmission systems, which are passing through forest and RoW congested areas e.g. Kudankulam and RAPP-C transmission system.

- **High Surge Impedance Loading (HSIL) Line:** In order to increase the loadability of lines, development of HSIL technology is gaining momentum. POWERGRID is building up one HSIL line viz. 400kV Meerut – Kaithal D/c where SIL is about 750 MW as against nominal 650MW for a normal quad bundle conductor line.

- **Compact towers:** Compact towers like delta configuration, narrow based tower etc. reduce the space occupied by the tower base are being used. First 765kV Sipat – Seoni 2xS/c line with delta configuration tower is under operation. Further, 400kV Pole structure is also being used in high population density areas. Pole type structures with about 1.85 m base width as against 12-15m base width of a conventional tower were used in transmission line approaching Maharani Bagh, Delhi substation to address Right-of-way problem in densely populated urban area.

- **Increase in current: High Temperature Low Sag (HTLS) conductor line:** High temperature endurance conductor to increase the current rating are in use for select transmission corridors and urban/metro areas. POWERGRID has already implemented twin INVAR conductor line for LILO portion (15kms stretch) of 400kV Dadri-Ballabgarh quad conductor line at Maharanibagh substation. Further, the Siliguri – Purnea, twin Moose conductor line is being re-conductored with high temperature low sag (HTLS) conductor.

- **Reduction in land for substation:** With scarce land availability there is a growing need for reduction of land use for setting up of transmission systems, particularly in Metros, hilly and other urban areas. Gas Insulated Substations (GIS), requires less space (about 70% reduction) i.e. 8-10 acres as compared to conventional substation which generally requires 30-40 acres area.

- **Regulation in Power Flow/ FACTS devices:** With electricity market opening up further, more and more need has been felt to utilize the existing assets to the fullest extent as well as regulate the power. This could be possible through use of power electronics in electricity **network.**

- **Improvement of operational efficiency**

  - **Condition Based Monitoring:** POWERGRID has adopted many state of the art condition monitoring & diagnostic techniques such as DGA, FRA, PDC, RVM etc. for transformers, DCRM for CBs, Third Harmonic Resistive current measurement for Surge Arrestors etc. to improve Reliability, Availability & Life Extension. Further, on-line monitoring systems for transformers have been implemented to detect faults at incipient stage and provide alarms in advance in case of fault in the transformers.

  - **Preventive Maintenance:** Preventive State-of-the-art maintenance techniques for various equipment applied in our system include On line monitoring of various components of transformers and reactors, Circuit Breakers, Instrument transformers, Lightening arrester etc.

- **1200kV Test Station:** In order to increase the power density of the corridor, development of 1200kV AC system as next higher AC voltage level has been decided. However, 1200kV AC technology is relatively a new one in the world.

Therefore, to develop this technology indigenously, a unique effort has been made by POWERGRID through a collaborative research between POWERGRID and Indian manufacturers to establish a 1200kV UHVAC Test Station.

2.7 SMART TRANSMISSION GRID

2.7.1 Smart Transmission Grid Implementation in India

WAMS (Wide Area Measurement System) based technology is to be implemented as a part of the Smart Transmission Grid implementation. WAMS requires installation of Phasor Measurement Units (PMUs) at the substations and power plants. The process for installation of PMUs has already been started. Eight (8) PMUs (at Moga, Kanpur, Dadri and Vindhyachal in first phase and Agra, Bassi, Hisar and Kishenpur in second phase) have already been commissioned in the Northern Region and proposal for installation of PMUs in other regions is also in the pipeline. Full implementation of WAMS technology would require installation of hundreds of PMUs in each region and reliable communication network with very high band width and with least latency. Phasor data concentrators (PDC) are to be installed at National, Regional and major State Load Despatch Centre (in states having 400 kV transmission system).

Availability of PMU at strategically located 400 kV/ 765kV sub-stations / power stations and a robust fiber optic communication network will facilitate situational awareness (especially dynamic state of the grid in terms of angular stability and voltage stability), control and regulation of power flow to maintain grid parameters**,** Remedial action scheme(RAS) and system integrated protection scheme(SIPS) and identifying corrective actions to be taken in the event of severe contingency to prevent grid disturbances.

2.7.2 Need for fiber optic based communication system:

With the restructuring & liberalization of power sector and the advent of new regulations, open access, power exchange etc reliable voice & data communication has become critically important. The requirement of effective communication system has increased with the advent of special protection schemes, wide area measurement technology, SCADA system and remote operation. Getting real time data of various power system elements ie, substations, generating plants, HVDC links, Interstate transmission lines etc has become an essential prerequisite for successful operation of modern power system as a 'Smart Transmission Grid'. Presently three modes of communication are being used viz, PLCC, Microwave and Fiber optic in power system operation. The Microwave links operating in 2.3 to 2.5 GHz band is being withdrawn by Ministry of Communication. The PLCC is considered an integral part of power system and its usage for power system are protection of the power system and providing speech communication in limited area. All these requirements can be met by fiber optic based communication system.

In view of issues brought out above, it is considered desirable that an institutional arrangement be mandated for planning, implementation and maintenance of dedicated high band width, fiber optic communication network connecting the existing and new substations and power plants under central sector, IPPs, UMPP, Merchant Power Plants coming under the control area of Load Despatch Centres. The mandate should address the communication requirements in power sector in all associated areas such as Smart Transmission Grid, Protection, data, speech, audio/video etc.

The CTU and STUs own the existing communication network including Optic fibre network over their respective power networks. Under Section 38 of the Act, CTU is responsible for all functions of planning and co-ordination related to ISTS. Further, under Indian Electricity Grid Code clause 4.6.2 the associated communication system to facilitate data flow up to appropriate data collection point on the CTU system is to be established by the concerned user or STU as specified in the connection agreement. In view of above, the CTU may be mandated by CERC regulations to perform the following functions:

i. CTU in consultation with POSOCO, CEA, STUs and SLDCs to prepare a comprehensive communication plan for connecting the existing and upcoming ISTS, State grid substations and existing and new power stations in the country. For new power stations and grid substations the communication network should be planned and developed simultaneously with the associated power transmission lines. The communication system of a new generating station or EHV substation should be ready at least one month before commissioning of the same.

ii. For the transmission projects through tariff based competitive bidding, the laying of communication network wherever required shall be decided in consultation with the CTU and shall be implemented as part of the project.

iii. The communication equipments at generating station and substations shall be installed by the owner agencies as per the technical parameters decide by the CTU.

iv. To ensure implementation of the planned communication network through POWERGRID, Private transmission developers, STUs, Generation developers etc.

v. Monitoring the progress of implementation of the planned communication network.

vi. Monitoring the availability of the communication network and coordinating its repair and maintenance.

The proposed CERC regulation in this regard should have provisions for CTU to recover cost in performing above functions.

All new 400 kV and above substations, irrespective of ownership (state sector, private sector, central sector) and type (ISTS, dedicated, intra-state) should have optical fibre communication (OFC) facility, unless specifically exempted by CTU, as a requirement for smooth grid operation.

A Standing Committee comprising of CTU, POSOCO and CEA should be constituted to identify (i) strategic lines where OFC shall be mandated (ii) strategic locations in the grid where PMUs and PDCs need to be placed. As a first step, this committee should identify all such locations in the existing grid within six months. It should meet periodically at least once in a year to review and identify new locations.

Presently, POWERGRID has built some optic fibre communication (OFC) network as part of telecom business and it is partly leased to RLDCs and NLDC for grid operation. Investment is not serviced by RLDCs. On the other hand POWERGRID has to give some normative revenue credit to its long term customers for using the RoW of transmission lines for telecom business. In future POWERGRID may be required to install optical fibre as per requirement of grid operation without assurance of telecom business. In such cases the investment should be serviced by the users/POSOCO as determined by CERC. Similar arrangements may be made for each STU/SLDC through their respective SERCs.

Grid communication users should have priority over the telecom customers of POWERGRID mandated for the smart transmission grid.

2.8 TRANSMISSION PLANNING FOR RENEWABLE GENERATION

The renewable generation capacity addition in the country, up to the end of 9th Plan i.e. 2001-02 was just 3,475 MW which, owing to conducive policies and programmes of central and state governments, has reached nearly 20,000 MW in just 9 years. Most of this renewable capacity is in the renewable potential rich states of Tamil Nadu, Maharashtra, Karnataka, Gujarat and Rajasthan. These five states contribute more than 80% of total renewable capacity installation in the country.

During the 12th Plan a tentative target for grid interactive renewable power addition of 18,500 MW (wind-11,000 MW, Solar-3800 MW, Small hydro-1600 MW and biomass/baggasse etc-2100 MW) has been estimated. In this estimated capacity addition the wind power concentration is more in Tamil Nadu, Gujarat and Rajasthan. The solar power would be available mainly in the states of Rajasthan and Gujarat. Similarly small hydro would be available in Himachal Pradesh, Uttrakhand, Sikkim and Arunachal Pradesh. State wise estimate of above capacity addition is yet to be assessed.

In the absence of information on location and type of renewable energy only broad transmission requirement for these resources can be assessed at this stage. As most of the renewable energy generation in terms of MW are smaller in size ranging from few MW to 25 MW or 50 MW, therefore their integration with the grid is normally done at 11kV, 22 kV, 33kV or 66 kV. The EHV transmission system beyond first connection point is either at 110 kV, 132 kV, 220 kV or 400 kV depending on the quantum power being pooled at EHV substations. Generally the power would be absorbed within the DISCOM area or at the most within the state for meeting the states RPO. As the RPO requirement of each state would be increasing on an yearly basis along with the increasing capacity addition of renewable energy generation, only a few RES rich states would have renewable energy additions beyond their RPO requirements. This would require augmentation of the State’s transmission system and interconnection with inter-state transmission system in some cases. In case of large scale renewable generation,it is not possible to absorb the energy locally particularly during off peak hours and a transmission system is required to be planned integrating renewable generation with the state grid as well as with inter-state grid. Integrated planning approach would ensure that renewable generation does not have to back down during off peak hours and local load centers are provided with uninterrupted supply even when renewable generation is not available

The transmission planning for renewable energy generation projects has to be done on a case to case basis depending upon the topology of the local grid, spatial distribution of renewable sources and the total quantum of power to be evacuated. The State Transmission Utilities of renewable rich states of Himachal Pradesh, Rajasthan, Gujarat and Tamil Nadu have prepared comprehensive long term transmission plans totaling to about 8200 crores and submitted them to MNRE for financial support. These reports are being examined by MNRE and CEA. Details of these plans are as follows:

- **Transmission proposal of Gujarat**: Capacity addition of 4500 MW wind energy and 960 MW of solar energy is planned. An investment of Rs. 900 crores in transmission infrastructure is proposed for evacuation of wind energy.

- **Transmission proposal of Rajasthan**: Capacity addition of 1500 MW wind energy and 1300 MW of solar energy is planned. An investment of Rs. 2350 crores in transmission infrastructure is proposed for evacuation of wind and solar power.

- **Transmission proposal of Himachal Pradesh**: Capacity addition of 560 MW small hydro projects is planned with an investment of Rs. 407 crores in transmission infrastructure.

- **Transmission proposal of Tamil Nadu**: Capacity addition of 4000 MW wind generation projects are planned with an investment of Rs. 3800 crores in transmission infrastructure.

- As per CERC (Grant of Connectivity, Long-term Access and Medium-term Open Access in inter-state transmission and related matters) Regulation 2009, a group of generating stations using renewable sources with capacity between 50 MW and 250 MW can also apply to the CTU for direct connectivity with inter state transmission system. Transmission charges for transfer of power from Renewable Energy Sources shall be as per the applicable CERC tariff norms. In case of solar plants which are to be commissioned by 2014, ISTS charges/losses are exempted.

Action has already been taken by CEA and CERC through appropriate technical standards and regulations for harnessing of wind and solar generation. CERC has amended Indian Electricity Grid Code to allow flexibility to wind and solar plants in scheduling and dispatch. CEA has issued draft amendment to connectivity standards specifying the technical requirements from wind generators to be synchronized with the grid, as per which, generating stations shall be capable of supplying dynamically varying reactive power support so as to maintain power factor within limits of 0.95 lagging to 0.95 leading. Also the generating stations shall have fault ride through capability of not less than 300 milli-seconds so that grid is not destabilized due to sudden outage of renewable generation in the event of a grid disturbance. Standards for maximum harmonic distortion have also been specified.

2.8.1 Need for grant – Grant needs to be made available for setting up transmission system for evacuation of power from renewable energy source. Major reasons are as follows:

- High cost of RPO: Since the preferential tariff for renewable energy particularly for solar energy is quite high, the consumers may not be burdened additionally with higher transmission tariff.

- Low Load Factor of RES: Generally, load factor of thermal generation is about than 80% and that of hydro is about 40%. However, in case of renewable energy, it is about 20% for Wind and Solar and about 40% for Small Hydro. As a result the cost of transmission per unit of energy becomes high. It is estimated that cost of transmission built for RES would be about double the cost of that built for a conventional hydro-thermal mix generation. When transmission system is built for substantive amount of renewable power, it would increase the overall transmission tariff of the State, which would have to be mostly borne by its consumers. This may discourage investment in transmission for renewable.

There is a need to encourage RES rich states to build transmission over and above their RPO requirement by providing grant.

2.9 EXCHANGE OF POWER WITH NEIGHBOURING COUNTRIES

Integration of Indian Electricity Grid with countries such as Bhutan, Nepal would result in optimization of electricity resources on a large scale and provide additional benefits and opportunities to the buying and selling countries. Cross border electricity transaction particularly with Nepal and Bhutan may be facilitated through Inter Governmental framework agreements. The cross country grid interconnection may be developed on a case to case basis based on assessment of electricity to be exchanged. There is also a need to develop coordinated procedures for scheduling and dispatch of cross border power and for financial settlement of electricity transactions.

India's Himalayan neighbors namely Nepal and Bhutan are endowed with immense hydro power potential of the order of 40,000 MW and 30,000 MW, respectively. The hydro potential of Nepal and Bhutan can be harnessed to mutual advantage and in overall interest of development of South Asia as a whole. The benefits of power exchange with Nepal and Bhutan are listed below:

- Enhanced energy security of South Asia.
- Lesser dependance on fossil fuels.
- Better hydro-thermal mix in generation.
- Reduction in carbon emissions and carbon intensity.
- Economic benefits to the countries of South Asia.

2.9.1 India-Bhutan: India and Bhutan already have agreed terms of cooperation for exchange of power between the two countries. Bulk of power generated at Hydro Electric Projects at Chukha (336MW), Kurichu (60MW) and Tala (1020MW) in Bhutan, is exported to India after meeting the internal demand of Bhutan. The associated cross- border transmission system (ATS) for evacuation and transfer of power from these HEPs has been developed and is operated in synchronism with the Indian Grid. Bhutan is planning to harness its hydro potential of about 1,20,00MW capacity by 2020. Among the various HEPs, Punatsangchhu-I (1200MW), Punatsanchhu-II (990MW), Mangdechhu (720MW) HEPs are under development stage and expected during 2015-17. After meeting its internal requirement, power will be exported to India. Power from these projects will be pooled at Alipurduar in India, for further transmission within India.

2.9.2 India-Nepal: Bilateral exchange of power between India and Nepal started in 1971 with exchange of about 5 MW of power on the principle of catering to the power needs of isolated local areas on both sides of the border. The power exchange takes place between Nepal Electricity Authority and utilities on the Indian side namely Bihar State Electricity Board (BSEB), Uttar Pradesh Power Corporation Limited (UPPCL) and Uttaranchal Power Corporation Ltd. (UPCL). India supplies 70MU from Tanakpur HEP (120MW) to Nepal under the Mahakali Treaty and under the bilateral power exchange, 50MW is exported to Nepal by BSEB. For further exchange of power on a bulk scale from the electricity markets of the two countries, Dhalkebar-Muzaffarpur 400 kV D/C 130 km line has been planned. This line would be initially charged at 220kV and proposed to be executed through joint venture companies. Construction of the line will commence after finalization and signing of Power Sale Agreement (PSA) and Implementation & Transmission Service Agreements (ITSA).

2.9.3 India-Bangladesh: An electrical grid interconnection between India and Bangladesh through a 400 kV Baharampur (India)- Bheramara (Bangladesh) 400 kV D/C 125 km line along with 1x500MW HVDC Back-to-Back asynchronous link at Bheramara is being developed for facilitating exchange of power up to 500 MW between the two countries. Due to asynchronous link any fluctuations or disturbances on one side would not affect the other side. Government of India has agreed to provide 250 MW power to Bangladesh under a long term PPA. Bangladesh would be able to procure additional 250 MW power from the Indian Electricity market. In future the transfer capacity of the interconnection can be upgraded by adding a new HVDC module.

2.9.4 India-Sri Lanka: A proposal to inter link India and Sri Lanka is under study. Under this proposal, feasibility of establishment of a HVDC transmission system of 1000 MW capacity using overhead lines and undersea cables from Madurai in India upto Anuradhapura in Sri Lanka is being studied. The India – Sri Lanka transmission link is tentatively envisaged to be a + 400kV HVDC Bipole line. The proposed link would consist of : (i)Overhead line from Madurai to Panaikulam in India - 130 km, (ii)Panaikulam(India) to Thirukketiswaram (Sri Lanka) submarine cable - 120 km, and (iii)Overhead line from Thirukketiswaram to New Anuradhapura in Sri Lanka - 110 km. The techno feasibility study is in progress and based on the same this link could materialize in future.

2.10 FOREST CLEARANCE AND ROW ISSUES AND THEIR MITIGATION

2.10.1 Forest Clearance

CERC has specified a fixed time schedule for commissioning of Inter State Transmission (ISTS) of different voltage levels ranging from 18 months to 42 months. Transmission projects are planned along with the upcoming generation projects and any delay/mismatch in commissioning of associated evacuation lines may result in bottling up of power. While finalizing the route alignment, emphasis is on avoidance of forest, National Parks, Wildlife Sanctuary etc., However, it is not possible to avoid such areas completely. Forest Clearance is a mandatory requirement for the portion of the line traversing through the forest. Getting Forest Clearance takes considerable time due to the lengthy process and involvement of different levels of officials at State and Central Government level.

2.10.2 Proposed measures- Measures to reduce the time for forest clearance are as follows:

i. The transmission projects have negligible impact on forest / environment and its habitants including the tribal people. Therefore, it is suggested that transmission projects may be exempted/relaxed from the preview of the circular for obtaining consent of the Gram Sabhas under Forest Conservation Act 1980, as a special case.
ii. Delegation of powers of Regional office of MoEF (RMoEF) for approval should be enhanced from present 5 hectares to 30 hectares, for transmission projects as a special case.
iii. The power of RMoEF for processing, which at present is up to 40 hectares, may be enhanced to 200 hectares for speedy approval.
iv. Expediting the Stage-II approval after Stage-I in principle approval:

2.10.3 Right of Way (ROW) for Transmission line

As per the provisions of Electricity Act, 2003 and Indian Telegraph Act 1885, land is not to be acquired to lay transmission lines but full compensation towards damages sustained is required to be paid. There is no specific mention of compensation towards diminution of land value and the term damages have also not been elaborated. Under Section 16 of Indian Telegraph Act 1885, the local authorities / District Magistrate have the powers to fix the compensation and adjudicate during the dispute for compensation. The Indian Telegraph Act 1985 was conceived mainly for Telecom purpose. When electricity was initially introduced in the country the nominal transmission voltage was quite low and the transmission lines were mainly pole type structure which required very little area and ROW. With increase in transmission voltage, the requirement of land for tower footing and ROW has increased substantially.

The following table indicates the range of land required for tower footing at different voltage levels depending on conductor configuration, type of tower and wind zone.

S.No.	Voltage level	Tower Base Area (in sq. meters)
1	220 kV	29 to 149
2	400 kV	61 to 306
3	500 kV	110 to 256
4	765 kV	156 to 588
5	800 kV	199 to 484
6	1200 kV	248 to 324

Norms for evaluation and fixing of compensation vary from state to state. Hon'ble Kerala High Court gave its opinion regarding compensation towards diminution of land value and observed that owners can claim compensation for diminishing of land value. The said judgment was challenged in the Hon'ble Supreme Court of India. The Supreme Court while staying the Kerala High Court order has taken a view that each case is required to be taken on its own merit on following parameters and reffered the case back to Kerala High Court:

- Situation of land;
- Distance between high voltage electricity line laid there over;
- Extent of the line there on as also the fact whether the high voltage line passes over a small track of land or through the middle of land and other similar relevant factors;
- The land value is also a relevant factor and whether the owner of land losses its substantial right to use the property.

Despite adoption of latest technological solutions to optimize the ROW requirements, difficulties in getting ROW results in delay in implementation of transmission projects.

Suggested measures to mitigate the Right of Way issues are given below:

i. As the patch of land occupied by the transmission tower would have zero resale value, it stands to reason that compensation for diminution of value of land occupied under tower base should be the full value of the private land at prevailing market rate as determined by the revenue authorities. It is suggested that Central Government may issue a notification in this regard in consultation with the states.
ii. Transmission corridors needs to be identified and reserved in high density population areas like metros and other upcoming urban areas to meet the future growing demand.
iii. **Land for Substations**: The land for substations is normally government land or private land acquired through Land Acquisition Act 1984. While doing town planning for new suburban area and industrial centers, provision for laying of substation and transmission line should be kept in mind. To reduce the requirement of land for constructing substation use of Gas Insulated Substations (GIS) which requires about 30 % land compared to conventional substation is being increasingly adopted in metro, hilly and other urban areas**.**

2.11 POWER SYSTEM OPERATION

2.11.1 Development of system operation

The power system in the country is demarcated into five regions and there is a three-tier structure for Load Despatch. State Load Despatch Centres (SLDCs) in states form the foundation block. The control centres at the regional level, known as Regional Load Despatch Centres (RLDCs) are at the intermediate level and the control centre at National level, known as the National Load Despatch Centre (NLDC) is at the top most tier. The functions, responsibilities and powers of the National/Regional/State Load Despatch Centres are clearly defined in the Electricity Act 2003 and the Indian Electricity Grid Code. The Bhakra Beas Management Board (BBMB) has a separate control centre at Chandigarh that coordinates water releases and despatch of hydropower from the stations that are jointly owned by the States of Punjab, Haryana, Rajasthan and Himachal Pradesh. Likewise the Damodar Valley Corporation (DVC) has a well-defined control area in the Eastern Region (covering portions of West Bengal and Jharkhand) with its own generation, transmission and distribution system to meet its load.

At the inter-state level, the boundary points have been fully metered with Special Energy Meters, scheduling of Inter State Generating Stations has been streamlined and a transparent and robust settlement system has been implemented. Open Access in Inter State Transmission System has been reasonably successful despite several technical and administrative challenges. Empowerment of SLDCs has been recognized as the key to implementing similar reforms at the state level.

2.11.2 Government of India's interventions to empower system operation

A committee headed by Shri Gireesh Pradhan was constituted by the Ministry of Power, Government of India in February 2008 to examine issues relating to manpower, certification and incentives for the personnel employed on System Operation at various levels and also for ring-fencing the load despatch centres to ensure their functional autonomy and give recommendations. The Committee recognized load despatching as a 'mission critical activity' for uninterrupted and reliable power supply and recommended several strategic interventions for imparting functional autonomy to LDCs and establishing independent and sustainable revenue streams for them. The report of the Committee submitted in August 2008 was endorsed by the Central and State Governments and Electricity Regulatory Commissions. Ministry of Power constituted four task forces for effective monitoring and implementation of the recommendations of the Committee.
The recommendations of the above Committees and task forces are being actively implemented at the Central level. A new organization, namely Power System Operation Corporation Limited (POSOCO) was formed as a 100% subsidiary of POWERGRID in March 2009. The Government of India notified POSOCO as the designated entity to operate RLDCs/NLDC wef 1st October 2010. A Forum of Load Despatchers (FOLD) has been constituted as approved by the Forum of Regulators (FOR) in January 2009 for harmonizing practices across the different LDCs. Likewise, the National Power Training Institute (NPTI) has been designated as the agency for training and certification of system operators.

2.11.3 Achievements on the market front

Empowerment of RLDCs/NLDC and their designation as nodal agency have led to the following significant developments on the electricity market front:

1. Successful implementation of Availability Based Tariff (ABT) in all the regions since 2002-03 at the inter-state level.
2. Successful implementation of inter state open access since May 2004 leading to choice for market players and promoting competition.
3. Successful operation of two Power Exchanges since June 2008 leading to a robust price discovery mechanism and investment signals.
4. Successful implementation of the Renewable Energy Certificates (REC) mechanism since October 2010 to fulfill Renewable Purchase Obligation (RPO) of DISCOMs.

2.11.4 Suggested measures to improve system operation

Sub-LDC for Renewable energy: Apart from transmission planning, system operation also needs a paradigm shift to accommodate the increased quantity of renewable generation. With effect from 1st April 2012, wind farms of 10 MW and above and solar plants of 5 MW and above connected at 33 kV level (and not under any PPA as on 3rd May 2010) and above are expected to forecast their generation up to accuracy of 70%. It is important that the State Load Despatch Centre (SLDC) under whose jurisdiction the renewable generation is operating has access to the following data:

1. Forecast data of temperature, wind speed and direction, solar insolation
2. Actual temperature, wind speed, direction and MW, MVAR and voltage from each wind farm
3. Metered energy data 15-minute time block wise

It is recommended that:

- A separate Load Dispatch Centre for renewable energies shall be set up to carry out above tasks The collated data from such sub-LDCs can be transferred to the respective SLDC and RLDC so that the grid can be operated in a secure manner as well as ensuring that the renewable generation is absorbed to the fullest extent.
- Such sub-LDCs may be set up in renewable energy rich States e.g Tamil Nadu, Gujarat and Rajasthan.
- These sub-LDCs may be set up with grant from clean energy fund.
- To start with such a sub-LDC may be set up in Tamil Nadu which has about 6000 MW of installed wind capacity.

2.11.5 Peaking Power

The DISCOMS/State utilities are self dispatch entities and responsible for maintaining their load generation balance. Yet in real time there are imbalances which cause frequency excursions particularly due to shortage of peaking power. The incremental short and any short fall in their peaking power requirement may be met through harnessing peaking power sources. The Power Exchanges could invite bids from peaking generators in the evening for the next day, stack these bids and forward it to the National Load Despatch Centre (NLDC). On the day of operation, in case these resources are required to be pressed into service, the system operator would requisition their services at say an hour’s notice. The generator whose services are requisitioned would be provided a certainty of say two hours for which it could generate. Payments would be made to the generator from the Unscheduled Interchange (UI) Pool Account. Any shortfall in the Pool Account could be made up from the Power System development Fund (PSDF). It is recommended that:

Detailed guidelines in respect of this ‘peak power harnessing service’ need to be formulated by CERC.

2.12 ANCILLIARY SERVICES

2.12.1 Voltage Support Service

Presently there is no legal binding on the generator for this facility and very often generators get away from this issue by citing contractual reasons for not commissioning this facility. There is an urgent need to operate large hydro plants as synchronous condensers when the water inflows are low. Operation of such generators as synchronous condensers will help in supporting the voltage and keeping the transmission system intact. It is recommended that:

The Grid Standards for Connectivity to the grid notified by CEA be amended to make it mandatory for hydro power stations to commission the synchronous condenser facility and test it periodically as prescribed by the system operator.

CERC to come out with guidelines/regulation for compensating the generator for the energy consumed during synchronous condenser operation, MVARh generated or absorbed by the generator and the extra Operation and Maintenance (O & M) costs associated with synchronous condenser operation.

Black-start Service: In case of black-out or partial blackout of certain areas expeditious restoration of the system is possible only if the hydro and gas power stations in the isolated portion are able to black start their units, supply local load till supply from the grid is available for synchronization. It is recommended that:

The Grid Connectivity Standards notified by CEA must make black start capability mandatory for all new hydro generating units and gas turbine units.

2.12.2 Creation of Reserve and Back Up Power in the System

The Optimal power system should have adequate reserves in order to meet the contingency of outage of certain operating generation capacity. Therefore, creation of adequate reserve and back up power in the system need to be planned along-with related evacuation networks.

2.13 RELIABILITY STANDARDS

The existing Grid Codes need to be complemented by Reliability Standards. These Reliability Standards are to be adhered by all utilities for maintaining grid security of the grid. It is recommended that:

POSOCO may constitute a Standing Committee for - formulation of ‘Reliability Standards and their approval from CERC/regulators.

2.14 NEED FOR A SEPARATE MARKET OPERATION (MO)

There would be an explosion in number of control areas at the regional level from the level of nearly one hundred (100) control areas today to over three fold in the coming years. The number of long term, medium term, and short term and PX transactions would grow manifold. Metering and settlement system would become more complex with the above explosion in control areas. Hitherto, the Central Transmission Utility (CTU) is providing the meters at all inter utility exchange points at the inter-state level and RLDCs are collecting, validating and processing the meter data. This data is forwarded to Regional Power Committee (RPC) Secretariat for issuing the accounts. Payments to and from the Pool Account were managed by RLDCs. With the explosion of control areas, Fund Administration and Pool Account operations would also become more voluminous. These developments bring out the need for a Market Operator (MO) to co-ordinate all the transactions and inform the System Operator (SO) a day in advance for physical delivery. Since the work load of RLDCs has become enormous and complex, it is desirable in the interest of efficient system operation that the work of RLDC may be segregated between a 'System Operator' and a 'Market Operator'. Therefore, the following steps are suggested:

- POSOCO, in consultation with CERC, CEA and CTU shall prepare a detailed organizational proposal for segregation of 'System Operation' and 'Market Operation' functions within six (6) months.
- The proposal shall be submitted to the Government for approval and issue of enabling orders.

2.15 CONCLUSIONS AND RECOMMENDATIONS (TRANSMISSION)

(i) All new 400 kV and above substations, irrespective of ownership (state sector, private sector, central sector) and type (ISTS, dedicated, intra-state) should have optical fibre communication (OFC) facility, unless specifically exempted by CTU, as a requirement for smooth grid operation. A Standing Committee comprising of CTU, POSOCO and CEA should be constituted to identify (i) strategic lines where OFC shall be mandated (ii) strategic locations in the grid where PMUs and PDCs need to be placed. As a first step, this committee should identify all such locations in the existing grid within six months. It should meet periodically at least once in a year to review and identify new locations.

(ii) In future POWERGRID may be required to install optical fibre as per requirement of grid operation without assurance of telecom business. In such cases the investment should be serviced by the users/POSOCO as determined by CERC. Similar arrangements may be made for each STU/SLDC through their respective SERCs. Grid communication users should have priority over the telecom customers of POWERGRID mandated for the smart transmission grid.

(iii) Grant needs to be made available for setting up transmission system for evacuation of power from renewable energy source. There is a need to encourage RES rich states to build transmission over and above their RPO requirement by providing grant.

(iv) It is proposed that viability gap funding may be provided on case to case basis for building intra-State transmission system for renewable generation and conventional hydro stations.

(v) As the patch of land occupied by the transmission tower would have zero resale value, it stands to reason that compensation for diminution of value of land occupied under tower base should be the full value of the private land at prevailing market rate as determined by the revenue authorities. It is suggested that Central Government may issue a notification in this regard in consultation with the states.

(vi) Transmission corridors needs to be identified and reserved in high density population areas like metros and other upcoming urban areas to meet the future growing demand.

(vii) While doing town planning for new suburban area and industrial centres, provision for laying of substation and transmission line should be kept in mind. To reduce the requirement of land for constructing substation use of Gas Insulated Substations (GIS) which requires about 30 % land compared to conventional substation is being increasingly adopted in metro, hilly and other urban areas.

(viii) The Grid Standards for Connectivity to the grid notified by CEA may be amended to make it mandatory for hydro power stations to commission the synchronous condenser facility and test it periodically as prescribed by the system operator. CERC shall come out with guidelines/regulation for compensating the generator for the energy consumed during synchronous condenser operation, MVARh generated or absorbed by the generator and the extra Operation and Maintenance (O & M) costs associated with synchronous condenser operation.

(ix) POSOCO may constitute a Standing Committee for formulation of 'Reliability Standards and their approval from CERC/regulators.

(x) POSOCO, in consultation with CERC, CEA and CTU shall prepare a detailed organizational proposal for segregation of 'System Operation' and 'Market Operation' functions within six (6) months. The proposal shall be submitted to the Government for approval and issue of enabling orders.

(xi) During 12th Plan period, a total of about 1,09,000 circuit kilometers(ckm) of transmission lines, 2,70,000 MVA of AC transformation capacity and 13,000 MW of HVDC systems are estimated to be added.

(xii) The total fund requirement during 12th Plan for evacuation of power works out to about Rs.1,80,000 Cr.

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Chapter- 3

DISTRIBUTION INCLUDING VILLAGE AND HOUSEHOLD ELECTRIFICATION

3.0 INTRODUCTION

The Distribution Sector plays a crucial role in the overall functioning of the Power Sector. The Government is emphasising on an efficient and well performing distribution sector and focusing on the improvement of financial health of utilities towards providing reliable and quality power supply and universal access to power.

Accessibility of Power in Rural Areas, AT&C loss Reduction, financial viability of discoms, Smart Grid, Demand Side Management (DSM), Private Sector Participation/Private Public Participation (PPP), etc. are also some initiatives taking centre stage today. These have largely been influenced by drivers in Policies and Acts introduced over the past decade. Considering the ambitious targets that were set for the 11th Plan, significant progress has been achieved. The key focus for the 12th Plan is to carry forward the achievements of the 11th Plan and to introduce improved initiatives. Viability of the power sector is largely hinged on the Distribution sector.

To further the reforms in line with the Electricity Act, 2003, unbundling of the State Electricity Boards, setting up of two power exchanges, making procurement of power by the distribution licensee through a competitive bid process mandatory, introduction of Multi Year Tariff (MYT) framework have been the major initiaves. While the results of Orissa privatization were instilling doubts on the reform process, the efficiency improvement in Delhi distribution sector has demonstrated marked improvement.

The recent years have been a witness to growing concerns over the financial health of Distribution Utilities. It was observed that a settlement of past dues alone would not solve the basic problem faced by the SEBs; it is essential that the problem of current unviability of this sector is addressed on priority, other wise dues/losses would mount further. The “Study on Specific Aspects of the Power Sector for Impact on State Finances” for “The Thirteenth Finance Commission, Government of India” shows the projected Net Losses for the next four years based on the prevailing tariffs. As per these studies, the cumulative Net Loss of the States in 2010-11 is projected at Rs.68,643 Cr and further projections for 2014-15 at Rs.116,089 Cr. assuming constant nominal tariff (2008) and without considering subsidy. Further, assuming increase in tariff @ 3% each year based on the past trend and Subsidy received assumed at 65% of subsidy booked based on data for 2008-09, the profitability status of State utilities is projected to come down to a cumulative net – loss of Rs.49,213 Cr. by the year 2014-15. Further, as per “Performance of State Power Utilities” published by PFC, the aggregate losses of all the utilities on subsidy received basis are estimated to be of the order of Rs.44,469 Cr for the year 2009-10. Urgent and immediate action for sustainable Distribution sector is therefore necessary.

3.1 INITIATIVES OF GOVERNMENT

3.1.1 Rural Electrification

Rural Electrification in India has long been regarded as a programme for socio-economic development. It is the key to accelerating economic growth, generation of employment, elimination of poverty and human development especially in rural areas.

Grid connectivity is the normal way of electrification of villages. For villages/habitations, where grid connectivity is not feasible or not cost effective, off-grid solutions based on stand-alone systems may be taken up for supply of electricity. Where neither standalone systems nor grid connectivity is feasible isolated lighting technologies like solar photovoltaic may be adopted. However, such remote villages may not be designated as electrified, as they would have to meet the requirements of the definition of village electrification. Decentralised Distributed Generation facilities together with local distribution network may be based either on conventional or non-conventional methods of electricity generation whichever is more suitable and economical. Poor financial health of utilities is a big constraint on investment. Therefore rural distribution system is having inadequate network and poor maintenance.

The earlier definition of rural electrification was narrow and therefore complete benefits of electricity did not reach to all people. Earlier a village was classified as electrified if the electricity is being used within its revenue area for any purpose whatsoever. The new definition which was introduced in the year 2004 requires setting up of basic infrastructure such as distribution transformers and distribution lines in inhabited locality as well as Dalit Basti/Hamlets, electrification of at least 10% rural households and access of electricity to public buildings like Schools, Dispensaries, Panchayat Bhawans etc.

After Independence by 1951, only 1561 villages were electrified and a total 3061 villages had access to electricity. During the 8th plan, the village electrification program was slow and only 34836 villages were electrified during the plan. During the 10th Plan, 48,387 villages were electrified whereas during the 11th Plan (till 31-7-2011) 60,087 villages have been electrified due to Central Govt. initiatives.

Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) in 10th and 11th Plan

Government of India, in April 2005, launched RGGVY – A comprehensive scheme of Rural Electricity Infrastructure and Household Electrification for providing access of electricity to all rural households. There is a provision of capital subsidy of 90% of the total project cost under the scheme and balance 10% of the project cost are being provided by REC as loan. Rural Electrification Corporation Limited (REC) is the nodal agency for implementation of the scheme in the entire country. Equal emphasis has also been accorded to sustainable rural power supply through deployment of rural franchisees and provision for revenue subsidies from the State Government as required under Electricity Act, 2003 so as to facilitate arriving at revenue sustainable rural power supply arrangement.

Under the scheme, projects have been financed with capital subsidy for provision of –

A. **Rural Electricity Distribution Backbone (REDB)** - Provision of 33/11 KV (or 66/11 KV) sub-stations of adequate capacity and lines in blocks where these do not exist.
B. **Creation of Village Electrification Infrastructure (VEI) -** Provision of distribution transformers of appropriate capacity in electrified villages / habitation(s).
C. **Decentralised Distributed Generation (DDG) and Supply -** Decentralised generation-cum-distribution from conventional or renewable or non-conventional sources such as biomass, bio fuel, bio gas, mini hydro, geo thermal and solar etc. for villages where grid connectivity is either not feasible or not cost effective provided it is not covered under the programme of Ministry of New and Renewable Energy.
D. **Electrification of Below Poverty Line Households -** Free electricity connection to un-electrified Below Poverty Line (BPL) households as per norms of Kutir Jyoti Programe in all rural habitations. Households above poverty line would be paying for their connections at prescribed connection charges and no subsidy would be available for this purpose.

For projects to be eligible for capital subsidy under the scheme, prior commitment of the States is obtained before sanction of projects under the scheme for:

- Guarantee by State Government for a minimum daily supply of 6-8 hours of electricity in the RGGVY network with the assurance of meeting any deficit in this context by supplying electricity at subsidized tariff as required under the Electricity Act, 2003
- Deployment of franchisees for the management of rural distribution in projects financed under the scheme and to undertake steps necessary to operationalize the scheme
- The states to finalize their Rural Electrification Plans in consultation with Ministry of Power and notify the same within six months.

The management of rural distribution would be through franchisees who could be Non-Governmental Organizations (NGOs), Users Association, Panchayat Institutions, Cooperatives or individual entrepreneurs. The franchisee should preferably be input based to reduce AT&C losses so as to make the system revenue sustainable.

Initially the RGGVY scheme was approved for implementation of Phase I of the scheme for capital subsidy of Rs.5,000 Cr during the 10th Plan period. The scheme was subjected to evaluation by the Planning Commission and approval for continuation of the scheme in 11th Plan was accorded in Feb. 2008 for capital subsidy of Rs.28,000 Cr during the 11th Plan period.

The following major modifications were incorporated in the scheme for continuation in 11th Plan.

Figure 3.1: Modifications to RGGVY

X Plan - RGGVY	XI Plan RGGVY
• States must make adequate arrangements for supply of electricity and there should be no discrimination in the hours of supply between rural and urban households. • Cost norms were Rs.6.5 Lakh per village for un-electrified village • Cost norms were Rs.1.0 Lakh per village for already electrified village • Cost norms were Rs.1500 per connection for BPL Household • Electrification of un-electrified habitations with a population of above 300. • Implementing agency to ensure that its own quality control systems and inspection procedures. • Ninety per cent capital subsidy towards overall cost of the projects. • No condition with regard to notification of RE Plan. • Decentralized distribution-cum-generation from conventional for villages where grid connectivity is either not feasible or not cost effective.	• For projects to be eligible for capital subsidy under the scheme, prior commitment of the States would also be obtained before sanction of projects under the scheme for Guarantee by State Government for a minimum daily supply of 6-8 hours of electricity in the RGGVY network.. • Cost norms were revised to Rs.13 Lakh per village for un-electrified village in normal terrain and Rs.18 Lakh per village in Hilly / desert / tribal areas • Cost norms were revised to Rs. 4 Lakh per village for already electrified village in normal terrain and Rs. 6 Lakh per village in Hilly / desert / tribal areas • Cost norms were revised to Rs. 2200 per connection for BPL Household • Electrification of un-electrified habitations with a population of above 100. • Introduction of 3-Tier Quality Control Mechanism. • Ninety per cent capital subsidy towards overall cost of the projects, excluding the amount of state or local taxes, which will be borne by the concerned State/ State Utility. • The states to finalize their Rural Electrification Plans in consultation with Ministry of Power and notify the same within six months. Rural Electrification Plan will be a roadmap for generation, transmission, sub-transmission and distribution of electricity in the state which will ensure the achievement of objectives of the scheme. • Decentralized distribution-cum-generation from conventional or renewable or non-conventional sources such as biomass, bio fuel, bio gas, mini hydro, geo thermal and solar etc. for villages where grid connectivity is either not feasible or not cost effective.

Source: REC

3.1.2 Restructured Accelerated Power Development & Reforms Programme (R-APDRP)

Re-structured APDRP was approved as a Central Sector Scheme on 31.07.2008 with total outlay of Rs.51,577 Cr. Major Charecteristics of R-APDRP Scheme are as follows:

Re-structured APDRP (launched in 2008-09)
• Objective: To reduce AT&C loss through establishment of base line data and integrated IT applications for energy audit / accounting and investing in improvement of distribution infrastructure.
• Central Sector Scheme and fund release directly to distribution utilities.
• Projects under the scheme to be taken up in Two Parts. o **Part-A:** Projects for establishment of baseline data and IT applications for energy accounting/auditing & IT based consumer service centers. (100% GOI loan convertible in grant). o **Part-B:** Regular distribution strengthening projects. (up-to 50% conversion of loan into grant on achieving targets).
• Grant is back ended as loan is converted into grant on achieving the targets.

The focus of the programme is on actual, demonstrable performance in terms of AT&C loss reduction. The coverage of programme is urban areas – towns and cities with population more than 30,000 (10,000 for special category states). Private distribution utilities are not covered under the programme and to be reviewed after two years from date of approval of R-APDRP. The prescribed implementation period for Part A and Part B projects is 3 years from date of sanction and 5 years respectively. Further, the repayment tenure for Part A is 10 years (including 3 years moratorium) and for Part B is 20 years (including 5 years moratorium)

The Projects under the scheme are taken up in the following parts.

Part A	Part B	Part C	Part D
Establishing IT enabled system for energy accounting / auditing and SCADA for big cities (population: 4 lacs and Annual Energy Input 350MU). The outlay for Part-A (IT enabled system and SCADA) is Rs. 10,000 Cr. The entire amount of loan for Part-A projects shall be converted into grant once the establishment of the required Base-line data system is achieved and verified by an independent agency appointed by MoP.	Regular distribution up-gradation & strengthening projects. The outlay for Part-B is Rs. 40,000 Cr. Initially 25% funds (90% for special category states) for Part B projects are provided through loan from the Govt. of India. The balance funds for Part B projects are to be raised from financial institutions. Up to 50% (90% for special category States) of the project cost of Part-B projects shall be converted into grant in five equal tranches on achieving the 15% AT&C loss in the project area on a sustainable basis for a period of five years. In addition, utility level loss reduction (AT&C losses) @ 3% per annum for utilities with baseline loss levels exceeding 30% and @ 1.5% for utilities with baseline loss levels less than 30% have to be achieved.	Programme is an enabling component for implementation of R-APDRP. Provision of Rs.1,177 Cr as a grant has been provided in the scheme.	Allows for a provision for incentive for utility staff in towns where AT&C loss levels are brought below 15%. There is provision of Rs.400 Cr (grant) for this purpose.

Figure 3.2: Components of R-APDRP Scheme

3.1.3 State Schemes

States have come out with specific schemes for Distribution and Rural Electrification. Some of the significant schemes are as follows:

3.1.3.1 Maharashtra - *Akshay Prakash Yojana*

Maharashtra State Electricity Distribution Company Ltd.(MSEDCL) had launched the Akshay Prakash Yojana (APY) in 2004. The objective is to ensure better availability of supply and other social benefits based on collective volunteer responsibility of the inhabitants of the village. Under the scheme, villagers voluntarily restrict the use of any 3 phase load during evening peak on week days. Patrolling is conducted by villagers to uncover theft and misuse of power. It was win – win solution for consumer – to get lighting power during peak hour – as well as for MSEDCL- demand side Management.

3.1.3.2 **Orissa-** ***Biju Gram Jyoti***

Biju Gram Jyoti – Govt of Orissa launched the programme in 2007 with an objective to provide access to electricity to all the habitations having population of less than 100. Altogether 10,000 habitations were covered during the 11th five year plan with budget allocation of Rs.314 Cr. The three components of the scheme are - Village/ habitation electrification, Kutir Jyoti (BPL) connections and Lighting Points.

3.1.3.3 **Gujarat -** ***Jyotigram Yojana (Rural Lighting Scheme)***

Gujarat Government launched the scheme in September 2003 with an objective to segregate the agriculture load from residential, industrial and commercial loads. The pilot scheme covering eight districts was completed in October 2004 and later on it was extended to cover over 18000 villages and about 9700 hamlets with an total expenditure of Rs.1,100 Cr. The primary objective was to improve quality and quantity of power supply for non agricultural consumption in rural areas has been met and Gujarat has managed to control the subsidy and financial losses.

3.1.4 Best Practices Adopted by DISCOMs:

Good practices have been adopted across the country by public and private utilities. The following table describes a summary of select good practices based on category.

Figure 3.3: Best Practices adopted by DISCOMs

3.2 REVIEW OF 11TH PLAN PROGRESS

During the 11th Plan emphasis was on creation of capacity in Sub-transmission & Distribution to strengthen the Distribution sector considering target Generation capacity addition. Emphasis has been given in Metering, Consumer Indexing, adoption of IT facilities, GIS mapping, modern payment system, HVDS, Rural franchisees etc. The achievements, as per the targets and expected outcomes envisaged, are detailed in the subsequent sections.

3.2.1 Access to Power for Population of India

As per Census 2001, 80% of the total inhabited villages were electrified and 44% of the rural households had access to electricity.

As on 31st July 2011, out of the total coverage of RGGVY, only 11,388 un-electrified villages are remaining and these shall be electrified by the end of XI Plan. In addition, about 10,000 villages are in remote areas and are to be covered by MNRE through Non-Conventional Sources. Therefore out of the total 5,93,732 villages in India (as per Census 2001), 5,72,344 villages have been electrified. Thus, total of 96% of the villages of the country have access to electricity.

As per Census 2001, there were total about 19.16 Cr. households in the country of which about 13.8 Cr. households were in rural areas and balance of about 5.36 Cr. in urban areas. As on 31.07.2011, a total of 13.22 Cr households (70%) out of total 19.16 Cr households have access to electricity at the end of 11th Plan. Assuming per household population of 5.37, 71 Cr out of total 102.7 Cr population of the country have access to electricity as on 31.07.2011.

3.2.2 Rural Electrification – RGGVY

Review of Achievements

(a) Sanction of Projects

Under the scheme, 576 projects in 546 districts covering 1,18,499 un-electrified villages, 3,54,967 already electrified villages and 246.45 Lakh BPL households with sanctioned project cost of Rs.26,514.14 Cr have been approved. Out of these, 235 projects covering 68,763 un-electrified villages, 1,11,936 electrified villages and 83.10 Lakh BPL households with the total sanctioned project cost of Rs.97,33.35 Cr were approved in 10th Plan and remaining 341 projects covering 49,736 un-electrified villages, 2,43,031 electrified villages and 163.34 Lakh BPL households with the total sanctioned project cost of Rs.16,780.79 Cr have been approved during 11th Plan. However, the total coverage against sanctioned projects have been reduced to about 1,10,000 un-electrified villages and 233 lakh BPL households based on survey and ground conditions.

Table 3.2: Sanction of projects under RGGVY in 10th and 11th Plan

Projects	No. of Projects	Outlay in Rs. Cr. (Sanctioned Cost)	Un-electrified Villages	Intensive Electrification of Villages	BPL HH Covered
Approved under 10th Plan	235	9,733	68,763 (63987)*	111,936	83.1 Lakh (78)*
Approved under 11th Plan	341	16,781	49,736 (46350)*	243,031	163.34 Lakh (155)
Total	576	26,514	118,499 (110337)*	354,967	246.45 Lakh (233)

*Revised Coverage (Provisional)

The revised sanctioned project cost as on date is Rs.32,668.51 Cr.

(b) Physical Progress

As on 31.07.2011, works in 98,612 Un-electrified villages has been reported complete. However, 83,820 Un-Electrified villages have been reported energized. The gap is primarily in the states of Bihar, Jharkhand, Orissa and Assam.

By the end of 11th Plan, most of the projects are expected to be completed excepting NE region and areas involving difficult terrain. The Bharat Nirman target of electrification of 1 Lakh un-electrified villages and 175 Lakh BPL households by March 2012 shall be surpassed.

Table 3.2: Physical achievement under RGGVY in 10th and 11th Plan

Particular	10th Plan Projects		11th Plan Projects		Total	
	Coverage	Achievement	Coverage	Achievement (as on 31.07.2011)	Coverage	Achievement (as on 31.07.2011)
Un-electrified Villages	68,763 (63987)*	62,968 (91%) (98%)*	49,736 (46350)*	35,644 (72%) (77%)	118,499 (110337)*	98,612 (83%) (89%)
BPL Households (Lakh Nos.)	83.10 (78)*	71.71 (86%) (92%)*	163.34 (155)*	97.14 (59%) (63%)*	246.45 (233)*	168.85 (70%) (72)*

*Revised Coverage (Provisional)

(c) Financial Progress

Against total allocation of capital subsidy of Rs.33,000 Cr (Rs.5,000 Cr under 10th Plan and Rs.28,000 Cr under 11th Plan), capital subsidy of Rs.23,913 Cr has been released as on 31.03.2011. The subsidy allocation for FY 2011-12 is Rs.6,000 Cr and accordingly the expected cumulative achievement at the end of 11th Plan would be about Rs.29,913 Cr. Thus, there would be spill over of about Rs.3,000 Cr. in the 12th Plan. This is mainly on account of release of final installment of funds (10% of project costs) to be released on closure of projects. Taking into consideration the expected savings, in implementation of sanctioned projects and to ensure utilization of allocated funds, additional projects of Rs.6,000 Cr covering remaining 32 districts earlier identified under Phase II, supplementary projects for Uncovered Habitations and BPL Households are being considered for sanction with the approval of Ministry of Finance and Planning Commission. The year-wise details of release of capital subsidy by Govt. of India are as under:

Table 3.2: Financial achievement under RGGVY in 10th and 11th Plan

Year	Amount in Rs. Cr
2005-06	1,500
2006-07	3,000
Total (10th Plan)	**4,500**
2007-08	3,913
2008-09	5,500
2009-10	5,000
2010-11	5,000
2011-12 (Budget Allocation)	6,000
Total (11th Plan – Likely)	**25,413**
Total (10th and 11th Plan – Likely)	**29,913**

(d) Delay in Implementation of Projects

Although there have been no shortfalls in achievement of targets for RGGVY, time overrun has been observed in implementation of RGGVY projects. The reasons that have contributed to these delays are as follows:

- Lower stake of states;
- Contracting delays;
- Absence of dedicated skilled manpower;
- Inadequate availability of key material / equipment;
- Delay in statutory clearances;
- Delay in providing authenticated list of BPL households.

The main reasons for delay in the energization of projects are:

- Slow progress in strengthening of network, especially in Jharkhand
- Delay in completion of sub-stations and associated lines covered under the scheme
- Delay in Statutory Clearances (Forest, Railway, Land etc.)

Even after completion of project and energization of newly connected habitations, it has been noticed that certain regions do not get power for sufficient duration of 6-8 hours per day due to overall shortages of power. Slow progress on deployment of franchisees by the states in rural areas is also contributing to delay in energisation as well as maintaining adequate power supply due to manpower constraints.

(e) Issues and Concerns

- **Coverage and Scope of the scheme**

RGGVY in the present form envisages providing access to electricity to rural households and ensures last mile connectivity for BPL households and providing free electricity connections. State utilities are expected to provide electricity connections to all other categories of prospective consumers including APL.

The RGGVY estimates were based on number of Revenue Villages. However, it is being realized that there are other factors such as Geographical spread, No. of habitations, Size of the Revenue Village, existing level of electrification and Number of BPL households that are required to be considered while working out the benchmark costs. Number of BPL households in under-developed states is more than those in developed states. Therefore required infrastructure for electrification of villages and BPL households in the states where household electrification level is very poor e.g. Bihar (5.13%), Jharkhand (9.9%), Assam (16.54%), Orissa (19.35%) (as per Census 2001), could not be provided under RGGVY.

The scheme envisaged only indirect benefits for the power requirement of agriculture and other activities including irrigation pump sets, small and medium industries, khadi and village industries, cold chains, healthcare, education and IT etc. for overall rural development.

Further, keeping in view the overall availability of funds, the coverage of habitations having population more than 100 was only considered.

- **Revenue sustainability – Deployment of Franchisees**

It was envisaged to attain revenue sustainability through (i) Deployment of franchisees for management of rural distribution (ii) Determination of bulk supply tariff for franchisees in a manner that ensures their commercial viability and (iii) Provision of requisite revenue subsidy by the State Government to the State Utilities as required under the Electricity Act. However, due to low load density leading to higher delivery cost and improper mix of consumer base, most of the utilities have not been able to adopt franchisee systems as mandated in the scheme. Under RGGVY it is specifically mentioned that in the event the projects are not implemented satisfactorily in accordance with the conditionalities indicated above, the capital subsidy would be converted into interest bearing loans. This has been specifically agreed by the states in the agreement signed by them with REC. If it is decided to take up infrastructure for productive load also, the issue of revenue sustainability of the scheme will be more serious.

- **Notification of RE plan and its implementation by states**

As per RE Policy, the State Governments should, within 6 months prepare and notify a Rural Electrification Plan to achieve the goal of providing access to all households encompassing the Plan for establishment of Transmission and Distribution System and availability of adequate power supply. The Rural Electrification Plan should map and detail the electrification delivery mechanisms (grid or stand alone) considering inter alia the available technologies, environmental norms, fuel availability, number of un-electrified households, distance from the existing grid etc. The Plan may be linked and integrated with District Development Plans as and when such plans become available. The Plan should also be intimated to the Appropriate Commission. The key points to be covered in the RE Plan are (i) ensuring 6-8 hours power supply, (ii) providing adequate subsidy in budget for additional BPL Households to be covered under RGGVY and (iii) creating / augmenting the up-stream infrastructure of adequate capacity.

Only 17 states have so far notified their Plans, but have not taken required steps to fulfill commitments made under the RE Plans.

- **Benchmark costs**

Benchmark costs per village including its habitations act as a guiding principle for effective control on overall cost of the scheme. The majority of the un-electrified villages have been already electrified and the balance work is mainly of electrification of Majra/ Tolas/ Habitations and intensive electrification of electrified villages. It may be mentioned that the cost of electrification of a village for intensive electrification in already electrified village depends upon parameters like Geographical conditions, Size of villages (area and population), density of population within villages (No. and size of habitations), availability of existing network etc. Therefore, it will be challenge to estimate benchmark costs to cater habitations with such diverse parameters.

- **Availability of 6-8 hours Power Supply**

For availing capital subsidy under the RGGVY scheme, the states have to ensure minimum 6-8 hours power supply in RGGVY network. While the states have committed to such arrangement, it is difficult to regularly monitor the availability of power supply.

- **Monitoring**

For timely completion of projects and better monitoring of the works, the scheme is supported by web based MIS. However, the automated MIS is unable to give accurate desired information and REC has to resort to create different MIS flow for fortnightly reporting.

- **Decentralized Distributed Generation (DDG)**

There is a provision of subsidy of Rs.540 Cr for Decentralized Distributed Generation (DDG) under RGGVY. Decentralized Distributed Generation can be from conventional or renewable sources such as Biomass, Biofuels, Biogas, Mini Hydro, Solar etc. for villages where grid connectivity is either not feasible or not cost effective. The DDG projects would be owned by State Government. Implementing agencies of the projects shall be either the State Renewable Energy Development Agencies (SREDAs)/ departments promoting renewable energy or State Utilities or the identified CPSUs. The State Governments will decide the implementing agency for their respective states.

Out of the allocated Rs.540 Cr. for DDG, the cost of projects sanctioned till July 2011 is Rs.139 Cr. for 87 sanctioned projects. The likely amount to be sanctioned by the end of 11th plan is Rs.270 Cr.

There has been shortfall in achieving the allocated amount for the scheme. The main reasons for the shortfall as follows:

- Lack of clarity on ownership of project.
- Low operational revenue.
- The villagers still prefer grid-connectivity and consider DDG as a sub-optimal choice.
- Lack of awareness among stake holders.
- The scheme in its present form does not provide adequate returns to entrepreneurs for a difficult task.

- **Social-economic Evaluation of RGGVY**

Studies have been carried out to evaluate the socio-economic impact of electrification in Orissa.
It is recommended that similar studies be continued in the 12th Plan.
The Key findings of the studies are:

Impact on savings, lighting, and energy: Electrification has altered the household energy mix through the substitution of traditional, kerosene-based lighting sources by electric light. Households that still consume kerosene are now able to meet their demand. Therefore, Energy savings are currently being realized as families would no longer be subject to the exorbitant price of kerosene.

Impact on standard of living: Electrification has resulted in a paradigmatic shift in post-sunset engagements among adults and children in all the selected villages. The incidence of idling or early sleep has been reduced, and other engagements such as household work, income generation or socializing have been regularized or introduced. Security within the village against fires, animal attacks, and theft has been enhanced with the use of electric light.

Impact on livelihood generation: Electrification has enhanced livelihood generation, in the areas of agriculture and related activities, petty shops, and entrepreneurial activities. In contrast to the pattern of outward migration for labour, jobs are now being created and retained within the village economy due to electrification.

Impact on health: Although hospitals remain unelectrified, contradictory to the intention of the scheme, other infrastructure, such as electric water pumps for sanitation facilities, have increased the health standards in some villages. Within the household, electric light appliances have benefited women by decreasing the risk of respiratory and stress-related illnesses. The role of media in information dissemination has significant implications for rural health.

Impact on education: Before electrification, prioritized use of wick lamps for economic activities or household work limited the availability of light for studying post sunset. The availability of electricity allows for an extension of study hours, thus resulting in enhanced academic performance and preparedness at school.

Impact on gender perspectives: Electrification offers progress in mitigating this disparity by facilitating domestic housework through the use of electric light and appliances. Electric light also enhances the feeling of security among women post sunset, resulting in increased mobility and comfort.

3.2.3 R-APDRP Scheme

The present status of R-APDRP scheme is as under:

- Under Part-A of R-APDRP, 1,401 projects at an estimated cost of Rs.5,176.90 Cr have been approved for 29 States/UTs and Rs.1,512.37 Cr have been disbursed.
- Part-A SCADA projects for 42 towns of 8 states have also been sanctioned at an estimated cost of Rs.982.45 Cr and Rs.170.77 Cr have been disbursed.
- Under Part-B of R-APDRP, 907 projects at an estimated cost of Rs.19,367.39 Cr have been approved for 15 States and Rs.2,291.35 Cr have been disbursed.
- Barring one state (Haryana), all Part A projects have been awarded and are under implementation.

Part-A of R-APDRP is currently under implementation and is in a stage of advanced progress in several States. Part A of the R-APDRP is to be completed by utilities after 3 years of sanctioning. As of now, there are no projects which have completed three years of time, post sanctioning. However, it has been observed that State Procurement Policy and procedures delayed the appointment of ITIA in some States.

If the States achieve the desired outcome of R-APDRP, it is expected that the AT&C losses in the project areas (towns) covered under R-APDRP will be brought down to 15% and utility level AT&C losses are expected to be reduced at the rate of 3% per year (for utilities having AT&C loss more than 30%) / 1.5% per year (for utilities having AT&C loss more than 30%). Expected AT&C loss of utilities for next five years has been extrapolated and placed at **Appendix-3.3**. It can be seen that AT&C losses at country level can come down to 17.99% after five years i.e.at the end of FY 2014-15 provided States achieve the desired outcomes of R-APDRP.

3.2.4 Financial Health of SEBs

(a) AT&C Losses:

Accelerated Power Development and Reforms Programme (APDRP) was launched in 2002-03 as an Additional Central Assistance (ACA) to finance the modernization of sub-transmission & distribution networks with the main objectives to reduce AT&C losses to 15%. AT&C loss at national level reduced from 38.86% in 2001-02 to 27.15% during 2009-10.

While some states have shown an improvement in AT&C Loss reduction, it is pertinent to note that the absolute loss levels are still at a higher level and require further efforts for loss reduction. Statewise details are furnished in the Table below:

Table 3.2: State-wise progress in AT&C Loss Reduction

State	AT&C Losses (%)	
	2008-09	2009-10
Jharkhand	54.01	10.43
Manipur	81.32	48.09
Goa	21.69	7.76
Arunachal Pradesh	60.15	52.93
Kerala	21.61	14.89
Maharashtra	31.19	25.02
Madhya Pradesh	46.61	41.03
Haryana	33.29	28.99
Assam	32.68	29.03
Tripura	31.91	29.16
Orissa	42.20	39.71
Mizoram	41.08	38.99
Punjab	18.51	17.73
Uttar Pradesh	40.12	39.65
Rajasthan	29.83	30.07
Karnataka	24.94	25.34
Gujarat	22.04	22.81
Puducherry	18.47	19.35
Jammu & Kashmir	69.05	70.44
Nagaland	44.12	46.15
Delhi	17.92	20.78
Andhra Pradesh	12.99	16.43
Sikkim	46.81	51.35
Chattisgarh	32.73	37.98

Meghalaya	43.37	48.77
Himachal Pradesh	12.85	18.46
Tamil Nadu	14.39	20.15
West Bengal	25.81	33.24
Bihar	34.37	43.92
Uttarakhand	40.23	55.00
TOTAL	**27.74**	**27.15**

Source: PFC

There is an urgent need of support from the Government (Administrative and Financial) for the efficient working of restructured Utilities. The reform process can succeed with the necessary support of Central Government, concerned State Governments and effective regulatory mechanism which ultimately will lead to commercial viability of the Utilities. Central Government is providing both technical and financial support to State Distribution Utilities. Distribution Utilities have to optimize the resources. A road map is required to be drawn by Distribution Company for reducing the AT&C losses in a time bound manner on sustainable basis. Distribution Company must evolve a result oriented strategy based on good practices adopted by other States to reduce the AT&C losses. Real time energy accounting and audit is to be enforced by the distribution company for reduction in AT&C losses on a sustainable basis. Segregation of technical and commercial losses is need of the hour. Along with other measures described herein the following needs critical attention:

- Setting up of special courts and special police stations to deal exclusively the cases of pilferage of electricity.
- Setting up of enforcement division and to outline an enforcement strategy.
- Metering: 100% metering of feeders, distribution transformers and consumers.
- Energy Accounting and Auditing on real time basis, employing AMR etc.
- 100% billing / collection efficiency
- Development of adequate distribution infrastructure by constructing new lines/ substations and augmentation /upgradation of existing distribution infrastructure.
- Systematic Planning & Development of distribution infrastructure using the system development techniques/software and do away with the present practice of haphazard / casual and ad-hoc practice.
- Adequate and proper maintenance of distribution infrastructure as per the best practices all over the world.

Setting up of Special Courts: Section 153 of the Act provides for setting up of special courts by the States. Though number of special courts has been opened, there is a need to set up more special courts and police stations to deal with the cases of theft and pilferage exclusively. The speedy disposal of the cases and penalizing heavily the culprit of power theft can only bring the solution. The connivance of police with the staff of the distribution company and the consumer also needs to be given due attention.

Feeder Segregation/Renovation: The scheme for feeder segregation may be judiciously implemented by various states after mapping of their agricultural load. Such scheme can be partially financed under the proposed reform linked National Electricity Fund which will be operationalised shortly. The programme can also be financed through multilateral Financial Institutions such as World Bank, ADB etc. As heavy investment would be involved to cover the entire country, a separate scheme may also be required for funding or funding from National Electricity Fund could be another option.

<u>High Voltage Distribution System (HVDS)</u>: High voltage distribution system by extending the 11 kV network in place of low voltage network has advantage of low line losses and are less prone to theft of electricity by direct hooking as in case of LT system of distribution of electricity. The Distribution companies must evolve a systematic approach to implementation of high voltage distribution system in urban as well as in rural areas and especially in theft prone areas.

(b) Revenue Loss (ARR and ACS gap)

As per the PFC report on "Performance of State Power Utilities" for the year 2009-10 the cash losses (revenue and subsidy realized basis) of utilities selling power directly to consumers increased from Rs.17,620 Cr. in the FY 2007-08 to Rs.42,415 Cr. in the FY 2009-10. The cumulative book losses (accrual basis) of the state utilities have increased from Rs.79,339 Cr. as on 31.03.2009 to Rs.1,06,247 Cr. at the end of year 2009-10

Gap between Average Cost of Supply and Average Revenue Realised is widening and has increased to Rs.0.73 per unit in 2009-10 from Rs.0.37 per unit in 2007-08 on subsidy realized basis. While some states have shown improvement in the financial health, others are yet to demonstrate the impact of the policy initiatives.

The increasing ACS-ARR gap trend for the country has been rising over the years as can be seen in the following table:

Table 3.210: Region-wise Gap in ARR and ACS

Region	Gap without subsidy (Rs./kWh)			Gap on subsidy booked basis (Rs./kWh)			Gap (subsidy/ revenue realized basis) (Rs./kWh)		
	07-08	**08-09**	**09-10**	**07-08**	**08-09**	**09-10**	**07-08**	**08-09**	**09-10**
Eastern	0.48	0.49	0.51	0.33	0.36	0.33	0.24	0.38	0.31
North Eastern	0.50	0.33	0.81	0.40	0.30	0.78	0.45	0.49	0.91
Northern	0.95	1.11	1.34	0.41	0.41	0.45	0.69	0.83	1.17
Southern	0.51	1.09	0.96	0.17	0.49	0.47	0.21	0.83	0.79
Western	0.15	0.26	0.34	0.06	0.15	0.21	0.20	0.41	0.29
National	**0.54**	**0.79**	**0.86**	**0.23**	**0.35**	**0.38**	**0.37**	**0.67**	**0.73**

("Performance of State Power Utilities" - PFC)

In order to restore the commercial viability of the distribution companies it is necessary to eliminate the gap between Average Revenue realised (ARR) and Average Cost of Supply (ACS). The tariff structure needs to be designed based on Multi Year Tariff with tariff revision in a time bound manner. The National Tariff Policy mandates the SERCs to notify roadmap with a target that latest by the end of year 2010-11 the tariffs are within ± 20 % of the average cost of supply. However, several states are yet to fully achieve this. Most States require tariff increases that are in the range of 0 – 20%.

An aggregate of Rs.97,87.54 Cr is owed by the Power Utilities to the CPSUs as on 31.07.2011 i.e. outstanding dues of Power Utilities (Principal and Surcharge).

A Panel chaired by former Comptroller and Auditor General Sh. V. K Shunglu has been formed to look into the financial health of power distribution companies and to suggest ways to improve the financial condition. Recommendations of the panel are awaited.

Provision of subsidy by State Government: The State Govt. has to abide by the provisions of Section 65 of the Electricity Act, 2003 as regards Grant of Subsidy.

Low Tariff/Free Power to Agriculture and payment of subsidy: Low tariff or free power to certain sections of the society/ categories of consumers is still in vogue in some States. This creates a liability on the State exchequer to pay to the Utility the gap between the concessional tariff and the tariff worked out by the Regulatory Commission. However, in practice either no subsidy is released to the Distribution Utility or even if, it is released, it is much less than the desired and that too the payments are released quite late which results into book adjustments only. At times the subsidies are even adjusted against the interest accrued on the loan released by the State Government to the Distribution Utilities. This kind of arrangement of subsidy adversely affects the financial performance of the Distribution Utilities. Hence, timely payment of the entire subsidy amount to the Distribution Utility has to be ensured and the State Government must make adequate provisions in their State Plan budget for such kind of subsidies.

(c) Mounting of Debt on Utilities

The total borrowings of state DISCOMs have touched Rs.1,77,602 Cr as on 31.03.2010 and total interest charged from state utilities in year 2009-10 is Rs.15,651 Cr. This in turn adds to the interest burden of the utilities and in the absence of any remedial steps, the cash gap increases even more over the years. In many a cases, it is learnt that utilities are servicing the interest on existing loans by fresh borrowings, which leads to a virtual debt trap in the long run.

RBI has taken cognizance of the difficult financial situations of DISCOMs and their attempts to bridge cash losses by short term borrowings. In order to bridge the gap between revenue and expenditure and to service interest on borrowing States resort to short-term borrowing and even divert long-term loans to bridge cash losses.

The suggested measures to improve the financial health of DISCOMs may include roadmap for reducing the gap between ACS and ARR and cash losses. This can be achieved by:

i. Reduction of high AT&C losses through administrative measures i.e. arresting theft and pilferage in power distribution
ii. Payment of outstanding subsidy by states
iii. Practice of paying subsidy upfront, as per section 65 of Electricity Act, 2003
iv. Timely payment of electricity dues by Government departments; by direct payment from the budget or deployment of prepaid meters as demonstrated through pilot projects by NDPL, BSES, WBSEDCL etc.

Conversion of existing Government loans to DISCOMs into Government equity will help cash flow of DISCOMs because now subsidy payable by State Government is adjusted against interest on loan. Many DISCOMs have negative net-worth and conversion of loan into equity may result into positive net-worth and enable DISCOMs to attract fresh funds.

(d) Cross-subsidy

The following table indicates the level of cross subsidy from Industrial consumers to Agricultural consumers.

Table 3.211: Level of Cross subsidy from Industrial and Agriculture Consumers

State	Agriculture (% of total Energy sold)	Agriculture (% of total Revenue)*	Industrial (% of total Energy sold)	Industrial (% of total Revenue)
Haryana	38%	3%	26%	31%
Karnataka	35%	10%	22%	32%
Rajasthan	39%	18%	26%	39%
Punjab	32%	-	34%	57%
Andhra Pradesh	31%	2%	31%	44%
Maharashtra	22%	10%	45%	51%
Gujarat	32%	14%	43%	58%
Tamil Nadu	22%	-	35%	54%
Madhya Pradesh	30%	12%	31%	39%

("Performance of State Power Utilities" - PFC)

***** *Revenue collected from farmers and does not include subsidy from Government.*

Adequacy of Tariff: Seeing the mounting losses of the distribution companies it is very clear that the health of the distribution companies can be improved in two ways. (i) by improving the operational efficiency to reduce the losses from technical, administrative and commercial intervention and, (ii) by setting appropriate tariff to meet the cost of supply and to bridge the gap between ARR and ACS. There is enough scope for enhancing the tariff. From the Govt. side it is also required that legitimate tariff increase is supported. In case the tariff is not increased to desired level the necessary subsidy has to be provided by the Govt. to the distribution companies. It is very necessary that the Govt. provides adequate financial support to the distribution company during transition phase as heavy investment is required in the distribution sector to augment the distribution network. The subsidy may have to be continued unless the tariff is rationalized.

The State Governments and to some extent the State Electricity Regulatory Commissions are not making desired progress towards tariff rationalization. Financial institutions are major stakeholders who can influence the State Government and the State owned distribution utilities and their insistence on tariff rationalization would help making the process faster. The support of the financial institutions could be garnered in two ways. Firstly, the erstwhile system of annual rating of the utilities needs to be revived. Secondly, the Government of India owned power sector FIs (PFC and REC) may be asked to lead in this aspect by insisting on tariff rationalization as a pre-condition of lending to the distribution utilities. The other important stakeholder is the Planning Commission which may emphasize on this aspect while finalizing the annual state plans. The Planning Commission may not only emphasize on tariff rationalization but also on strict compliance with section 65 of the Electricity Act which mandates advance payment of subsidy committed by the State Government.

(e) Distribution Franchisee

The Government of Maharashtra had taken the initiative to introduce an input-based franchisee for distribution in selected towns. At the time of takeover in the area of Bhiwandi the power scenario was poor and the network was in shambles. M/s Torrent Power was selected as the distribution franchisee in January, 2007 for Bhiwandi on input based. In three and half years since take over there have been substantial improvement. The AT&C losses have come down from 54.64% to 20.20%, Distribution Transformer failure rate from 40% to 3.7% and metering has improved from 23% to 100%. Learning from the experience of Bhiwandi, the towns of Nagpur, Aurangabad and Jalgaon in Maharashtra have also been awarded to Franchisees. Similarly franchisee have been appointed for Agra in Uttar Pradesh.

As regards, Rural Franchisee, some states have demonstrated success in rural franchisee model. The states of Uttarakhand and West Bengal have deployed Self Help Groups as rural franchisees for management of rural distribution.

Public Private Partnership (PPP) initiative:

While Privatisation is the long term solution, Franchisee model being a softer approach faces lesser resistance from various stakeholders. As such it has emerged as the preferred route recently and many states have initiated action in this direction.

Distribution Franchisee:

Many Distribution Companies are on their way to adopt urban franchises based on Bhiwandi Model with longer control period and also with the rural franchisee.

Urban pockets, with AT&C loss in excess of 25 % may also be taken up. Not only because private players have previous experience of operating in urban locations but also because these are easier to deal with because of good management practices and no crunch of financial resources.

A time bound plan for identification of areas for PPP needs to be worked out by each state and they need to initiate implementation of the plan in coordination with all the concerned agencies. This is in light of the urgency of inducting efficiencies in the distribution sector for its commercial sustenance.

Appointment of Franchisee in Urban area: The staff in the State Electricity Boards/Distribution Companies is depleting and there is a need to outsource various activities. In case it is becoming unmanageable by the Distribution Company to bring improvement in performance, the Public Private Partnership (PPP) Model is seen as the only feasible solution as many Distribution Companies are on their way to adopt urban franchises based on Bhiwandi Model with longer control period. This will facilitate investment from private sector to bridge the gap between availability and requirement of funds. Since distribution sector is mainly within the purview of the State Government, a strong government support is necessary for introducing PPP model in the distribution sector. The merit in promoting PPP model in power distribution sector is to improve the viability which is hampered due to high subsidies to certain categories of consumers which at present the State Governments are not able to fully compensate to utilities due to their poor finances. CERC is in the process of finalization of standard bidding document for urban franchisee.

3.3 REFORMS AND POLICY IMPLEMENTATION STATUS

3.3.1 Open Access

The Open Access at Inter-State level is fully operational. During the FY 2009-10, the total number of transactions under Open Access was 18,128 as against 778 in 2004-05. Further, Central Transmission Utility (CTU) is reported to have received 225 applications from private developers for Long Term Open Access.

At State level, as per information available with Forum of Regulators secretariat, 24 SERCs have notified terms and conditions of Open Access Regulations, 21 SERCs have determined cross subsidy surcharge, 25 SERCs have allowed Open Access up to 1 MW and above, 21 SERCs have determined transmission charges and 18 SERCs have determined wheeling charges.

3.3.2 Tariff Rationalization

It is seen that the tariff is not appropriate to meet the cost of supply of electricity. This hinders the sustainability of distribution companies. Further, default in payment, non-metering of consumers, no proper energy accounting/ auditing, inadequate upgradation of the distribution system are issues that need to be addressed. State Governments may have to examine the possibility of increasing the tariff in respect of agriculture and domestic sector or providing adequate revenue subsidy. Comptroller and Auditor General of India (CAG) have also carried out a study of 24 utilities on issues impacting financial performance of Power Distribution Utilities in India and have mentioned the issues of cross subsidy and tariff not being rational. Unles the tariff are not made rational and higher losses are not contained, DISCOMs will reach at break down level due to financial imprudence.

Adoption of Multi-Year Tariff (MYT) would reduce the effort and expenditure of Utility in filing the ARR on annual basis; this would also enhance the working capacity of the Utility. MYT would provide certain degree of certainty and would also be helpful in improving the confidence of the investors. Accordingly there is a need to determine rational tariff to reduce the gap between ARR & ACS based on multi year tariff with revision of tariff in a time bound manner.

Ministry of Power approached Appellant Tribunal for Electricity (APTEL) to take appropriate action by issuing necessary directions to all the State Commissions to revise the tariff periodically, if required by suo moto action, in the interest of improving the financial health of the power sector.
In its judgment dated 8th November 2011, APTEL has issued following directions to state Commissions:

(i) Every State Commission to ensure Annual Performance Review, true-up of past expenses and Annual Revenue Requirement and tariff determination on year to year basis as specified in regulations.
(ii) Every State Commission to ensure that tariff for the financial year is decided before 1st April of the tariff year.
(iii) In case of delay in filling of ARR beyond schedule date of submission, the State Commission must initiate suo-moto proceedings for tariff determination in accordance with section 64 of the Act read with clause 8.1(7) of the Tariff Policy.
(iv) In tariff determination, the revenue gaps ought not to be left and Regulatory Asset should not be created as a matter of course except where it is justifiable. The recovery of the Regulatory Asset should be time bound and within a period not exceeding three years at the most and preferably within Control Period. Carrying cost should be allowed.
(v) Truing up should be carried out regularly and preferably every year.
(vi) Every State Commission must have in place a mechanism for Fuel and Power Purchase cost in terms of Section 62 (4) of the Act. The Fuel and Power Purchase cost adjustment should be preferably be on monthly basis but in no case exceeding a quarter.

3.4 PROGRAMME FOR 12TH PLAN

The recent growth of the country has led to rapid urbanization and the trend is likely to continue in the future. This has impacted the energy requirement of the country due to changes in lifestyle, consumption pattern and consumer base, resulting in requirement of additional capacity in the distribution network. To aggravate the situation, the cumulative book losses (accrual basis) of the state utilities is estimated as Rs.1,06,247 Cr. at the end of year 2009-10. Therefore, the poor financial health of the utilities has resulted in under-investment in the distribution network leading to poor upkeep and maintenance. Consequently, the quality of supply gets hampered leading to customer dissatisfaction and poor recovery. This in turn leads to further deterioration of financial health. This is a vicious cycle and needs to be arrested

The utilities are therefore facing dual challenge of meeting the increasing demands of consumers as well as maintaining their own financial health. Achieving the MoP's vision of "Reliable, adequate and quality power for all at reasonable prices" will therefore require financial assistance and incentivizing investment from the GoI.

The per capita electricity consumption of the country for 2009-10 is 778.7 kWh (provisional). Although, the recent trend in per capita electricity consumption has shown an increasing trend, it is observed that India's per capita electricity consumption is one of the lowest in the world. The distribution system planned for the 12th Plan includes setting up of new lines (13,05,000 ckm), installation of new substations(88,000 MVA), augmentation of substation etc. The total fund requirement is Rs 3,06,235 crs for distribution sector. Detailed estimates of Physical programme and financial requirement for 12th Plan are given in **Appendix 3.1.**

Providing access to electricity and actual flow of electricity are both important. Although, access to electricity has been provided to 96% of the villages, many villages are unable to get daily 6-8 hours of power supply. Therefore, it is important that steps may be taken towards providing improved power supply in such areas. Going forward, the 12th Plan should address the issues of both electrification and energization. Apart from continuation of the current scheme and extending its scope, it is also necessary to take initiatives such as inclusion of Productive Load, Feeder Separation, and Central Subsidy for consumption of power by BPL consumers.

The DDG scheme was initially intended to serve areas where grid-connection is not technically & commercially feasible. Further, in the left wing extremist (LWE) areas which are grid-connected, it was realized that these areas do not get adequate electricity supply (6-8 hours per day). Moreover, there were implementation bottlenecks. In this context an empowered group of officers was constituted under MHA. The group in its meeting held on 17th January 2011 suggested modifications to relax conditions in the DDG guidelines with respect to non-availability of grid for implementation of the DDG scheme. The recommendations have now been incorporated in the DDG scheme. The details are attached as **Appendix 3.2**. It is also being proposed to explore establishment of DDG projects in Grid connected areas (other than LWE area) where adequate power supply is not available.

The key challenges to be addressed in 12th Plan are providing access of power to all, Sustainability, Efficiency and Effectiveness of Distribution sector. To address these challenges, Penetration and System Strengthening are the two key measures.

Similarly, it is also necessary to address the issue of quality of power. While it requires discipline from both demand and supply side, there is an immediate need for up-gradation of distribution infrastructure to ensure quality power.

During the Power Minister's Conference (held on 13-07-2011 at New Delhi), it was resolved that for improving the financial health of the distribution sector the state governments would ensure timely finalization and computerisation of accounts; filing of Annual Tariff Revision Petition regularly; clearing of all the outstanding subsidies to the utilities; payment of all outstanding dues to the distribution utilities or release payments from the State budget directly; and considering converting loans to equity.

Adequate funds @ Rs 4 crores/MW for development of distribution network are needed so as to meet the increasing demand, avoid overloading of networks and reduce the losses. To make up the losses and to revamp the distribution sector there is a need to make further investments in the distribution sector to make the distribution sector commercially viable. Under these situations franchisees in the distribution sector or privatization may be looked into.

Preparation of Distribution Plan: Utilities need to prepare a distribution plan clearly defining the road map to augment their distribution system to match the capacity addition program, identify land for sub-stations and their timely acquisition so as to avoid time lag in commissioning of project, prepare bankable detailed project reports for system improvement etc.

The commercial accounting system needs to be strengthened to take care of true and fair view of the profitability. The introduction of computerization with suitable MIS will help in finalization and reporting system of accounting.

Identifying sources for accelerating the implementation of progress of R-APDRP such as awarding of contract of part A scheme and Identifying the system strengthening scheme under Part B and to submit the schemes to PFC.

3.4.1 Recommendations for Sustainable Distribution Sector

Achieving the MoP's vision of "Reliable, adequate and quality power for all at reasonable prices" will require financial assistance and incentivizing investment from the Government of India. Some of the key initiatives proposed for 12th Plan are:

I. Improvement of Financial Health of Utilities

- **R-APDRP:** The scope of the scheme may be expanded to cover more towns by lowering the existing population thresholds. Intensive coverage will bring uniformity in billing and customer services of the utility across all its service areas. Thus, it is recommended that for:
  - Non Special Category States – Additional towns with population between 15,000 and 30,000
  - Special Category States – Additional towns with population between 5,000 and 10,000

- o SCADA – Additional towns with population of 200,000 and annual input energy of 175 MUs

The estimated total fund required for enhanced scope of R-APDRP will be around Rs.15,870 Cr with a grant amount of Rs.9,924 Cr.

In addition, Rs. 9,900 Crore will be required in XII Plan for enabling component (Part-C), Incentive scheme (Part-D) and ongoing R-APDRP projects sanctioned in XI Plan assuming that GoI loan for entire Part-A and 25% (90% for special category states) of Part-B would be converted into grant.

Assistance to Private Companies under R-APDRP: RAPDRP may cover assistance to private distribution companies also.

Presently RAPDRP covers investments in towns having population of 30,000 for non-special category and 10,000 for special category states. During the last Conference of Chief Ministers'/Power Ministers', it was raised that RAPDRP must cover all the towns having population of 10,000 for non-special category states and towns having population more than 5000 for special category states. This would require large investments in establishing baseline data, implementation of IT facilities, including SCADA and system improvement schemes.

Similarly, at present, RAPDRP has envisaged implementation of SCADA in towns having population of more than 4 lakhs and having input annual energy of 350 million units. All towns would be required to be provided with SCADA system so that the interoperability/interfacing issues don't arise due to time lag between installations of SCADA equipment.

- **National Electricity Fund (Interest Subsidy Scheme):** Under the 12TH Plan about 75,000 MW capacity is proposed to be added which needs an investment of Rs.450,000 Cr.(@ Rs.6 Cr./ MW). As a rule of thumb the proportion of fund requirement for Generation, Transmission and Distribution is in the ratio of 2:1:1. Therefore, the fund requirement for Distribution may be about Rs.225,000 Cr. to evacuate and distribute power to be generated from the added capacity. Out of this 225,000 Cr. around 75,000 Cr. is proposed to be funded through R-APDRP (Rs. 40,000 Cr) and RGGVY (35,000 Cr.). The remaining amount of Rs.150,000 Cr. to be invested needs to be channelized into Distribution through various sources of funding such as FIs/ Banks etc. Therefore, the Government of India is considering extending interest relief to the Distribution Utilities to cover such loans from financial institutions in addition to those from PFC and REC for Non RGGVY and Non R-APDRP areas. It is envisaged to provide interest subsidy for over 15 years at an estimated outlay of Rs.63,750 Cr. from the National Electricity Fund (NEF). The amount of Rs.22,000 Cr. has been estimated for 12th Plan under NEF, assuming an average interest subsidy of 5% p.a..

- **100% metering of Consumers:** There is an urgent need to identify an action plan for 100% metering of consumers and implementation. It is recommended to implement metering of consumers in phases and to take up Pre-paid metering on pilot basis especially in rural areas.

- **Tariff rationalization**: Utilities and Regulators need to make an action plan to eliminate ARR – ACS gap through improved tariff implementation and adoption of Multi Year Tariff framework by all States.

- **Time of Day (TOD) metering and tariff** : TOD metering should be taken up by all the utilities for effective demand side management (DSM). It will be an important component of Smart Grid Pilots being planned under R-APDRP.

- **Load Shifting Arrangements**: India is reeling under power deficit conditions. Under such environment, there is a tremendous need that adequate demand side management is resorted to for flattening of load curve. Appropriate Electricity Regulatory Commissions may come out with a suitable regulation for making it mandatory to operate the industries during night time with suitable TOD tariff. Pilot schemes for smart grid implementation using two way communication, advance metering infrastructure, TOD metering including consumer home energy management systems may be taken up by the utilities for demand side management (DSM).

- **Rating of utilities** : It is recommended to revive the system of rating the performance of utilities which may also be utilized for prizing and allocation of Grant / Loan for future initiatives / schemes

- **Distribution Franchisee:** It is proposed that Input-Based franchisee model be adopted for urban pockets, in order to ensure active participation from the private sector, the size of the pocket may be at least 500 Million Units as annual energy requirement.

- **Corporate Governance for Utilities :** It is also proposed to complete process of Unbundling of remaining SEBs and Utilities should follow the provisions of Company Law in implementing the Guidelines on Corporate Governance issued by the Department of Public Enterprises

- **Pre-conditions for short term loan (STL) sanction**

  Recently, some reform related conditionalities have been imposed through PFC & REC for granting short term loans to Discoms. Details are as follows:

  - Order of last year's tariff petition
  - Payment of outstanding subsidy for the current year.
  - Submission of audited accounts not older than 18 months from close of relevant financial year or financial statement finalized by Shunglu Committee.
  - FY 2012-13 tariff petition to be filed by 30.11.2011.

  Conditions to be complied within 6 months of sanction of STL

  i. Fuel surcharge to be made automatic or State Government to pay equivalent subsidy by 31.03.2012.

ii. Clearance of outstanding dues for power consumed by Government departments by 31.03.2012 and submit plan for installation of pre-paid meters by 31.03.2012.

iii. Plan to clear arrears of subsidy by March, 2013 with quarterly break-up.

iv. There should be no revenue gap in tariff order and the regulatory assets shall not be created as a matter of course except when it is justifiable and in accordance with Tariff Policy and Regulations. For exceptional circumstances, when regulatory assets is created, the recovery should start within one year of creation of regulatory assets and to be fully recovered within 3 years and carrying cost for same to be provided.

v. Submit Plan to wipe out cumulative losses by the end of 12th Plan with cash surplus to be generated within 2 years with intermediate half yearly milestones.

vi. Adoption of Model Tariff Regulations by respective SERCs.

vii. State Governments to convert its loans to distribution utilities into equity to ensure equity infusion and improvement of net worth of the utilities – Plan to be given within 6 months.

viii. States to immediately invite bids to meet the uncovered generation capacity gap vis-à-vis the requirement of 12th Plan in their states.

ix. States would create a unit in their States for integrated planning of Generation, T&D to meet future requirements of the states by March, 2012.

x. loans to be given initially for 6 months and further grant of loan will be possible if aforementioned conditionalities are fulfilled.

xi. All future loans will be guaranteed by State Government.

II. Scheme for Replacement of Inefficient Pump Sets by Energy Efficient Pump Sets in Agriculture Sector

It has been observed that pump sets installed in Agriculture sector are not energy efficient and results in more consumption of electricity for pumping of ground water than an energy efficient pump. It is pertinent to mentioned here that, whereas agriculture contributes approx. 15% to GDP, it consumes more than 25% of total energy consumed in the country. This sector, being energy intensive, requires energy efficient practices especially with respect to replacement of electrically operated inefficient pumps with efficient pumps. If such inefficient pumps are replaced by energy efficient pumps, energy intake for pumping of ground water can be reduced significantly which will help in effective demand side management. DSM scheme of BEE has so far not shown significant results in this regard. Therefore, Ministry of Power intends to take up a new scheme for replacement of existing inefficient pump sets by energy efficient pump sets in Agriculture Sector. It is estimated that there are about 2 crore pumps in the agriculture sector and significant number of pumps will need replacement. Energy efficient pump will cost approx. Rs. 30,000. Extent of subsidy can be decided depending on availability of resources. Savings in use of electricity will also reduce subsidy burden of State Governments, where subsidized supply of electricity is being made available to farmers.

Considering that about 1 Crore pump sets are to be replaced out of total about 2 crore pump sets and estimated cost of a pump set is about Rs.30,000 per pump sets, the total fund requirement (subsidy) for subsidizing the cost of 1 Crore pump sets works out to Rs. 15,000 Crore with subsidy of 50%.

III. Initiatives for Accessibility

RGGVY: Under RGGVY, infrastructure is being created so as to provide access to electricity to all the households. In order to make rural areas self sustainable and to provide 24 hours power supply to not only BPL families but to APL and to meet other requirements of commercial establishments and small scale industries, utilities would have to make additional expenditure. Further, MOP has already issued guidelines for implementation of distributed decentralized generation (DDG) and a provision of Rs 540 crores has been kept for the same. No developer is coming presumably because of poor revenue potential in the rural areas. Guidelines for DDG should be reviewed so as to give option to the developer for grid connectivity and under such circumstances feed-in-tariff in line with Jawahar Lal Nehru National Solar Mission may be offered so as to make the scheme more attractive. States must give priority to DDG and/or take themselves implementation of DDG.

All the generators based on renewable energy in rural areas need to be supported by the local distribution company by way of (i) providing hassle free grid connectivity and (ii) full assurance of purchase on tariff determined by the SERC.

A Continuation of RGGVY

It is proposed that the RGGVY scheme may be continued for uncovered villages / habitations / BPL households with capital subsidy up to 90% of the project cost, for remaining 32 districts which were not covered in the 10th and 11th Plan, supplementary projects to cover the left out habitations and BPL households. The key modifications proposed in the scheme include:

- The cost of providing BPL connection may be enhanced to at least Rs.3,000/- per connection
- Enhancement of BPL Load from the range of 40-60 W to 250 W
- As part of strengthening the infrastructure, more than one 33/11 KV sub-stations in a block may be funded on the basis of actual requirement on case to case basis.
- The infrastructure in terms of sub-station, transformers for Above Poverty Line (APL) households may also be created based on per house-hold load of 500 W.
- The benchmark costs need an upward revision and may be based on habitations instead of village.

The Monitoring Committee on RGGVY has approved the revised bench mark costs for electrification of villages and habitations on the basis of Revised Cost Estimates approved by the Monitoring Committee during XI Plan considering the award costs and quantity variations in projects under implementation. These revised bench mark costs are also proposed to be adopted for evaluation of projects in XII Plan. Details of old and revised benchmarks are furnished below:

Table : Revised Benchmark Costs and Old Benchmark Cost under RGGVY

Sr. No.	Partuculars	Old Benchmark Cost (Rs. In lakhs)	Revised Benchmark Cost (Rs. In lakhs)
1.	Electrification of un-electrified villages		
	a) In normal terrain	13	**19**
	b) In hilly, tribal, desert area	18	**22.50**
2.	Intensive electrification of already electrified villages		
	a) In normal terrain	4	**8**
	b) In hilly, tribal, desert area	6	**10.5**
3.	Cost of electricity connection to BPL households	0.022	**0.022**
4.	Electrification of un-electrified habitations		
	a) In normal terrain	-	**8**
	b) In hilly, tribal, desert area	-	**10.5**
5.	Intensive electrification of already electrified habitations		
	a) In normal terrain	-	**5**
	b) In hilly, tribal, desert area	**-**	**6**

It is proposed to electrify the remaining villages and habitations in the country for universal coverage by year 2017. For this, a total investment of Rs. 63,490 Cr would be required, out of this Government subsidy would be Rs 57,141Cr.

Provision of LED lamp for BPL households

In XI Plan, BPL households have been provided with a CFL along with free electricity connection under RGGVY. In XII Plan, it is proposed to provide a LED lamp to BPL households instead of CFL. The cost of providing LED lamp has been taken into account in cost estimates for XII Plan and accordingly cost of providing electricity connection to BPL household has been enhanced to Rs. 3000 from Rs. 2200 per connection. It is also proposed to distribute a LED lamp; free of cost; to each of the BPL household already covered under RGGVY or erstwhile Kutir Jyoti scheme. As per Census 2001, there are around 13.8 Cr. Rural Households. Assuming 30% of the rural households of India to be Below Poverty Line (BPL), there are around 4.14 Crore Rural BPL households in India, of which 1.14 Crore BPL households will be covered under XII Plan projects for which cost of LED lamp has been taken into account. Remaining 3 Cr house-holds are covered in X and XI Plan under RGGVY (2.4 cr) and erstwhile Kutir - Jyoti schemes (0.6 cr) for which provision of providing free LED lamp is being made under XII Plan estimates. The total estimated cost for providing a free LED lamp to 3 crore BPL households @Rs.500/- works out to Rs. 1500 Crore.

DDG: In Grid connected areas, where-in at least 6-8 hours of power supply is not available on account of either shortage of power or inadequate upstream infrastructure capacity, Viability Gap Funding (VGF) may be considered for setting up of DDG. A provision of Rs.1,000 Cr. may be considered for 12TH Plan.

Total Estimated Cost of RGGVY scheme

Thus, in XII Plan all habitations irrespective of population criteria shall be covered for electrification under RGGVY and the total estimated cost of the scheme works out to Rs. 65,990 Crore.

B **Creation of Infrastructure for Productive Load:** It is suggested that electricity infrastructure for providing connections to pumpsets in agriculture sector may be taken up in a phased manner. Financial Assistance for strengthening of Infrastructure (HT/LT line, DT Centre including 33/11 kV backbone) to cater to the requirement of Productive Load like agricultural pumps, may also be considered with 50% subsidy. The projects with estimated cost of Rs 61,940 Cr. including grant component of Rs.30,970 Crs are proposed during the 12th Plan.

C **Separation of Agriculture Feeder:** Feeder Separation may also be taken up under a separate new scheme with lesser subsidy (in the range of 25% to 50%) in those states where agricultural consumption is more than 20% of the total consumption. Further, adoption of HVDS and use of AB Cable is also recommended. The total proposed cost estimate for about 18,750 feeders (@Rs. 1.06 Cr. per feeder) will be of the order of Rs.20,000 Cr. with subsidy component of Rs.10,000 Cr. (assuming 50% subsidy).

IV. Initiatives for Reliable and Quality power to consumers

- **Open Access**: To promote Open Access as per section 42 of the Act in 12th plan (mandatory provision of providing Open Access to consumers with more than 1 MW), as it is expected that the Regulators will resolve the issues of Independence of SLDC, Single Buyer Model, various charges, procedural requirement etc. Open Access facilitates consumers to procure power from any source of choice.
- **Underground Cabling:** Underground Cabling works may be taken up by the utilities for the Towns under R-APDRP especially towns of religious and tourist importance in view of aesthetics and safety aspects.
- **Smart Grid:** The Smart Grid will be a key focus area for the Distribution Sector in the 12th Plan. The guiding principles recommended for the Smart Grid initiative include developing an indigenous model, Procuring hardware/ equipments locally and providing adequate training for maintenance. Smart grids and smart metering using two way communication can enable advance metering infrastructure, time-of-day metering including consumer home energy management systems. Smart Grids having AMI with two-way communication along with customer interface, integration of renewables and electrical vehicles with the grid, intelligent sub-stations with self-healing are emerging technologies worldwide. Pilot of Smart Grids and Smart Metering will be taken up within Distribution Sector. A taskforce on Smart Grids has already been setup. Policy framework to promote use of Smart Grids in India would be developed after pilot implementation. The outlay of Rs.500 Cr. has been estimated for various pilot project to be executed during the plan. The total outlay of Rs 9,500 Cr. has been estimated, which includes pilot projects and scaling up of pilots, phased installation of smart meters, extending SCADA system to 100 more towns and integration of renewable into the grid.

V. Research & Development

Establish dedicated R&D institutes to study develop and promote technological advancements needed in distribution sector in the Indian context. Challenges faced by Indian distribution companies needs an indigenous solution for ensuring effectiveness of the implementation. R&D will help in serving the objective of energy efficiency in long term for the nation.

It is proposed to give adequate thrust on R&D in Distribution and Rural Electrification. The key research areas may be Distribution Sector including AC / DC Micro-grid demonstration for improving reliability and power quality, Energy storage schemes for improving the reliability of sensitive loads, Development of Intra-operable Standards & Protocol for energy metering, Load Research (Load modeling), IT applications in Distribution & Smart Grid etc . R&D initiatives are required for enhancing Material strength & durability and for Standardization of their specifications. Also forward looking design that can take additional load and future systems which can be easily integrated with existing systems can be focal point of R&D.

It is therefore, recommended that the key initiatives for R&D in the 12th Plan may include setting-up of a Technical Cell of CEA, which will focus on best practices, R&D in terms of data collection and specific projects, Technical support to States for consultancy and implementation. It is also proposed to appoint a Distribution Chair from IIT or equivalent institute at an estimated cost of Rs. 5 Cr annually.

VI. Human Resource Development

Training and Development

Electricity Distribution is people intensive business with over 1.5 million people employed by the sector. There is not only scarcity of staff currently, but as the sector grows at 8 to 10 % rate there is need for more people adequately equipped with various skills.

As the customer expectation becomes more exacting and as newer technologies and IT systems are introduced, there is a need for planning and investment in elaborate training and development setup. Technical training to keep the staff updated on technological front. Soft skills and behavioral training to develop a friendlier customer facing staff to raise the customer service levels.

There is a need to setting up institutions to impart various skills needed for long term development of the human resource for the sector. An adequately skilled manpower will ensure delivery of the desired result for the investments being planned to be put in the sector for its improvements

Some of the key recommendations for a comprehensive capacity building exercise include developing training road-map, mapping the available resources in capacity building and ensuring sustainability by institutionalizing responsibility and accountability. It is envisaged that with proposed extension of R-APDRP and RGGVY programs in 12th Plan there is a need to identify & integrate respective training Program to be conducted at CIRE or any other suitable institution. The budget of Rs.150. Cr has been estimated against the several training program to be conducted during the plan.

On the basis of above recommendations, the requirement of GoI Assistance has been estimated as Rs. 1,62, 360 Cr. against the total outlay of Rs 2,25,475 Cr. However, the GOI may consider funding in accordance with the available resources and priorities. The details of the above recommendations are discussed in subsequent chapters.

Summary of investments:

S. No.	Scheme type	Total fund requirement (Rs. Cr.)	GoI Assistance (Subsidy) (Rs. Cr.)
1.	**R-APDRP**	**15,870**	**9,924**
1.(a)	**Additional requirement of funds for the ongoing projects sanctioned during XI Plan (Details enclosed)**	**-**	**9,900**
2.	**Smart Grid**	**9,500**	**5,000**
3.	**Research & Development (Rs. 5 Cr annually)**	**25**	**25**
4.	**RGGVY**		
	(i) For Electrification of remaining villages & habitations	**63,490**	**57,141**
	(ii) Providing LED lamps for BPL households	**1500**	**1350**
	(iii) DDG	**1000**	**900**
	Total (RGGVY)	**65990**	**59391**
5.	**Inclusion of Productive Load Scheme**	**61,940**	**30,970**
6.	**Feeder separation Scheme**	**20,000**	**10,000**
7.	**National Electricity Fund**	**22,000**	**22,000**
8.	**Human Resources Development Plan**	**150**	**150**
9.	**Scheme for Replacement of Inefficient Pump Sets by Energy Efficient Pump Sets in Agriculture Sector**	**30,000**	**15,000**
	Grand Total	***2,25,475***	***1,62,360***

GOI Funds envisaged in XII Plan for R-APDRP ongoing schemes

	Sanctioned Cost	GOI Funds	Remarks
Part-A including SCADA	6582.37	6582.37	100% GoI Funding
Part-B	23658.18	7761	25% (90% for special category states) loan
Expected snction of Part-B	1500	635	25% (90% for special category states) loan
Total Sanction in XI Plan	31740.55	**14978.37**	
Expected GOI release in XI Plan		**6000**	

	Sanctioned Cost	GOI Funds	Remarks
Release envisaged in XII Plan for projects sanction in XI Plan (Part-A & B)		**8978.37**	It is expected that enire GOI loan for Part-A and 25% of Part-B would be converted into grant in XII Plan. Up-to 50% of Part-B loan to be converted in to grant annually in five years on achieving the desiored target. It is expected that only 2 to 3 annual conversion will take place in XII Plan.
	Provision in Scheme		
Funding under Part-C	1177		
Expected expenditure in XI Plan	200		
Balance required in XII Plan ecluding Smart Grid Pilots worth Rs 500 Cr	**477**		For enabling components
Funding under Part-D	400		
Expenditure in XI Plan	Nil		
Expenditure against Incentive Scheme under Part-D envisaged in XII Plan	**400**		
Total fund projection for XII Plan (8978.37+477+400)	**9855.37**		
	Say 9900		

In light of initiatives required under the 12TH Plan, it has been estimated that investments of the order of Rs. 3 lakh Crores are required for Distribution Sector corresponding to Capacity Addition in 12th Plan. The details of such investment are tabulated in **Appendix 3.1.** However, the GOI may consider funding in accordance with the available resources and priorities.

3.5 CONCLUSIONS AND MAJOR RECOMMENDATIONS:

1. AT&C Loss reduction is a priority and is to be achieved through various administrative and technical measures.
2. Electrification of all villages and habitations for universal coverage by year 2017.
3. Payment of subsidy/outstanding dues by States shall be made upfront, as per section 65 of Electricity Act, 2003. Clearing of all the outstanding subsidies to the utilities. Release payments from the State budget directly;
4. Rationalization of tariff and timely filing of Tariff Revision Petition regularly;
5. Adoption of Multi Year Tariff with tariff revision in a time bound manner.

6. Timely finalization and computerisation of accounts;
7. Establishment of DDG projects in Grid connected areas also where adequate power supply is not available. Setting up of Decentralisaed Distribution Generation (*DDG)* projects based on Viability Gap Funding (VGF) through competitive bidding process.
8. Continuation of R-APDRP and RGGVY in 12th Plan.
9. Under National Electricity Fund assistance to be linked to sates (for interest subsidy) based on process of reforms and other eligibility criteria.
10. 100% Metering of Consumers to be ensured.
11. Distribution Franchisee as a PPP model in electricity distribution to be promoted.
12. Funding for smart grid pilot projects, training initiatives, and for Research and Development are recommended to be as grants.
13. Distribution Sector R&D to be promoted. Setting-up of a Technical Cell of CEA, which will focus on - Best practices, R&D in terms of data collection and specific projects, Technical support to States for consultancy and implementation.
14. The distribution system planned for the 12th Plan includes setting up of new lines (13,05,000 ckm), installation of new substations(88,000 MVA), augmentation of substation etc. The total fund requirement is Rs 3,06,235 crs for distribution sector.

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Appendix 3.1

Estimates of physical & financial requirement for distribution during 12th Plan.
(Capacity Addition 75000 MW)

Sl. No.	Name of Segment	Units	Physical	Financial (Rs. Cr)
			2012-17	2012-17
I	**New Lines**			
(i)	33 KV O/H line	Ckt Kms	121500	9720
	33 KV U/G Cable(30%)	Ckt Kms	13500	4050
	Total 33 KV line	Ckt Kms	**135000**	
(ii)	11 KV O/H line	Ckt Kms	448000	22400
	11 KV U/G cable	Ckt Kms	112000	22400
	Total 11 KV line	Ckt Kms	**560000**	
(iii)	LV O/H	Ckt Kms	488000	24400
	LV ABC	Ckt Kms	122000	9760
	Total LV	Ckt Kms	**610000**	
II	**Installation of new S/S**			
	33/11 KV(2X10 MVA)	No	4400	22000
	No of 10 MVA Transformers	No	8800	
	Transformation capacity	MVA	**88000**	
III	**Installtion of DTs including all accessories**	MVA	**105000**	
	1000 KVA	No	10500	1260
	630 KVA	No	33500	3350
	315 KVA	No	67000	4020
	200 KVA	No	105000	5250
	100 KVA	No	210000	8400
	25 KVA	No	424000	8480
	Total No of DTs	No	**850000**	
III	**Aug of Sub-Station**			
	33/11 KV	MVA	50000	10000
	11/0.4 KV	MVA	50000	10000
IV	Capacitors	MVAR	16000	1280
V	Service Connections		50000000	25000
VI	Re conductoring of lines			
	(i) 33 KV	Ckt. Kms	100000	3000
	(ii) 11 KV	Ckt. Kms	500000	10000
	(iii) LV	Ckt. Kms	1000000	20000
	SUB TOTAL			**224770**
	Productive Load Scheme			61940
	Smart Grid			9500
	IT facilities,& SCADA including HRD			10000
	R&D			25
	TOTAL			**306235**
	Say Rs 3.06 Lakh Crores			

NOTE :
The above estimates have been prepared based on the optimal loading of lines and transformers assuming that there have been no margin in the capacities of existing network and the actual expenditure may under go change depending upon the usage of lightly loaded existing infrastructure.

The above estimates have been prepared for capacity addition from conventional energy sources and do not include the fund requirement for distribution network for renewable capacity addition.

Appendix 3.2

Recommendations from Empowered group of officers on DDG

18

सत्यमेव जयते

सुधा पिल्ले, आई.ए.एस.
सदस्य-सचिव
SUDHA PILLAI, I.A.S.
MEMBER-SECRETARY
D.O.No. M-13053/2/4/2010-MLP

जय हिन्द

भारत सरकार
योजना आयोग
योजना भवन, संसद मार्ग
नई दिल्ली - 110 001

Government of India
Planning Commission
Yojana Bhavan, Parliament Street
New Delhi-110001
Tel: 23096574 Fax: 23096575
E-mail:secypc@nic.in

9th February, 2011

Dear Shri Umashankar,

Secy(P)

As you are aware the Empowered Group of Officers constituted by the MHA in pursuance to the decision of the Cabinet Committee on Security inter alia, have the mandate to over-ride or modify existing norms/guidelines relating to various development programmes and Flagship Schemes in respect of 60 IAP districts. The Empowered Group reviewed the status of electrification under RGGVY and the steps required for speedier development of these districts and also noted that works are in progress under RGGVY scheme to connect villages to the Grid but difficulties are being experienced in energisation and providing electricity for the assured duration of 6-8 hours. Ministry of Power was accordingly asked to explore the possibility of extending the DDG solutions in these 60 IAP/ LWE districts.

AS(AL)

The representative of Ministry of Power pointed out that the DDG schemes as approved by the Cabinet, entails providing for DDG only in cases where Grid connectivity is either not feasible or not cost effective. The Empowered Group reviewed the position and felt that the DDG guidelines need modification to facilitate development of these areas by providing electricity in these areas. Empowered Group noted that there are villages and habitation which though connected to the grid do not get adequate electricity supply (6-8 hours per day). Further, there are some villages and habitations where RGGVY projects have been sanctioned but due to implementation bottlenecks, it is taking considerably long time to take the grid supply to these villages and as an interim solution it is necessary to provide electricity to these villages until grid power becomes available. Empowered Group in its meeting held on 17th Jan, 2011 decided that in such cases the Ministry of Power will relax the conditions in the DDG guidelines with respect to non-availability of grid for implementation of the DDG scheme. The suggested modified Para 3.0 of the DDG Guidelines is enclosed.

I shall be grateful if you could communicate to us at the very earliest the action taken on the above decision of the Empowered Group.

With warm regards,

Yours sincerely,

(Sudha Pillai)

09/FTS/S(P)
14/2

O/o AS (AL)
Dy. No.....
14 FEB 2011

Shri P. Umashankar,
Secretary,
Ministry of Power
Shram Shakti Bhawan,
New Delhi.

Para 3.0 of the Guidelines for Village Electrification through Decentralized Distributed Generation (DDG) under Rajiv Gandhi Grameen Vidyutikaran Yojana would read as under:

"Decentralized Distributed Generation (DDG) can be from conventional or renewable sources such as Biomass, Biofuels, Biogas, Mini Hydro, Solar etc. for villages where grid connectivity is either not feasible or not cost effective. However, in case of 60 Left Wing Extremism affected districts DDG can be implemented in those villages:

(a) where the infrastructure for electrification was developed but could not be energized due to issues relating to the backward connectivity of the grid such as non-availability land for sub-stations, continued inadequate transformation capacity in the sub-stations and where this capacity can not be enhanced in near future.

(b) where the energisation is not likely to take place in the next two years due to pending statutory clearances like those from Ministry of Environment & Forests, etc.

(c) where the works have been sanctioned under RGGVY but not taken up so far or works have stopped due to various local/standing problems of a serious nature.

(d) where infrastructure has been created for the grid connectivity but where availability of power is far less than the stipulated 6 to 8 hours as mandated under RGGVY.

In case the existing distribution infrastructure created under RGGVY is available, only the generation component under DDG Scheme would be taken up thereby avoiding duplication of expenditure for distribution infrastructure."

Appendix 3.3

Expected AT&C loss (%)

Region	State	2009-10		2010-11	2011-12	2012-13	2013-14	2014-15
		Input Energy (MU)	AT&C loss (%)					
Eastern	Bihar	9281	43.92	40.92	37.92	34.92	31.92	28.92
	Jharkhand	8396	10.43	8.93	7.43	5.93	4.43	2.93
	Orissa							
	CESCO	6232	39.99	36.99	33.99	30.99	27.99	26.49
	NESCO	4705	36.68	33.68	30.68	27.68	26.18	24.68
	SESCO	2286	51.01	48.01	45.01	42.01	39.01	36.01
	WESCO	6301	37.58	34.58	31.58	28.58	27.08	25.58
	Sikkim	512	51.37	48.37	45.37	42.37	39.37	36.37
	West Bengal	25427	33.24	30.24	27.24	25.74	24.24	22.74
North Eastern	Arunachal Pradesh	670	52.99	49.99	46.99	43.99	40.99	37.99
	Assam	4392	29.03	27.53	26.03	24.53	23.03	21.53
	Manipur	454	48.02	45.02	42.02	39.02	36.02	33.02
	Meghalaya	1342	48.73	45.73	42.73	39.73	36.73	33.73
	Mizoram	320	39.06	36.06	33.06	30.06	28.56	27.06
	Nagaland	385	45.97	42.97	39.97	36.97	33.97	30.97
	Tripura	672	29.17	27.67	24.67	21.67	18.67	15.67
Northern	Delhi							
	BRPL	9667	19.83	18.33	16.83	15.33	13.83	12.33
	BYPL	5645	28.63	27.13	25.63	24.13	22.63	21.13
	NDPL	6910	15.69	14.19	12.69	11.19	9.69	8.19
	Haryana							
	DHBVNL	15884	28.10	26.60	25.10	23.60	22.10	20.60
	UHBVNL	15211	29.91	28.41	26.91	25.41	23.91	22.41
	H.P.	6806	18.47	16.97	15.47	13.97	12.47	10.97
	J&K	9813	70.45	67.45	64.45	61.45	58.45	55.45
	Punjab	38806	17.73	16.23	14.73	13.23	11.73	10.23
	Rajasthan							
	AVVNL	12345	33.04	30.04	27.04	24.04	21.04	18.04
	JDVVNL	12820	31.51	28.51	25.51	22.51	19.51	16.51
	JVVNL	16286	26.69	25.19	23.69	22.19	20.69	19.19
	Uttar Pradesh							
	DVVN	13143	49.62	46.62	43.62	40.62	37.62	34.62
	MVVN	9653	28.72	27.22	25.72	24.22	22.72	21.22
	PaVVN	17766	27.92	26.42	24.92	23.42	21.92	20.42
	PoVVN	12783	54.46	51.46	48.46	45.46	42.46	39.46
	KESCO	2722	37.36	34.36	31.36	28.36	26.86	25.36
	Uttaranchal	8280	33.53	30.53	27.53	24.53	21.53	18.53
Southern	Andhra Pradesh							
	APCPDCL	31933	17.93	16.43	14.93	13.43	11.93	10.43
	APEPDCL	10814	9.69	8.19	6.69	5.19	3.69	2.19
	APNPDCL	10464	18.52	17.02	15.52	14.02	12.52	11.02
	APSPDCL	15300	16.63	15.13	13.63	12.13	10.63	9.13
	Karnataka							
	BESCOM	20317	21.10	19.60	18.10	16.60	15.10	13.60
	GESCOM	5764	38.05	35.05	32.05	29.05	27.55	26.05

Region	State	2009-10		2010-11	2011-12	2012-13	2013-14	2014-15
		Input Energy (MU)	AT&C loss (%)					
	HESCOM	7402	28.51	27.01	25.51	24.01	22.51	21.01
	MESCOM	3274	18.39	16.89	15.39	13.89	12.39	10.89
	CHESCOM	4245	28.22	26.72	25.22	23.72	22.22	20.72
	Kerala	16129	14.89	13.39	11.89	10.39	8.89	7.39
	Pondicherry	2527	19.35	17.85	16.35	14.85	13.35	11.85
	Tamilnadu	66974	20.15	18.65	17.15	15.65	14.15	12.65
Western	Chattisgarh	18476	37.98	34.98	31.98	28.98	27.48	25.98
	Goa	2962	7.77	6.27	4.77	3.27	1.77	0.27
	Gujarat							
	DGVCL	10565	15.23	13.73	12.23	10.73	9.23	7.73
	MGVCL	6727	15.27	13.77	12.27	10.77	9.27	7.77
	PGVCL	19858	32.34	30.84	29.34	27.84	26.34	24.84
	UGVCL	14891	18.89	17.39	15.89	14.39	12.89	11.39
	Madhya Pradesh							
	MPMKVVCL	10563	42.26	39.26	36.26	33.26	30.26	27.26
	MPPKVVCL	12705	36.16	33.16	30.16	28.66	27.16	25.66
	MPPuKVVCL	9632	46.11	43.11	40.11	37.11	34.11	31.11
	Maharasthra							
	MSEDCL	80526	25.02	23.52	22.02	20.52	19.02	17.52
	Grand Total	667963	**27.15**	**25.23**	**23.31**	**21.48**	**19.73**	**17.99**

Note: Expected AT&C loss of utilities for nex 5 years have been computed assuming the reduction at the rate of 3% per year (for utilities having AT&C loss more than 30%) and 1.5% per year (for utilities having AT&C loss more than 30%) keeping the same input energy.

Targets

The targets have been further split into categories such as Urban and Rural areas, Parameter-Based Targets, Metering, Reforms and Management etc. as below

Urban Areas

Sl. No.	Name of Segment	Target
1	Consumer Indexing	Non-RAPDRP towns
2	Households will have access to electricity (Including urban poor)	100%
3	Development of PPPs	100 Towns
4	Customer Care Centres to cover all urban consumers	All Towns
5	SCADA	76 Towns
6	IT usage	All Towns

(Source: CEA)

Rural Areas

Sl. No.	Name of Segment	Target
1	Consumer indexing	200 villages
2	Power supply to domestic consumers	24 hours
3	Households will have access to electricity	Spill over from RGGVY and other consumers such as APL
4	Power to APL	100%
5	Street Lights in every village	100%
6	DDG schemes through grid inter connections	500 nos.
7	Setting up e-Seva Centres / Customer Care Centres	1000 nos.
8	Development of input based franchisee	1000 villages
9	Agricultural Pump sets to be energized	100%

(Source: CEA)

Parameters based targets

Sl. No.	Name of Segment	Target
1	Reduce AT&C Losses	Up to 15-20%
	- Urban Areas	15%
	- Rural Areas	20%
2	Feeder separation in States which consume high energy for agriculture for improved load management & proper accounting	All States wherever necessary
3	Introduction of HVDS system to improve HT:LT ratio	100% wherever necessary
4	Energy Accounting & Auditing in all Utilities	100% in urban areas and 10% in rural areas

(Source: CEA)

Metering

Sl. No.	Name of Segment	Target
1	Rural 11 kV feeder (AMR)	100%
2	Distribution transformers (AMR)	100%
3	Rural domestic consumers (AMR)	10%
4	Urban domestic consumers (AMR)	100%

(Source: CEA)

Turnaround Targets for State Utilities

Sl. No.	Name of Segment	Target
1	Reform process and perceptible turnaround of State Utilities	30 Utilities
2	Time of the Day metering for HT and three phase LT	All States
3	Time of Use metering for single phase consumers	15 States

(Source: CEA)

Management

Sl. No.	Name of Segment	Target
1	Public Private Partnership	
	- Towns & Cities	100
	- Villages	1000

(Source: CEA)

Other Reforms

Sl. No.	Name of Segment	Target
1	Open Access operational (1 MW and above)	All States
2	Open Access operational (less than 1 MW)	15 States
3	Multi Year Tariff	All States
4	Integration of IT applications	All States
5	Implementation of ERP solutions	20 DISCOMs

(Source: CEA)

Chapter- 4

LEGISLATIVE & POLICY ISSUES- FORULATION, IMPLEMENTATION & FEEDBACK

4.0 INTRODUCTION

Government of India's Policy of "Power for All" is in pursuance of the objective of the Electricity Act 2003 to protect the interest of consumers and supply of electricity to all areas. Several programmes have been initiated to achieve this objective. This objective has also been stated in the National Tariff Policy and National Electricity Policy and after many years of the implementation of these schemes and programmes, a need has been felt to review these policies in order to make Government's stated objectives achievable, within the boundaries of institutional and financial viability and to bring the benefits of electrification to the entire population. The suggested policy changes seek to accomplish the objective of achieving inclusive growth by providing affordable, adequate and quality power for all consumers.

4.1 LEGISLATIVE ISSUES

The Electricity Act 2003 has put in place a liberal and progressive framework for the development of electricity sector in the country. Its main objectives are Promoting competition, protecting interest of consumers, Supply of electricity to all areas, Rationalization of electricity tariff and Ensuring transparent policies regarding subsidies.

The following issues were deliberated and recommendations have been made entailing legislative change:

4.1.1 Procurement of Power by Distribution Licensees

The Appellate Tribunal for Electricity in its judgment dated 31st March 2010 held that the State Commissions have discretionary powers to give approval for the PPA or to direct the distribution licensee to resort to the competitive bidding process in accordance with the Tariff Policy. The Tribunal has held that the State Commission should direct the distribution licensee to carry out power procurement through competitive bidding process in cases where the rates under negotiated agreements are high and CERC/FOR should evolve benchmark tariff for guidance of the SERCs for this purpose.

Given the trend of prices discovered through competitive bidding process, which are more efficient than cost plus tariff, it may be desirable for the SERCs to encourage the distribution licensees to go for competitive bidding process. APTEL in its judgment has interpreted Section 62 and 63 of the Act providing for optional routes for the procurement of power which is against the provision of Tariff Policy. Though the Government of India has filed appeal petition in the Supreme Court against this judgment, it will be desirable that *more clarity is brought in respect of purchase of power by DISCOMS through suitable legislative changes.*

4.1.2 Separation of "Carriage and Content" and further operationalization of open access in Transmission and Distribution

An important issue in connection with inter-state open access is the issue of directions by some State Governments to generating companies under section 11 of the Electricity Act 2003 from time to time. There have been several instances when the State Governments have used Section 11 or Section 108 of the Act for prohibiting the sale of surplus power from a generating unit to the entities outside the State. The provision under section 11 or 108 of electricity Act, 2003 should not be misused to deal with shortage of power in the State as this section was meant to be invoked in extra ordinary circumstances like security of the State, public order or a natural calamity. This is patently against the letter and spirit of the Act and the policy.

In certain cases it has placed the SLDCs /RLDCs in a piquant situation. For instance, SLDCs have withheld standing clearance to many such generating companies on the plea of section 11; however this has led to action by CERC against such SLDCs involved. SLDCs are construing a direction issued to Generating Companies under Section 11 as a de-facto directive under Section 37.

At the same time this will also have adverse impact on investment in capacity addition. Provision of open access or third party sale is one of the important drivers of reforms as it is seen not only as an instrument of market development but also as a mechanism that gives comfort to investors in terms of payment security. Restrictions on sale of surplus electricity would therefore frustrate all efforts at fostering competition in the sector.

Therefore, it was recommended that the Act might provide further clarification on the meaning of 'extraordinary circumstances' mentioned in Section 11, in case required. Considering that the DISCOMs have access to the entire country's wholesale market rather than depending solely on the generating companies within the state, there can be no 'extraordinary circumstances' forcing generating companies to sell power only within the state. Further, the Appropriate Commissions might in line with the provisions of the Act clearly specify the compensation to be provided to Generating Companies whenever section 11 directive is issued to generating companies i.e. ex-ante formula for compensating the generating company in case it is forced through section 11 directive to sell power only to the host state.

The other issue pertains to Section 14 of the Electricity Act, 2003 which provides for grant of multiple licensees in the same area of supply. The 6th proviso to Section 14 of the Act states that the Appropriate Commission may grant license to two or more persons for distribution of electricity, if the applicant complies with the additional requirement as prescribed by the Central Government. Rule 3 of the Central Government Rules, 2005 stipulates the requirement of capital adequacy and credit worthiness for grant of license for distribution of electricity.

Defining minimum area for second/subsequent licensee restricts the flexibility even in genuine cases like granting license co-terminus with the area of the existing licensee etc. The other view was that the fixation of minimum areas was done in the rules after due consultation with all concerned so that there is no "cherry picking" by the second licensee.

In most of the developed Countries, there is a single entity which takes care of wires and multiple suppliers of power which use the common network. This can be achieved in India by issuing separate licenses, one for Wires and the other for Supply business as Distribution Licenses. A legal opinion has been sought by the Forum of Regulators (FOR) from Solicitor General of India (SG) on following issue:

Can distribution and retail supply business be separated under the existing provisions of the Electricity Act, 2003?

On above raised query, Solicitor General of India has opined that the Electricity Act 2003 assigned the dual role of network operator and of supplier to the distribution licensee, hence, the two cannot be separated.

Therefore in order to have two different types of distribution licensees, the power granted to Appropriate Commission, under Section 14 to grant a distribution license, will have to be amended to the effect that it can grant two different types of distribution licensees.

Further, it would appear that the twin objectives of ushering in competition by grant of multiple distribution licenses and enabling choice to consumers while at the same time avoiding additional costs on the consumers to pay for the operation and maintenance of stranded assets, legislative changes may be required, as it is felt that the present requirement of laying parallel network by the second Licensee may not result in minimum engineering cost.

Meanwhile, the definition of minimum area of supply may be modified and it may be left to the discretion of the SERCs to decide the area, however, with due consideration to the fact that the grant of second/subsequent license does not lead to “cherry picking”.

4.1.3 Development Of Power Markets And Exchanges:

Section 66 of the Electricity Act 2003 states that *‘The Appropriate Commission shall endeavour to promote the development of a market (including trading) in power in such manner as may be specified and shall be guided by the National Electricity Policy referred to in section 3 in this regard.’* Section 60 has suitable provisions allowing the Commissions to intervene in case of market domination.

The Central Electricity Regulatory Commission (CERC) came out with the first set of regulations on 30th January 2004 regarding grant of trading license. Subsequently, regulations for fixing of trading margin was issued on 23rd January 2006. Based on these regulations, a total of forty one (41) inter state trading licenses have been issued by the Commission till 30th June 2011.

However, with regard to further development of electricity markets, there is a need for clarity in the Act so that jurisdiction issues regarding forward and future market products may be sorted out at the earliest so as to facilitate Power Market development in India further.

4.1.4 Cogeneration From Renewable Energy Sources

Section 86 (1) (e) of the Act deals with the promotion of Renewable Energy sources and mandates SERCs to promote co-generation and generation from renewable sources of energy. Renewable Energy is understood and defined to be energy generated from non-fossil fuel or from energy sources which are inexhaustible like wind, solar, water etc.

However, the Appellate Tribunal for Electricity in its judgement dated 26th April 2010, has interpreted this provision and held that co-generation based on fossil fuel also should be treated at par with Renewable

Energy sources for the purpose of promotion of such energy sources and RPO should not be made applicable on consumers of electricity generated from co-generation plant irrespective of fuel source.

It is therefore opined that the present definition of cogeneration plants as interpreted by APTEL does not prescribe the source of fuel (fossil or non-fossil). It is therefore recommended to bring clarity in this regard through legislative changes, if required, in consultation with MNRE. Further, RPO as envisaged under Section 86(1)(e) is in relation to the 'consumption' in the licence area of a distribution licensee. So, consumption by all such entities i.e. distribution companies, CPPs and open access consumers taken up together constitutes total consumption in the area of such licensee, exclusion of CPPs & open access consumers would amount to putting additional burden on other consumers 'consuming' electricity in the area of supply of the distribution licensee.

4.1.5 Empowering Regulatory Commissions for suo moto revision of tariff of consumers.

Section 64 of Electricity Act 2003 may be amended by incorporating an additional provision for empowering the Regulatory Commissions for suo moto revision of tariff of consumers. The additional provision may be on the lines mentioned below.

"Provided if the Appropriate Commission is satisfied that the expected revenue of a distribution licensee (s) at the current tariff differs significantly from the revenue it is permitted to recover, it may order the licensee(s) to file an application within the time specified by the Commission to amend its tariffs appropriately failing which the Commission shall suo moto start the proceedings for determination of tariff."

4.2 POLICY ISSUES

The National Electricity Policy and the Tariff Policy have been notified under the provisions of the Electricity Act, 2003. The National Electricity Policy, inter-alia, aims at Providing access to electricity to all, Overcoming energy and peaking shortages and having adequate spinning reserves for fully meeting the demand, Supply of reliable and quality power of specific standards in an efficient manner and at reasonable rates.

The Tariff Policy aims at ensuring financial viability of the sector and promoting transparency, consistency and predictability in regulatory approaches. It also aims at promoting competition and efficiency in operation and meeting quality of supply.

The National Electricity Policy and Tariff Policy endeavor to fundamentally change the Power Sector to function in an open, competitive regime under regulatory oversight. The provisions of these Policies must be implemented within the stipulated time in order to make power available at affordable cost to all.

The following issues were deliberated and recommendations have been made entailing policy change accordingly:

4.2.1 NATIONAL ELECTRICITY POLICY(NEP)

Section 3 (1) of the Electricity Act 2003 requires the Central Government to formulate, inter alia, the National Electricity Policy in consultation with Central Electricity Authority (CEA) and State Governments. The provision is quoted below:

"The Central Government shall, from time to time, prepare the National Electricity Policy and tariff policy, in consultation with the State Governments and the Authority for development of the power system based on optimal utilization of resources such as coal, natural gas, nuclear substances or materials, hydro and renewable sources of energy".

Accordingly, Central Government notified the National Electricity Policy on 12th, February, 2005. The National Electricity Policy aims at achieving the following objectives:

(a) Access to Electricity - Available for all households in next five years
(b) Availability of Power - Demand to be fully met by 2012. Energy and peaking shortages to be overcome and adequate spinning reserve to be available.
(c) Supply of Reliable and Quality Power of specified standards in an efficient manner and at reasonable rates.
(d) Per capita availability of electricity to be increased to over 1000 units by 2012.
(e) Minimum lifeline consumption of 1 unit/household/day as a merit good by year 2012.
(f) Financial Turnaround and Commercial Viability of Electricity Sector.
(g) Protection of consumer's interests

The details are given at **Appendix-4.1**

Some specific issues which may require a review of some specific clauses from National Electricity Policy are listed below:

4.2.1.1 Institution Building:

Ministry of Power, Govt. of India constituted a committee chaired by Sh.G.B. Pradhan, to examine issues relating to manpower, certification and incentive for the personnel employed in System Operation at various levels and also for the ring fencing of the LDCs to ensure their functional autonomy and give recommendations.

The G. B. Pradhan Committee has recommended that the Load Despatch Centers should be ring fenced and should have functional and financial autonomy. The Recommendations of the Pradhan Committee have been agreed upon at all levels in the Government including at the Chief Ministers and Power Ministers Meetings. All efforts need to be made to create an environment where the Load Despatch Centres have functional autonomy, independent and sustainable revenue streams and are adequately staffed with people having the right skill, equipment and incentive to deliver.

Central Government has notified POSOCO, a wholly owned subsidiary of POWERGRID, to operate all the RLDCs / NLDC w.e.f 1st October, 2010. For transparent system operation, the independence of

POSOCO is critical. SLDCs also have a critical role in operationalisation of open access Therefore, in view of above, the following recommendations may be made:

i) Strengthening of institutions at the National/ Regional/State level such as NLDC/RLDCs/SLDCs is vital to the implementation of open access.
ii) The recommendations made by the Pradhan Committee needs to be implemented for ensuring empowerment of SLDCs.
iii) The management of POSOCO should be separated from the PGCIL
iv) For ensuring their independence, there is a need for functional & financial separation in operation of SLDCs.

In view of the fact that their concurrence is a pre-requisite for permitting open access. Independence of SLDCs will only ensure non discriminatory open access in line with the spirit of the Act.

4.2.1.2 DISCONTINUATION OF SINGLE BUYER MODEL & RE-ORGANIZATION OF SEBs:

With the enactment of the Electricity Act 2003 and implementation of open access, the market structure in the power sector changed from the old single buyer structure to a multi-buyer model. Currently many states, which have unbundled the SEBs, have reported improvements in their operational efficiency and are able to ensure reliable power supply to consumers.

However, there are some States where SEBs have been unbundled but the single buyer model has been perpetuated by transferring the function of bulk purchase and sale from the TRANSCOs to intermediary bulk supply companies/trading companies/agencies.

Power purchase agreements have not been reallocated to the distribution companies to enable them to enter into a direct contract with the generating companies as envisaged in the Act and the Policy. This model camouflages inefficiencies of one DISCOM against another which is against the spirit of the Act.

Therefore, it is recommended that the NEP may be amended to give a clear timeline for States to expedite reassignment of the PPAs to DISCOMs and for winding up the single buyer model as early as possible.

4.2.1.3 TRAJECTORY OF RENEWABLE PURCHASE OBLIGATION (RPO) & ENFORCEMENT

Stable RPO regime is a pre-requisite for promotion of renewable energy sources. The long term trajectory for Renewable Purchase Obligation would give greater visibility for the market players to plan their investment in the Renewable Energy Sector.

A suitable forum (FOR) may conduct studies to suggest the possible RPO trajectories for different states and at the same time ensure homogeneity in the RPO regulations of respective states and UT's.

It is also equally important to ensure compliance of RPO by all the obligated entities including open access users as per the CERC (Terms and Conditions for Recognition and Issuance of Renewable

Energy Certificate for Renewable Energy Generation) Regulations, 2010. Renewable Energy Certificate (REC) mechanism provides an option for compliance of RPO.

i) ***SERCs should provide long term trajectory for Renewable Purchase Obligation.*** FOR should conduct studies in this regard and suggest possible trajectories for different States keeping in view availability of RE sources in the country and impact of increasing level of RPO on the power purchase cost of the respective distribution licensee. FOR should develop homogeneity in the RPO regulations of respective states and UT's.

ii) The Principles & guidelines evolved through consensus by the Forum of Regulators for the RPO of Obligated entities and REC mechanism should be followed up for timely adoption by corresponding Regulations of SERCs in keeping with Government Policies. A time limit of 3 to 6 months may be prescribed under the policy for respective SERCs to issue the relevant Regulation once it is adopted by the FOR with or without modification.

4.2.1.4 Cogeneration from Renewable Energy Sources

Section 86 (1) (e) of the Act deals with the promotion of Renewable Energy sources and mandates SERCs to promote co-generation and generation from renewable sources of energy. Renewable Energy is understood and defined to be energy generated from non-fossil fuel or from energy sources which are inexhaustible like wind, solar, water etc. The spirit of Section 86(1)(e) of the Act and the relevant provisions made in the National Electricity Policy and the Tariff Policy is to promote generation of electricity in the area of distribution licensees from Renewable Energy sources and cogeneration.

Further, RPO as envisaged under Section 86(1)(e) is in relation to the 'consumption' in the licence area of a distribution licensee. As such RPO has to be imposed on distribution companies, CPPs and open access consumers. As consumption by all such entities taken up together constitutes total consumption in the area of such licensee, exclusion of CPPs & open access consumers would amount to putting additional burden on other consumers 'consuming' electricity in the area of supply of the distribution licensee.

However, the Appellate Tribunal for Electricity in its judgement dated 26th April 2010, has interpreted this provision and held that co-generation based on fossil fuel also should be treated at par with Renewable Energy sources for the purpose of promotion of such energy sources and RPO should not be made applicable on consumers of electricity generated from co-generation plant irrespective of fuel source.

As the present definition of cogeneration plants as provided in the Act and as interpreted by APTEL does not prescribe the source of fuel (fossil or non-fossil), it is recommended to bring clarity in this regard through legislative changes, if required, in consultation with MNRE.

4.2.1.5 Consumer Grievance Redressal Forum (CGRF)

Clause 5.13.3 of the National Electricity Policy also advises State Electricity Regulatory Commissions to notify guidelines/ regulations for the establishment of the Forum and the Ombudsman for consumer protection. The Government of India (GoI) has also framed rules detailing the provisions of the CGRF and the Ombudsman.

Though some states have established Consumer Advocacy Cells, it is important that such cells may be instituted by all the Commissions to provide the required legal advice, support, and assistance to Complainants for representing their case before the Ombudsman. Such a Cell could be funded by the Commission.

Presently all expenses related to the Ombudsman's office including that of the Secretariat are usually borne by the distribution licensee and are recovered from consumers through ARR. However, it might raise a question on the independence of the Ombudsman. There is a provision for the appointment of an Ombudsman in the Act under Section 42 (6), this implies that there appears to be no need for creation of a separate post for Ombudsman and consequently there is no need for seeking approval of the Government under Section 91 (2) on the lines of Delhi example.

Therefore, the CGRF should be multi member setup with members from all stakeholders and FOR should play an important role in ensuring consonance of guidelines/regulations pertaining to CGRF & Ombudsman in respective States and UT's.

Also, the expenses of the office of the Ombudsman should not be met by the distribution licensee. The office of the Ombudsman should be funded by SERCs and a separate budgetary allocation could be made in the budget of SERC for this purpose.

Consumer Advocacy Cells may be instituted by all the Commissions to provide the required legal advice, support, and assistance to Complainants for representing their case before the Ombudsman. Such a Cell could be funded by the respective Commission.

4.2.1.6 Energy Policies By States Regarding Free Power/Power at Concessional rates From The Generation Projects

Several State Governments have announced policies requiring the investors to supply a specified quantum of power from their generating stations to the State Governments/State utilities free of cost or at concessional rates. These conditionalities are pre-requisites for investment in these states

To the extent these policies of State Governments mandate sale of certain quantum of generated power, be it surplus or otherwise, to the host State Governments, they curtail, restrict and contravene the provisions of sub-section (2) of Section 10 of the Act. Further, any restriction placed on IPPs / Generating companies to deal with the generated power in any manner by making them sell any quantum to State Government as a return for facilities / benefits given to them while they set up their plants, contravenes the aforesaid legal provisions.

Therefore, it is recommended that Power procurement and allocation of power is to be done in line with the tariff policy and the guidelines/ Standard Bid documents (SBD) issued by Govt. of India under the Electricity Act, by the State Governments. Any restriction placed on IPPs/Generating companies to deal with the generated power in any manner by making them sell any quantum to State Government as a return for facilities / benefits given to them while they set up their plants, contravenes the provisions of the Electricity Act, 2003 and Policies made there under. It is recommended that enabling provisions may be made in the NEP in this regard.

4.2.1.7 Dedicated Transmission Lines

As there is no license required for Generation of power under the Electricity Act, the generators who construct *dedicated transmission lines* defined separately in the Electricity Act are not being governed by the Work of Licensee Rules applicable to Transmission & Distribution Licensees. As a result, there are disputes between generating companies and owner/occupier of the land over which such lines are laid, which are essentially on the issue that dedicated transmission lines were laid without taking prior consent from the owner or occupier.

Therefore it is recommended that while giving prior approval of Govt. under Section 68 of the Electricity Act 2003, following condition is inter-alia imposed, for setting of dedicated transmission line:

'the project developer shall abide by the provisions of Works of Licensee Rules 2006 notified by the Government of India, Ministry of Power in the Gazette of India, extra Part-II Section 3(i) dated 18.4.2006 (vide GSR 217(E) dated 18.4.2006).'

It was also observed that under the Works of Licensee Rules, any dispute is to be adjudicated and compensation decide by District Magistrate etc. Adjudication on such matters is a function of normal judiciary and does not falls in the domain of CERC.

Therefore, it is recommended that a new Para in the Policy may be added so that similar condition/ provision as above may be made on the lines of Works of Licensee Rules for conditions of construction of dedicated transmission lines and also any dispute is to be adjudicated and compensation decided by District Magistrate etc...

4.2.1.8 Independent Monitoring Group

Effective implementation of various programs such as RGGVY, NEF, R-APDRP etc. is crucial to improve health of the sector as well as to improve service quality to poor. Hence there is a need to strengthen program review and monitoring mechanism. One of the suggestions was constitution of separate 'Independent Monitoring Group' for oversight on important programs / schemes such as RGGVY, NEF and R-APDRP. These groups should consist of independent experts and representatives of Ministry and concerned implementation agencies. Mandate of these groups should be to undertake review of particular program every six month and suggest measures to improve effectiveness of the program. These groups should submit formal report to the Secretary (MoP) every six months and the same should be made public. These groups should be empowered to seek required data or to undertake studies / assessments.

In line with the above suggestion, it is recommended that to give effect to this mechanism provision on following lines could be made in the plan document / National Electricity Policy.

"To improve policy & program implementation, transparency and accountability, Independent Monitoring Groups (IMGs) will be created for major programs / schemes of the Ministry. These groups will consist of official as well as independent experts and will review progress of policies/ programs / schemes every six months. IMGs will submit reports to Secretary (MoP) and these reports will be widely circulated."

4.2.2 Tariff Policy:

Section 3 (1) of the Electricity Act 2003 empowers the Central Government to formulate the Tariff Policy. Section 3 (3) of the Act enables the Central Government to review or revise the Tariff Policy from time to time.

Accordingly, Central Government notified the Tariff policy in continuation of the National Electricity Policy (NEP) on 6th January, 2006.The objectives of this tariff policy are to:

(a) Ensure availability of electricity to consumers at reasonable and competitive rates;
(b) Ensure financial viability of the sector and attract investments;
(c) Promote transparency, consistency and predictability in regulatory approaches across jurisdictions and minimize perceptions of regulatory risks;
(d) Promote competition, efficiency in operations and improvement in quality of supply.

Some specific issues which may require a review of some specific clauses from Tariff Policy are listed below:

4.2.2.1 Cross Subsidy Surcharge

An opinion was impressed for review of the formula given in the Tariff Policy uses the weighted average cost of power purchase of top 5 % as a factor which leads to a negative cross subsidy surcharge in certain cases. Allowing consumers to migrate to open access under these conditions increases the burden of the DISCOM and this was not in line with the spirit of the cross – subsidy surcharge as per the Tariff Policy**.** There is thus a need to re-determine the formula for calculating cross subsidy surcharge. The options suggested were based on the average cost or bottom 5% costs.

Section 61 (g) of the Electricity Act,2003 provides that appropriate Commission shall determine tariff keeping in view the factor that the tariff progressively reflects the cost of supply of electricity and also, reduces cross-subsidies in the manner specified by the Appropriate Commission. However, very few SERCs have specified the roadmap of reduction of cross subsidies. Therefore, roadmap of reduction of cross subsidies should be specified by SERCs in line with the spirit of the Act.
Keeping in view of the above, it is recommended that:

i) Alternative methods of calculating cross subsidy surcharge could be worked out to ensure that neither open access is throttled nor does the host DISCOM unduly suffer.
ii) SERCs may calculate Cross-Subsidy Surcharge based on the assumptions that the power available as a result of exit of open access consumer will be sold at the average revenue realization rate. The wheeling charge (grossed up by the system loss at appropriate level)

to be recovered from the open access consumers should also be factored into computation of surcharge.

iii) For a situation where there is no power cut, SERCs may calculate Cross-Subsidy Surcharge based on the estimation that the DISCOM will avoid purchase of the quantum of power for which open access has been sought. This principle of avoided cost method should be adopted in areas where there are no power shortages. Other assumptions relating to quantum of power avoided and the wheeling charges could be on the same lines as above.

iv) As envisaged under Sec. 61(g) of the Act, all SERCs/JERCs should specify through a regulation the roadmap for reduction of cross-subsidy between different consumer categories. SERCs should compute cost of supply for each consumer category based on principles as may be evolved by the Forum of Regulators. Tariffs should be so fixed as to ensure that latest by the end of year 2015-2016 tariffs are within ± 20 % of the cost of supply. The road map should also have intermediate milestones, based on the approach of a gradual reduction in cross subsidy.

v) At the same time it should also be ensured that the formula incentivizes the distribution licensees to reduce their distribution losses.

4.2.2.2 Trading Margin

SERCs should impose reasonable trading margin for the intra-state sale irrespective of the final destination of the electricity and also incentivize the intra-state trading in line with Act and Policy.

4.2.2.3 Impact of rise in cost of fuel on tariff

The concerned SERC should ensure automatic pass through for any increase in power purchase cost arising out of rise in cost of fuel

4.2.2.4 Provisions of National Electricity Policy & Tariff Policy due for revision

The review of the clause 5.5.2 in National Electricity Policy was considered and it was observed that no modification of the clause 5.5.2 is required and hence, the same provision can be continued further and "*This provision will be further re-examined after five years.*" may be deleted from the clause.

The review of the clause 8.3(1) in Tariff Policy was considered and it was observed that no modification of the clause 8.3(1) is required and hence, the same provision can be continued further and "*This provision will be re-examined after five years.*" may be deleted from the clause.

4.2.2.5 Intra-State ABT

The National Electricity Policy had recommended implementation of Availability Based Tariff (ABT) at the intra state level within one year. However, despite five years after elapse of the deadline only Delhi, Gujarat and West Bengal have implemented intra state ABT in the same manner as done at inter-state level. Madhya Pradesh has also implemented it with the proviso that accounting is done on monthly basis instead of weekly. Implementation of intra state ABT would give a further boost to markets as it would lead to more of intra state trading as DISCOMs would enter the fray more aggressively. The present practice of a single procurement agency for each state makes it a single buyer model. The relevant clause of Tariff Policy are Given in **Appendix 4.2**.

It is opined that once intra state ABT is implemented and the multiple buyer model is brought in, there would be a further fillip to trading and market development.

4.3.1 Development of Ancillary Power Markets And Exchanges

National Electricity Policy mentioned about enabling regulations for 'Power Exchange' to be notified by the Appropriate Commission. The CERC came out with a staff paper in July 2006 on Power Exchange platform. After public hearings on the subject, approval was accorded by CERC vide order dated 9th June 2008 to Indian Energy Exchange (IEX) to commence operations. IEX commenced operation wef 27th June 2008. On 22nd October 2008, the second Power Exchange viz. Power Exchange India Limited (PXIL) commenced operations. On 20th January 2010, CERC notified the Power Market Regulations 2010. Starting from a modest quantum of 2.77 BUs traded through both the exchanges in 2008-09, it increased to a record 15.52 BUs in 2010-11.

One of the most fundamental requirements of the electricity market is that its design should be such that it complements the reliability and security of the system. The balancing market keeps supply and demand in balance until the system operator is forced to intervene. In a market oriented electricity industry, commercial mechanisms need to be in place for procurement of various services and to have prompt response from the entities.

Ancillary services are those functions performed to support the basic services of generation, transmission, energy supply and power delivery. These are necessary to support the transmission of electric power from seller to purchaser given the obligations of control areas and transmitting utilities within those control areas to maintain reliable operations of the interconnected transmission system.

Ancillary services are concerned with the despatch, trade and delivery of power. They are usually defined by the benefits they provide to the market participants and not by their method of provision. Broadly all these services can be grouped under one of the three following major categories:

(a) Frequency Control Services - FGMO, AGC, spinning reserves etc
(b) Network Control Services (Voltage Control)- AVR, SVC, Capacitors, Reactors etc
(c) System Restart Services - Black Start Units

Presently, the real time active power imbalance is handled through the UI mechanism which is a part of the Availability Based Tariff. UI mechanism works on the principle of a pre-defined frequency and price relationship and is a regulatory fiat.

Accordingly, following recommendations are made:

i) Two Power Exchanges (PX) are in operation leading to two spot prices today. Two PX, while facilitating competition, also leads to fragmentation of transmission service. It is suggested that while there could be multiple PX, a central price clearing algorithm could be adopted. A single spot price would lead to more certainty as far as investors are concerned.

ii) An alternative suggestion received was that as the Power Exchanges were still at a nascent stage, they should be allowed to mature before having a concept of a central price clearing algorithm. In the interim, there could be arbitrage opportunities between the two PX.

iii) It is suggested that the ancillary active power market be developed. This would be a move in the direction of developing a market based mechanism for ancillary active power from the present regulated tariff based system (UI). CERC should come out with a framework for implementation of ancillary market.

4.3.2 Guidelines for short term procurement:

Section 63 of the Electricity Act 2003 provides for ERCs to adopt the tariff arrived at through a transparent process of bidding in line with the guidelines issued by the Central Government. Section 86 (b) mandates that the State Commission shall regulate the electricity purchases by DISCOMs (including the price of purchase).

Section 5.7.1 of the National Electricity Policy specifies that in order to promote market development a part of new generating capacity, say 15% may be sold outside long term Power Purchase Agreements (PPAs). Section 5.12.2 of the NEP recommends procurement from renewable generators also on the basis of competitive bidding in the long run. Till such time, a preferential tariff by ERCs has been recommended.

Section 8.2.1 (1) of the Tariff Policy recommends that all power purchase costs needed to be considered legitimate unless it is proved that the principle of merit order has been violated. Revenues on account of power purchase should not be denied unjustly and consumers willing to pay at a tariff which indicates efficient costs have the right to get 24 hour uninterrupted power supply.

Thus the main thrust of the EA 2003 and the policy pronouncements has been with reference to long term PPAs. Going by the spirit of the Act and policies, accordingly, it is felt that a substantial part, say about 80-85% of the power purchased by utilities should be through long term/ medium term PPAs.

Looking at the CERC report on short term trading for 2010-11, it is seen that the bilateral trades have not increased significantly over 2009-10. In contrast, transactions through Power Exchange have increased significantly. The Power Exchange provides mainly the Day Ahead Market. (DAM). If supplies are eased on account of the increment in the generating capacity being sold outside long term PPA due to capacity addition, it could lead to a situation where most of the markets might shift to DAM in PX.

i) The need for long term adequacy statement by DISCOMs was emphasized in order to reduce uncertainty to the end consumer. It is felt that a substantial part, say about 80-85% of the requirement needed to be sourced by DISCOMs through long/ medium term contracts so that the infrastructure is developed accordingly.

ii) While model PPAs for long term procurement (7 years and above) and medium term (1 year to 7 years) are available, the progress on this front by DISCOMs has been very slow. Failure to strike medium term and long term contracts has a strong bearing on the day-ahead markets and the attendant problems of system security besides uncertainty to the consumer. In view of the slow progress made by the distribution licensees for arranging long-term power purchase agreements through competitive bidding, it is recommended that a separate group may be set up to examine the impediments in this regard and suggest remedial measures required.

iii) Short term procurements can be done three months in advance by the DISCOMs. Other products available in short term are First Come First Served (FCFS), day ahead and same day. A suggested model could be to source up to 98-102% of the requirements two days in advance and leaving only the last 2-3% for the day-ahead market. The day-ahead market might be taken recourse to only to account for load forecast errors and/or forced outage of some generating units.

4.3.3 SEPARATION OF CARRIAGE AND CONTENT AND FURTHER OPERATIONALIZATION OF OPEN ACCESS IN TRANSMISSION AND DISTRIBUTION

The statutory provisions with respect to open access in the Electricity Act 2003, National Electricity Policy and Tariff Policy are enclosed at ***Appendix 4.3.*** It would be seen that elaborate provisions exist in the statute to facilitate open access with the ultimate objective of introducing competition.

Implementation of these provisions in the Act has given mixed results. The sections below outline the progress at both the inter state and intra state are given as under:

4.3.3.1 Inter State Level

At the inter-state level, separation of carriage and content was already fairly well in place before the Electricity Act 2003. The Central Transmission Utility (CTU) was already barred from engaging in generation or trading or electricity and was involved solely in the transmission and system operation business. Inter state bilateral transactions were already in existence well before the Electricity Act 2003. It got a further fillip after EA 2003. In Aug 2003, the Central Electricity Regulatory Commission (CERC) came out with an approach paper for implementing open access at the inter-state level. After a series of public hearings, inter state open access was implemented at the inter-state level wef 6th May 2004 and the Regional Load Despatch Centres (RLDCs) were designated the nodal agencies for the purpose. Thus inter state open access took off well before notification of the National Electricity Policy and Tariff Policy.

Starting from 17 BUs of energy transacted through Short Term Open Access (STOA) at the inter state level in 2004-05, the volume has grown to 55 BUs in 2010-11 (a Compound Annual Growth Rate or CAGR of 21.6%).

A significant number of captive power plants (CPPs) and Independent Power Producers (IPPs) are participating in the market. The Central Electricity Regulatory Commission (CERC) is exercising regulatory oversight in this market. The Market Monitoring Cell (MMC) in CERC brings out extensive reports every month since August 2008 indicating the market volumes, prices, participation by different players etc.

One of the major concern of stakeholders in connection with inter state open access has been the issue of pan-caking of transmission charges and losses in case of inter-regional transactions. The issue has been resolved satisfactorily with the new method of sharing of transmission charges and losses approved by CERC and implemented wef 1st July 2011. The new method is based on Point Of Connection (POC) of a regional entity in the grid.

While carriage and content separation at inter state level has been largely addressed by design, a point of concern has been the adequacy of 'carriage'. Adequacy issues with respect to carriage needed to be specified. Each state needed to test the adequacy of transmission with respect to various uncertainties such as fuel shortage, contingencies, high load growth without commensurate increase in internal generation etc. Such instances would be frequent and have to be factored for such uncertainties. Investment in a robust transmission system would also allow greater economy interchange. Each state might evaluate its maximum import capability from the grid. For surplus states, it would be the maximum export capability. The issue assumes importance as it is observed that many states are importing as much as 30-35% of their consumption through short term transactions.

4.3.3.2 Intra State Level

Open Access granted by the distribution licensee is the only mode of introducing competition within the present statute. The issue of open access at the intra state level has been covered extensively in the following reports:

1. Forum of Regulators-Open Access, Theory and Practice issued in November 2008.

2. 'Report of the Task Force for operationalising open access in the power sector', Planning Commission, Government of India, January 2009 (headed by Shri B. K. Chaturvedi, Member, Planning Commission).

Recently, the Forum of Regulators has issued Model regulations for intra state open access in September 2010. Adoption of these model regulations by SERCs would go a long way in successful implementation of intra state open access.

Further, the Second Task Force on measures for operationalizing open access in power sector has been constituted to review the progress made by the previous Task force and suggest further course of action on the issues upon which there was no consensus in the First Task Force.

Therefore, in order to make open access happen, it is also important to evolve a uniform approach to operational level issues like metering, billing and settlement etc. and various charges for open access. FOR should evolve uniform principles on all such issues through the consensus evolved and follow up for timely implementation.

Also, Adequacy issues with respect to 'carriage' must be clearly understood and documented both at the inter state and intra state transmission. Stakeholders must clearly understand the limitations of the network and the maximum possible power that can be transacted either way into and out of the network.

Considering the huge amount of uncertainties involved such as weather conditions, fuel security, natural disasters etc., the network should be capable of withstanding such large contingencies (High Impact Low Frequency or HILF incidents) either through the planning process or adoption of System Protection Schemes (SPS) in large numbers.

4.3.3.3 Standby Charges

As per the latest FOR guidelines, demand charges for standby supply can be charged for 42 days in a year. However, some of the States have suggested that standby charges should be payable for the entire 365 days. For open access availed over express feeders, procurement of standby supply on a day-ahead basis through the market can be explored.

In order to facilitate standby supply, the concerned utility may also enter into PPAs for say 10% of the requirement and the demand charge can be recovered from the open access consumers. However, it is noted that the issue of Standby charges is under deliberations in the *Second Task force on measures for operationalizing open access in power sector.*

It was opined that for all 1 MW and above consumers seeking open access, Stand by charges should apply only if the distribution licensees continue to have the universal service obligation for energy supply. In case the distribution companies do not have the universal service obligation, stand by charges may be decided by mutual agreement between the open access consumers and the distribution companies.

4.3.3.4 Minimum Licensee Area

Defining minimum area for second/subsequent licensee restricts the flexibility even in genuine cases like granting license co-terminus with the area of the existing licensee etc. Also Special Economic Zones (SEZs) which are deemed distribution licensees, do not necessarily meet the requirement of minimum area as defined in the rules. The other view was that the fixation of minimum areas was done in the rules after due consultation with all concerned so that there is no "cherry picking" by the second licensee.

It is opined that in order to have two different types of distribution licensees, the power granted to Appropriate Commission, under Section 14 to grant a distribution licence, will have to be amended to the effect that it can grant two different types of distribution licences. Further, it would appear that the twin objectives of ushering in competition by grant of multiple distribution licenses and enabling choice to consumers while at the same time avoiding additional costs on the consumers to pay for the operation and maintenance of stranded assets, legislative changes may be required, as it is felt that the present requirement of laying parallel network by the second Licensee may not result in minimum engineering cost.

4.3.3.5 Separation Of Wires And Retail Business Of Distribution Licensee

Traditionally, distribution business in the country is bundled i.e. Wire Business (Installation and maintenance of electricity Infrastructure) and Retail Business (Procurement and Supply of Power to retail consumers) is carried out by single licensee. In most of the developed Countries, there is a single entity which takes care of wires and multiple suppliers of power which use the common network. This can be achieved in India by issuing separate licenses, one for Wires and the other for Supply business as Distribution Licenses.

Solicitor General of India has opined that the Electricity Act 2003 assigned the dual role of network operator and of supplier to the distribution licensee, hence, the two cannot be separated.

It is opined that Single entity which takes care of wires and multiple suppliers of power which use the common network may be a vital step for operationalization of Open Access in Distribution Sector. A detailed study should be conducted by FOR in this regard based on international experience and implications should be assessed.

4.3.3.6 Creation Of Distribution Control Centres

Institutions are the soft side of the reform process and are a vital step for success. Open access implementation is possible only if nodal agencies are identified at the National, Regional and State level. The success of open access in transmission at the inter-state level has been mainly on account of designating NLDC/RLDCs as nodal agencies and empowering them. Likewise open access has been a success in many states mainly on account of the nodal agency identification and empowerment viz. State Load Despatch Centres (SLDCs). For open access at the distribution level, it is important that DISCOMs also create their Distribution Control Centres (DCCs) and empower the same. As all these nodal agencies act as single window clearing agencies and also collect and distribute the charges on behalf of all the players, all taxation related issues need to be resolved at the earliest.

4.3.3.7 Competitive Bidding

The Appellate Tribunal for Electricity in its judgement dated 31st March 2010 held that the State Commissions have discretionary powers to give approval for the PPA or to direct the distribution licensee to resort to the competitive bidding process in accordance with the Tariff Policy. The Tribunal has held that the State Commission should direct the distribution licensee to carry out power procurement through competitive bidding process in cases where the rates under negotiated agreements are high. CERC/FOR should evolve benchmark tariff for guidance of the SERCs for this purpose.

4.3.3.8 Other issues

In order to improve efficiency, Right of Way (ROW) issues, forest clearance and land clearance for transmission projects needed to be accorded high priority and addressed by all concerned. A robust transmission system is sine-qua-non if the electricity markets have to flourish.

4.4 FINANCIAL VIABILITY OF DISTRIBUTION SECTOR AND GENERATION MIX

4.4.1 Dedicated courts to finalize THEFT OF ENERGY / MALPRACTICE cases

As per information available, 23 special courts have already been setup under the section 153 of the Electricity Act to facilitate early disposal of such cases. However, as of now there is no dedicated court for the purpose of finalizing cases involving theft of energy and associated malpractices as the Courts lack domain expertise in proper and quick disposition of cases and as such revenue realization gets delayed.

It is recommended that States may also consider setting up dedicated mobile courts and police stations for dealing with offences mentioned in Electricity Act. This will facilitate expeditious disposal of cases and provide an effective deterrent to errant consumers.

4.4.2 Strengthening of Chief Electrical Inspector to the Government

Govt of Punjab has pointed out difficulties in inspection and testing of electrical installations keeping in view the manifold increase in electrical installations which have gone upto to 1.5 lakh. It has become virtually impossible for the EIs/CEIs to inspect the said installations, which may jeopardize the public safety. As the installations are to be inspected in every 5 year. The dearth of EIs/ CEIs vis-à-vis exceptional growth of the electrical installation has led to increase in corruption. Govt. of Punjab has proposed a scheme of Testing & Inspection of Electrical Installations by qualified Chartered Engineers. Under the scheme the periodic inspection of electric installations would be done by the Chartered Engineers or EIs/CEIs as per the option of the owner. The charges shall be borne by the owner of installation.

It is opined that States should ensure that the institution of Chief Electrical Inspectorate to Govt. of India (CEIG)/State Government is strengthened so that quick and timely approvals are given. Taking into account the practical difficulties in view of the growing number of connections and the shortage of the staff, CEA should work out a scheme of delegation of authority of mandatory inspections, including self-certifications, which would be in consonance with liberalization of bureaucratic control without compromising system safety and suggest possible steps for strengthening of Chief Electrical Inspector institutions which may be adopted by the State Governments.

4.4.3 Curbing increase in power purchase costs & improving commercial efficiencies

Key Demand side Management Initiatives such as dynamic reactive power compensation in Ahmedabad Electricity Company (AEC), TOD and KVAH based tariff in Gujarat, Maharashtra and Andhra Pradesh have significantly contributed in overall improvement in Grid conditions. In view of the above, it is strongly felt that the other utilities should also come up with such initiatives based on the principles and guidelines that are to be evolved by FOR through consensus based on the utilities experiences and further progress to be reviewed by FOR.

4.4.4 Concessional / Preferential Procurement by Host state under MOU route

A number of State Governments have issued policies which are not in accordance with the provisions of Electricity Act and the Policies notified under the Act. The ERCs are mandated to be guided by the policies issued under the Act for Determination of Tariff. Therefore, the statutory status of such Energy policies shall come in way of Determination of tariff for the power procured under these policies. Various provisions of these energy policies require sale of power to host State at concessional rates. Such purchase of power at concessional rates by host state will result in increased cost of electricity in other States

Acquisition of large quantities of power at concessional rates by the host State Governments will impact competition if these governments enter in trading of power. Power available with ERCs to prevent and act against market domination is applicable only in respect of licensees and generating companies. Considering these State Governments as trading licensees, trading of surplus power by State Governments would be subjected to regulatory jurisdiction.

It is opined that there is an urgent need to align power/energy policies by the States with the Tariff Policy notified under the Electricity Act. Trading by state entities should be undertaken only after meeting the power demands of its own consumers. ERCs could consider initiating investigation under Section 128 to investigate on any action with respect to procurement and/ or disposal of power by Sate Government in its capacity as a deemed licensee u/s 14 and give appropriate direction. ERCs could also take action if they feel that their tariff fixation powers are being encroached upon or being vitiated on account of the State Government policies.

4.4.5 Issues related with development of renewable purchase obligation (RPO)

Renewable Purchase Obligation (RPO) is fundamental to the growth of renewable energy as without this commitment, given higher cost of renewable energy, the States may not be willing to purchase such power. In order to meet the targets set up under the National Action Plan on Climate Change (NAPCC) the States should strive to make mandatory RPO equivalent to the minimum as per the NAPCC targets.

Given that the country has very high wind and solar power potential and that solar specific power purchase obligation has been introduced through amendment in the tariff policy, similar obligation be taken for wind power also. As the wind power tariff cost has come down significantly and it is likely that the cost of generating power will get reduced the State can have higher percentage of wind power in the RPO. But similar clarity needed in case of wind power as in the case of National Solar Mission which specifies clearly the capacity addition plan, targets over the years etc, to have a specific wind power obligation.

Within the overall RPO, the State regulators can determine the percentage of each of the resources, namely, solar, wind, biomass and small hydro projects taking into consideration the emerging tariff of each.

The procurement of solar and wind power should be necessarily through open competition bidding process. In case of solar, this is the practice in vogue and the same practice will need to be introduced for wind as well.

It is opined that RPOs should be distributed among the states in line with the targets set under the NAPCC through suitable legislative changes in consultation with MNRE, if required. Further, the subject of mandating Renewable Purchase Obligation for sources of energy other than solar was deliberated and it was felt that the renewable purchase obligation for these sources have to be fixed in line with the expected generating capacities and for which the corresponding action plan/mission of on the lines of National Solar Mission which will look into all related steps like corresponding transmission evacuation capacity, the technical and commercial issues associated with it are considered in consultation with all stakeholders.

4.4.6 Trajectory Of RPO & Enforcement

Stable RPO regime is a pre-requisite for promotion of renewable energy sources. The long term trajectory for Renewable Purchase Obligation would give greater visibility for the market players to plan their investment in the Renewable Energy Sector.

A suitable forum (FOR) may conduct studies to suggest the possible RPO trajectories for different states and at the same time ensure homogeneity in the RPO regulations of respective states and UT's. It is also equally important to ensure compliance of RPO by all the obligated entities including open access users.

It is observed that SERCs should provide long term trajectory for Renewable Purchase Obligation. FOR should conduct studies in this regard and suggest possible trajectories for different States keeping in view availability of RE sources in the country and impact of increasing level of RPO on the power purchase cost of the respective distribution licensee. FOR should strive to develop homogeneity in the RPO regulations of respective states and UT's.

The Principles & guidelines evolved through consensus by the Forum of Regulators for the RPO of Obligated entities and REC mechanism should be followed up for timely adoption by corresponding Regulations of SERCs in keeping with Government Policies.

4.4.7 Renewable Power Procurement Options

In order to bring more competition to the Renewable Energy sector with consequent reduction in prices of power production through the renewable sources of energy, the following options were deliberated :

a) Long term procurement of power by the distribution licensee to be done only through competitive bidding process (CBP) and Power Purchase Agreements (PPA).
b) REC Mechanism has already been launched by CERC which along with the preferential tariffs takes care of the short term procurement by the distribution licensees.

It is recommended that Long term procurement of power by the distribution licensee is to be done through competitive bidding process (CBP) and Power Purchase Agreements (PPA). To start with, the provisions in the Tariff Policy may be amended suitably for phase-wise introduction of competition for the different sources of renewable energy. Renewable Power procuring state will have the following procurement options:

1. Long term procurement through competitive bidding.
2. Short term procurement through Purchase of REC or at preferential tariffs.

Also, for the procurement of renewable power individual demands of more than one distribution licensees/ States may be pooled at the regional level and procured through competitive bidding route under Section 63 (A) of EA 2003/ National Tariff Policy.

4.4.8 Creation and Management of Spinning reserves

The generation of Variable Renewable Energy (VRE) is intermittent and infirm in nature which limits their absorption into the grid which has built-in flexibility to a particular range. There is need to set up balancing power stations in the form of pumped storage hydro stations and/or gas-based open cycle power stations. Pump storage hydro stations being limited and not necessarily available in the State where the solar and wind power are available, accordingly the Ministry of Petroleum & Natural Gas, may be approached to provide natural gas on priority to the plants coming up in areas where wind energy potential exists so that gas based peaking stations could be set up and to provide the balancing mechanism.

4.4.9 Evacuation of Renewable power

The potential of wind, solar and small hydro power is confined to a few States and that too in certain pockets. Most of the generating units are small in size and dispersed. These locations are in the remote places. Evacuation of power generation from these units presents technical and commercial challenges. Further, the possibility of consumption of such VRE is limited within the State, considering the resultant grid disturbance.

It is opined that Suitable incentive for low cost transmission system linking the renewable energy generation sources, development of Smart Grid for evacuation and transmission of renewable power, creation of Spinning Reserves managed by the Regional Load Dispatch Centre needs to be developed may be done through the National Clean Energy Fund .

4.4.10 Biomass power tariff & other issues related to renewable energy sources

Considering that the prices of biomass fluctuate wildly and there is no mechanism to control the same and that most of the plants are facing closure as they are not able to profitably honour the power supply commitment under the long-term power purchase agreements (PPAs).

As the issues require technical and commercial solutions which are still emerging in the country and there is no ready data available in this regard, It is recommended to constitute a Committee consisting of representatives from MOP, MNRE, CERC/CEA to examine and report upon these issues in consultation with other experts.

4.4.11 Issues related to Competitive Bidding framework

A separate committee has been formed to review the guidelines for Standard Bidding Documents (SBD) for both Case-I & Case-II.

4.4.12 Legislative changes for creation of a multi-disciplinary body to review performance of Regulatory Commissions

Through suitable legislative changes it is recommended that a Multi-disciplinary body shall be constituted comprising of representatives from Centre and States to review the performance of the Regulatory Commissions periodically on the basis of a performance evaluation matrix and report to the appropriate Government for necessary corrective action.

4.4.13 CERC to regulate coal prices

Through suitable legislative changes, to entrust CERC with the additional function of regulating coal prices and its transportation charges

4.5 SUMMARY OF RECOMMENDATIONS

A Summary of Recommendations on 'Legislative and Policy Issues – Formulation, Implementation and feedback' is as follows:

1. Strengthening of institutions at the National/ Regional/State level such as NLDC/RLDCs/SLDCs is vital to the implementation of open access. The management of POSOCO should be separated from the PGCIL. There is a need for functional & financial separation in operation of SLDCs for ensuring their independence. The recommendations made by the Pradhan Committee need to be implemented for ensuring empowerment of SLDCs.

2. To give a clear timeline for States to expedite reassignment of the PPAs to DISCOMs and for winding up the single buyer model as early as possible enabling provision may be made in this regard in the NEP.

3. SERCs should provide long term trajectory for Renewable Purchase Obligation. FOR should conduct studies in this regard and suggest possible trajectories for different States keeping in view availability of RE sources in the country and impact of increasing level of RPO on the power purchase cost of the respective distribution licensee. FOR should strive to develop homogeneity in the RPO regulations of respective states and UT's.

4. The Principles & guidelines evolved through consensus by the Forum of Regulators for the RPO of Obligated entities and REC mechanism should be followed up for timely adoption by corresponding Regulations of SERCs in keeping with Government Policies. A time limit of 3 to 6 months may be prescribed under the policy for respective SERCs to issue the relevant Regulation once it is adopted by the FOR with or without modification.

5. As the present definition of cogeneration plants as provided in the Act and as interpreted by APTEL does not prescribe the source of fuel (fossil or non-fossil), it is recommended to bring clarity in this regard through legislative changes, if required, in consultation with MNRE.

6. Empowering Regulatory Commissions for suo moto revision of tariff of consumers.

   Section 64 of Electricity Act 2003 may be amended by incorporating an additional provision for empowering the Regulatory Commissions for suo moto revision of tariff of consumers. The additional provision may be on the lines mentioned below.

   "Provided if the Appropriate Commission is satisfied that the expected revenue of a distribution licensee (s) at the current tariff differs significantly from the revenue it is permitted to recover, it may order the licensee(s) to file an application within the time specified by the Commission to amend its tariffs appropriately failing which the Commission shall suo moto start the proceedings for determination of tariff."

7. The CGRF should be a multi-member setup with members from all stakeholders. FOR to play an important role in ensuring consonance of guidelines/regulations pertaining to CGRF & Ombudsman in respective States and UT's.

8. The office of the Ombudsman should be funded by SERCs and a separate budgetary allocation could be made in the budget of SERCs for this purpose and should be recovered from distribution licensees.

9. Consumer Advocacy Cells may be instituted by all the Commissions to provide the required legal advice, support, and assistance to Complainants for representing their case before the Ombudsman. Such a Cell could be funded by the Commission.

10. Power procurement and allocation of power to be done in line with the tariff policy and the guidelines/ Standard Bid documents (SBD) issued by Govt. of India under the Electricity Act, by the State Government. The right of any State Government nominated agency to purchase power from these IPPs would also amount to allocating certain quantum from the IPPs by virtue of exercise of such right of State Government nominated agency. Any restriction placed on IPPs/Generating companies to deal with the generated power in any manner by making them sell any quantum to State Government as a return for facilities / benefits given to them while they set up their plants, contravenes the provisions of the Electricity Act, 2003 and Policies made there under. The Sub-Group recommends that enabling provisions may be made in the NEP in this regard.

11. A new Para in the policy may be added so that similar condition/ provision may be made on the lines of Works of Licensee Rules for conditions of construction of dedicated transmission lines and also any dispute is to be adjudicated and compensation decided by District Magistrate etc...

12. ‘Independent Monitoring Group’ for oversight on important programs / schemes such as RGGVY, NEF and R-APDRP may be constituted separately. To give effect to this mechanism provision on following lines could be made in the plan document / National Electricity Policy.
"To improve policy & program implementation, transparency and accountability, Independent Monitoring Groups (IMGs) will be created for major programs / schemes of the Ministry. These groups will consist of officials as well as independent experts and will review progress of policies/ programs / schemes periodically, say, every six months. IMGs will submit reports to Secretary (MoP) and these reports will be in the public domain."

13. Alternative methods of calculating cross subsidy surcharge could be worked out to ensure that neither open access is throttled nor does the host DISCOM unduly suffer.

14. SERCs may calculate Cross-Subsidy Surcharge based on the assumptions that the power available as a result of exit of open access consumer will be sold at the average revenue realization rate. This is the most practical scenario in a situation of shortage of power supply. The SERCs may assume certain percentage (say, 10%) of the total consumption by eligible open access consumers for the purpose of estimation of power available for sale at average realization rate. The wheeling charge (grossed up by the system loss at appropriate level) to be recovered from the open access consumers should also be factored into computation of surcharge. At the same time it should also be ensured that the formula incentivizes the distribution licensees to reduce their distribution losses.

15. For a situation where there is no power cut, SERCs may calculate Cross-Subsidy Surcharge based on the estimation that the DISCOM will avoid purchase of the quantum of power for which open access has been sought. This principle of avoided cost method should be adopted in areas where there are no power shortages. Other assumptions relating to quantum of power avoided and the wheeling charges could be on the same lines as above.

16. As envisaged under Sec. 61(g) of the Act, all SERCs/JERCs should specify through a regulation the roadmap for reduction of cross-subsidy between different consumer categories. SERCs should compute cost of supply for each consumer category based on principles as may be evolved by the Forum of Regulators. Tariffs should be so fixed as to ensure that latest by the end of year 2015-2016 tariffs are within ± 20 % of the cost of supply. The road map should also have intermediate milestones, based on the approach of a gradual reduction in cross subsidy.

17. SERCs should impose reasonable trading margin for the intra-state sale irrespective of the final destination of the electricity. SERC's should incentivize the intra-state trading in line with Act and Policy.

18. The concerned SERC should ensure automatic pass through for any increase in power purchase cost arising out of rise in cost of fuel

19. Provision in National Electricity Policy which needs review is reproduced below :

"5.5.2 A minimum level of support may be required to make the electricity affordable for consumers of very poor category. Consumers below poverty line who consume below a specified level, say 30 units per month, may receive special support in terms of tariff which are cross-subsidized. Tariffs for such designated group of consumers will be at least 50 % of the average (overall) cost of supply. This provision will be further re-examined after five years."

The review of the clause quoted was taken by this Group and observed no modification of the clause is required and hence, the same provision can be continued further and *"This provision will be further re-examined after five years."* may be deleted from the clause.

20. Provision in National Tariff Policy which needs review is reproduced below:

"8.3 Tariff design : Linkage of tariffs to cost of service……
………..1. In accordance with the National Electricity Policy, consumers below poverty line who consume below a specified level, say 30 units per month, may receive a special support through cross subsidy. Tariffs for such designated group of consumers will be at least 50% of the average cost of supply. This provision will be re-examined after five years."

The review of the clause quoted was taken by this Group and observed no modification of the clause is required and hence, the same provision can be continued further and *"This provision will be re-examined after five years."* may be deleted from the clause.

21. Two Power Exchanges (PX) are in operation leading to two spot prices today. Two PX, while facilitating competition, also leads to fragmentation of transmission service. It is suggested that while there could be multiple PX, a central price clearing algorithm could be adopted. A single spot price would lead to more certainty as far as investors are concerned.

22. An alternative suggestion received was that as the Power Exchanges were still at a nascent stage, they should be allowed to mature before having a concept of a central price clearing algorithm. In the interim, there could be arbitrage opportunities between the two PX.

23. It is suggested that the ancillary active power market be developed. This would be a move in the direction of developing a market based mechanism for ancillary active power from the present regulated tariff based system (UI). CERC should come out with a framework for implementation of ancillary market.

24. There is a need for clarity in the Policy/ Act so that Jurisdiction issues regarding forward and future market products may be sorted out at the earliest so as to facilitate Power Market development further.

25. The need for long term adequacy statement by DISCOMs was emphasized in order to reduce uncertainty to the end consumer. It is felt that a substantial part, say about 80-85% of the requirement needed to be sourced by DISCOMs through long/ medium term contracts so that the infrastructure is developed accordingly.

26. While model PPAs for long term procurement (7 years and above) and medium term (1 year to 7 years) are available, the progress on this front by DISCOMs has been very slow. Failure to strike medium term and long term contracts has a strong bearing on the day-ahead markets and the attendant problems of system security besides uncertainty to the consumer. In view of the slow progress made by the distribution licensees for arranging long-term power purchase agreements through competitive bidding, it is recommended that a separate group may be set up to examine the impediments in this regard and suggest remedial measures required.

27. Short term procurements can be done three months in advance by the DISCOMs. Other products available in short term are First Come First Served (FCFS), day ahead and same day. A suggested model could be to source up to 98-102% of the requirements two days in advance and leaving only the last 2-3% for the day-ahead market. The day-ahead market might be taken recourse to only to account for load forecast errors and/or forced outage of some generating units.

28. The Act might provide further clarification on the meaning of 'extraordinary circumstances' mentioned in Section 11, in case required. Considering that the DISCOMs have access to the entire country's wholesale market rather than depending solely on the generating companies within the state, there can be no 'extraordinary circumstances' forcing generating companies to sell power only within the state. Further, the Appropriate Commissions might in line with the provisions of the Act clearly specify the compensation to be provided to Generating Companies whenever section 11 directive is issued to generating companies.

29. The provision under section 11 or 108 of electricity Act, 2003 should not be misused to deal with shortage of power in the State as this section was meant to be invoked in extra ordinary circumstances like security of the State, public order or a natural calamity. This position may be clarified in the National Electrical Policy

30. To make open access happen, it is also important to evolve a uniform approach to operational level issues like metering, billing and settlement etc. and various charges for open access. FOR should evolve uniform principles on all such issues through the consensus evolved and follow up for timely implementation.

31. For all 1 MW and above consumers seeking open access, Stand by charges should apply only if the distribution licensees continue to have the universal service obligation for energy supply. In case the distribution companies do not have the universal service obligation, stand by charges may be decided by mutual agreement between the open access consumers and the distribution companies.

32. In line with the opinion of the Sub Group that in order to have two different types of distribution licensees, the power granted to Appropriate Commission, under Section 14 to grant a distribution licence, will have to be amended to the effect that it can grant two different types of distribution licences. Further, it would appear that the twin objectives of ushering in competition by grant of multiple distribution licenses and enabling choice to consumers while at the same time avoiding additional costs on the consumers to pay for the operation and maintenance of stranded assets, legislative changes may be required, as it is felt that the present

requirement of laying parallel network by the second Licensee may not result in minimum engineering cost.

33. Meanwhile, the definition of minimum area of supply may be modified and it may be left to the discretion of the SERCs to decide the area, however, with due consideration to the fact that the grant of second/subsequent license does not lead to "cherry picking".

34. At the state level, DISCOMs also need to create Distribution Control Centres (DCCs) and empower them so that open access at the distribution level becomes a reality. The nodal agencies identified also need to be protected against taxation related issues with respect to single window clearance operation.

35. Single entity which takes care of wires and multiple suppliers of power which use the common network may be a vital step for operationalization of Open Access in Distribution Sector. A detailed study should be conducted by FOR in this regard based on international experience and implications should be assessed.

36. Given the trend of prices discovered through competitive bidding process, which are more efficient than cost plus tariff, it may be desirable for the SERCs to encourage the distribution licensees to go for competitive bidding process. APTEL in its judgment has interpreted Section 62 and 63 of the Act providing for optional routes for the procurement of power which is against the provision of Tariff Policy. Though the Government of India has filed appeal petition in the Supreme Court against this judgment, it will be desirable that more clarity is brought in this regard through suitable legislative changes.

37. Adequacy issues with respect to 'carriage' must be clearly understood and documented both at the inter-state and intra state transmission. Stakeholders must clearly understand the limitations of the network and the maximum possible power that can be transacted either way into and out of the network.

38. States may also consider setting up dedicated mobile courts and police stations for dealing with offences mentioned in Electricity Act. This will facilitate expeditious disposal of cases and provide an effective deterrent to errant consumers.

39. States should ensure that the institution of Chief Electrical Inspectorate to Govt. of India (CEIG)/State Government is strengthened so that quick and timely approvals are given.

40. Taking into account the practical difficulties in view of the growing number of connections and the shortage of the staff, CEA should work out a scheme of delegation of authority of mandatory inspections, including self-certifications, which would be in consonance with liberalization of bureaucratic control without compromising system safety and suggest possible steps for strengthening of Chief Electrical Inspector institutions which may be adopted by the State Governments.

41. Suitable incentives to those states who have adopted such measures viz., TOD tariff should be given.

42. TOD for LT industries and Domestic consumers should be operationalized in phases

43. Pre – paid meters shall be promoted to High value consumers and to those categories of consumers who are chronic defaulters to avoid piling up of arrears.

44. 100% Spot billing, Spot collection, Semi / fully automated meter reading and Standardization of metering protocols shall be done for extensive usage of AMR.

45. Dedicated feeders may be extended to energy intensive consumer groups at their cost.

46. The State Governments should not only clear all the outstanding dues to the Utilities, but ensure payment of subsidies as per section 65 of EA 2003 in future. FOR to evolve principles & methodologies in this regard through consensus and further follow up the progress.

47. There is an urgent need to align power/energy policies by the States with the Tariff Policy notified under the Electricity Act. Though the Act provides for transmission, distribution and trading activities by the State Governments under section 14 of the Act, in the interest of promoting competition and fair play; Trading by state entities should be undertaken only after meeting the power demands of its own consumers.

48. ERCs could consider initiating investigation under Section 128 to investigate on any action with respect to procurement and/ or disposal of power by Sate Government in its capacity as a deemed licensee u/s 14 and give appropriate direction. ERCs could issue directions u/s 60 to State Govt (in its capacity as a deemed licensee u/s 14) to not force generating company to export surplus power only through SEB and thereby examine whether unfair conditions are being imposed on account of violation of Section 10(2) and / or whether unlawful actions are being taken by contravention of the Tariff Policy. ERCs could also take action if they feel that their tariff fixation powers are being encroached upon or being vitiate on account of the State Government policies

49. Renewable purchase obligation for these sources have to be fixed in line with the expected generating capacities and for which the corresponding action plan/mission of on the lines of National Solar Mission which will look into all related steps like corresponding transmission evacuation capacity, the technical and commercial issues associated with it are considered in consultation with all stakeholders. Thereafter, RPOs should be distributed among the states in line with the targets set under the National Action Plan on Climate Change to be done through amendment in Electricity Act 2003 and/ or Tariff Policy

50. Each state to have 5-10 years RPO for different renewable resources

51. All states should take Renewable Purchase Obligation (RPO) in all renewable power resources.% share of each resource may depend upon availability of resource in the state, e.g. Bihar with higher biomass resources may take higher PO for biomass and remaining from others-this will create market for each renewable resource

52. All Generators who set up Power plants may be encouraged to set up corresponding renewable source power generation through suitable incentives by MNRE

53. Long term procurement of power by the distribution licensee to be done through competitive bidding process (CBP) and Power Purchase Agreements (PPA). To start with, the provisions in the Tariff Policy may be amended suitably for phase-wise introduction of competition for the different sources of renewable energy. Renewable Power procuring state will have the following procurement options:-
    1. Long term procurement through competitive bidding.
    2. Short term procurement through Purchase of REC or at preferential tariffs.

54. For the procurement of renewable power individual demands of more than one distribution licensees/ States may be pooled at the regional level and procured through competitive bidding route under Section 63 (A) of EA 2003/ National Tariff Policy

55. Spinning reserves need to be facilitated for grid stability at the regional level to accommodate the infirm renewable energy injection into the grid.

56. Suitable incentive for low cost transmission system linking the renewable energy generation sources, development of Smart Grid for evacuation and transmission of renewable power , creation of Spinning Reserves managed by the Regional Load Dispatch Centre needs to be developed may be done through the National Clean Energy Fund .

57. Through suitable legislative changes it is recommended that a Multi-disciplinary body shall be constituted comprising of representatives from Centre and States to review the performance of the Regulatory Commissions periodically on the basis of a performance evaluation matrix and report to the appropriate Government for necessary corrective action.

58. Through suitable legislative changes, to entrust CERC with the additional function of regulating coal prices and its transportation charges

Appendix 4.1

Relevant National Electricity Policy clauses

- Clause 5.3.7: *The spirit of the provisions of the Act is to ensure independent system operation through NLDC, RLDCs and SLDCs. These dispatch centers, as per the provisions of the Act, are to be operated by a Government company or authority as notified by the appropriate Government. However, till such time these agencies/authorities are established the Act mandates that the CTU or STU, as the case may be, shall operate the RLDCs or SLDC. The arrangement of CTU operating the RLDCs would be reviewed by the Central Government based on experience of working with the existing arrangement. A view on this aspect would be taken by the Central Government by December 2005.*

- Clause 5.4.3: *For achieving efficiency gains proper restructuring of distribution utilities is essential. Adequate transition financing support would also be necessary for these utilities. Such support should be arranged linked to attainment of predetermined efficiency improvements and reduction in cash losses and putting in place appropriate governance structure for insulating the service providers from extraneous interference while at the same time ensuring transparency and accountability. For ensuring financial viability and sustainability, State Governments would need to restructure the liabilities of the State Electricity Boards to ensure that the successor companies are not burdened with past liabilities. The Central Government would also assist the States, which develop a clear roadmap for turnaround, in arranging transition financing from various sources which shall be linked to predetermined improvements and efficiency gains aimed at attaining financial viability and also putting in place appropriate governance structures.*

- Clause 5.4.5: *The Electricity Act 2003 enables competing generating companies and trading licensees, besides the area distribution licensees, to sell electricity to consumers when open access in distribution is introduced by the State Electricity Regulatory Commissions. As required by the Act, the SERCs shall notify regulations by June 2005 that would enable open access to distribution networks in terms of sub-section 2 of section 42 which stipulates that such open access would be allowed, not later than five years from 27th January 2004 to consumers who require a supply of electricity where the maximum power to be made available at any time exceeds one mega watt. Section 49 of the Act provides that such consumers who have been allowed open access under section 42 may enter into agreement with any person for supply of electricity on such terms and conditions, including tariff, as may be agreed upon by them. While making regulations for open access in distribution, the SERCs will also determine wheeling charges and cross-subsidy surcharge as required under section 42 of the Act.*

- Clause 5.4.7: *One of the key provisions of the Act on competition in distribution is the concept of multiple licensees in the same area of supply through their independent distribution systems. State Governments have full flexibility in carving out distribution zones while restructuring the Government utilities. For grant of second and subsequent distribution licence within the area of an incumbent distribution licensee, a revenue district, a Municipal Council for a smaller urban area or a Municipal Corporation for a larger urban area as* *defined in the Article 243(Q) of Constitution of India (74th Amendment) may be considered as the minimum area. The Government of India would notify within three months, the requirements for compliance by applicant for second and subsequent distribution licence as envisaged in Section 14 of the Act. With a view to provide benefits of competition to all section of consumers, the second and subsequent licensee for distribution in the same area shall have obligation to supply to all consumers in accordance with provisions of section 43 of the Electricity Act 2003. The SERCs are required to regulate the tariff including connection charges to be recovered by a distribution licensee under the provisions of the Act. This will ensure that second distribution licensee does not resort to cherry picking by demanding unreasonable connection charges from consumers.*

- *Clause 5.12.2: The Electricity Act 2003 provides that co-generation and generation of electricity from non-conventional sources would be promoted by the SERCs by providing suitable measures for connectivity with grid and sale of electricity to any person and also by specifying, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee. Such percentage for purchase of power from non-conventional sources should be made applicable for the tariffs to be determined by the SERCs at the earliest. Progressively the share of electricity from non-conventional sources would need to be increased as prescribed by State Electricity Regulatory Commissions. Such purchase by distribution companies shall be through competitive bidding process. Considering the fact that it will take some time before non-conventional technologies compete, in terms of cost, with conventional sources, the Commission may determine an appropriate differential in prices to promote these technologies.*

- *Clause 5.12.3: Industries in which both process heat and electricity are needed are well suited for cogeneration of electricity. A significant potential for cogeneration exists in the country, particularly in the sugar industry. SERCs may promote arrangements between the co-generator and the concerned distribution licensee for purchase of surplus power from such plants. Cogeneration system also needs to be encouraged in the overall interest of energy efficiency and also grid stability.*

- *Clause 5.13.3: It is advised that all State Commissions should formulate the guidelines regarding setting up of grievance redressal forum by the licensees as also the regulations regarding the Ombudsman and also appoint/designate the Ombudsman within six months.*

Appendix 4.2

Relevant Tariff Policy clauses

- ***Clause 8.5:*** *Cross-subsidy surcharge and additional surcharge for open access*

  8.5.1 National Electricity Policy lays down that the amount of cross-subsidy surcharge and the additional surcharge to be levied from consumers who are permitted open access should not be so onerous that it eliminates competition which is intended to be fostered in generation and supply of power directly to the consumers through open access.

  …………………………

  Surcharge formula:

  $S = T – [C (1+ L / 100) + D]$

  Where

  S is the surcharge

  T is the Tariff payable by the relevant category of consumers;

  C is the Weighted average cost of power purchase of top 5% at the margin excluding liquid fuel based generation and renewable power

  D is the Wheeling charge

  L is the system Losses for the applicable voltage level, expressed as a percentage.

  The cross-subsidy surcharge should be brought down progressively and, as far as possible, at a linear rate to a maximum of 20% of its opening level by the year 2010-11.

- ***Clause 9.0: Trading Margin:*** *The Act provides that the Appropriate Commission may fix the trading margin, if considered necessary. Though there is a need to promote trading in electricity for making the markets competitive, the Appropriate Commission should monitor the trading transactions continuously and ensure that the electricity traders do not indulge in profiteering in situation of power shortages. Fixing of trading margin should be resorted to for achieving this objective.*

Appendix 4.3

Statutory provisions with respect to open access

The Electricity Act 2003 in force from 10th June 2003 has the following provisions with respect to open access.

i. Section 2 (47) defines open access as '*the non-discriminatory provision for the use of transmission lines or distribution system or associated facilities with such lines or system by any licensee or consumer or a person engaged in generation in accordance with the regulations specified by the Appropriate Commission*'.

ii. Section 9 (2) states that '*Every person, who has constructed a captive generating plant and maintains and operates such plant, shall have the right to open access for the purposes of carrying electricity from his captive generating plant to the destination of his use:*

Provided that such open access shall be subject to availability of adequate transmission facility and such availability of transmission facility shall be determined by the Central Transmission Utility or the State Transmission Utility, as the case may be:

Provided further that any dispute regarding the availability of transmission facility shall be adjudicated upon by the Appropriate Commission'.

iii. Section 38 (2) (d) lists the functions of the Central Transmission Utility (CTU) '*to provide non-discriminatory open access to its transmission system for use by-*

any licensee or generating company on payment of the transmission charges; or

any consumer as and when such open access is provided by the State Commission under sub-section (2) of section 42, on payment of the transmission charges and a surcharge thereon, as may be specified by the Central Commission:

Provided that such surcharge shall be utilised for the purpose of meeting the requirement of current level cross-subsidy:

Provided further that such surcharge and cross subsidies shall be progressively reduced in the manner as may be specified by the Central Commission:

Provided also that the manner of payment and utilisation of the surcharge shall be specified by the Central Commission:

Provided also that such surcharge shall not be leviable in case open access is provided to a person who has established a captive generating plant for carrying the electricity to the destination of his own use.'

iv. Similar provision as above exists in section 39 (2) (d) and 40 (c) respectively for State Transmission Utilities (STUs) and transmission licensees with Central Commission replaced by State Commission/Appropriate Commission.

v. Section 42 (2) with respect to distribution licensees states that *'The State Commission shall introduce open access in such phases and subject to such conditions, (including the cross subsidies, and other operational constraints) as may be specified within one year of the appointed date by it and in specifying the extent of open access in successive phases and in determining the charges for wheeling, it shall have due regard to all relevant factors including such cross subsidies, and other operational constraints:*

Provided that 1[such open access shall be allowed on payment of a surcharge] in addition to the charges for wheeling as may be determined by the State Commission:

Provided further that such surcharge shall be utilised to meet the requirements of current level of cross subsidy within the area of supply of the distribution licensee :

Provided also that such surcharge and cross subsidies shall be progressively reduced in the manner as may be specified by the State Commission:

Provided also that such surcharge shall not be leviable in case open access is provided to a person who has established a captive generating plant for carrying the electricity to the destination of his own use:

[Provided also that the State Commission shall, not later than five years from the date of commencement of the Electricity (Amendment) Act, 2003, by regulations, provide such open access to all consumers who require a supply of electricity where the maximum power to be made available at any time exceeds one megawatt.]'

vi. Section 42 (3) states that *'Where any person, whose premises are situated within the area of supply of a distribution licensee, (not being a local authority engaged in the business of distribution of electricity before the appointed date) requires a supply of electricity from a generating company or any licensee other than such distribution licensee, such person may, by notice, require the distribution licensee for wheeling such electricity in accordance with regulations made by the State Commission and the duties of the distribution licensee with respect to such supply shall be of a common carrier providing non-discriminatory open access.'*

vii. Section 42 (4) states that *'Where the State Commission permits a consumer or class of consumers to receive supply of electricity from a person other than the distribution licensee of his area of supply, such consumer shall be liable to pay an additional surcharge on the charges of wheeling, as may be specified by the State Commission, to meet the fixed cost of such distribution licensee arising out of his obligation to supply.'*

viii. Section 49 states that *'Where the Appropriate Commission has allowed open access to certain consumers under section 42, such consumers, notwithstanding the provisions contained in clause (d) of sub-section (1) of section 62, may enter into an agreement with any person for supply or purchase of electricity on such terms and conditions (including tariff) as may be agreed upon by them.'*

ix. Section 86 describing the functions of the State Commission states that the State Commission shall ' *a) determine the tariff for generation, supply, transmission and wheeling of electricity, wholesale, bulk or retail, as the case maybe, within the State:*

Provided that where open access has been permitted to a category of consumers under section 42, the State Commission shall determine only the wheeling charges and surcharge thereon, if any, for the said category of consumers;'

The National Electricity Policy (NEP) issued on 12th February 2005 has the following provisions with respect to open access.

i. Section 5.2.26 states as under:

A large number of captive and standby generating stations in India have surplus capacity that could be supplied to the grid continuously or during certain time periods. These plants offer a sizeable and potentially competitive capacity that could be harnessed for meeting demand for power. Under the Act, captive generators have access to licensees and would get access to consumers who are allowed open access. Grid inter-connections for captive generators shall be facilitated as per section 30 of the Act. This should be done on priority basis to enable captive generation to become available as distributed generation along the grid. Towards this end, non-conventional energy sources including co-generation could also play a role. Appropriate commercial arrangements would need to be instituted between licensees and the captive generators for harnessing of spare capacity energy from captive power plants. The appropriate Regulatory Commission shall exercise regulatory oversight on such commercial arrangements between captive generators and licensees and determine tariffs when a licensee is the off-taker of power from captive plant.

ii. Section 5.3.2 states that '*Network expansion should be planned and implemented keeping in view the anticipated transmission needs that would be incident on the system in the open access regime. Prior agreement with the beneficiaries would not be a pre-condition for network expansion. CTU/STU should undertake network expansion after identifying the requirements in consultation with stakeholders and taking up the execution after due regulatory approvals.'*

iii. Section 5.3.3 states that '*Open access in transmission has been introduced to promote competition amongst the generating companies who can now sell to different distribution licensees across the country. This should lead to availability of cheaper power. The Act mandates non-discriminatory open access in transmission from the very beginning. When open access to distribution networks is introduced by the respective State Commissions for* *enabling bulk consumers to buy directly from competing generators, competition in the market would increase the availability of cheaper and reliable power supply. The Regulatory Commissions need to provide facilitative framework for non-discriminatory open access. This requires load dispatch facilities with state-of-the art communication and data acquisition capability on a real time basis. While this is the case currently at the regional load dispatch centers, appropriate State Commissions must ensure that matching facilities with technology upgrades are provided at the State level, where necessary and realized not later than June 2006.'*

iv. Section 5.3.4 states that '*The Act prohibits the State transmission utilities/transmission licensees from engaging in trading in electricity. Power purchase agreements (PPAs) with the generating companies would need to be suitably assigned to the Distribution Companies, subject to mutual agreement. To the extent necessary, such assignments can be done in a manner to take care of different load profiles of the Distribution Companies. Non-discriminatory open access shall be provided to competing generators supplying power to licensees upon payment of transmission charge to be determined by the appropriate Commission. The appropriate Commissions shall establish such transmission charges no later than June 2005.'*

v. Section 5.3.6 states that '*The necessary regulatory framework for providing non-discriminatory open access in transmission as mandated in the Electricity Act 2003 is essential for signalling efficient choice in locating generation capacity and for encouraging trading in electricity for optimum utilization of generation resources and consequently for reducing the cost of supply.'*

vi. Section 5.4.2 states that *'The Act provides for a robust regulatory framework for distribution licensees to safeguard consumer interests. It also creates a competitive framework for the distribution business, offering options to consumers, through the concepts of open access and multiple licensees in the same area of supply.'*

vii. Section 5.4.5 states that *'The Electricity Act 2003 enables competing generating companies and trading licensees, besides the area distribution licensees, to sell electricity to consumers when open access in distribution is introduced by the State Electricity Regulatory Commissions. As required by the Act, the SERCs shall notify regulations by June 2005 that would enable open access to distribution networks in terms of sub-section 2 of section 42 which stipulates that such open access would be allowed, not later than five years from 27th January 2004 to consumers who require a supply of electricity where the maximum power to be made available at any time exceeds one mega watt. Section 49 of the Act provides that such consumers who have been allowed open access under section 42 may enter into agreement with any person for supply of electricity on such terms and conditions, including tariff, as may be agreed upon by them. While making regulations for open access in distribution, the SERCs will also determine wheeling charges and cross-subsidy surcharge as required under section 42 of the Act.'*

viii. Section 5.7.1 (c) states that *'Captive generating plants should be permitted to sell electricity to licensees and consumers when they are allowed open access by SERCs under section 42 of the Act.'*

ix. Section 5.8.3 states *'Under sub-section (2) of Section 42 of the Act, a surcharge is to be levied by the respective State Commissions on consumers switching to alternate supplies under open access. This is to compensate the host distribution licensee serving such consumers who are permitted open access under section 42(2), for loss of the cross-subsidy element built into the tariff of such consumers. An additional surcharge may also be levied under sub-section (4) of Section 42 for meeting the fixed cost of the distribution licensee arising out of his obligation to supply in cases where consumers are allowed open access. The amount of surcharge and additional surcharge levied from consumers who are permitted open access should not become so onerous that it eliminates competition that is intended to be fostered in generation and supply of power directly to consumers through the provision of Open Access under Section 42(2) of the Act. Further it is essential that the Surcharge be reduced progressively in step with the reduction of cross-subsidies as foreseen in Section 42(2) of the Electricity Act 2003.'*

The Tariff Policy in force from 6th January 2006 has the following provisions with respect to open access.

i. Section 5.5 states that '*Though, as per the provisions of the Act, the outer limit to introduce open access in distribution is 27.1.2009, it would be desirable that, in whichever states the situation so permits, the Regulatory Commissions introduce such open access earlier than this deadline.'*

ii. Section 6.3 states that '*Grid connected captive plants could also supply power to non-captive users connected to the grid through available transmission facilities based on negotiated tariffs. Such sale of electricity would be subject to relevant regulations for open access.'*

iii. Section 8.5 deals with the provisions of cross subsidy surcharge and additional surcharge for open access as under:

'8.5 Cross-subsidy surcharge and additional surcharge for open access

8.5.1 National Electricity Policy lays down that the amount of cross-subsidy surcharge and the additional surcharge to be levied from consumers who are permitted open access should not be so onerous that it eliminates competition which is intended to be fostered in generation and supply of power directly to the consumers through open access.

A consumer who is permitted open access will have to make payment to the generator, the transmission licensee whose transmission systems are used, distribution utility for the wheeling charges and, in addition, the cross subsidy surcharge. The computation of cross subsidy surcharge, therefore, needs to be done in a manner that while it compensates the distribution licensee, it does not constrain introduction of competition through open access. A *consumer would avail of open access only if the payment of all the charges leads to a benefit to him. While the interest of distribution licensee needs to be protected it would be essential that this provision of the Act, which requires the open access to be introduced in a time-bound manner, is used to bring about competition in the larger interest of consumers.*

Accordingly, when open access is allowed the surcharge for the purpose of sections 38,39,40 and sub-section 2 of section 42 would be computed as the difference between (i) the tariff applicable to the relevant category of consumers and (ii) the cost of the distribution licensee to supply electricity to the consumers of the applicable class. In case of a consumer opting for open access, the distribution licensee could be in a position to discontinue purchase of power at the margin in the merit order. Accordingly, the cost of supply to the consumer for this purpose may be computed as the aggregate of (a) the weighted average of power purchase costs (inclusive of fixed and variable charges) of top 5% power at the margin, excluding liquid fuel based generation, in the merit order approved by the SERC adjusted for average loss compensation of the relevant voltage level and (b) the distribution charges determined on the principles as laid down for intra-state transmission charges.

Surcharge formula:

$$S = T – [C (1+ L / 100) + D]$$

Where

S is the surcharge

T is the Tariff payable by the relevant category of consumers;

C is the Weighted average cost of power purchase of top 5% at the margin excluding liquid fuel based generation and renewable power

D is the Wheeling charge

L is the system Losses for the applicable voltage level, expressed as a percentage

The cross-subsidy surcharge should be brought down progressively and, as far as possible, at a linear rate to a maximum of 20% of its opening level by the year 2010-11.

8.5.2 No surcharge would be required to be paid in terms of sub-section (2) of Section 42 of the Act on the electricity being sold by the generating companies with consent of the competent government under Section 43(A)(1)(c) of the Electricity Act, 1948 (now repealed) and on the electricity being supplied by the distribution licensee on the authorisation by the State Government under Section 27 of the Indian Electricity Act, 1910 (now repealed), till the current validity of such consent or authorisations.

8.5.3 The surcharge may be collected either by the distribution licensee, the transmission licensee, the STU or the CTU, depending on whose facilities are used by the consumer for availing electricity supplies. In all cases the amounts collected from a particular consumer should be given to the distribution licensee in whose area the consumer is located. In case of two licensees supplying in the same area the licensee from whom the consumer was availing supply shall be paid the amounts collected.

8.5.4 The additional surcharge for obligation to supply as per section 42(4) of the Act should become applicable only if it is conclusively demonstrated that the obligation of a licensee, in terms of existing power purchase commitments, has been and continues to be stranded, or there is an unavoidable obligation and incidence to bear fixed costs consequent to such a contract. The fixed costs related to network assets would be recovered through wheeling charges.

8.5.5 Wheeling charges should be determined on the basis of same principles as laid down for intra-state transmission charges and in addition would include average loss compensation of the relevant voltage level.

8.5.6 In case of outages of generator supplying to a consumer on open access, standby arrangements should be provided by the licensee on the payment of tariff for temporary connection to that consumer category as specified by the Appropriate Commission.'

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Chapter-5

DEMAND SIDE MANAGEMENT ENERGY EFFICIENCY & ENERGY CONSERVATION

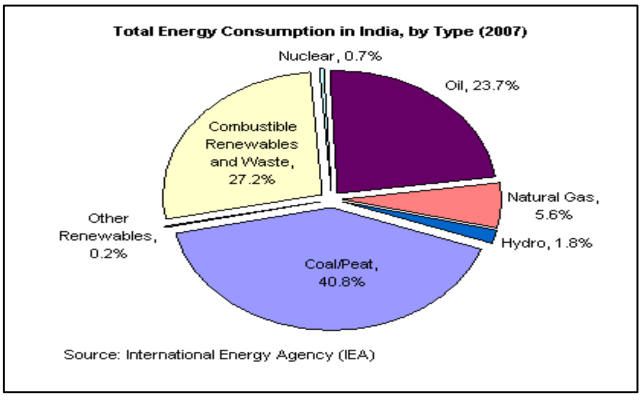
5.0 INTRODUCTION

Improving the efficiency with which energy is used to provide economic services meets the dual objectives of promoting sustainable development and of making the economy competitive. Energy Efficiency & Conservation has also assumed enhanced importance with a view to conserve depleting energy resources.

Over the past one decade energy efficiency in India has been increasing at a good trot, and energy intensity declined by about 20-25%. Yet there are places where energy efficiency opportunities continue to exist largely because of a range of market failures, information, risks and split incentives. This has led the Government of India through the Energy Conservation Act and the Bureau of Energy Efficiency to launch several programs.

The Energy Conservation Act (2001) is the most important multi-sectoral legislation in India and is intended to promote efficient use of energy in India. The Act specifies energy consumption standards for equipment and appliances, establishes and prescribes energy consumption norms and standards for designated consumers, prescribes energy conservation building code for efficient use of energy in commercial buildings, and establishes a compliance mechanism for energy consumption norms and standards .Large scale energy savings can be realized through strengthening of the existing policies, schemes as well as expanding and reaching out to new areas in the 12th Five Year Plan.

The primary energy consumption of India is 421 million tonnes of oil equivalent (mtoe) (2008; International Energy Agency 2009) which is about 3.5% of the world primary energy consumption in the year 2008. The per capita energy consumption is only 0.53 kilogram of oil equivalent (kgOE) whereas the world average is 1.82 kgOE (2008; International Energy Agency 2009). India lacks sufficient domestic energy resources and imports much of its growing energy requirements. According to the International Energy Agency (IEA), coal/peat account for nearly 40 percent of India's total energy consumption, followed by nearly 27 percent for combustible renewables and waste. Oil accounts for nearly 24 percent of total energy consumption, natural gas 6 percent, hydroelectric power almost 2 percent, nuclear nearly 1 percent, and other renewables less than 0.5 percent. About 30 percent of India's total energy needs are met through imports.



5.1 11TH FIVE YEAR PLAN – TARGETS & ACHIEVEMENTS

Bureau of Energy Efficiency (BEE) and Ministry of Power (MoP) had introduced a number of schemes during 11th Five Year Plan for promotion of energy efficiency in India. The schemes of BEE include Standards and Labeling (S&L), Energy Conservation Building Code (ECBC) & Energy Efficiency in Existing Buildings, Bachat Lamp Yojana (BLY), SDA strengthening, Energy Efficiency in Small and Medium Enterprises (SMEs), Agriculture & Municipal Demand Side Management (DSM) and Contribution to State Energy Conservation Fund (SECF).

The schemes of the Ministry of Power (MoP) include Energy Conservation Awareness, Energy Conservation Awards & Painting Competition on Energy Conservation for school students and National Mission for Enhanced Energy Efficiency (NMEEE). In the 11th Five Year Plan (2007–12), it was proposed to achieve the energy saving of 5% of the anticipated energy consumption level in the beginning of the 11th Five Year Plan.

The outcomes of these schemes are quite encouraging; various activities under different schemes of BEE and MoP have resulted in savings in avoided power capacity of 7,415 MW (verified; till Dec 2010) and 250 MW (unverified for 4th Quarter of year 2010 – 11) and 3409 MW avoided power capacity savings is projected during the last year of the 11th Five Year Plan (2011-12).

5.2 UTILITY BASED DEMAND SIDE MANAGEMENT IN THE 12TH PLAN

Demand-Side Management (DSM) is the selection, planning, and implementation of measures intended to have an influence on the demand or customer-side of the electric meter. DSM program can reduce energy costs for utilities, and in the long term, it can limit the requirement for further generation capacity augmentation and strengthening of transmission and distribution system. BEE would provide the technical assistance for establishment of DSM cells in the DISCOMs and capacity building of personnel of DSM cells for enabling them to undertake the following strategies and schemes of DSM in 12th Five Year plan:

(i) Load Survey

The questionnaire based surveys are the most commonly adopted tools to study the consumption pattern of the consumers by a utility. “Standard load survey techniques” need to be developed which may be adopted by the DISCOMs. Also it is envisaged that DISCOMs to develop utility/city level load profiles which may be uploaded on DISCOMs and BEE’s DSM website (http://www.bee-dsm.in) on a periodical basis which can be utilized for DSM plans and for further analysis.

(ii) Load Strategies

Load strategies are to be adopted by electricity utilities to modify customer load profiles and thereby reduce their peak demands. Following Load management strategies may be demonstrated by DISCOMs/Utilities:

* Demand Response

Demand Response is an effort to create additional capacity during the peak hours, by involving voluntary load curtailment by consumers during peak hours or when requested by the distribution companies. The load curtailment can be achieved through implementing load reduction by Energy Efficiency or by load shifting measures.

* Load Management Programmes

- Dynamic/Real Time Pricing: Based on real time system of supply & demand

- Time-of-Use Rates: Customers are offered different rates for electricity usage at different times of the day.
- Automated/Smart Metering: Implementing Dynamic/ Real Time Pricing or Time-of-use rate structure and billing accordingly.
- Web-based/Communication System: This is a tool used along with the above to convey to the customer about the prevailing demand, supply, prices on real time basis and the incentives and options for him, which are used by the customer to manage the demand.

(iii) Demonstration Studies

Direct installation programs that provide complete services to design, finance, and install a package of efficiency measures.

(iv) Advanced Metering

Advanced Meter has the capability of online communication, accurate measurements, local intelligence, load connect-disconnect facility and consumer friendly display unit. Adoption of this technology will help distribution companies in implementing Demand Side Management specially Demand Response Activities.

(v) DSM Financing

The strategic value of DSM measures and energy efficiency lies in their ability to improve the financial cash flow of Indian utilities.

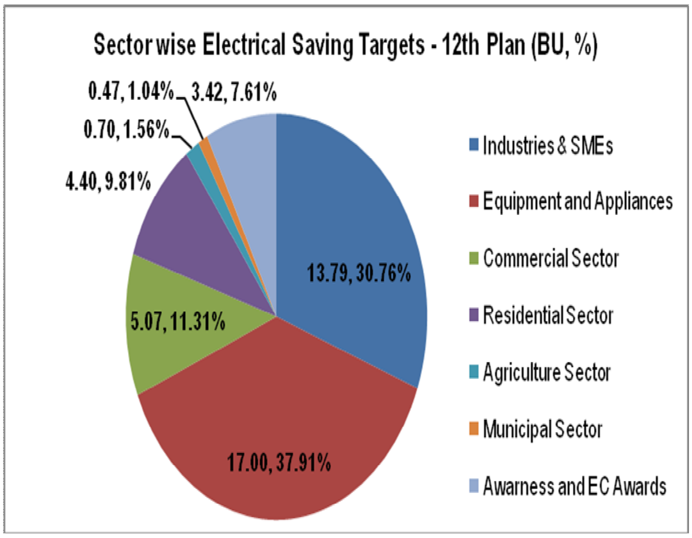
Moreover, DSM and Demand Response (DR) Activity are utilized to curtail the peak electricity demand. In other words, it helps to negate spending on generation, transmission and distribution infrastructure by curtailing the peak. Thus, it can be said that funds are freed up which would otherwise be utilized to meet the peak demand. At the National level, the load growth should be reviewed with and without DSM and the fund freed up because of lower peak growth should be used for DSM/DR activity. In other words, the DSM/DR should have a target (say 0.5% to 1%) of peak demand reduction and the net saving in infrastructure due to that should be used for DSM/DR activity.

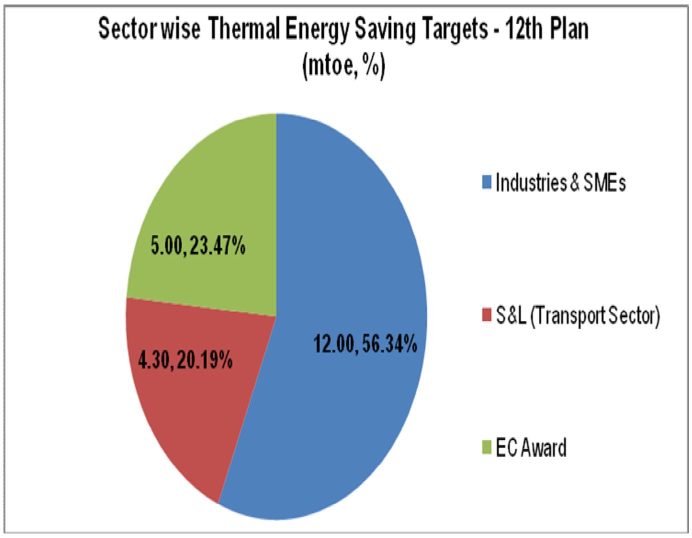
The total funds required for providing technical assistance for capacity building of DSM cells established by DISCOMs under 12th Five Year Plan is Rs. 300 crore.

5.3 ENERGY CONSERVATION STRATEGY IN THE 12TH PLAN

The strategies adopted during the 11th Five Year Plan have started showing encouraging outcomes. It is necessary to carry forward the existing schemes as well as further strengthen the activities to accelerate the process of implementation of energy efficiency measures to achieve the desired energy savings.

Further, large scale energy savings can be realized through strengthening of the schemes in industrial, commercial, residential and agriculture sectors as well as expanding and reaching out to new areas. Projected electrical energy saving potential at the end of 12th Five Year Plan i.e during the year 2016-17 is 44.85 BU on the demand side (equivalent to 60.17 BU at Bus bar) and an additional energy saving equivalent of 21.3 mtoe in the industrial sector (including Thermal Power Stations (TPS) and Small and Medium Enterprises), Transport Sector and Energy Conservation (EC) award scheme. The share of target energy saving (Electrical & Thermal) for various proposed schemes under 12th Plan is given below:





Details of the above are furnished hereunder :-

5.3.1 Strengthening State Designated Agencies

State designated agencies (SDAs) in different states need to play a very important role in terms of carrying forward various energy efficiency initiatives at the state level. The thrust of the SDA program during the 12th Plan will be on strengthening the 32 SDAs which would enable them to implement various programs and activities initiated by BEE or SDAs themselves.

In the 11th Plan, BEE supported State designated agencies (SDAs) in preparation of action plan, building institutional capacity of SDAs, to perform their regulatory, developmental and promotional functions in their respective states, by way of technical assistance, guidance and funding etc. Each SDA has been supported to develop a five year Energy Conservation Action Plan, customized to local needs aiming at and delivery of the EC act mandates.

The proposed activities for the 12th Plan include sector specific interventions in areas like municipality (drinking water and sewage treatment), agriculture sector (pumping), street lighting, commercial buildings, government buildings and waste heat recovery in SMEs including demonstration projects. Following initiatives of SDA are proposed to be supported that would help in strengthening the capacities of SDAs and undertaking of various projects and programmes to promote energy efficiency in their respective states:

- Support for implementing state-wise sector specific energy saving plan by the SDAs
- Continued engagement of SDAs with energy efficiency professionals like energy auditors, energy managers and ESCOs
- Implement various EE demonstration projects in the states to showcase the effectiveness of the most advanced energy efficient technology and pursue state governments to replicate the project in other parts of the state.
- LED village campaign in the villages and pursue state governments to replicate the project in other parts of the state.
- Publicity /awareness on EE in the states
- Workshops/ training programmes for all the stakeholders
- Capacity building programmes for the SDAs

The total funds requirement for the above proposed activities is Rs. 140 crore.

The State Energy Conservation Funds (SECF) as mandated under the Energy Conservation Act, 2001, have already been constituted in 22 states and funds have been released to 21 states during the 11th

Plan to operationalize the SECF for various energy efficiency initiatives. The state governments of Andhra Pradesh, Rajasthan, Chhattisgarh, Karnataka, Haryana, Gujarat and Mizoram have also contributed a matching grant to the SECF.

In the 12th Plan, it is proposed to set up the SECF in all the states and

- Pursue with SDAs for constitution of SECF in the states and matching contribution by the state governments to the SECF.
- Coordinate with SDAs to implement various energy conservation activities and utilization of fund under SECF.

Contribution of Rs. 70 crore to state energy conservation fund is proposed under the 12th Plan.

Total fund required for strengthening of SDAs and SECF is Rs. 210 crore.

5.3.2 Industrial Sector

The total commercial energy consumed by the industries and SMEs together stands at about 40-50% of the total commercial energy consumption in the country. In view of continuing growth of industry sector, the proportion of commercial energy consumed by industry is envisaged to be around 40-45% in the next five-year plan also.

(a) Large Industries (Designated Consumers)

The projected energy saving potential in the 12th Plan is 11.43 mtoe which consists of a saving of 6.2 mtoe from the seven energy intensive industries (DCs) and 5.23 mtoe from thermal power stations sector. The total energy saving per year during 2011-12 to2016-17 for 7 DC sectors is calculated on the basis of 1.2% p.a. of the total energy consumed and at 1% p.a. of the total energy consumed for the Thermal Power Plant sector during the 12th Plan period.

With the above assumptions, the extrapolation is also made further to see the expected energy saving in 2019-20 in 7 Industrial Sectors. The projected energy savings stand at 10.03 mtoe and 11.53 BU in thermal and electrical energy respectively in 2019-20.

The tabular and graphical representation of projected energy consumption trend (electrical and thermal) and saving targets in 7 industrial sectors (Designated Consumers) is given in below.

The details of projected energy consumption trend (electrical and thermal) and saving targets in 7 industrial sectors (Designated Consumers) are given in below.

Table 5.1

Energy consumption and saving projection in 7 Industrial Sectors (DCs)

Particulars/Years	***2012-13***	***2013-14***	***2014-15***	***2015-16***	***2016-17***	***2017-18***	***2018-19***	***2019-20***
Electrical Energy Consumption, BU	94.80	101.02	107.68	114.92	**122.68**	131.00	139.94	**149.53**
Thermal Energy Consumption, mtoe	82.44	87.84	93.63	99.93	**106.68**	113.91	121.69	**130.02**
Electrical Energy Saving, BU	1.14	2.35	3.64	5.02	**6.50**	8.07	9.74	**11.53**
Thermal Energy Saving, mtoe	0.99	2.05	3.17	4.37	**5.65**	7.02	8.47	**10.03**

The instruments to achieve the projected savings in 12th Plan in DCs and other industries are:

- **Continuation of on-going Schemes/Programs by Bureau of Energy Efficiency and Ministry of Power**
  - ***National Energy Conservation Award -*** Many industries have taken up a number of energy saving initiatives through voluntary energy audits. In the national EC awards, it has been

observed that energy saving to the tune of 1 % per annum has been achieved by participating units during the last 4 years. The scheme is proposed to be continued in the 12th Plan and its base will be widened. The anticipated savings in the year 2016-17 of the 12th Plan (for non PAT sector) are 3.42 BU and 5 mtoe as electricity and thermal energy respectively.

- ***Notification of Energy Intensive Sectors as Designated Consumers (DC)-*** After the notification of Designated Consumers (DC) among selected industrial sectors, more concerted efforts have been put forward in achieving energy savings through adoption of exclusive energy management policies, creation of a separate EC cell and improvement in energy monitoring and accounting system. All the sectors covered in the Schedule to EC Act are proposed to be covered as Designated Consumers.

- ***Enhanced Capacity Building of Energy Management Professionals (National Certification Examination for EA/EM) -*** Enrolment & success in National certification examination for Energy Managers / Auditors from industries has been growing at a healthy rate. BEE has taken a pro-active role in establishing a proper energy management system in the country. In this context, BEE has successfully conducted 11 National Certification Examinations across the country till 2010-11. After 11th Examination, 8525 persons have qualified as energy managers out of which 6091 have also qualified as energy auditors. The National Certification of EA & EM will continue in the 12th Plan and refresher training courses for qualified candidates will be taken up to further strengthen their knowledge base.

- **Implementation of Perform, Achieve & Trade (PAT) Scheme** - As per the EC act, 2001, the central government in consultation with BEE has identified a list of energy intensive industries and other establishments. The Perform, Achieve & Trade (PAT) mechanism is a market based mechanism to enhance cost effectiveness of improvements in energy efficiency in 8 energy intensive industries (including TPS) through certification of energy saving which can be traded. The scheme is expecting an energy saving of 3.5 million tons of oil equivalent (mtoe) in seven selective industrial sectors and 3.1 million tons of oil equivalents in Thermal Power Stations by 2014-15.

The following points describe the vision for PAT scheme during 2012-2017.

- *Implementation of 1st Cycle of PAT to achieve the set target of 6.6 mtoe by 2014-15*
- *Widening and Deepening the Scope of PAT during the 2nd Cycle of PAT by including other energy intensive sectors like Refineries, Chemicals, Petrochemicals, Automobile manufacturing, Sugar, Glass etc. in the scheme and reducing the threshold energy consumption limit of existing sectors to bring in additional industries.*
- *Accelerate the Implementation of ISO 50001 to promote benchmarking of Energy Management system in Industries and facilities*
- ***Implementation of Frame work for Energy Efficient Economic Development** - Fiscal instruments like Partial Risk Guarantee Fund (PRGF) and Venture Capital Fund for Energy Efficiency (VCFEE) have already been proposed in NMEEE for successful implementation of PAT scheme.*
- ***Getting support from National Clean Energy Fund (NCEF)** - In order to achieve the target in PAT scheme, the industry has to look for newer technology, Renovation & Modernization (R&M), adoption of clean energy and efficient energy management systems. BEE proposes a 3% interest subsidy scheme for adoption of energy efficient technologies by Designated Consumers in 7 sectors under PAT scheme.*
- ***Facilitation for Need for R&D in NMEEE / PAT Scheme** - Major R&D program may be initiated in selective areas and selective sectors for developing new customized energy efficient technology through indigenous development of applications of already available energy efficient technologies/concepts. It is proposed that a need based framework for research in industrial*

energy efficiency may be undertaken, centres of excellence may be established and improving the industry-institute-interaction at state level.

The total projected saving in the year 2016-17 i.e end of 12th Five Year Plan is of the tune of 11.43 mtoe in which 10.41 mtoe is contributed by thermal energy. The rest, which is equivalent to 11.96 BU of electricity saving is estimated at bus-bar in 2016-17. The fund requirement is Rs. 190 crore to support the proposed PAT schemes.

The total funds requirement for Industrial Sector (excluding SMEs) under the 12th Five year plan is Rs. 3767 Crore.

(b) Small & Medium Enterprises

The MSME sector is an important constituent of the Indian economy, contributing significantly in GDP, manufacturing output and export. Similarly this sector also plays a significant role in energy consumption which is about 25% of the total energy consumption by industrial sector. In the 12th Five Year Plan, BEE would target the SME sector for reduction in energy consumption by 5.75% of the energy used in the energy intensive manufacturing SMEs which is equivalent to 1.75 mtoe. The targeted goal is proposed to be achieved by introducing innovative business models and financial instruments (like Venture Capital Fund/Revolving Fund, Partial Risk Guarantee Fund). The proposed schemes/activities to be undertaken in 12th Plan are as mentioned below:

- Sector specific approach for energy efficiency and technology upgradation through facilitation of implementation of DPRs
- Energy mapping of the targeted SME Sector on all India basis
- Undertaking of Innovative Financial Schemes for adoption of EE Technologies in the SMEs
- Technical assistance and capacity building
- SMEs Product Labelling Promotion Scheme

The approach would be based on the replication of results and findings from the 11th Plan. This would include implementation of DPRs on energy efficient technologies and development of Local /technologies Service Providers for SMEs, capacity building of stakeholders including bankers /FIs and strategic approach for dissemination of results. The strategy will be to move from cluster based approach to sector based approach to enable large degree implementation in the sectors selected under the 11th Five Year Plan. The details of projected energy consumption trend (electrical and thermal) and saving targets in energy intensive SMEs are given in below.

Table: 5.2

Energy consumption and saving projection in energy intensive SMEs

Particulars/Years	***2012-13***	***2013-14***	***2014-15***	***2015-16***	***2016-17***	***2017-18***	***2018-19***	***2019-20***
Electrical Energy Consumption, BU	41.2	44.0	47.0	50.1	**53.5**	57.2	61.1	**65.2**
Thermal Energy Consumption, mtoe	20.06	21.42	22.88	24.44	**26.10**	27.87	29.76	**31.78**
Thermal Energy Saving, mtoe	0.06	0.24	0.63	1.06	1.59	2.16	2.76	**3.40**
Electrical Energy Saving, BU	0.07	0.27	0.72	1.22	**1.83**	2.48	3.18	**3.91**

The projected saving in the year 2016-7 of 12th Five Year Plan is 1.75 mtoe in which 1.59 mtoe is thermal energy and rest is equivalent to the 1.83 BU of electricity with the financial budget requirement of Rs. 55 crore. In addition to this, Rs. 400 crore is also proposed for setting-up of Revolving fund and partial risk guarantee fund.

The total funds requirement for SMEs under the 12^{th} plan is Rs. 455 Crore.

5.3.3 Equipment and Appliances

(a) Standard & Labeling (S&L) Programme

During the 11^{th} Plan, under this scheme, a large number of appliances were covered initially under the voluntary labeling categories, out of which four appliances/equipment are under the mandatory labeling program. The S&L Program was quite successful during the 11^{th} Plan period and has contributed to the savings in avoided capacity addition of 4,898 MW upto 31^{st} March 2011. It is anticipated that by the end of the 11^{th} plan, total savings in avoided capacity addition would be 7,315 MW.

The 11^{th} Plan has already envisaged completion of 21 appliances under S&L programme and the 12^{th} Plan also envisage similar numbers. However, data on some of the appliances/equipments such as chillers, pumps, data centres, furnaces, boilers, desert coolers, laptop chargers, deep freezers etc. is not available and is planned to be collected through baseline survey.

The proposed activities in 12^{th} Five Year Plan under S&L for equipments and appliances include:

- Inclusion of at least 5 selected new equipment and appliances (selection is to be made from the list provided in the table given below). Standby power loss reduction in few of the electrical appliances will also be focussed in the 12^{th} Plan.
- Awareness creation among all the stakeholders,
- Undertaking of check testing, label verification, market impact assessment for appliances/ equipments covered under S&L scheme and
- Up-gradation of energy performance standards for equipment/ appliances covered during 11^{th} Plan.

The equipments/appliances which are to be undertaken for up-gradation of energy performance standards covered during 11th Plan and inclusion of selected new appliances in 12th Five Year Plan is given in table below;

Table: 5.3

List of the Equipment & Appliances under S&L during 12^{th} Plan

No. of Individual Appliances	Appliances	Appliances Category
1	Room Air Conditioner	
2	Refrigerator (Direct cool & Frost Free)	
3	Ceiling Fan	**Fans**
4	Exhaust / Table Fan	
5	Colour TV	**Entertainments Gadgets**
6	Set-top Box	
7	Music System	
8	Distribution Transformer	
9	Storage water heaters	
10-15	Office Automation Products (Printer, Scanner, Fax Machine, Photocopier, MFD)	
16	Laptop	**Computer and Accessories**
17	Desktop Computer	
18	Computer Monitors	

No. of Individual Appliances	Appliances	Appliances Category
19	Server / Data centres	
20-22	Power Back-up Systems (Inverter, UPS, Inverter Battery)	
23	Router /Modem	
24	Fluorescent tube light	**Lighting**
25	Ballast	
26	LED	
27	Voltage Stabilizer	
28	Drinking Water Coolers	
29	Microwave Ovens	
30	Tea / Coffee Vending Machine	

The energy saving projection in 12th Five Year Plan for the refrigerator and room air conditioner which dominate the electricity consumption in the domestic and commercial sectors is represented in the table and figure that follow:

Table: 5.4

Sales and energy saving targets for Refrigerator and Air-conditioners

Appliances	***Refrigerators (FF & DC)***			***Room Air-Conditioners***		
Year	Total Sales, MU/Year	Sales of S&L Refrigerators, MU/Years	Energy Saving , BU	Total Sales, MU/Year	Sales of S&L RAC, MU/Years	Energy Saving , BU
2012-13	11.02	11.02	0.19	4.93	4.93	0.44
2013-14	11.69	11.69	0.39	5.52	5.52	0.93
2014-15	12.39	12.39	0.60	6.18	6.18	1.48
2015-16	13.13	13.13	0.83	6.92	6.92	2.09
2016-17	**13.92**	**13.92**	**1.07**	***7.75***	***7.75***	***2.78***
2017-18	14.75	14.75	1.32	8.68	8.68	3.55
2018-19	15.64	15.64	1.59	9.73	9.73	4.42
2019-20	**16.58**	**16.58**	**1.88**	**10.89**	**10.89**	**5.38**

S&L for Transport Sector

There are total 13.3 million passenger cars (2010 – 11) in India which consume about 9 mtoe. The average annual sales of new passenger cars in the country are about 1.1 million. Under the labeling scheme, the following activities are proposed

- Introduction of fuel economy norms effective from 1st year of 12th Plan,
- Technical study for 2 & 3 wheelers and commercial vehicles (Truck & Buses) to finalise S&L programme

The targeted energy saving by the end of the 12th Five Year Plan is 4.**3** mtoe.

Based on the above proposed schemes, fund requirement of Rs. 183 crores have been envisaged for the Standard & Labeling programme for the 12th Plan. Based on the above investment, the likely saving from the S&L scheme in the year 2016-17 is estimated to be 10.4 BU of electrical energy and 4.3 mtoe of thermal energy. The proposed savings are based on the baseline data of 2006-07 on which basis the energy savings have been assessed.

(b) Super Efficient Equipment Program (SEEP)

SEEP is a part of Market Transformation for Energy Efficiency (MTEE) initiative, one of the four initiatives of the National Mission on Enhanced Energy Efficiency (NMEEE). The primary objective of MTEE is to accelerate the shift to energy efficient appliances through innovative measures to make the products more affordable. NMEEE seeks to achieve annual savings of 19,598 MW of power and 23 million tonnes of fuel and greenhouse gas emissions reduction of 98.55 million tonnes. The mission is one of the eight mission under the Prime Minister's National Action Plan on Climate Change (NAPCC). BEE is the mission implementing agency for NMEEE.

This programme proposes to deal directly with the manufacturers of select key appliances. Usually, only a handful of manufacturers account for 70 to 90% of the market share of these appliances. SEEP would compensate the manufacturers for a major part of the incremental cost of producing Super Efficient Appliances (SEAs), and encourage them to not just produce but also sell SEAs at an affordable price to common consumers. The need for incentive is expected to reduce very fast as volumes pick up.

In this manner, the programme would help to introduce appliances that are far more efficient than the ones currently available in India thus, narrowing the massive gap between the efficiency of the average purchase and that of the most efficient technology available internationally.

Super efficient appliances (SEA) may consume 30 to 50 percentages less energy than the five star rated equipments of BEE. SEAs will have their high first cost which can be decreased by large scale production facilities, but due to uncertainty of market demand, manufacturers feel reluctant to make the initial investment to change production lines for super efficient appliances. This barrier needs to be removed by innovative policy interventions.

BEE has already announced the SEEP for ceiling fans, and has initiated a dialogue with manufacturers on setting the technical specification, monitoring process etc. SEEP would also be extended to LED Tube lights & LED bulbs. Financial incentives of Rs 244 crore per year would be required (depending on the market situation and technical preparation).

The ceiling fan market will undergo a significant transformation because of the SEEP intervention. It is expected that 26.86 million SEA ceiling fans will be sold in 12th Plan which will provide savings of 2.2 billion units in the year 2016-17 of 12th five year Plan.

Estimated market of Tube Fluorescent Lamp (TFL) in terms of lighting points shall be about 270 million in 2016-17. With an incentive pattern under SEEP, it is assumed that about 33.96 million lighting points would get converted from conventional lighting to LEDs lighting points giving a saving of around 10 -12 Watt per lighting point. The savings the year 2016-17 of 12th five year Plan from sales of 33.96 million LED TL would be around 0.91 billion units.

Further, currently both in the S&L and SEEP programme, no intervention in the bulb market was envisaged, although, BLY scheme considers the replacement of inefficient incandescent lamps (bulb) by CFL. The new emergent technology under SEEP through LEDs bulb (replacement of 60 W incandescent bulbs with 8-12 Watt LED bulb) would give large savings about 70-80%. The saving in the year 2016-17 of 12th five year Plan from sales of 33.96 million LED bulbs would be around 3.42 billion units.

The details of sales (total sales of appliances and sales of SEAs) and energy saving is given in the table that follows (base year 2012-13):

Table: 5.5

Sales and energy saving targets for SEEP Appliances

Appliances	*Ceiling Fans*			*Tube Light*			*Bulb*		
Year	Total Sales, MU/Year	Sales of SEA (Fan), MU/Years	Energy Saving , BU (TWh)	Total Sales[1], MU/Year	Sales of SEA (LED TL), MU/Years	Energy Saving BU (TWh)	Sales, MU/Year	Sales of SEA (LED Bulb), MU/Years	Energy Saving BU (TWh)
2012-13	36.75	0.00	0.00	41.0	0	0.00	665.0	0.000	0.00
2013-14	38.59	2.32	0.19	49.6	0	0.00	678.3	0.000	0.00
2014-15	40.52	4.86	0.59	54.6	5.46	0.15	691.9	5.460	0.55
2015-16	42.54	8.51	1.30	60.0	12	0.47	705.7	12.000	1.76
2016-17	44.67	11.17	2.22	66.0	16.5	0.91	719.9	16.500	3.42
2017-18	46.90	23.45	4.17	72.6	29.04	1.69	734.3	29.040	6.35
2018-19	49.25	24.62	6.20	79.9	39.95	2.77	748.9	39.950	10.38
2019-20	51.71	25.86	8.34	87.9	52.74	4.18	763.9	52.740	15.69

The energy saved from appliances under SEEP is about 6.6 BU in the year 2016-17. The financial support required for the proposed activities is Rs. 1470 crores which includes Rs. 250 crore for capacity building and creating awareness regarding S&L and SEEP.

5.3.4 Commercial Sector

Energy Conservation Building Code & Energy Efficiency in Existing Buildings

To set the minimum energy performance standards for new commercial buildings, having connected load of 100 kW and above, as well as to promote energy efficiency in the existing buildings through retrofitting, Energy Conservation Building Code (ECBC) was launched during the 11th Plan. Rajasthan and Orissa have notified ECBC and three other states (, Kerala and Uttrakhand) are in the process of notification. Star labelling programme (Voluntary) for day use office buildings, BPOs and Shopping complexes have been developed and 123 buildings have been awarded energy star ratings label.

The draft report on “Low Carbon Strategies for Inclusive Growth” indicates that by mandating ECBC for new commercial complexes and energy audits in existing buildings, 75 % of new commercial buildings constructed during the 12th Plan would be compliant to the ECBC. Similarly, 20% of existing buildings would reduce their present energy consumption by 20% through energy audits & retrofits. Consequently, the estimated savings in energy use in new and existing buildings over the Business As Usual (BAU) scenario is likely to be 5.07 BU.

BEE would assist both central and state government agencies in undertaking energy audits and promoting implementation of energy efficient measures. For the performance contracting route, BEE would assist in the development of standard documents for performance contracting and monitoring & verification protocols for carrying out retrofits through ESCO mode.

The projected energy saving at the end of the 12th Five Year Plan i.e. 2016-17 is 5.07 BU with the financial budget requirements of Rs. 65 crore.

[1] *Projected from the sales figure of BEE star labeled TFLs of 2009-10*

5.3.5 Residential Sector

Bachat Lamp Yojana

The residential sector accounts for 25.87 percent of the electricity demand in the country. The lighting load comprises of 28% of this electricity demand in the residential sector and contributes almost fully to the peak load as well. To promote the penetration of energy saving CFLs in the residential sector, BEE has developed the "Bachat Lamp Yojana" (BLY) Scheme. Under the BLY scheme, a maximum of 4 nos. long-life, quality CFL would be distributed by the CFL supplier to the grid-connected residential households in exchange of equivalent no. of incandescent lamp (ICL) and Rs. 15 per CFL. The savings in electricity that would mitigate GHG emissions will be leveraged in the international market by the CFL supplier under the Clean Development Mechanism (CDM) of the Kyoto Protocol.

Three types of ICL lamp wattages commonly in use viz. 40 W, 60 W and 100 W are likely for replacement under the BLY scheme. This Bachat lamp Yojana Scheme is registered as Programme of Activities (PoA) with the CDM executive board to reduce the transaction cost associated with CDM. The project brings together the three key players, namely BEE, the Electricity Distribution Companies (DISCOMs) and investors to supply the households with CFLs. To bridge the cost differential between the market price of the CFLs and the price at which they are distributed to households, the Clean Development Mechanism (CDM) is harnessed. The CFL supplier (Investor) would cover the project cost through the sale of greenhouse gas (GHG) emission reductions achieved in their respective project areas.

BEE, the Coordinating and Managing Entity (CME) will have to keep a functionary to handle the various documentation and protocols required by the UNFCCC (United Nations framework Convention for Climate Change) and the PoA. Further to facilitate the implementation of BLY projects and CFL distribution, this functionary will have to continuously engage with the State Electricity Distribution Companies and CFL suppliers. The database management of the BLY projects and Capacity building of State Electricity Distribution Companies and CFL suppliers along with BEE functionary will be the key focus areas in 12th Plan.

In 12th Five Year Plan, activities proposed to be undertaken are: strengthen the on-going BLY scheme by continued engagement with the state electricity distribution companies and streamlining and sustaining operations-mainly database management, data security, BLY system audit, PoA updation & re-validation, and CDM Project Activities (CPA).

The projected electricity saving at the end of 12th Plan is i.e. 2016-17 about 4.4 BU with the financial budget requirement of Rs. 6 crore.

5.3.6 Agriculture Sector

Agriculture DSM (Ag DSM)

Electricity consumption in agriculture sector has been increasing mainly due to the subsidized electricity rates and meeting the growing irrigation need of agricultural land. To tap the energy saving potential in the agriculture sector, which is estimated to be 20.75% (2007-08) of the total energy consumption, the activities planned to be undertaken in the 12th Plan would focus on development of innovative financial mechanisms like Venture Capital Fund (VCF) and Partial Risk Guarantee Fund (PRGF) for the large-scale implementation of AgDSM projects on Public Private Partnership (PPP) mode, in the states for which DPRs have been prepared in the 11th Five Year Plan. The major impacts of the Ag DSM scheme during the 11th Five Year Plan includes 97 MU of annual energy saving potential assessed across eight different states covering about 20,885 pump sets.

Based on the results achieved during the 11th Plan, the targeted reduction in electricity consumption at the end of 12th Plan is 0.7 billion units (BU) which would be about 0.57% of the electricity consumption in the agriculture pumping system. The following instruments are proposed to meet the proposed target:

- Financing mechanism for promoting investments in Ag DSM projects (Target – 0.25 million pump sets, 0.7 BU of energy savings, Total Budgetary Provision: Rs. 352 crore).
  - Placement of partial risk guarantee fund for risk mitigation of Manufacturer/Implementer/ESCOs/FIs.
  - Placement of capital subsidy fund/venture capital fund for providing incentive to Manufacturer/Implementer/ESCOs.
  - Monitoring and verification protocol under the AgDSM scheme (Total Budgetary Provision: 25 crore)
- Monitoring and verification protocol under the AgDSM scheme (Total Budgetary Provision: 25 crore)
- Integrated water and energy conservation scheme – 100 Joint Demo projects implementation(Total Budgetary Provision: Rs. 10 crore)
- Technical assistance & capacity development of all stakeholders (Total Budgetary provision – Rs. 6 crores)

At the end of the 12th Five Year Plan, it is forecasted that through market transformation of agriculture pump sets, major manufacturer of agriculture pumps in the organized SME sector would transform into manufacturing of energy efficient star labelled pumps through the various initiatives of BEE schemes/programmes.

Wider involvement of stakeholders like DISCOMs, state regulatory commissions, State Designated Agencies, State Governments, pump manufacturers, energy saving companies, farmers/ consumers etc. is one of the key initiatives under the scheme.

The projected electricity saving at the end of 12th Plan i.e. 2016-17 is about 0.7 BU with the financial budget requirement of Rs. 393 crore.

5.3.7 Municipal and Public Utility Sector

Municipal DSM (Mu DSM)

The basic objective of the Municipal Demand Side Management (MuDSM) programme is to improve the overall energy efficiency of the Urban Local Bodies (ULBs) which could lead to substantial savings in the electricity consumption, thereby resulting in cost reduction/savings for the ULBs.

The situation analysis was carried out in the Municipal sector in 2007 covering 23 States/UTs. The finding across all the 171 cities spread in 23 states points out that only 9 cities have exclusive energy cell. Other Municipal's region neither had energy cells nor having any medium for collection of data for improvement of energy efficiency.

- **Energy Efficiency in ULBs**

As low as only 38 cities out of 171 have separate allocation in their budget for any energy efficiency initiative. Notably out of total budget allocation of Rs. 12,123 crore across these 171 cities, only Rs 128.5 crore (1.06%) was allocated exclusively for energy efficiency initiatives in the year 2006-07. This subsequently went down to 0.88% in 2007-08 with the allocation of Rs 161.8 crores out of total budget provision of Rs 18,430 crore. Based on the data collected in the situation analysis survey, the energy saving potential for 12th Plan has been estimated as 257 million units (MU) in the urban local bodies.

- **Energy Efficiency in Water pumping**

During the course of initial Investment Grade Audits (IGAs) of ULBs, it was found that over a period of time, many of the water pumping bodies (Jal Nigam/ Jal Sansthan/ Water Department) have separated out from the scope of ULBs and therefore, a separate situation analysis of these bodies was carried out.

The representative water bodies, encompassing total of 3520.65 lakh of population in 1896 Sq.km spread across 105 cities, were covered during this sample based survey for situation analysis covering 19 states. In this study, the overall estimated electricity consumption in the pumping was 1040 MU with an estimated electricity saving potential of 208 MU.

Based on the above survey, funding requirement of Rs. 45 crores is assessed for the MuDSM Scheme as this scheme would create an institutional mechanism for implementation of the MuDSM in the country. The above budget is meant for undertaking investment grade energy audits in both ULBs and Jal-Nigams. It is envisaged that implementation of the proposed IGAs can be achieved through funding under JNNURM and linking the same through development fund of MoUD to realize the savings. Any implementation programme under BEE scheme is to be considered for separately funded.

The projected electricity saving at the end of 12th Plan i.e. 2016-17 is about 0.47 BU with the financial budget requirement of Rs. 45 crore.

5.3.8 Energy conservation awareness, awards and painting competition

Many activities to promote awareness on energy conservation amongst the targeted sectors and general public and also for school children were undertaken during the 11th Plan which include National Energy Conservation Award for industries, buildings and railways and Painting Competition on energy conservation for school children.

Painting competition is being organized since 2005 for students at School, State and National levels. In the year 2010, about 15.63 lakh students participated in the competition in comparison to 3.43 lakh in the year 2005. The National Energy Conservation Award Scheme of Ministry of Power covers about 34 sectors of industry, thermal power stations, office buildings, hotels and hospitals, zonal railways, state designated agencies, municipalities and manufacturers of BEE Star labelled appliances. The avoided capacity saving achieved in the first four years of 11th Plan was 1441 MW.

It is proposed to strengthen all ongoing activities during the 12th Plan and introduce the following specific activities:

- Creation of data base and its analysis EC Award participating units
- Compilation and dissemination of best-practices in industry and building sector
- Continuation of EC Awards and paintings competition on energy conservation
- Awareness creation on energy conservation through print, electronic and other media for general public

The projected saving in the year 2016-17 of 12th Plan is about 3.42 BU of electrical energy and 5 mtoe of thermal fuel saving with the financial budget requirement of Rs. 100 crore.

5.4 HUMAN RESOURCE DEVELOPMENT PROGRAMMES

Human Resource Development (HRD) activities are required to meet the challenges of energy efficiency and sustainability together. A sound policy for creation, retention and up-gradation of skills of Human Resources is very crucial for penetration of energy efficient technologies and practices in the various sectors. Access to information and training is considered to be one of the most important bariers limiting the transfer of energy efficient technologies. BEE and SDAs have played a major role for stimulating a major change in the energy efficiency practices in the various sector of economy. BEE will continue the capacity building of energy professionals through national certification programme for Energy Manager/Energy Auditors. In addition to the HRD activities undertaken in each of the scheme of BEE and MoP, the following initiatives are also proposed to be undertaken in the 12th Five Year Plan:

- Student awareness programs
- Training, skill up gradation and refresher training of energy managers and energy auditors
- Training, skill upgradation and refresher training of operators handling fuel fired furnaces and boilers.
- Inter-institutional networking in energy efficiency training
- Training of Power plant personals

The HRD plan is developed with both widths through general public awareness and student groups as well as depth through special training packages for sector specific energy efficiency of operators, energy auditors and managers. It meets the need of most of the sectors such as the power sector, SME, North East, agricultural, buildings, etc.

The total budget proposed is Rs. 288 crores in the 12th Plan.

5.5 OTHER TECHNOLOGIES/AREAS FOR ENERGY CONSERVATION

5.5.1 Award for manufacturer offering the most energy efficient appliance models

Appliances manufacturing companies may have started producing energy efficient, star rated models. However, they also produce a wide range of models that are cheaper and popular but energy inefficient. An award will incentivize the manufacturing companies to offer more energy efficient models and will act as recognition of their commitment to energy efficiency.

The Ministry of Power already has the National Energy Conservation Award (NECA) scheme to recognize the innovation and achievements in energy conservation & efficiency by the industry, and the above proposed award can be a part of the scheme.

5.5.2 Energy Efficiency Research Centers

Setting up of 10 energy efficiency research centers for selected energy consuming sectors may be considered in collaboration with the Department of Science & Technology (DST). Based on a model appropriate for India, BEE may invite offers from academic institutions, manufacturing associations & ESCOs and offer funding for initial set up, partial running and maintenance cost for the first 5 year period.

The financial budget requirement for this activity is Rs. 200 crore in 12th Five Year Plan.

5.5.3 Other Strategies and Initiatives

5.5.3.1 Other strategies

Encourage planners and regulators related to energy and technology up gradation sector to adopt integrated resource planning in the entire value chain of activities, right from extraction or procurement, and conversion to final end use.

5.5.3.2 New areas/initiatives

- ***Railways***

  The Indian Railways in past has undertaken many initiatives to conserve energy. However, still many opportunities may exist for improving the energy efficiency in the railway sector as a whole. Given the energy saving potential that may exist in this sector, it is proposed to initiate studies and various schemes in coordination with the Ministry of Railways.

- ***Additional sectors***

  A few additional sectors are proposed under the 12th Plan, where possibilities to reduce energy consumption exist, which are not presently/ adequately covered under the existing BEE schemes. These include the defence establishments like ordinance factories (purely on a voluntary basis), Public Sector Units (PSUs) township and large engineering/ manufacturing industries.

5.5.3.3 Lighting Center of Excellence

Creating a demonstration centre on lighting technologies (Lighting Centre of Excellence) to showcase energy efficient lighting technologies, may be considered in the 12th Plan.

5.6 CONCLUSION AND RECOMMENDATIONS

The target of energy saving which may be achieved in the terminal year 2016-17 of 12th Five year Plan as a consequence of Demand Side Management (DSM), Energy Efficiency and Energy Conservation schemes as proposed in the plan is expected to be 44.85 BU (at consumer side) which is equivalent to 60.17 BU at the Bus bar side. The equivalent avoided peaking capacity is estimated to be 12,350 MW at the end of the 12th five year plan. In addition to the electricity saving, total thermal energy saving equivalent to 21.30 million tonne of oil equivalent (mtoe) in the Industries & SME, Transport sector and Energy Conservation (EC) award is also expected to be achieved in the terminal year of 12th Plan.

The details of target of energy saving during 12th Plan as well as corresponding fund requirement for various programmes initiated by BEE are summarized in following table.

Table: 5.6

Energy Saving Targets for 12th Plan

Sr No	Sectors	Schemes	Total Fund requirement in schemes (Rs. In Crore)	Total Fund requirement in sector (Rs. In Crore)	Targeted Electricity Saving, BU	Targeted Thermal Fuel Saving, mtoe
1	Utility Based DSM	DSM Programme for Utilities	300	300	-	-
2	Industries	Industries	3767	4222	11.96	10.41
		SMEs	455		1.83	1.59
3	Residential Sector	Bachat Lamp Yojana	6	6	4.40	-
4	Equipment & Appliances	Standards & Labeling (S & L)	183	1653	10.40	4.30
		SEEP	1470		6.60	-
5	Agriculture Sector	Agricultural Demand Side Management	393	393	0.70	-
6	Commercial Sector	ECBC & Energy Efficiency in Existing Buildings	65	65	5.07	-
7	Municipal Sector	Municipal Demand Side Management	45	45	0.47	-

Sr No	Sectors	Schemes	Total Fund requirement in schemes (Rs. In Crore)	Total Fund requirement in sector (Rs. In Crore)	Targeted Electricity Saving, BU	Targeted Thermal Fuel Saving, mtoe
8	State Designated Agencies	SDA Strengthening	140	210	-	-
		State Energy Conservation Fund	70		-	-
9	National Awards, Painting & Awareness	National Awards, Painting & Awareness	100	100	3.42	5.00
10	Innovative Technologies/Areas	Energy Efficiency Research Centre	200	200	-	-
11	HRD	HRD	288	288	-	-
Total				7482	44.85	21.30
Total electricity saving at demand side, BU					44.85	
Total electricity saving at Bus bars, BU					60.17	

Following recommendations/new initiatives are suggested for 12th Plan.

- Continuation of on-going Schemes/Programs by Bureau of Energy Efficiency and Ministry of Power
- State designated agencies (SDAs) in different states need to play a very important role in terms of carrying forward various energy efficiency initiatives at the state level. The thrust of the SDA program during the 12th Plan will be on strengthening the 32 SDAs which would enable them to implement various programs and activities initiated by BEE or SDAs themselves.
- In the 12th Plan, it is proposed to set up State Energy Conservation Fund (SECF) in all the States and pursue with SDAs for constitution of SECF in the states to implement various energy conservation activities and utilization of fund under SECF. Matching contribution may be made by the state governments to the SECF.

The proposed activities in 12th Five Year Plan under Standard & Labelling Programme (S&L) for equipments and appliances include:

- Inclusion of at least 5 selected new equipment and appliances. Standby power loss reduction in few of the electrical appliances will also be focussed in the 12th Plan.
- Awareness creation among all the stakeholders,
- Undertaking of check testing, label verification, market impact assessment for appliances/ equipments covered under S&L scheme and
- Up-gradation of energy performance standards for equipment/ appliances covered during 11th Plan.

Under the labelling scheme, the following activities are proposed

- Introduction of fuel economy norms effective from 1st year of 12th Plan,
- Technical study for 2 & 3 wheelers and commercial vehicles (Truck & Buses) to finalise S&L programme

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Chapter-6

RESEARCH AND DEVELOPMENT

6.0 INTRODUCTION

Depleting energy resources and environmental pollution are the biggest challenges facing the Indian power sector. Hence, there is an emergent need for developing efficient power plants which are eco friendly. The modern power plant should be capable of making optimum and effective use of depleting resources like coal, and natural gas. Development of hydro and renewable sources of energy needs to be encouraged due to their inherent advantages.

Power Sector being highly technology intensive, Research and Development (R&D) plays a major role in the developmental plans, especially while considering introduction of new and advanced Technologies for strengthening the power sector. The adoption and absorption of new technologies in a phased manner is essential towards a balanced growth of this Sector. It is of vital importance to focus our attention now on ways and means to build expertise within the country, to find solutions for the problems existing in the system and also for the problems that may arise in the future. To absorb high technology, the indigenous R&D base is important to understand the various technicalities involved to apply the same to Indian environment.

Collaborative Research in a phased manner is needed to bridge the gap between knowledge and technology (with rapidly changing technology), build expertise to find solutions for the problems existing in the system and also for problems that may arise in the future. There is a need to form a proactive & collaborative R&D Policy to develop innovative solutions to strengthen the Indian Power Sector through networking with research organizations, academic institutions and the power industry.

6.1 OVERVIEW OF R&D IN POWER SECTOR

R&D in the power sector is presently in the domain of following organizations:

- R&D Wings of Corporations like the BHEL, NTPC, NHPC, SJVNL, PGCIL and other units of the Ministry of Power (MoP).
- R&D in private sector i.e. TATAs, Reliance, Crompton Greaves, L&T, TERI, GE, SEIEMENS etc.
- R&D under MoP: National Perspective Plan (NPP) for R&D in Indian Power Sector, Research Scheme on Power (RSoP), and Research projects of CPRI.
- R&D laboratories of CSIR working on energy related areas and sponsored projects of DST.

In the thermal generation sector commendable work has been done by NTPC and BHEL in the areas of stabilization of supercritical units of capacity 660 MW, efficiency improvement of Thermal Power Plants, control, instrumentation and loss minimization. Similarly in the area of hydro generation, BHEL, NHPC and other hydro utilities have contributed in uprating of old units, improving turbine design etc.

In the transmission field, commendable work has been done by POWERGRID such as introduction of 1200kV Ultra High Voltage (UHV) AC system with totally indigenous development under public private partnership model. POWERGRID has associated 34 manufacturers in this developmental work. This commendable work of POWERGRID needs to be supplemented with further development in 800kV & 1200kV indigenous equipment development. POWERGRID have also introduced many new technologies like Series Compensation, Thyristor Controlled Series Capacitor, Transformer Online Monitoring system, Compact towers, High temperature low sag conductors, Controlled Switching of reactors etc. They have also contributed significantly to the development of high temperature conductors, development of insulators, planning of 1200kV AC and ± 800 kV DC first time in the country.

6.2 REVIEW OF R&D ACTIVITIES DURING 11th PLAN

i. Details of R&D activities by NTPC are in the following areas:

Development of IGCC Technology, Solar Thermal Platform & Solar Photovoltaic Research set ups, Waste heat recovery from flue gas for air conditioning, Development of aqueous-ammonia technology, Establishment of integrated biodiesel pilot plant, Development of robotic based inspection systems for boiler tubes, Set up of Solar thermal based HVAC system, Development of Water & Waste Treatment Technology, Set up of Pressure Swing Adsorption (PSA) based pilot plant for CO_2 capture, Studies on fixation of CO_2 through Microalgae, Studies on aqueous mineralization of fly ash by flue gases, Feasibility studies on Extraction of moisture from flue gas, Development of PDC-RVM instrument and expert system for moisture measurement in insulating papers of transformers, Retrofitting of VFD drives in existing cooling tower fans, Development & installation of artificial intelligence based software for plant performance improvement, Development & installation of online boiler water chemistry monitoring & advisory software, CFD modeling of flue gas ducts to improve temperature & velocity imbalances, etc

Scientific & technical support provided to all NTPC stations as well as many outside stations by NETRA plays a definite role in increasing the availability & reliability of stations in terms of failure investigations, corrosion analysis & control, water & waste water treatment, condition monitoring, health assessment, etc.

ii. Research projects taken up by BHEL during 11th plan under transmission sector are as follows:

a) 2.5 MVAr STATCOM: This project has been taken up jointly with CPRI and the system was developed and successfully commissioned at BHILAI steel plant.
b) Development of IEC 61850 Compliant Substation Automation System. Under this project IEC 61850 client has been developed. Bay Control Unit (BCU) has been developed. Based on this, a 132 kV substation of AP TRANSCO at Chintal has been provided with BHEL developed SAS under a field trial project.
c) Based on the development of 33kV Phase Shifting Transformer (PST) with Thyristor controlled static tap changer, BHEL has made efforts to develop and manufacture PST suitable for transmission applications. In this regard, with the help of CEA and APGENCO, system studies were made and a proposal for the design, manufacture and commissioning of 400kV, 315 MVA +/- 15 degree PST was proposed at KTPS stage VI . Based on the proposal, APGENCO has awarded a commercial order on BHEL. The project is under advanced stage of execution.
d) BHEL is working on the development of 400kV GIS and all the systems have cleared required dielectric tests and the efforts for field trial of the developed GIS is proposed in 2012. The field trail may spill over to 12th plan.

e) BHEL has developed IEC 61850 Process Bus requirements. In this regard, A Merging Unit (MU) has been developed and successfully tested at KEMA in the beginning of 2011. Field trail of full scale SAS along with process bus is contemplated in 2012 and the same is likely to come up in 12th plan.

iii. National Perspective Plan (NPP) –Initiative of MoP in R&D

R&D projects are executed through National Perspective Plan (NPP) Scheme of MoP in a collaborative mode. During the 11th plan period, thrust was given to new technologies such as: High temperature superconducting (HTS) systems, National Effort to Develop Custom Power Devices, Development of materials to address Silt erosion, Grid integration issues with renewable generation such as wind. These are addressed in a project mode.

The projects taken up during the period are:

a) Development of 630kVA HTS transformer for Distribution system application, project executed by M/s EMCO, Mumbai. Field trials are in progress.
b) Development of HTS based Fault Current Limiter (FCL), being executed at Crompton Greaves, Mumbai.
c) Development of 500kVAr STATCOM for IT-Park. Successfully developed by CDAC, Trivandrum, field trials are in progress.
d) Development of 2.5MVAr STATCOM for Bhilai Steel Plant. by BHEL, Hyderabad, field trials are in progress.
e) Development of new materials for hydro turbine components for silt mitigation issues. New material is developed by NML, Jamshedpur. IIT-Roorkee is focusing on developing new coatings for silt mitigation. NHPC and SJVNL are collaborating in these projects, which are relevant to hydro sector.

The total fund spent so far in 11th Plan R&D works is 352 Crore only. Thus, MoP has initiated R&D Plan in new and emerging technologies, which need to be continued during the 12th plan.

6.3 INFRASTRUCTURE DEVELOPMENT FOR R&D IN POWER SECTOR

The in-house R&D setups of major utilities like NTPC, NHPC and POWERGRID address introduction and absorption of new technology by applied research primarily through project routes. Major manufacturers like BHEL, Crompton Greaves, EMCO have their own R&D set up, focusing on product development. Central Power Research Institute (CPRI) is provided with capital funds from the Ministry of Power for in-house research as well as funds to coordinate and manage MoP's research schemes. Central Electricity Authority has a role in identification of appropriate new technologies for the country. Twelve projects are in progress under National Perspective Plan (NPP) on R&D, which are collaborative research projects involving more than one organisation. The R&D policy of the Government is to promote R&D projects that help the nation to become self reliant in technology.

The RGGVY scheme of MoP launched in 2005 has earmarked Rs.160 Crores amounting to 1% of scheme cost, for enabling activities including technology development

R &D in power sector and consequent changes has resulted in developing a sound generation base, a reliable grid and an upcoming modern distribution system. Continued and sustained efforts are required through various science and technology laboratories of CSIR, DRDO, BARC, TIFR and through Government bodies of DST, such DSIR, TIFAC and others, for promoting technology in India.

6.4 PROPOSED R&D PLAN FOR 12TH PLAN

In the present scenario it is proposed to categorize the R&D initiatives into four different conventional sectors, viz. Generation, Transmission, Distribution and Environment. Under each Sector different technologies are listed for development of prototypes and pilot plant demonstration. The different areas in these sectors are as below:

a. Generation Sector:

- Thermal and Fuel
- Hydro
- Renewable Energy and Distributed Generation

b. Transmission sector

The adoption and absorption of new technologies in transmission sector can be implemented by further classification in to following sub-sections:

- Design and development of equipment, real time simulators and controllers
- Creation of data-bank
- Automation
- Pilot plant/Demonstration
- Development of alternative materials
- Equipment performance
- Biological effects
- Concept proving / Exploratory studies

c. Distribution sector:

Smart Grid, Distributed generation

d. Environment

- Clean Development Mechanism
- Bulk utilization of fly ash
- SOx, NOx, and mercury control.

Details of projects proposed to be taken up for R&D are furnished below (list not exhaustive)

6.5 R&D IN GENERATION SECTOR

6.5.1 Technological Advances and R&D in Thermal Generation

(a) Ultra Super Critical (USC) and Adv- USC Plants

Ultra super-critical plants operate at higher temperature and pressure (approximately 32 MPa and 600°C) resulting in higher efficiency. This translates into lower coal usage per kWh of power and less CO2 emissions. A few such plants have been built in Europe and Japan. The efficiency of these plants goes up to 44% leading to lower carbon emissions of 0.7 kg per kWh. However the extreme operating parameters impose stringent requirements on materials.

Considering that coal shall remain as the mainstay of India's power industry and the inevitability of pressures India will face to reduce emissions due to global climate concerns, Development of Advanced Ultra Supercritical (Adv-USC) Technology for Power Plants has been taken as one of the

four Sub-Missions as part of the above National Mission under the guidance of the Principal Scientific Adviser to the Government of India.
Under this initiative, it is proposed to develop and establish an 800 MWe Adv-USC Power Plant on a Mission Mode, as a collaborative project involving IGCAR, NTPC, BHEL and CPRI. Material degradation issues and Condition assessment programmes are also to be investigated.

(b) IGCC TECHNOLOGY

IGCC integrates a coal gasifier, a gas clean up system and gas turbine in a combined cycle mode where coal is gasified with either oxygen or air and the resulting synthesis gas (or syngas) consisting primarily of hydrogen and carbon monoxide is cooled, cleaned and fired in a gas turbine. The technology has shown capability of power generation at higher efficiency and lower emission level with respect to pulverized coal combustion technologies as demonstrated in Wabash and Tampa in USA, Buggenum in Netherland and Puertallano in Spain. Various studies conducted in the 11th Plan by NTPC (NEXANT) and BHEL indicates that high ash Indian coal (> 40% ash) combined with its high ash fusion temperature (1300-1500 deg C) may not be suitable for entrained bed gasification as it will require gasifier operating temperature beyond 1500 deg C. The studies supported by pilot plant testing and simulation also indicated that IGCC technology with fluidized bed gasifier will be most suitable for Indian coal with gap areas in carbon conversion and syngas calorific value which may be overcome by using enriched air and fines recycling.

The other important aspect of IGCC where technological advances are continuously made is in the syngas cleaning especially at higher temperature. This removes the efficiency penalty of cooling the syngas to ~90 deg C and again heating it to the required temperature for the gas Turbine. These demonstration plants should have sufficient slip stream facilities where the upcoming warm gas cleaning technologies can be tested in actual operating condition.

Furthermore, IGCC technology opens up new product area along with electricity generation like liquid fuel generation, hydrogen production, pre-combustion CO2 capture and integration of fuel cell which may provide future options of zero emission coal technologies with higher efficiency.

To demonstrate these aspects and to take forward the studies carried out in pilot plant it is felt that there is a greater need to demonstrate and improve the performance of IGCC for high ash Indian coal in a higher scale plant. There is a need to set up 100 MWe (Net) project involving NTPC, BHEL and APSEB.

(c) Waste Heat Recovery Systems

The thermal power plants operating on Rankine power cycle normally achieve power generation efficiency in the range of 35-40 % depending on various site conditions, turbine inlet steam conditions and design of equipment etc. Balance of the heat input is essentially lost as condenser losses (about 48-50%) and boiler exhaust gas losses (about 6-7%) besides other nominal losses viz. radiation losses, un-burnt carbon losses etc.

In a 500 MW unit, about 25 MWth of thermal heat would be available if the flue gas temperature is dropped, say, from 140 to 110 Deg C. The major challenge in low temperature heat recovery system is the requirement of large heat transfer area and thus additional pressure drops, which increases the cost of the system. Use of waste heat recovery system, though desired for obvious cost benefit, is equally important for environment protection as lesser quantity of fossil fuels shall be burnt for same quantum of useful energy.

Integration Options:

Waste heat can be gainfully recovered and applied to: (i) Produce refrigeration / air-conditioning using Vapor Absorption Machines based on Li-Br, Ammonia absorption system. (ii) Plant cycle efficiency improvement using condensate pre-heating. (iii) Produce electric power independent of the main plant TG set using aqua-ammonia Cycle or Organic Rankine Cycle.

Before integrating the recovered heat with power cycle of boiler, to begin with it is necessary to prove the design in the following:

(i) Vapor Absorption Air-conditioning
(ii) Aqua-Ammonia Cycle
(iii) Organic Rankine Cycle

It is suggested to take up on a Pilot scale, installation as retrofit to the existing power plant and on its successful completion, scaling up can be initiated.

(d) Development of Artificial Neural Network based Power Plant Optimization, Advisory and feasibility of Integrating Supervisory Controls

Real time Boiler operation under optimum conditions implies efficient fuel combustion and reduced fuel cost for the same amount of electricity generated. A modest efficiency improvement of 0.5% in boiler efficiency for a 500 MW boiler at a pithead station should result in a huge annual saving. Boiler operation control and optimization envisages variation of controllable parameter viz. excess O2%, wind box pressure etc. On the other hand TG cycle heat rate improvement by reduction in left/ right steam temperature imbalances, reducing spray, maintaining metal temperature at its best, further involves real time adjustment of above said controllable parameters.

Therefore real time optimization is an important need of the day. The challenges for meeting these operational goals in real time require that an increasing amount of information be simultaneously evaluated. As more complex emission control strategies are applied to the system, the complexity of the problem increases significantly.

As a result of this increasing complexity, traditional single-value cause and effect models have reached a peak in their ability to address these operational goals. Artificial Intelligence (AI) is a modern tool that can be assigned the task of constantly reviewing recent data to aid in making multivariable decision to achieve goals. AI attempts to model complex processes using various operating parameters that are involved in control and optimization of power plant's overall efficiency. Various nonlinear parameters viz. WB press, FAD position, burner tilts, Metal temperature etc. for which writing mathematical equations for plant efficiency is not possible, can be correlated with plant efficiency using Artificial Neural Network (Branch Of AI). Online retraining of ANN, addresses the model development for modified operating conditions, seasonal variations etc. very efficiently. Application of Evolutionary algorithms like Genetic Algorithm (GA) (another branch of AI) known for searching global optimum conditions eliminates the problems of incorrect advisory due to local optima in any other traditional optimization techniques. Further with advent of sensor, other monitoring techniques viz. flame imaging and advance control like model predictive control etc. this real time optimization using AI shall be able to give very accurate and powerful solutions to plant optimization.

Concerted R&D effort is needed to develop such ANN based software for fossil fired power plant.

(e) Advanced Non-Destructive Testing (NDT) Inspection Technologies (Robotic Boiler Tube Inspection, and phased array technology)

Robotic based boiler tube system for water wall tubes through eddy current based robotic system. The water wall tubes in the primary pass of thermal power plant boiler are subjected to severe corrosion problems especially in the burner zones leading to loss in thickness. The wall thickness of each tube needs to be monitored during annual shutdown periods for ascertaining their suitability for continued service and schedule for replacement if necessary. In view of the short shut down periods, it is not possible to measure the thickness of all tubes using conventional ultrasonic technique. In a robotic based system, the probe/magnetizing coil is supported on robotic device which can crawl along the whole length of the water wall tubes and maps the tube thickness or detects abnormality.

Second pass of boilers consists of bank of LTSH and economizer tubes having 1.5-2 mtr height and coils are so close together that making difficult for inspection. Robotic inspection devices are to be developed for inspection of these tubes resulting benefits in down time and higher reliability.
Phased array technique is a specialized type of testing that utilizes multi element array transducers and software controls for steering the ultrasonic beam. In view of complexity in shape & geometry of component of turbine components such as blades, rotor steeple and disk rim attachments, the conventional techniques suffer by reliability, accuracy & reproducibility. The advanced linear phased array ultrasonic technology wherein multiple UT probes mounted in a single holder is used for this purpose and reported that the reliable and redundant results can be obtained in respect of defect detection, sizing and shape.

HP / IP rotors suffer in-service degradation from rotor material temper embrittlement. The rotor material fracture toughness, which governs the size of the critical flaw for fracture, is hence adversely affected. A reliable assessment of the fracture toughness properties of steam turbine rotor requires sampling of material from in-service rotor. A miniature sample removal and small punch testing technique for direct estimation of fracture toughness provides a rational basis for reduction of conservatism during RLA of rotor.

The adoption of advanced RLA methodologies leads to the emergence of sophisticated practice in RLA with reliable and upgraded assessment technologies in the short time available during periodic maintenance, application of Robotics, improved deterministic routes and evolution of technology options.

The project envisages development of state-of-art technology in the area and adopts them in a few thermal power stations. The project will support a number of spin off research in the related area.

(f) Development of advanced NDT based diagnostics and inspection tools for condition assessment of plant components

Establishment of Centre of Excellence for Non-Destructive Testing and development of advanced Remaining Life assessment(RLA) methodologies (robotic corrosion mapping, phased array technology, digital radiography, remote eddy current, residual stress measurements etc.) for condition assessment of plant components, development of inspection methodologies and field implementation programmes as a part of Remaining Life assessment studies

(g) Development of Pressure Swing Adsorption (PSA) process for CO_2 capture

PSA is a technology used to separate some gas species from a mixture of gases under pressure according to the species' molecular characteristics and affinity for an adsorbent material. Special adsorptive materials (e.g., zeolite) are used as a molecular sieve, preferentially adsorbing the target gas species at high pressure. The process then swings to low pressure to desorb the adsorbent material.

PSA based process is an alternative of the energy intensive amine based process for CO2 capture from power plant flue gas. As CO2 capture and storage (CCS) is a global concern, more so for India which is likely to be dependent on fossil fuel for several years to come for electricity generation, a concerted R&D effort is necessary.

There is a need to undertaking development and set up of a three bed bench scale PSA test unit for CO2 capture from flue gas.

(h) Development of Microalgae process for CO_2 fixation

Biological fixation of carbon dioxide is an attractive option because plants naturally capture and use carbon dioxide as a part of the photosynthetic process and discharge gases from heavy industries commonly contain sufficient carbon dioxide levels for algae growth. Therefore, it would be wise to develop strategies to limit this value.

Biofixation of CO2 from the power plant flue gases through microbial and microalgae processes is one of the important approaches for CO2 mitigation. CO2 is converted into biofuel and other useful products without risk of CO2 leakage as may be in CCS. Thus, combination of flue gas utilization and biofuel production is a very promising alternative in the present scenario.

Microalgae are capable of producing more than 30 times the amount of oil (per year per unit area of land) when compared to best known terrestrial oil seed crops. The productivity can further go up many times if instead of open pond, algae are grown in bioreactors.

There is a need for R&D to explore and prove biological route for CO_2 utilization / fixation.

(i) Boiler combustion Computational Fluid Dynamics, CFD modelling of sub and Supercritical boilers

Boiler is the one of the key equipment governing the overall cycle efficiency of coal fired power stations. Performance of a coal fired boiler depends on several design and operating parameters. It is essential to develop a comprehensive understanding and be able to model the influence of varying coal quality, coal blend, ,coal flow, burner design, burner tilt, flow rates of primary and secondary air on combustion efficiency overall performance of a boiler.

Knowledge of temperature distribution within the boiler, flue gas velocity distribution and localised heat transfer at boiler tubes are also of interest to reduce boiler tube failures. Knowledge of particle trajectories (bottom ash as well as fly ash) is also one of the key interests in understanding slagging, ash deposition and erosion behaviour. A validated CFD modelling of the complex processes of coal-gas turbulent flow with devlolatalization, combustion, heat transfer and ash formation modelling providing a visual parametric profile within the boiler is such a tool.

There is need to develop a fully validated CFD model for boiler, turbine and other aux components of a power station to optimise the design , manufacturing and in situ modification to increase efficiency and availability of power station with reduced cost.

In the 12th Plan, the CFD model should be expanded to encompass, dynamic behaviour of steam and gas turbine by manufactures and boiler modelling with ash formation and deposition model. For the supercritical boilers where the water to steam formation is not at a constant temperature as is in case of sub critical boilers, CFD modelling is a challenge that may be taken up by /with manufacturer.

(j)Advanced surface engineering technologies for higher life expectancy of Thermal plant components

The surface engineering technologies are becoming essential in critical applications of power plants involving wear, erosion as well as corrosion. Thus the immediate technological requirements to be addressed in respect of damage tolerance capacity of materials are: (i) High temperature wear and erosion resistance of thermal components (Burner, liner, and shield) (ii) Silt erosion resistance of hydro parts

The crucial R&D needs are: (i) CVI SiCf-SiCm (500% improvement in wear resistance & meeting the required toughness & stiffness, higher oxidation resistance up to 15000C and superior corrosion resistance) (ii) Nano High Velocity Oxygen Fuel (HVOF) sprayed coatings viz., Tungsten carbide, Titanium carbide, complex carbide, Alumina (100% improvement compared to conventional coatings) (iii) Cladded titanium carbide, tungsten carbide plates/flexible clothes brazed with parent materials which gives very effective and good adhesion bond characteristics.

The research focus shall address: (i) Development of small coupons in respect of SiC based advanced ceramics by CVI method, nano materials (like Alumina, Silicon Nitride, tungsten carbide) by HVOF spray process and cladding of WC/TiC to the base plate/flexible cloth (ii) Performance evaluation of materials under simulated conditions (iii) Computational fluid dynamics approach to study and analyze the performance of the developed materials (iv) Large scale production of SiCf-SiCm based composites, HVOF nano coatings, cladded plates/clothes and followed by simulated and accelerated tests for performance evaluation (v) Establishment of advanced center of excellence on surface engineering technologies (CVI based SiCf-SiCm CMCs, WC/TiC cladded plates, HVOF nano coatings) followed by field demonstration in burner nozzle, boiler tubes, coal conveying systems, pulverizers and promoting new developments to the power sector (super critical boilers).

(k) Design & Development of Last Stage Steam Turbine Blades and balancing of flue gas flow inside boiler for Improved Performance

The forced outages due to boiler components is considered significant compared to other components such as Turbine, generator, auxiliaries, etc. Considerable scope exists to improve the overall efficiency of the plant by controlling the heat loss of the last stage of low pressure turbine blades, balancing of flue gas flow inside boiler, optimization of air/fuel ratio for a specific grade of coal etc.. The major problems for the low efficiencies in steam turbine are due to aerodynamic & secondary losses due to inadequate blade profiles (geometry) and other clearances of the last stage blades. The other problems are erosion of blades, deposition on blades, breaking of blades, leakages from condenser, feed water heaters, valves, man hole gaskets, etc. The fluid flow in thermal plants is quite complex in view of its high turbulence and multi-phase nature. The quality of coal used by varies utilities varies from time to time. The utilities are posed with challenges for balancing the flue gas flow inside the boiler, as the efficiency of heat transfer gets affected readily due to imbalanced gas flow.

There is a scope for improvement in heat rate and efficiency in the existing plants by adopting latest design developments in blade profile by using numeric / CAD modeling, CFD, aerodynamic & stress analysis, etc. The potential for improvement is very large in small size turbines (though capital intensive) and even in bigger turbines (210 MW and 500 MW). Opportunity exists for effecting upto 5% improvement in the efficiency. However owing to service degradation improvements up to 3% in existing turbines appears possible and thus provides unique opportunity forgetting higher output from the running power plants. The scope of research shall focus on: (i) Design & development of Low Pressure Steam Turbine last stage blades through CAD modeling and CFD based analysis for determination of efficiency (ii) Modeling of utility boiler (250/500 MW) with simulated imbalance conditions and assessment on plant performance and control measures for achieving uniform flow conditions (iii) Production of proto-type new turbine blades (iv) performance evaluation of new blades.

(l)Improvement of ESP performance
To study the effect of fly ash characteristics viz ash resistivity, composition, size, unburnt carbon on the efficiency of ESP components, and improved efficiency through Flue gas flow modeling.

(m)Establishment of Advanced facilities for coal combustion / blended coal combustion evaluation studies

To study the coal /blended coal combustion characteristics of different coals under simulated conditions in an advanced laboratory scale combustion test facility. CFD simulation of combustion process covering issues like burning profile, slagging and fouling problems, coal reactivity , emissions, hot spots and burning efficiency in a typical utility boiler.

- *Application of technologies for on-line measurements of coal flow, fineness , heating value, and balancing for combustion optimization in utility boilers*
- *Development of Hot Gas Cleanup Systems for Integrated Gasification Combined Cycle*
- *Optimization of Boiler and Turbine steam cycles and balance of plant for improved energy efficiency*

6.5.2 Technological Advances and R&D in Hydro Generation

Hydro power development in the country is of great significance due to the inherent advantages. For obtaining high reliability operation of the forthcoming large hydro electric power projects, it is essential to keep pace with the technological development and improvements taking place in the developed countries. Also, considering the problems of silt erosion damages, which are typical for Indian conditions, corrosion etc. in the existing power stations, the required technology development in hydro power sector needs a big thrust. Specially to mitigate the problem of silt erosion in the run of river Hydro Power Station under operation, construction & Planning stage in Himalayan region, big thrust is required to find indigenous solution through continual research & development.

Required areas of research in Hydro Power Generation are as follows:

(a) Integrated Operation of Cascade Hydro Power Plants
The optimal management of the hydro cascade plants includes determining of each hydro plant and the operating regime in which it operates. The optimal operation of cascade plants aims at meeting the demand with minimum water consumption. The analysis of loading profile under various constraints can be of immense use at planning stage as well as during operation.

Studies based on actual data for various river basins making use of innovative methods may be taken-up by an educational institute in collaboration with Govt./ Pvt. Agencies.

(b) Optimization Studies for Exploitation of Hydro Potential
Power Potential studies are carried out for assessment of available Power Potential of a river/basin based on a set of inflows and available head conditions under various operating policies. These studies play an important role in the optimization and design of new hydro facilities. They are used for examination of various configurations and their integration into existing networks. The studies are carried out for optimization of project parameters and for evaluation of Energy and Power benefits.

Studies proposing innovative methods may be taken-up by an educational institute in collaboration with Govt./ Pvt. Agencies for Optimization studies for exploitation of hydro potential.

(c) Studies on Benefits of Pump Storage Schemes in the Indian Context

More Pump storage schemes are required to be taken up in areas where run of river schemes have either exhausted or are not feasible. Studies proposing innovative methods may be taken-up by an educational institute in collaboration with Govt./ Pvt. Agencies for working out Benefits of Pump Storage Schemes in Indian Context.

(d) Technological Advancement in Investigation of Hydro Projects and use of GIS/GPS

Geological investigations of hydroelectric projects are of paramount importance in understanding the geological set up of varied terrains and their geo-dynamic development. The purpose of most engineering geological work is to ensure that a proposed structure is built at the lowest cost consistent with currently accepted safety standards. The "need base" of survey and investigation module for hydroelectric projects constitutes delineation of lithology, stratigraphy and geological structure of the area, geo-mechanical properties of the ground and identification of extraordinary phenomenon, if any.

The accuracy and reliability of Survey and Investigation (S&I) data is very important for subsequent techno-economic evaluation and project implementation. Detailed explorations may sometimes reveal adverse geological features which in turn may either lead to drastic changes in the design or even render a particular structure un-feasible. To avoid adverse surprises during the implementation, the improved technology needs to be adopted by the S&I agencies. There is an immediate need for acquiring/ developing software, instrumentation and techniques for engineering geological, geophysical, Seismological and Construction material surveys. Application of GIS/GPS in river inflow/ discharge measurement, flood forecasting etc needs to be considered.

This development work can be taken-up by an educational institute in collaboration with Govt./ Pvt. Agencies involved in S& I work.

(e) Numerical Flow Simulation using Computational Fluid Dynamics (CFD) tools for Hydro Turbine Optimization and Enhanced Efficiency

The hydraulic design of turbines needs to be developed by means of CFD (Computational Fluid Dynamics) simulations and model studies in order to optimize and enhance efficiency. With these technologically advanced tools important flow features could be predicted with high accuracy. This allows the performance, efficiency and cavitation limits of a turbine to be predicted realistically for different operating conditions.

The development work using CFD flow simulations could be undertaken by domestic manufacturers in association with educational institutes for wide range of turbines.

(f) Technology for Spilt Runners/ Site Fabrication of Runners

It has been observed that owing to transportation limitation in India we are unable to plan hydro stations with large capacity units. While in other countries units up to 700 MW has been installed, we are still struggling with unit size of 300MW or so. The constraint is very large diameter runners of high capacity machines and this could only be overcome through the technology of runner with split type or site fabricated runners.

Technology for the design and manufacturing of such runners is not available in the country. R&D efforts are needed to assess the performance and life of these types of runners by interacting with the firms who have developed this technology and look into absorption of this technology for the Indian conditions.

(g) Development of Facilities for Large Size/Weight Casting and Forging Facilities

There is no facility in India for large size/weight casting and forging components, therefore there is a total dependence on foreign supplier. There is a need of development of such facility in India.

(h) Development of Shaft Seal for Silty Water

It is well known that water in most of Himalayan region rivers have silty water and there is a need to develop shaft seal for such conditions. This is one area where the hydro utilities are facing problem and there is urgent need to develop reliable shaft seal specific to Indian condition. The large manufacturers may take a lead in such development.

(i) Generator Modernization to Increase Efficiency.

Presently Generator efficiency is between 98% to 98.8%, however, there is a scope for further improvement in efficiency and reliability of Generators. Globally lot of work is going on in this direction particularly with respect to better insulation material which occupies lesser slot area leaving more space for the conductor, improvements in ventilation, utilization of magnetic wedges and improvements in material quality of the pole sheets which would reduce the losses.

There is a need for acquiring / developing techniques for improving efficiency of Generators. This development work can be taken-up by the large Generator manufacturers in house or in collaboration with foreign institutions or consultants.

(j) Variable Speed Drive for Pump Storage Schemes

The technology of variable speed drive for pump storage schemes is not available in the country. As more and more pump storage scheme would come in future, there is need to fill this technology gap keeping future market in India and the World.

Large unit manufacturers may be encouraged to develop the technology of variable speed drives for large unit sizes.

(k) Site Assembly & Acceptance Testing of 400kV Generator-Transformer to overcome Transport Limitations.

As indicated previously, the constraint of transportation is preventing us from installing higher unit size and one such item is generator transformer for large unit. There is an urgent need to find technological innovations whereby 400kV Generator-Transformer could be transported in parts and assembled/ tested at site. Any breakthrough in this direction would a landmark development as it has not happened anywhere in the World so far.

Large transformer manufacturers may be encouraged to do R&D in this field.

(l) Modernization of Automation, Control and Protection

The implementation of modern automation, control and protection equipment offers safety and operational advantages. There is a continuous development in this field and the recent development is implementation of control & protection system to comply IEC 61850 requirements.

Development project may be undertaken by control & protection manufacturer to implement IEC 61850 as it would provide immense benefits to the upcoming projects.

(m) Monitoring System for On-line Measurement of Turbine Efficiency & Silt Monitoring System

The real cost benefit of turbine efficiency is realized only when it is maintained during its lifetime. The sudden/gradual degradation of efficiency may point to some problem and may provide valuable information to O&M staff.

Although the technology of on-line measurement techniques are available in the world, but the same needs to be evolved in India also to make it suit site specific conditions. The entrepreneurs in association with educational institutions may be encouraged to develop reliable on-line monitoring system suiting Indian conditions.

(n) Solving silt Erosion Problems

In the 11th Plan period lot of R&D has been carried out to understand the silt problem and make the components wear resistant by way of development of new material/alloys as well coating techniques. The R&D in this field needs to be continued and improved upon.

(o) Simulation Test Facility to Study the Coating Material Characteristics

There is a need to set up simulation test facility to study the coating material characteristics. This facility could be set up in CPRI or some other institute so that effectiveness of coating material could be studied.

(p) Monitoring Cavitation Causing Erosion

Development of innovative methods like sensing & interpretation of vibration signals or any other method to monitor the cavitation problem in hydro plants may be taken up. This project could be jointly undertaken by an educational institution in association with the utility/equipment manufacturers.

(q) Development of PTFE (Poly Tetra Fluoro Ethylene) Material

For higher thrust the use of PTFE (Poly Tetra Fluoro Ethylene) type material on bearing is advantageous, however the technology is not available in India and we have to depend on imports. The domestic manufacturers may be encouraged to develop this material keeping in view vast Indian and International demand.

(r) Measures to tackle Corrosion/Erosion Problems in Acidic Water

In one of the project in north-east, the problem of corrosion/erosion has occurred due to acidic water having PH of about 4. Studies to understand & find ways to encounter such situation may be undertaken.

(s) Construction Methodology for Arch Dams

The technical knowledge of arch gravity dams needs to be built up in the country as the same has not been designed & constructed in the country. Idukki dam in Kerela is the only arch dam that was built in sixties with the Canadian assistance. The arch dam is of great relevance to accelerate the power development in the **country. The technology could be acquired through project route from other countries where such design exists.**

(t) RCC Dams - Construction Techniques and Construction Material

The recent advances in the dam construction using roller compacted concrete had made it feasible to commission hydro-power plants sooner than the normal schedule. State-of-the-art technology in this sphere has not reached to the extent desired in India. Transfer of technology would be very useful in this sphere as it would help speed up projects in remote areas in shorter durations.

(u) CFD (Computational Fluid Dynamics) Analysis for Improving Desilting Chamber Efficiency

Due to high silt content in our rivers, the efficacy of desilting chamber is very important. CFD (Computational Fluid Dynamics) analysis projects for improving desilting chamber efficiency may be undertaken.

(v) Measures to Increase Service Life for Silt Flushing Gates

It has been observed that due to high quartz content in silt, the service life of silt flushing gate is less. Studies to find measures to increase service life for these gates may be undertaken.

(w) Excavation of Large Size Cavern with Stabilization Technology and Soft Rock Tunneling

The future hydropower development will be concentrated in the Himalayan region and most of them would be under ground with long head race tunnel(HRT). At present the experience available in the country is for the cavern width up to 23-25m is possible and HRT diameter of 11m. However for larger size cavern & higher diameter HRT, it would be desirable to develop the technology in house or acquire the technology from the developed countries.

(x) Measures to tackle bad geology in Dam Foundation and Cutoff Wall

In some of the recent projects unexpected geology has been encountered and considerable time has been lost in the process. The advantages of application of jet grouted wall versus plastic concrete cutoff wall may also be analyzed.

A study on above may be undertaken to predict the geology of dam foundation and measures to tackle the bad geology.

The following studies may be undertaken:

i) Estimation of variation in flows due to environment changes

ii) Environmental sustainability of Hydro Projects

(y) In stream Power Generation: Power generation technology assessment and development

In stream hydrokinetic uses the river flow to generate the electricity. Installation of turbine farm without restricting the flow course can be useful for country. As our country is blessed with river resources, successful implementation of present proposal will help in mitigating energy problem (may be in small percentage). But this scheme is environmentally and eco friendly. The goals of the project are: (i) Acquiring river characteristics in North-eastern region of India (ii) Locating suitable section for implementation of such project (iii) Suitable region will be downscaled so that lab realization and experimentation can be performed (iv) Successful lab experiments may then scale up to field experiments (v) Design of Turbine farm and (vi) Life cycle assessment of such scheme.

(z) Performance optimization of hydro plant components through Computational Fluid Dynamics (CFD) approach

i) Hydro-turbine blade profiles for runners

The performance of hydro unit is affected by the complex blade profiles as the water flows through the turbine. The 3D profiles need to be optimized for a given capacity and head conditions. The problems become more acute in plants utilizing silt laden water. Elaborate de-silting arrangements are made for preventing the large size particles above 200 microns to alleviate erosion problems.. The high hardness quartz rich silt particles travelling at very high velocities causes severe erosion problems in the under-water parts of the turbine leading to loss of operating efficiencies. Computational modeling of silt particle trajectories and identification of critical erosion prone regions in turbines is still a challenging issue need to be addressed.

ii) De-silting Chambers

The size of the de-silting units is very large and performance evaluation through proto type systems is not possible. The geometry of silt chambers should be tailored for achieving effective sedimentation of silt particles through modeling and thus considered important for achieving improved efficiency and availability of plants under high silt conditions of flow.

The R&D shall focus on: (i) Design of 3D vortex shaped blading systems –full and half blades of hydro turbine runner through CFD approach (ii) Numerical analysis of pressure drop along the blades and optimization of blade profile for achieving lowest outlet pressure for a specific head & flow conditions. (iii) Fabrication of protype blade as per the finalized design and estimation of efficiency through experimental setup. (iv)Prediction of efficiency of silt chambers in use and modification of geometry and flow circuit for achieving improved efficiency.

6.5.3 R&D in Renewable Energy and Distributed Generation

Hydrocarbon resource limits are bound to force the world away from fossil fuels in coming decades. In addition, the environmental and health burdens arising out of the use of hydrocarbons may force mankind towards clean energy systems. Therefore there is need for electric power industry to look at other technologies of power generation through solar, wind, biomass, fuel cells, geothermal etc.

Technologies related to Wind, Biomass, Solar, Geo thermal, Fuel Cells, Waste to Energy (Wte) need to be identified. Research focus is on grid connectivity of large wind mills, self healing wind connected micro grids, distributed generation and large use of ethanol for energy products. Development of micro & mini grids and larger penetration of renewable energy is an important area for research.

The main areas of R & D in renewable and Distributed Generation are:

- Primary converter: developments for enhancement of efficiency, cost reduction and new technology routes
- Energy storage: electrical and thermal storage with enhanced charge-discharge efficiencies and new technology routes
- Electrical energy distribution and gridding: conventional grid-renewable grid ties, micro grids, domestic grid tied systems, etc.
- End use equipment for efficient interface to renewable power

6.5.4 Application of Nano materials in Generation sector

Nano materials technology is considered to involve the manipulation of matter on a near-atomic scale to produce new structures, materials, systems, catalysts, and devices that exhibit novel phenomena and properties. Nanotechnology offers the possibility of introducing technologies that are more efficient and environmentally sound than those used today.

The R& D focus shall include,

- Nano-optimized cells (polymeric, quantum dot, dye, thin film) and antireflective coatings for photovoltaic application
- Nano-composites for lighter and stronger components with wear and corrosion protection for thermal, hydro and wind energy applications.
- Nanostructured compounds for waste heat conversion to electricity
- Nano-ceramics and composites for superconducting power applications
- Nano-optimized membranes and electrodes for fuel cell and energy storage devices.
- Nano-coatings for efficient lighting
- Nano-catalysts for hydrogen generation and biofuels.

6.6 R&D IN TRANSMISSION SECTOR

Implementation of new technologies aim towards increasing stability of the system, availability of transmission network and in maintaining reliable and efficient operation and control of transmission network. Therefore, several technologies are being developed to support these goals such as: bulk power transfer over long distances, enhancement of loadability of lines and maintaining system stability. The key technologies that are being considered include development of controls, EHV and UHV AC and DC transmission systems, compact towers that significantly reduce RoW requirements, application of High Temperature Superconducting technology in developing transformers, cables, fault current limiters, motors etc, Gas Insulated Substations that require about 80% less area than conventional substations, substation automation and remote operation systems.

The Technical developments in communication technology and measurement synchronization for reliable voltage phasor measurements have made the design of system wide protection solution possible. The introduction of Phasor Measurement Units (PMU) has greatly improved the observability of Power System dynamics. Based on PMU's, different kinds of Wide Area Protection and emergency control and optimization systems can be designed.

Additionally, Smart Grids to support utilities in making optimal usage of the transmission grid capacity and to prevent the spreading of disturbances are also being considered. By providing on-line information on stability and safety margins for dynamic condition monitoring, smart grids would serve as an early warning system in case of potential power system disturbances.

Further, 1200kV UHV AC Transmission Technology is in evolving stage and is not available worldwide. A number of countries are working on UHV AC technology but it is still in evolving stage and international standards are also not available. In view of the above, need arises for indigenous development of 1200 kV system.

6.6.1 Transmission Projects for 12th Plan

A number of projects have been identified/ suggested to be taken up in 12th Five Year Plan for transmission sector. The projects identified for indigenous design, development, manufacture and commission in Indian power network are as given below:

1 Design and development of Equipment for UHV AC System

(i) Design and development of equipment for 1200kV AC System

Power sector growth necessitates development of indigenous technology for absorption in to network at higher voltage levels, mainly to strengthen the system and power evacuation. The key equipment proposed for indigenous development: 1200kV sub-station, Circuit Breakers, Shunt Reactors and Controlled Shunt Reactors for dynamic reactive power compensation. Development of High Energy (55MJ) ZnO blocks for Lightning Arrestor of class 5 duty is required for dissipation of High energy. Development of operating mechanism 1200kV disconnector is essential in the light of UHV transmission system technology.

(ii) Design and development of Equipment for 765kV AC system

The Power Transmission network is strengthened through a strong 765kV AC system, which will be the main corridor for transmission. Thus, infrastructure facilities for equipment development are

essential, especially for Controlled Shunt Reactors, Phase Shifting Transformers and seismic qualification of substation equipment is required.
The existing test facilities at UHV class would be utilized optimally, and additional facilities will be augmented. Also, suitable maintenance techniques for maintenance of UHV lines under live conditions are to be evolved.

2 Advanced technologies in Transmission

Transmission towers and conductors play major role in power transfer. To meet the growing demand for power in urban and industrial areas requires transfer of huge power. Due to the constraints in getting environmental clearances, and acquiring right of way, introduction of compact transmission lines is an alternative choice. The **compact transmission lines** have the advantage of reduced RoW, reduced tower dimensions. The compact lines invariably require polymer or long rod insulators for effecting reduced dimensions of tower. Re-conductoring of existing lines with High temperature & Low sag (HTLS) conductor is a viable option to increase the power transfer capacity. Design aspects of compact towers and feasibility study of different types of HTLS conductors are to be explored for implementation.

(i) Compact Transmission Line support using FRP is gaining importance and adopting compact transmission lines in Indian power network has become essential due to increase in load growth and difficulty in building new lines due to RoW issues. The main features of compact lines are reduced RoW and tower dimensions. The compact lines have reduced clearances and require polymer or long rod insulators for effecting tower dimensions. The aspects need to be addresses are: Design, development and testing of 220kV and 400kV towers and implementation in a utility as a pilot project.

(ii) Development of high temperature electrical conductors for Transmission lines is essential, keeping in view of transfer bulk power. The major challenges are to overcome the Transmission losses, increase the power transmission on the existing lines and the development of more efficient power conductors for new lines. The development of efficient power transmission system seems to have the major stake in the future of Transmission system and will become the national priority keeping in view the current scenario. One of the major requirements of conductors is to have high ampacity and low sag properties. In this direction, high temperature conductors which can withstand temperatures well above 250^{o}C is required to meet the growing demand to transfer power.
Recent developments have demonstrated that 6201 and Al59 are the two major alloy conductors in use. However, further enhancement is possible by designing new alloys and economically viable processing techniques. The present alloy conductors use alloying elements such as Zr and/or mischmetal to restrict the re-crystallization temperatures of the alloy conductors so that the conductor can withstand high temperatures. The strength and conductivity of conductors need to have a best compromise so as to get the maximizing benefit during power transmission.

Research in **developing high temperature All Alloy Aluminium Conductors (AAAC)** for transmission and distribution line applications is needed specially developing new materials for this purpose, and exhibit through pilot project. The aimed high temperature conductor will have an allowable temperature of 300 ^{o}C in emergency condition and 250-260 ^{o}C in continuous transmission.

(iii) Design and development of Seismic Resistant Substation is necessary to maintain reliability and safety of electrical equipment after an earthquake depend on the seismic response of individual substation components such as transformer, bushings, switchgear etc. The use of seismic qualification of electric equipment is one of the most cost effective methods for reducing the damage and disruptions from earthquake. Thus, equipment and supporting structures for power generating stations, and substations located in seismically sensitive regions / zones have to be designed and standardized to with stand possible earthquakes.

3 Pollution and Lightning mapping studies: Creating Data Repository / bank

Tripping of transmission lines and failures of insulators due to Pollution and Lightning has become routine especially NR and NER regions. Thus Pollution and Lightning Mapping Studies, and creating data bank are essential. This would help in analyzing the operational problems. Frequent tripping of EHV lines on account of accumulation of atmospheric pollution in the insulator surface leading to tripping of lines, which is common near coastal areas. In view of the huge expansion plan of EHV/UHVAC and Dc transmission system pollution mapping studies play key role, and helps in designing the line insulators. The lighting mapping studies helps in determining the actual causes of line tripping & insulator failure. These study results become guideline for remedial measures and creating data repository / bank is essential.

4 Composite insulators for power engineering applications

Polymeric insulators are in service in the country for more than a decade. They have been employed for both distribution and transmission lines. The in-service reliability of polymeric insulators appears to be satisfactory both from pollution performance and dielectric strength. Considering the large life span of transmission lines, it is necessary to evaluate their performance at various stages of their service and also under different electrical and environmental stresses they are subjected to. In this connection, it is to be noted that standardization of ageing tests on polymeric insulators is still under way in leading laboratories of the world.

At present, manufacturers in the country are capable of manufacturing polymeric insulators used up to 765kV class transmission system. However, their field ageing performance, particularly with respect to the FRP rod, behavior of polymeric material under different pollution conditions, exposed to different intensities of UV radiation, different type and severity of surface contaminations, etc. need to be studied in order to assess their reliability levels and to enhance reliability for improved transmission system availability.

Moreover, 1200 kV AC and ± 800 kV DC systems are becoming operational in the country prompting indigenous development of reliable polymeric insulators to be used in them.

Considering all the above and to asses the reliability of in-service polymeric insulators – there is a need to address the design and operational problems and explore new materials for composite insulators to make them preferred insulators in all classes of transmission (AC & DC) and distribution system.

5 UHV DC +/- 800kV

Considering the implementation of next DC transmission at +/- 800 kV, and substantial requirement, indigenous manufacture of equipment is required, and also the research focus will cover the following aspects: (1) DC electric field, corona studies on equipment and electrodes; (2) Effect of pollution on insulator surface; selection of insulator profile, configuration to Withstand DC stress under normal and polluted conditions. (3) Performance of bushings under DC electric stress. (4) Effects of DC stress on transformer insulation, ageing studies, diagnostic tools (5) Overhead Transmission Lines (6) Bushings and Transformers

(i) VSC based HVDC transmission has become an attractive option for bulk power transfer between meshed grids. The advantages of VSC based HVDC transmission is: high controllability of active and reactive power at the converters terminal and the ability to improve the stability. The project envisages design, develop and deployment of 50MW VSC based back-to-back HVDC system, as a pilot project study.

(ii) High Speed Grounding Switches (HSGS) for HVDC systems is required for to connect the station neutral to the station ground, if the ground electrode path becomes isolated. The development of Indigenous HSGS will be carried out as a pilot project study for installation at HVDC substation.

(iii) The concept of **Transformer less HVDC transmission** is under active research at various institutions. A pilot project study is proposed to evaluate various aspects.

To adopt the VSC based HVDC transmission technology, High Speed Grounding Switches for HVDC systems and to absorb the concept of transformer less HVDC transmission system in power sector, pilot project study is required to be undertaken to gain the experience for wider acceptability for implementation.

6. **Automation**

(i) To address the natural calamity, fire in substation, for quick restoration **Emergency Restoration System (ERS)** for substations is necessary to implement. Design and deployment of mobile substation is considered necessary for implementation.

(ii) Considering the advantages of **process bus technology** over the conventional station bus technology, it is proposed to take up pilot project. Process bus technology has the advantage of reduction in huge copper wiring, integration of any number of IEDs at bay level etc. Integration of optical Current Transformers in place of conventional current transformer is to be considered.

(iii) Demonstration project of IEC 61850 substation automation comprising of both process bus and station bus, along with interoperability.

7 System performance improvement

(i) Development of **On-line monitoring system** for transformers, optical CTs, breakers etc., is an essential task, which helps in taking remedial measures before occurrence of fault. The condition based maintenance on-line diagnostics techniques will be developed.

(ii) **Condition monitoring** of polymer insulators include: Visual inspection of Polymer Insulators and inspection using Corona camera. Certain guidelines will be specified for assessing the defects at the initial stage, which helps is taking preventive action.

(iii) Robotic inspection of transmission system involves use of remotely controlled machines that incorporate imaging, sensing, and other technologies to assess the condition and status of transmission system components. The robot will be equipped to collect the data pertaining to lightning strikes, wind related damage and corrosive conditions. Application of robotics in transmission lines inspection is proposed to carry out in association with experts like Hydro-Quebec, in Indian environment.

(iv) NIFPES: A feasibility study is proposed for introduction of NIFPES, while reviewing the existing provisions of fire protection of transformers.

Feasibility study of use of **advanced sensors** for overhead lines inspection is considered through application of advanced communication and sensor technology.

8 Development of controllers for FACTS devices

(i) Application of FACTS devices in Indian Power System is proposed extensively supported through system studies. Research in the direction of developing indigenous **development of FACTS devices and its controls** are essential and the objective is to design, develop controls for FACTS devices such as: Static Compensator, HVDC, multi-terminal HVDC, switchable shunt reactors, series and shunts HVDC taps, UPFC, IPFC, STATCOM and deploy in network. The controller performance is to be studied in real time.

(ii) There is a need to develop controller for **controlled switching of circuit breakers**, which is used to close or open the contacts of circuit breaker by time dependent control of trip coils, to eliminate undesirable transients. Substantial research in this direction is required.
Thus, design, develop and implementation of controllers is required to be carried out by application of advanced control techniques such as: adaptive control, fuzzy logic control, ANN etc.

9 Advanced Technologies in Transmission

The ever increase in demand for bulk power transmission, and huge requirement in urban areas, there is need for implementing advanced technologies for power transmission such as: Gas Insulated Transmission Lines, EHV Cables and Submarine cables (34, 35, 36). These technologies would help power sector in meeting the projected load demand.

(i) Gas Insulated Transmission Lines are means for bulk power transfer at EHV/UHV levels. The application of GIL is viable option in densely populated areas or in environmentally sensitive regions, and where application of cables is not possible or reaches technical limits. An exploratory project to study the feasibility of application of GIL is necessary. The study results would help in popularizing the technology. There is a need for developing GIS substation technology.

Superior technology and excellent know-how are required to ensure quality and reliability of GITL. This uses SF_6 tubular conductor technology, which has been around for several decades. GIL consists of a central aluminium conductor with a typical electrical cross section of up to 5,300 mm^2. The conductor rests on cast resin insulators, which center it within the outer enclosure. This enclosure is formed by a sturdy aluminium tube, which provides a solid mechanical and electro technical containment for the system. To meet up-to-date environmental and technical aspects, GIL is filled with an insulating gas mixture of mainly nitrogen and a smaller percentage of SF_6. For increased lifetime, the “performance line” product series has a longitudinal particle trap installed over the entire horizontal route section. An automated orbital

Welding procedure, accompanied by tailored ultrasonic inspection techniques, ensures perfect gas-tightness of the aluminum tubes. During service, the fully encapsulated design completely protects the GIL against environmental influences. Thanks to the technologically clear-cut, logical design and the use of high-quality materials, an absolutely maintenance-free product is achieved which requires external inspection only. And at the end of its service life, the issue of de-installation has to be addressed. The GIL tubular system with all its components and the insulation gas mixture are 100 percent recyclable. These factors help to minimize lifetime costs.
(ii) Application of **EHV class cables** is gaining importance owing to many advantages, such as: reduced emission into the surrounding area, of electromagnetic fields and reduced space. An exploratory project is necessary to promote the application and this would help Indian cable industry to produce indigenously.
(iii) Application of **submarine cable** for power transmission becomes unavoidable where there is no feasibility of overhead lines. The application of submarine technology in the proposed India – Sri Lanka interconnection as an exploratory project would give big boost to transmission planners.
These advanced technologies in power transmission are is necessary to take up to gain experience and meet the future challenges in transmission technology.

10 Indigenous Development of power system equipment and components, accessories and materials

Considering the growth of the Indian power network size, the requirement of new power system equipment is also growing proportionately, thus necessitating the development indigenous equipment, through technical collaborations with leading manufacturers around the world. Most important are: **CRGO steel for transformers**, **High Quality Pressboard Insulation** for transformers of class 400kV and beyond, **Resin Impregnated Paper** (RIP) Condenser bushings, Maintenance free

Vacuum type on load tap changer (OLTC) for Transformers, **SF6 filled** large capacity **power transformers technology**, which is more suitable for installations at underground stations, GIS stations and fire prone stations**. Mixed Technology Switchgear** (MTS) facilitates area space optimization to install a high number of bays. The MTS is compact, modular and easy exchange of modules. The indigenous development of MTS technology is to be introduced in Indian context.

11 Promising Technologies for future

(i) The objective of **Innovative Visualization** with sustainable self-awareness feature is to serve real time data for different level of users with the specified authorization and based on their usability which leads visualization to self-awareness. For this purpose it is required to maintain customized data repository and intended data set to be visualized for particular user/EMS operator.

(ii) The power trading is becoming important aspect in the present competitive electricity market, and also to meet the load generation balance. This necessitates the requirement of a comprehensive proposal to include the design and development of an Application framework with Software Sub Modules for Energy Trading, Billing, Pricing and Tools for Load Forecasting in the form of Software as a Service (SaaS).

(iii) With the increase in size of the network, **data mining and repository** aspects needs to be considered while carrying out the real-time simulation studies. In the era regulatory regime, energy trading, pricing and tools for load forecasting is essential to build up. The data analysis in energy domain shall cover advanced forecasting techniques, tools for operation, simulators and training for system operation and security assessment. This would cover Energy Management System aspects also.

(iv) Real-Time Power System Simulator: The Power system analysis and studies is a continuous process. This requires the maintaining of system data repository for carrying out planning and operational studies. Developmental studies especially the development of new controllers is to be studied in real-time. The indigenous development of real-time power system simulator is required in the context of training the personnel for system operation and developmental activities. The simulator development requires involvement of academicians, hardware and software experts and system operational experts, to various aspects of system performance. The simulator is tool to understand the behaviour of power system including distributed generation, and take possible remedial measures for reliable operation. The aspects like steady state, dynamic and testing of controls in real time need to be considered.

6.6.2 Indigenous Development of Power System Equipments & Components, accessories and materials

(a) Alternatives to minerals based Transformer oil: GREEN TRANSFORMER OIL

Transformer fluids are generally petroleum based fluids and are non-bio-degradable, non-renewable and non-environmental friendly and their availability is limited and are very expensive. Substitution of the mineral based dielectric oil with a new environmental-friendly dielectric fluid is an immediate requirement in our country.

An ideal liquid dielectric has very good electrical, physical and chemical properties along-with stable ageing characteristics. It should be compatible with electrical equipment construction materials like paper, press board, copper, metal housing, polymer containers etc.

A practical study is proposed to test suitable vegetable oil, as a replacement for mineral oil.

(b) Vegetable based transformer oil

Raw vegetable oils are not suitable for use as dielectric fluids because of poor dielectric strength and lack of hydrolytic/thermal stability. However, certain chemical/physical modifications are required to overcome these deficiencies.

The Research in this area should focus:

- The substitute oil should be developed from non-edible, indigenous oil
- It should be Eco-friendly (i.e. biodegradable), renewable hence provide safer disposal methods and avoid environment hazards
- Ensure very high class quality
- Provide safety margin for flash point by double than that of mineral oil
- Reduced fire hazards since the fire point should b e above 300°C
- Enhance the service life of transformer by absorbing moisture from the paper during normal service life and therefore, less shut down and reduced investment on filtration etc.
- More useful for remote, pole mounted, sealed distribution transformer which are normally unattended
- Improved Reliability of Power Apparatus
- Total absence of corrosive sulphur and PCB

Further studies are required for:

A **methyl ester** of rapeseed oil (MRSO) has also been tested for possible use in power capacitors Soybean based transformer oil

Insulation systems for electrical distribution transformers are being re-evaluated based on their total life cycle cost from both an economical and an environmental perspective. Due to the inherently higher efficiency design offered by liquid cooled transformers, development has focused on fluids having improved environmental and health properties while maintaining the fire resistant properties of "less-flammable" fluids. Because esters have lower inherent resistance to oxidation and differences in the type and magnitude of oxidation by-products, a novel insulation system has to be developed to overcome this potential handicap.

(c) Development of CRGO Silicon Steel for Transformer core

There is no indigenous manufacturer for CRGO Steel required for magnetic core of Transformers. Annual requirement for CRGO Steel is about 150,000 T. **India requires foreign collaboration to adopt the technology successfully for commercial production**.

(d) High Quality Pressboard Insulation for transformers

For application to UHV/EHV class transformers, presently available materials are inadequate in terms di-electric strength and chemical purity. India has manufacturing capability for press board insulation for transformers up to 220kV only. For transformers of 400kVand above; press board is imported. For making Indian Transformer competitive, it is necessary to have indigenous production

In order to manufacture pressboard insulation for 400KV class and above, the Indian manufacturers will have to upgrade their manufacturing and processing capability.

(e) Resin Impregnated Paper Condenser bushing (RIP)

RIP Bushing technology is to be adopted by Indian bushing manufacturers, by upgrading the existing manufacturing process.

(f) Maintenance free Vacuum type on load tap changer (OLTC) for Transformers

Resistor type on load tap changer is mainly used for transformers. Due to operation of tap changer under load, heavy arcing is experienced in Diverter chamber of the tap changer. This arcing damages the contact and also the oil. In order to avoid the wear and tear, vacuum bottle is used for making and breaking of contact. Vacuum type tap changers have almost same price as that of resistor type tap changers. At the same time, it is more reliable and has very long contact life. This helps longer life for the tap changer

At the moment, Indian customers are specifying VAC type tap changers only for Furnace transformers and few selected transformers. IF VAC type tap changers are produced in India, price will be comparable to resistor type changers and many customers will prefer VAC type tap changer.

(g) SF6 Filled large capacity Power transformer Technology

SF6 filled transformer is an advanced technology for manufacture of transformers, for installation at underground stations, GIS Stations and fire-prone stations. This technology is very much advanced in Japan and other ASEAN Countries. Even transformers of 300MVA, 300kV class are in operation

SF6 gas is used as insulation in Circuit breakers up to 765kV class in India.SF6 filled Technology is yet to be developed. Nevertheless, transformer is ready to adopt the technology. The basic transformer technology is similar to oil filled transformer. The main difference is in insulation materials and pressure vessel. Major transformer manufacturers will be able to develop the product.

6.6.3 Advanced technologies in Transmission

(a) Gas Insulated Transmission Lines

Gas Insulated Transmission lines offer flexibility either above- or below the ground. Second-generation gas-insulated line Power transmission is the best option where environmental or structural considerations rule out the use of overhead transmission lines. The outstanding features of a GIL system are its high transmission capacity, superior electromagnetic compatibility (EMC) to any other transmission system, low losses, high safety (no fire hazard) and flexible installation options. GIL can be laid aboveground, installed in tunnels or buried directly in the soil, depending on individual requirements.

(b) Application of EHV class power cables

The demand for EHV cables is expected to grow tremendously in the coming years. A large part of the requirement would come from underground cables that would replace overhead lines. Besides, industrial consumption to sectors like steel, cement, petroleum refineries, special economic zones, industrial parks, etc. would substantially drive demand for EHV cables. R&D concerning reactive power management in 220kV and 400kV voltage underground cables and issues for maintenance need to be explored, as there is a need to equip with state-of-art technology to meet challenges of HV underground cables due to constraints in overhead transmission.

(c) Application of submarine cables

Application of submarine cables in areas where there is no feasibility of overhead lines. Alternating-current (AC) submarine cable systems for transmitting lower amounts of three phase electric power can be constructed with three-core cables in which all three insulated conductors are placed into a single underwater cable. Most offshore-to-shore wind-farm cables are constructed this way.

For larger amounts of transmitted power, the AC systems are composed of three separate single-core underwater cables, each containing just one insulated conductor and carrying one phase of the three-phase electric current. A fourth identical cable is often added in parallel with the other three, simply as a spare in case one of the three primary cables is damaged and needs to be replaced. This damage can happen, for example, from a ship's anchor carelessly dropped onto it. The fourth cable can substitute for any one of the other three, given the proper (and complicated) electrical switching system. Application of sub-marine cables can be considered as pilot project at suitable locations.

6.6.4 Promising Technologies for future

(a) Innovative Visualization with sustainable self-awareness feature

The Perspective of the real time data set at different levels is required for different aspects. It is required to have customized and intended data set to be visualized for particular user/EMS operator. The objective of Innovative Visualization with sustainable self-awareness feature is to serve real time data for different level of users with the specified authorization and based on their usability which leads visualization to self-awareness. The System will depict the required real time data efficiently with the expert system/intelligent system.

The proposed System has user adaptive and self aware UI which has ability to adapt itself according to the user's preferences. In real time application like SCADA/EMS, the HMI should be person centric where different users and SCADA operators have their own perspective to visualize the real time data set. In order to incorporate adaptive and sustainable self–awareness UI, there must be an intelligent system to track the user's behavior and to depict the UI accordingly. The adaptive self awareness UI can be adaptable in the present context.

(b) Next Generation Data Analytics in Energy Domain: Data Analytics for Power System Analysis could be efficiently implemented on Cloud Infrastructure. Project shall include the design and development of an Application framework with Software Sub Modules for Energy Trading, Billing, Pricing and Tools for Load Forecasting in the form of Software as a Service (SaaS). Data Analytics assist in Analyzing specific consumer benefits, support efficient delivery and investment in the electric system, Facilitate Customer Choice etc on which exhaustive and heuristic analysis can be done.

Using Data Analytics, it is becoming possible to run simulations or models to predict the future outcome, rather than to simply provide backward looking data about past interactions, and to do these predictions in real-time to support each individual business action. While this may require significant changes to existing operational and Business Intelligence (BI) infrastructure, the potential exists to unlock significant improvements in business results and other success rates. Next-generation Analytics can support BI search tools that can find reports and generate SQL queries, (2) visual discovery tools to slice/dice data intuitively at the speed of thought.

Application & Features:

- ❖ Advanced forecasting techniques for sustainable operations
    - Novel Forecasting Techniques
    - Advanced modeling tools
- ❖ Architectures & tools for operations
    - Self Healing Grids
    - Control Methodologies for Sustainable self aware services
- ❖ Simulators and training for operations of smart grids

- ❖ Transmission grids, real time security assessment
  - Innovative solutions to demands of real time security analysis
- ❖ Prognostic Health Management in the Smart Grid.

(c) Real-time Power System Simulator

Power Systems cannot be tested at full power rating in the labs, and simulation is an extremely valuable tool for designing, operating and understanding complex systems. The ability to simulate the sequence-of-operation using real-time data is of fundamental importance & Real-time simulation can avoid inadvertent outages caused by human error, equipment overload, etc. Furthermore, the proliferation of distributed generation plants, often based on the use of renewable energy resources, presents significant challenges to the design and stable operation of today's power systems. The idea is to develop indigenous real-time simulator to study the various aspects in power systems like Load flow, Short circuit, Transient stability, Optimal dispatch of generating units, Transmission, power quality issues etc.

The goal is to develop a Power System simulator that solves transient and steady state simulation in real time. The following areas need to be focused: (i) Distributed generation - wind, solar, fuel cells (ii) Real time response for closed-loop testing (iii) Protective relay testing - line, transformer, generator etc. (iv) Control system testing - HVDC, SVC, FACTS. (v) Large scale real time simulations (vi) Smart grid applications.

Developments are required in hardware, high speed parallel architecture and Power system applications. The major areas are: (i) High speed CPU & Powerful parallel processing hardware and custom I/O (ii) Advanced and comprehensive user interface (iii) Extensive, well proven power and control system component libraries (iv) High power digital current and voltage amplifiers (v) Power System Application development with the help of experts.

The indigenous development of real time simulator shall aim at cost effectiveness, flexibility to handle large scale systems and capability to handle user defined models.

6.7 R&D IN DISTRIBUTION SECTOR

Distribution system needs careful attention in the areas such as reduction in losses, metering, distribution automation, planning, harmonic pollution, custom power devices, demand side management etc. High Voltage Distribution System is an effective method for reduction of technical losses and improved voltage profile. Application of IT has great potential in reducing technical & commercial losses. Integrated resource planning and demand side management also needs special attention and implementation. Substantial efforts are required for capacity building, so that the present day Distribution system would be transformed into a modern day distribution system namely Smart grid. Smart grid represents a vision for a digital upgrade of Power Distribution system to both optimize current operation as well as open up new avenues for alternative energy production. Improvement in reliability of **distribution network** can be achieved with deployment of SCADA/ DMS for remote monitoring and control of various network elements, obviating need for manned substations. Distribution Management System (DMS) extends the monitoring and control functionality of SCADA to distribution transformers. Remote Terminal Unit's (RTU) and Fault Passage indicators (FPI's) are installed at substations. This improves reliability indices by over 50%.

Design and development of High Temperature Superconducting transformers, and compact transformers in distribution systems needs careful attention and applied research in this area in phased manner is proposed.

6.7.1 Areas of Research in Distribution

In the distribution sector, areas such as Methods to reduce losses, Advanced metering, Distribution Automation, Custom Power Devices, Power quality analysis, Distribution System Planning tools, demand side management, development of solid state transformer for distribution systems, utility automation covering SCADA, mapping and GIS, outage management system, advanced metering infrastructure and distribution automation covering customer level intelligent automation systems, substation and feeder level automation, data communication and standardization of distribution automation needs R&D activities. Application of Smart Grid technology and concepts in distribution systems need special attention.

6.7.2 Distribution Automation: Research Work Initiative

The research work should be aimed at developing indigenous know-how of full scale Distribution Automation system, which can cover from primary substations to consumer level intelligent automation. The future research initiatives for power distribution automation are:

- Customer level intelligent automation system
- Computer aided monitoring and control of Distribution Transformers
- Substation and feeder level automation
- Data communication system for Distribution Automation
- Distribution Control Centre (DCC) software

(i) Customer Level Intelligent Automation System

(a) Automated Meter Reading
(b) Prepaid Metering
(c) Embedding Harmonic Detectors in the Meters

(ii) Computer Aided Monitoring and Control of Distribution Transformers

(a) Remotely Operable Load Break Switches
(b) Low Cost Controllers for Capacitor Switching
(c) Low Cost Pole Top RTU

(iii) Substation and Feeder Level Automation

(a) Indigenous Auto Reclosures and Sectionalizers
(b) Intelligent Electronic Devices (IEDs)

(iv) Data communication system for Distribution Automation

(a) Interfaces for Code Division Multiple Access (CDMA) and Wireless in Local Loop (WLL)
(b) Interfaces for Global System for Mobile (GSM)
(c) Interfaces for Distribution Line Carrier Communication (DLCC)
(d) Cost Effective Substation RTUs

(v) Development and Standardization of Distribution Automation software

(a) Master Distribution Automation Software
(b) Application / Engineering Analysis Software
(c) Integration of GIS
(d) Energy Audit and Accounting Software (EAAS)
(e) Trouble Call Management Software (TCMS)
(f) Customer Information System (CIS)
(g) Web Based Metering, Billing, and Collection System
(h) Web Based Monitoring of Distribution System

(i) Pilot level Demonstration Projects

6.8 ENVIRONMENT

Areas of research in Energy - Environment are as follows:

Clean environment mechanism at thermal power stations, creating data base for ash quality, advanced ash management schemes, sustaining coal based power generation considering new and emerging environmental issues, effects of electromagnetic waves on human beings with specific reference to up-gradation of transmission voltages, ec0-design and energy efficient power transformers, utilization of CO_2 from flue gas for aqueous mineralization of fly ash, development of water & waste water treatment & recycling technologies, emission control technologies for NOx, SOx and mercury are some of the areas where R&D activities are required for improvement of environment and for sustainable development.

6.9 ATTRACTING AND RETAINING OF YOUNG TALENT FOR R&D IN POWER SECTOR

First of all the young engineers should be trained in all aspects of Power Engineering. Training shall include:

- Field exposure
- System simulation for carrying out system studies
- Any other specialized areas in which they are supposed to work
- The problems faced in the Power sector shall be obtained from utilities Specific areas for R&D should be identified by experts; young talent can be used to solve the problems under the guidance of experts
- Incentives should be given for good R&D work.

(a)To retain engineers/ young talent they should be allowed to pursue higher studies such that the research work they are carrying out becomes their project work for their masters or doctoral work.

(b)Institute should go for campus interviews in IIT's /NITs/Universities, explain to them the importance of R&D, the facilities and avenues for research, so that they make a proper choice of their future work.

(c) The problems faced in power sector should be made known to the researchers so that they can appreciate and take up such research work.

(d) More job opportunities should be created to absorb engineers for a job placement who are successful/excel in R&D.

(g) Researchers should be rewarded suitably, and if the research works ends up in patent he should also be eligible for the royalty, awards and citations etc.

(h) Researchers should be sent to training programs on advanced topics for research.

(i) Curriculum at degree level should be revamped to make students to realize the importance of R&D in power sector, so that they can pursue R&D

(j) Educational institutions should provide motivation to students to take up research work.

(k) R&D jobs should be paid on par with IT professionals else there is every chance that power engineers also take up IT related work and there is no brain drain.

(l) There should be an increased emphasis on induction level and advanced training focusing on career development of individuals and organization.

The educational institutions in the order of IIT/NIT/ Universities where the staff of Electrical Engineering Department is active should be identified for carrying advanced research and identifying as centres of excellence in specific fields.

Changes at graduate and post-graduate curriculum to create opportunities for getting exposed to all aspects of Generation, Transmission, Distributions and other areas of power sector is suggested.

6.10 R&D POLICIES AND GUIDELINES

With the opening up of the Indian market, foreign companies are now allowed to set up their own 100 percent subsidiaries and tap the domestic market demand. Technology transfer was considered to be one of the most important benefits of permitting FDI into a country. This is however not happening. International technology leaders are not willing to share technology with Indian companies and insist on “business sharing” approach. Hence, it is becoming difficult to purchase state-of-the art technologies. In this context, following issues need to be addressed at policy level:

(A) Corporate R&D

The Planning for R&D should commence with the Corporate R&D policy of the company which every CPSE must have. This Corporate R&D policy should align itself with the Company’s Vision and Mission. The Corporate R&D policy should also have IPR policy for protection, maintenance of IP generated.

Based on the R&D policy, the CPSE must develop R&D manual and R&D plan. R&D plan should contain long, medium and short term plans as per need and have clearly earmarked objectives, scope, expenditure, benefits expected, deliverables, time periods etc. It may also include details of expected tax benefits. To achieve the objectives and goal, it is necessary to prioritize R&D projects depending on the benefits that are likely to accrue.

R&D plans should also contain details about implementation as well as procedures and methodologies for monitoring results and modalities of concurrent and final evaluation. It should also specify about mandatory documentation of the R&D efforts as well as results achieved. It should also include plan for obtaining / maintaining recognition of its R&D center with DSIR, so that applicable tax / duty benefits can be claimed by CPSE.

R&D plans shall contain projects to be undertaken. The target to be achieved against each project should be clearly defined. The plan should clearly specify:

- Projects to be undertaken;
- Activities to be undertaken for each project;
- Budget allocated as a percentage of PAT;
- Responsibilities and authorities defined;
- Major measurable and perceivable results expected;
- Knowledge management systems and HR issues of manpower, incentives and rewards;
- Proposed net working with academic/research institutions, customers and vendors.

- Projects labeled as R&D should not overlap with projects under Corporate Social
- Responsibility or Sustainable Development.

(B) Need for Domestic R & D

1. It is well recognized that domestic Research & Development is an important ingredient in self sustenance effort of the country. However, efforts being made in this regard require to be further strengthened. National Level Policy changes are needed to encourage indigenous development of technologies with focus on the following specific aspects:

    a) In the context of Power Sector, for indigenously developed products, especially those involving substantial developmental investment, the qualification requirements pertaining to equipment performance over a minimum period specified by customers like Electricity Boards, NTPC, etc. should be removed. This would enable domestic companies pursue product development, testing and marketing of indigenously developed products & systems. At the same time user's interests can be safeguarded by the product developers by way of recourse to deferred payments, extended guarantees or insurance cover to indemnify them against the risk of failure. Further, development of indigenous products must be encouraged by providing an opportunity to the developers to carryout field trials on no cost no commitment basis.

    b) To support commercialization of indigenously developed products, an acceptable mechanism/ enabling provision is needed for risk mitigation. This could be in the form of insurance scheme to cover any potential risk over and above the normal warrantees and guarantees offered by the product developer and funded through the aegis of a R&D cess.

    c) As per the Research & Development Act, 1986, as amended in 1995, a cess of 5% is being levied by Government on all payments made towards import of technology, etc. The Government should encourage R&D in capital goods sector and other critical areas of strategic importance by providing funding from this cess. Further, additional R&D funds can be created by imposing a nominal cess on the turnover of every company, on the lines of the cess on petrol and diesel for developing national highways.

    d) In certain specific areas identified for attracting FDI, policy changes are necessary to include transfer of technology to an Indian company as a mandatory condition to allow access to our huge domestic market.

    e) A few developing countries including India, Indonesia, Pakistan, Tanzania, etc. have set up a Working Group on Trade and Transfer of Technology for discussions within the WTO and have put up a draft proposal to the WTO Secretariat in Geneva. In this document, currently under discussion, it is clearly mentioned that special treatment will be given to developing countries for transfer of clean coal technology on reasonable terms and conditions and in a manner that contributes to the long-term developmental prospects of the host developing country. This must be vigorously pursued.

    f) Enunciate a clear policy to provide incentives for the commercialization of products developed through indigenous R&D efforts. The incentive could be among others, in the form of excise duty exemption at least for a period of five years from the date of commercialization.

g) Application of BIS standards in power industry to be made mandatory

h) Rationalization/acceptability of new materials by statutory authorities like IBR for boiler applications must be permitted. If alternate materials for usage not codified by ASME are available, the same should be permitted provided these alternate materials have been codified by any other international specification formulating agency or certified by reputed national laboratories that are approved by IBR.

i) Huge investments are needed in R&D, skill base development and new technologies to foster innovation. For example, research in the field of combustion process, gasification process, nano technology, high temperature steels, etc. find application in a variety of sectors like energy, automotive, ship building, etc. Such inter-sectorial innovations can be effectively steered at Government level for bringing out the synergy. Policy framework must support such research involving various sectors of industry with appropriate funding mechanism.

j) Identify and support certain high cost domestic R&D efforts of Indian companies through government funding through grants and soft loans with the purpose of establishing references for technologies/ products thus developed. For demonstration projects, a collaborative approach involving the developer, the user and the Government with appropriate equity participation could be considered. For example, BHEL has made a beginning in terms of a tie-up with APGENCO for 182 MW IGCC project. There is a need for financial support from the Government for such projects. It should also be extended to other areas like development of 765 kV transmission equipment, Advance Ultra Super Critical Technology, etc. It may be pertinent to mention here that U.S government has already extended 50% funding on such demonstration projects.

k) Consider appropriate delegation to Maharatna, Navaratna and Min-Ratna CPSEs boards for outsourcing of expert knowledge/ technology in niche areas for carrying out R&D from international experts/ institutions on exclusive basis giving consideration to quality and capability rather than price determination on L-1 basis.

C. Strengthening R&D Infrastructure

1. R&D Infrastructure at National Level needs strengthening in terms of facilities especially for type testing of prototypes with a view to minimize development/commercialization cycle. The areas to be considered for strengthening are:

a) Prototype and material development in case of special castings and forgings used in power generating equipment requires infrastructure supplementation at national level to improve their development pace.

b) Testing Laboratories in India are to be upgraded to address capacity & availability issues obviating the need for sending the equipments abroad for type testing.

c) Promote Joint endeavors of Indian companies with IGCAR, MIDHANI etc. to develop and commercialize production of prototypes.

D. **Intellectual Property Rights and Commercialization**

It has been found that Indian brain working on new technologies for multi-nationals in India are made to file patents on behalf of MNCs in India and in their country of origin and products designed, engineered and manufactured on the basis of these patents are commercialized at premium prices in our own country. A mechanism should be developed to take care of this aspect while framing the policies so as to empower the technology base of the country.

The projects executed through the scheme of NPP of MoP, the guidelines as stipulated by MoP shall be followed from time to time.

Project implementing organization shall furnish all details documents/test reports etc. as required for registration of patent. *The patent will be jointly held by CPRI and project implementing organization. All other commercial benefits will be available equally to both CPRI and project implementing organization.* CPRI and project implementing organization will jointly patent the product/Technology/process developed. The patent rights will vest with CPRI and project implementing organization.

Technology developed through the projects will be available to everyone however at a commercial cost. Transfer of technology to a third party on mutual consent between CPRI and project implementing organization, all commercial benefits, such as royalty, shall be available equally to both CPRI and project implementing organization. Royalty covering Technology transfer fees, commercial production etc. shall be decided by mutual consent after achieving key milestones.

6.11 INSTITUTIONAL AND FUNDING FRAMEWORK FOR R&D

Government should fund the R&D programmes through various schemes such as National Perspective Plan (NPP), Research Scheme on Power (RSoP). Some of them can be in collaborative mode with participation from CPSU's, Industry and academic institutes and utilities.

CPRI, NTPC, NHPC, SJVNL, PowerGrid, DISCOMs, BHEL, CSIR, Crompton Greaves, CSIR laboratories, IITs, NITs will execute the projects identified, which shall be coordinated and managed by CEA and CPRI on behalf of MoP. The financial requirements to execute the projects outlined through NPP R&D scheme of MoP are to the tune of Rs 1,500 Crores. The proposed budget requirement thrust area wise is as follows:

Sl.No	**Thrust area**	**Proposed budget in Crores**
1	Generation: Thermal, Hydro, Renewables and Distributed generation	Rs 400
2	Transmission	Rs 600
3	Distribution	Rs 150
4	Energy & Environment	Rs 50
5	Centre of Excellence: (i) Energy Storage Devices (ii) High Temperature Superconducting (HTS) technology in Power Sector (iii) Power Electronics (iv) Smart Grid Technologies	Rs 100
6	Power - Academy	Rs 200
	TOTAL	**Rs 1,500**

Out of the Rs 1,500 crores proposed for R&D, direct government grant should be to the tune of Rs 750 crores and balance can be through participation from CPSUs, Utilities and industry.

Fund requirement of CPRI

With a view to take up R&D projects under major thrust areas, and to establish new facilities and augment existing facilities the following capital projects amounting to Rs 2,668 crores is proposed.

DETAILS OF PROPOSALS

Sl. No.	Capital projects in Testing and Consultancy	Amount (Rs. In Crores)
I.	Up-gradation of Short Circuit Test facilities including Addition of 2500 MVA Short Circuit Generator	1379.00
II	Up-gradation of High Voltage/Ultra High Voltage Test facilities	79.00
III.	Augmentation of Power System, Custom Power & Electronics.	15.00
IV	Augmentation of test facilities like Energy Meters, SPV, Energy Efficiency Motor	81.00
V	Augmentation & Modernisation of Diagnostics, Cables, Capacitors, Temperature rise, Environmental test facility	109.00
VI.	Establishment of New Transmission Tower and Seismic Test Facility	150.00
VII.	Augmentation of existing testing Regional Testing Laboratories at Kolkata & Guwahati and Establishment of new Regional Testing Centres	420.00
VIII.	Infrastructure improvement for Business Development and Protection	32.00
IX.	Setting up of Advanced Research facilities like Superconductive Technology, Nano, Super grid laboratory etc.	253.00
	Research & Development Projects	
X.	CPRI Research Contingency (Plan R&D) projects and Research Scheme on Power (RSoP).	100.00 50.0
	Total	**2,668.00**

Thus total requirement of fund during 12th Plan for R&D works out to Rs. 4168 Crore.

6.12 PROMOTION OF R&D IN POWER SECTOR

The Standing Committee on Research and Development (SCRD), which is presently managing NPP R&D, should be strengthened and empowered to make policy document on R&D for the power sector and prioritize problems of National importance having short, medium and long term impact. This should be the apex committee for R&D of power sector. This committee should be well represented by senior executives of central R&D institutions, CPSUs, Utilities and industry.

(a) Utilities should have collaboration with research institutes so that the problems faced by them can be taken up as research work and will also have immediate application.

(b) Manufacturers should also participate and sponsor the research program relevant to power sector.

(c) The successful R&D projects should be given a wide publicity within the power sector

(d) The power sector should have joint collaboration with similar research institutes abroad to have exchange of know-how and latest methods.

The proposed 'POWER – ACADEMY' should be entrusted with complete research need of country, and shall work in coordination with SCRD. All the manufacturing firms, utilities and all concerned even remotely with power sector should be reporting their problems, R & D requirement to this academy.

The recommendations can be implemented by R&D institutions which are financially and administratively autonomous. Such institutions can draw road map for R&D for the next decade.

6.13 KEY ORGANIZATIONS TO ACHIEVE THE R&D TARGETS OF THE TWELFTH PLAN

The research projects proposed will be executed through NPP scheme of MoP, in a collaborative manner involving, CPSUs, utilities, research organizations and academic institutions as mentioned below:

1. Generation – NTPC, NHPC, SJVNL and NPCIL will be the key central agencies in the generation sector. They will be complemented by state generation companies and IPPs

2. Transmission - At the center POWERGRID will play a critical role with the state transmission and private transmission companies.

3. Distribution – The state DISCOMs will be the key agencies in the distribution sector apart from private distribution licensees and input franchisees

4. Nodal Centre for R&D: MoP through CPRI and CEA.

6.14 CONCLUSION AND RECOMMENDATIONS

1. Power Sector, being highly technology intensive, there is need to promote extensive Research and Development (R&D) in the country, especially while considering introduction of new and advanced
2. Collaborative Research in a phased manner is needed to bridge the knowledge and technology gaps, build expertise, to find solutions for the problems existing in the system and also for problems that may arise in the future.
3. Technologies such as FACTS and HVDC transmission have played a crucial role in alleviating transmission system constraints. More R&D in these area need to be promoted.
4. Special attention is needed for the development of the eight States of the NE Region of the country through a separate R&D Programme on renewable energy.
5. It is proposed to institute Scholarship schemes in some of the Engineering colleges in North East, institute Cash incentive schemes for students and encourage students to take up Masters and Doctoral Programmes in Engineering.
6. Human Resource and Competence building Development for R&D in power sector would require creating a separate cadre for research in taking up application oriented research. The success of the R&D projects will largely depend upon quality of manpower, freedom for research and continuity. Keeping this in view, special schemes such as: attractive fellowships, provision to improve qualification and exposure will be introduced, for attracting young talent and to retain them in power sector.

7. With a view to strengthen the multi disciplinary collaborative research activity amongst CPSUs, utilities, industry and academic institutions, ***Centres of Excellence (CoE)*** need to be created to take up application oriented research projects in strengthening the performance of power sector.
8. There is a need to establish ***'Power – Academy'*** in line with the 'CSIR-Academy', ISRO – Indian Institute of space science and Technology, to attract young engineers, and provide scope to build professional carrier in R&D.
9. Thus total requirement of fund during 12th Plan for R&D works out to Rs. 4168 Crore.

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Chapter-7

KEY INPUTS

7.0 INTRODUCTION

Government of India has made an action plan to provide power to all and has taken many initiatives in this direction. In order to bridge the existing gap between demand and supply and to meet the future requirements, there is a need of enhancing the installed capacity to about 275 GW by 2017. The capacity addition required during the 12th Plan is about 75,785 MW (excluding capacity addition through renewable sources) in the thermal, hydro & nuclear sector during 12th. Five year plan, details of tentative year-wise phasing are as shown at Table 7.1.

Table- 7.1

(figures in MW)

Capacity Addition - Projection for 12th plan *						
Type	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**Total**
Hydro	1370	1808	2077	2539	1419	9204
Coal	13685	12970	13555	12575	9910	62695
Gas	986	100	0	0	0	1086
Thermal	14671	13070	13555	12575	9910	63781
Nuclear	0	0	0	1400	1400	2800
Total	**16041**	**14878**	**15632**	**16505**	**12729**	**75785**

** Year-wise capacity addition plan from 'Renewable' not included*

A capacity addition of about 93,400 MW has been tentatively projected for the 13th Plan period.

Coal-based generation is expected to continue to be the predominant source of electricity in the 12th plan period and beyond. Out of the total capacity addition of 75,785 MW envisaged during the 12th plan, coal-based capacity addition is expected to be about 62,695 MW i.e., about 82.73%. Hydro, Nuclear and Gas based generation is expected to constitute about 12.14%, 3.70% and 1.43%.

Timely availability of key inputs such as equipment, material, fuel, land and water transport etc., is crucial for the timely completion of power projects. Infrastructural support such as Port facility, construction & manufacturing capabilities specifically erection machinery and erection agencies including civil and BOP contractors are also of utmost importance. This chapter gives details of Infrastructural support required for 12th and 13th Plan for the following:

- Fuel
- Transport
- Port facilities
- Construction & Manufacturing Capabilities

- Roads
- Steel, Cement, Aluminium and other material

7.1 FUEL - COAL, LIGNITE AND GAS

7.1.1 Coal

7.1.1.1 Coal Requirement

(a) For 12th Plan

Coal is recognized as the most important fuel source for power generation in India, due to its abundant availability compared to other fuels. At present out of the total installed capacity of 1,82,689 MW, coal based generation constitutes 1,00,098 MW. Coal based electricity generation is almost 81% of total generation. Coal is likely to remain the main fuel source for the domestic energy market over the next few decades. As per the projection of CEA, coal-based capacity addition at the end of 12th Plan will be 1,66,724 MW, as detailed in Table- 7.2:

Table- 7.2

Coal-based Capacity Addition / Generation & Coal Requirement Projection					
DESCRIPTION	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**
Installed Capacity [Coal based]	108029	121714	134684	148239	160814
Additions (Coal Based)	13685	12970	13555	12575	9910
Retirements	0	0	0	0	4000
Total Installed Capacity (MW) (coal based)	**121714**	**134684**	**148239**	**160814**	**166724**
Total Generation (BU)*	**690**	**783**	**890**	**1010**	**1155**
Total Coal Requirement (MT) **	**515**	**572**	**650**	**737**	**842**

** PLF considered as 82.5% for units above 200 MW and 80% below 200 MW.*

*** Including coal requirement of imported coal based stations*

Assumption: Sp. Coal Consumption of '0.73'

(b) For 13th Plan

The Capacity Addition target for 13th Plan has been tentatively envisaged as 93,400 MW out of which thermal capacity would be 63,400 MW. The coal required for the total capacity at the end of 13th Plan is estimated to be 1040 MT (against 842 MT at the end of 12th Plan).

7.1.1.2 Coal Availability

During the last 5 years (2006-07 to 2011-12) coal-based generation capacity has increased at a CAGR of 8.72% while the domestic coal production has increased at a CAGR of only 5.10%. For the 12th Plan period, the corresponding CAGR for coal based Capacity addition is likely to be at 8.97% while domestic coal production is expected to grow at a CAGR of 6.04% only. This clearly indicates a continuing shortfall in availability of Domestic Coal and calls for major policy initiatives such as opening up coal production to private sector and setting up an Independent Coal Regulator by the Ministry of Coal, besides adequate measures for substantially increasing coal production from domestic sources by CIL and its associate companies. It is also suggested that the new captive coal mines need to be allotted for competitive bidding by State Power Utilities at the lowest price of power generated instead of auctioning proposed by the Ministry of Coal.

(a) For 12th Plan

Coal availability from CIL, the major coal producer in India, is a major concern. During 2010-11, total non-coking coal production of CIL declined to 390 MT from 395 MT in the previous year. Production of Coal by CIL (Coal India Limited) and SCCL (Singareni Collieries Company Ltd.) during the last 5 years along with their projections for 12th. five-year plan period are as under :

Table -7.3

Coal Availability Projection from CIL, SCCL & Captive Blocks											
Sources	**Coal Production [Last 5 yrs.] [MT]**					**2011 -12#**	**Coal Production [12th. Plan] [MT]**				
	2006 -07	**2007 -08**	**2008 -09**	**2009 -10**	**2010 -11**		**2012 -13**	**2013 -14**	**2014 -15**	**2015 -16**	**2016-17**
CIL											
Total production	361	379	403	431	431	447	466	485	507	530	556$
For power sector	262	280	295	298	304	347*	355	364	381	410	415
SCCL											
Total production	37	41	44	50	51	52	52	52	53	55	57
For power sector	27	29	30	34	33	33	34	34	34	35	35
Captive Blocks @											
Total production	18	21	30	35	35	39	42	50	59	71	97
For power sector	10	13	21	26	25	28	29	31	31	35	49

*# Targeted @Data from Coal Controller * Coal dispatch plan of CIL*

$ Target for coal production agreed by CIL under optimistic scenario is 615MT.

Based on the above projections given by Coal India Ltd. and SCCL, availability of coal from indigenous sources by the end of 12th Plan for Power Sector will be only 450 Million Tonnes against a total requirement of 842 Million Tonnes including requirement of imported coal based power plants. Considering an optimistic production of 100 Million Tonnes from captive coal mines the total domestic coal availability is projected to be 550 Million tonnes which still leaves a short fall of about 292 MT of coal from domestic sources. If 10 to 15% blending with imported coal is considered, about *55 to 82 MT imported coal eqvt to 83 to 115 MT domestic coal would be required.* Considering another 54 MT of domestic coal equivalent required for imported coal based plants, there shall still be a shortfall of about *155 MT (for 10% blend) or 115 MT (for 15% blend)* from domestic sources.

Thus CIL / SSCL will have to increase domestic coal production to ensure supply of at least 565 to 605 MT from their mines.

(b) For 13th Plan

The coal availability from CIL & SCCL is expected to be about 553 MT considering 70% of CIL/SCCL production for the power sector. Additionally about 250 MT of coal is expected to be produced from captive coal blocks and about 80 MT will be imported by the developers of imported coal based plants. Thus there will be shortfall in coal availability to the extent of 160 MT which will have to be met through imports. This only emphasizes the need for a quantum increase in domestic coal production on a sustained basis in order to meet the country's Power Capacity addition targets in the 12th and 13th plan periods.

7.1.1.3 Coal Reserves

Since coal is our major source of energy and would remain the mainstay of future energy requirement, coal production needs a boost. And, to facilitate enhancement of coal production, there is an urgent need to accelerate exploration activities for finding out coal reserves in our country. A total of 276.81 billion tonnes of Geological Resources of Coal have so far been estimated in the country as on 01.04.2010. Hard coal deposit spread over 27 major coalfields, are mainly confined to eastern and south central parts of the country. Over the past 5 years, coal consumption has grown by around 6% in a restricted supply scenario, whereas addition in coal reserves in the Indicated and Proven category has been still low of around 2.01 % & 2.58 % respectively (As shown in Table 7. 4).

Table – 7. 4
CATEGORY OF COAL RESERVES & ITS GROWTH

(MOC Coal statistics 2009-10)

Reference date	CATEGORY OF COAL RESERVES							
	Proved		Indicated		Inferred		Total	
	Qty. [MT]	Y-to-Y Growth (%)	Qty. [MT]	Y-to-Y Growth (%)	Qty. [MT]	Y-to-Y Growth (%)	Qty. [MT]	Y-to-Y Growth (%)
1/1/2002	87320		109377		37417		234114	
1/1/2003	90085	3.17	112613	2.96	38050	1.69	240748	2.83
1/1/2004	91631	1.72	116174	3.16	37888	-0.43	245693	2.05
1/1/2005	92960	1.45	117090	0.79	37797	-0.24	247847	0.88
1/1/2006	95866	3.13	119769	2.29	37666	-0.35	253301	2.20
1/4/2007	99060	3.33	120177	0.34	38144	1.27	257381	1.61
1/4/2008	101829	2.80	124216	3.36	38490	0.91	264535	2.78
1/4/2009	105820	3.92	123470	-0.60	37920	-1.48	267210	1.01
1/4/2010	109798	3.76	130653	5.82	36358	-4.12	276809	3.59

Against the estimated coal requirement of 842 Million tonnes (as projected by CEA), the cumulative availability of coal for this sector from CIL, SCCL and from the captive mine blocks, already allotted to Power Utilities, is estimated at about 550 Million tonnes. The detailed year-wise coal requirement vis-à-vis capacity addition during 12th Plan period, as projected by CEA, and Demand-Supply Gap Analysis of two scenarios placed are shown in Table-7.5

Table- 7.5

Coal Demand-Supply Projection for Power Sector (12th Plan Period)

					(As Projected By CEA)
DESCRIPTION	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**
Installed Capacity [Coal based]	108029	121714	134684	148239	160814
Additions	13685	12970	13555	12575	9910
Retirements	0	0	0	0	4000
Total Installed Capacity (MW)	**121714**	**134684**	**148239**	**160814**	**166724**
Total Generation (BU)	**690**	**783**	**890**	**1010**	**1155**
Total Coal Requirement (MT) ^	**515**	**572**	**650**	**737**	**842**
Likely Coal Availability [MT]					
- From CIL	355	364	381	410	415
- From SCCL	34	34	34	35	35
- From Captive Mines ***[Coal Controller's estimate]***	29	31	31	35	49
- From Captive Mines ***[CEA's estimate]***	27	38	56	76	100
Total Coal Availability *[Coal Controller's estimate]*	**418**	**429**	**446**	**480**	**499**
Total Coal Availability *[CEA's estimate]*	**416**	**436**	**471**	**521**	**550**
Qty. (MT)	**-97**	**-143**	**-204**	**-257**	**-343**
Demand-Supply Gap *[Considering coal from captive blocks as per CEA's estimate]*					
Qty. (MT)	**-99**	**-136**	**-179**	**-216**	**-292**
Coal requirement for imported coal-based Projects - to be arranged by Project Developers [MT]	***-23***	***-44***	***-51***	***-53***	***-54***
Additional imported coal required to meet the demand-Supply Gap [domestic equivalent] [MT]	***-76***	***-92***	***-128***	***-163***	***-238***
Additional equvt imported coal required [MT]	**-51**	**-61**	**-85**	**-109**	**-159**
Imported Coal Requirement for blending with domestic coal to meet the shortage[domestic equivalent] [MT]					
- at 10% blending	***62***	***65***	***71***	***78***	***83***
- at 15% blending	***94***	***98***	***106***	***117***	***123***
Demand supply gap after import of coal [domestic equivalent] [MT]					
- at 10% blending	***-14***	***-27***	***-57***	***-85***	***-155***
- at 15% blending	***18***	***6***	***-22***	***-46***	***-115***

\# *Total coal based capacity expected at the end of 11-12 : 108029 MW*

^ *Including coal requirement of imported coal based stations, Sp. Coal Consumption of '0.73'*

The total quantity of coal to be imported for power generation by utilities works out to about 91MT for 10 % blend and 118 MT for 15% blend. Impact of additional burden due to cost of imported coal on Generation companies needs to be considered apart from development of necessary Port and Railway infrastructure to handle such large quantities of imported coal. The responsibility for importing coal to meet the gap in supply from domestic sources shall be entirely of CIL and the issue of coal price pooling also needs to be addressed by MoC/CIL, in line with provisions of National Coal Distribution Policy. With regard to washing of coal it has been suggested that cost of washed coal should be based on actual cost of washing instead of import parity as proposed by CIL. The issue of utilisation of rejects from coal washing plants is also to be addressed.

7.1.1.4 Strategies for improvement of domestic coal production

- **<u>Use of State-of-the art technology for improvement in efficiency & productivity in coal mines and related Policy changes</u>:**

  To facilitate adoption of State-of-the-art International coal mining technology, high output – high efficiency HEMM, new technology in Mine Safety, etc., further liberalization of import policies by the Indian government is needed. In addition to it, Coal Sector may be given "Infrastructure Status" with 'Tax Holiday' & Duty exemptions. Alternatively, the concept of Mega Project may be introduced in the coal sector also by according Mega Status to Coal Mines of production level of 5 MTPA or above and providing benefits of tax / duty concessions.

- **<u>R&R Policy for Coal Mining Industry</u>:**

  Resettlement and rehabilitation policy needs to be evolved to protect the livelihood of project-affected people. To bring in clarity and uniformity – Nationwide, a uniform R&R policy needs to be formulated which should be adopted by all coal producing companies in India. With increased use of state-of-the-art technology and sophistication, more automation & computer control in coal mining operation, less manpower deployment will be required in the new mines and thus there will be less job opportunities. So, while formulating National R&R policies for coal mining, this aspect may also be looked into and suitable alternatives, beneficial for upliftment of livelihood of the displaced persons, may be agreed upon. Moreover, in order to avoid erosion of land compensation amount by the land oustees in a short span, a suitable mechanism like Interest-carrying deposits of land compensation amount – part or full in a suitable fund created by the mine owner, issuance of Bonds, etc., may be explored.

  Unlike other industries, coal mining industry does not require establishment of permanent fixtures over the entire acquired land, hence the some of the land, after mining, can be used for cultivation with proper development like earth-filling & putting in of fertilizers, etc. R&R Policy for Coal Mining may look into another dimension like taking of agricultural land from local people on term-lease & returning of land to the extent possible in an area where mining operation is completed after proper development of that land so that cultivation can again be done. The Agency/Organization, engaged in coal mining in a particular block, will remain responsible for development & return of the land.

- **<u>Expeditious clearances for development of Coal Mining Projects</u>:**

  Govt. support in terms of simplified procedures and single-window approach for granting of various clearances and permissions, including environmental clearance, faster investment decisions, closer coordination between the Centre and the State Govt. agencies etc. would be needed for speedier execution of coal mining projects.

- **<u>Captive Coal Mining</u>**

  Coal production, modernization and efficiency improvement would depend on the level of competition in the industry. Mobilization of the requisite investment in coal mining also reinforces the need to induct more players from both the public and private sectors. The introduction of new players in the coal sector would be beneficial to the sector as a whole and is considered essential. It would also be essential to gradually increase the production through captive mining of 40 to 50 % of the total production of the country. Reputed International Coal Mining Companies may be encouraged to come to India for development & operation of coal mines which will facilitate introduction of latest mining technology & mine safety measures

- **State Governments must become partners in development of coal**
  i. There is a need to incentivise states from mining operation.
  ii. Before the allocation of blocks, concerned Sate Govt. may be consulted with and made party to it, as mining of coal in their States would directly and indirectly benefit that particular state.
  iii. In mineral rich states, a separate cell may be made operational for land acquisition process, processing of proposal related to environment and forest clearance (Single window approach through MOU), etc.
  iv. Coal-bearing states, in addition to Royalty, are demanding additional benefits. This issue needs to be resolved early.

- **Special Task Force for monitoring the progress of project implementation**

  A special Task Force may be in place for periodic review & monitoring of the progress of coal mining projects. It will prevent any slippage, help in clearances / approvals and ensure timely commencement of production of coal. Such monitoring & status reporting must be done in a transparent manner and in electronic form.

- **To ensure adequate exploration of coal mines and reliability of estimates of extractable reserves**

  It is needed to speed up our efforts to accelerate the pace of regional surveys and drilling to complete the comprehensive coal resource assessment exercise. Therefore, there is a need to enrol more specialist agencies to conduct exploration of blocks and prepare GRs, so that production from blocks can start in a timely manner.

- **Commercial coal mining by private sector**

  The need to provide adequate investments in coal mines, conserve coal reserves ensure mine safety and environmental protection and to assure decent living standard for the coal labour was the basic reason for nationalization of coal mines during 1971 and 1973.

  In this regard, Coal Mines (Nationalisation) Amendment Bill, 2000 is a step towards promoting liberalisation in the coal sector. It will also address the need for augmenting coal production in the country through wider participation of private coal mining companies. The proposed amendment bill is pending for long time to be expedited

7.1.1.5 Strategies for Mitigation of demand supply gap of coal

7.1.1.5.1 Import of coal

Based on the demand-supply mismatch of domestic coal, as experienced in 11th Plan period, non-coking coal has to be imported to meet fuel requirement of existing coal based capacities and capacity addition during 12th Plan. As per the demand-supply analysis of domestic coal, done above, import of non-coking coal equivalent to around 340 MTPA of domestic coal by the end of 12th Plan period is needed to meet the demand of power sector. The present port capacity can handle around 55 MT of thermal coal and would need to be augmented to meet the rising coal import forecasted. Further, imported coal can be used as a blend with the domestic coal to substitute requirement of washed coal, which is required for Power Stations to adhere with MoEF's stipulation. Such a situation would also ease the problem of handling washery rejects. However, high cost of imported coal will have adverse impact on the power tariff.

Impacts of high import of coal for power sector:

- ***Impact on Power tariff:*** The price of imported coal has witnessed a steep increase of around 75 percent in the last financial year. It has resulted in an increase in the price of electricity in the range of 30 to 80 paisa per KWh depending on percentage of blending carried out with domestic coal. Due to this fact, the variable charges of electricity touched more than Rs 3 in some of the stations. The Financial health of most of the DISCOMs / SEBs is not good and import of coal will be a further burden on them. DISCOMs / SEBs are in-fact reluctant to draw such costly power.
- ***Impacts on boiler design efficiency:*** It is not possible to blend more than 15 to 20% of imported coal as boilers are designed for Indian coal and this may lead to technical difficulties during the operations of power stations.
- ***Logistic problems:*** As the quantum of coal import are going to reach 120 Million Tonnes by 2016-17, but Ports and Railways are not equipped to handle such huge quantum of coal. Port Rail infrastructure will require to be augmented.
- ***Impact on foreign exchange reserves:*** There will be substantial outflow of the country's foreign exchange reserves. Based on present CIF price of coal, import of 120 million tonnes of coal will result in annual out flow of foreign exchange of Rs. 72,000 Crores.
- ***Sustainable long term contract***: Most of the coal is imported from countries like Australia, Indonesia and their tax regimes are under review. This may lead to uncertainty in long term contract price.

Regarding imported coal, following are suggested:

- To enhance the import of coal, infrastructure at ports to be strengthened to receive large ships and to handle required imported coal quantity.
- Logistics, Railways in particular, needs to be augmented, for movement of imported coal from port to power stations.
- Power plants may be designed to operate with high blending of imported coal. CEA has already issued guidelines for designing all future plants for 30% blending.
- Construction of more costal power plants to operate on imported coal to be encouraged, however, required policy changes be made to address risks of sourcing countries.
- Making 15-20% blending with imported coal.

7.1.1.5.2 Coal price pooling:

The concept of pooling of price of domestic and imported coal is necessitated due to the fact that the production of domestic coal is not increasing commensurate with the requirement of coal for power stations which are existing and are being planned, based on domestic coal. Most of the new Power Utilities would be required to import coal to bridge the gap between their requirement and availability of domestic coal.

Coal for thermal power plants is predominantly being imported from countries like Australia and Indonesia which has a high Calorific Value ranging from 6000-6500 Kcal/ Kg with low ash content. Major ports for import are Mundra, Vizag, Gangavaram, Ennore, Tuticorin, Pipavav etc. Transportation cost from these ports to power plant site which are not in the coastal region or not in the state where these ports are located may be as high as Rs. 1500 per tonne.

Coal for the Power Utilities in the country is being transported by Indian Railways and most of their routes are already facing congestion due to heavy movement of traffic. There is cross movement of coal from port to Power Utilities located in Central India and from domestic coal mines to Power Utilities located in coastal or adjoining areas. This is causing duplicate movement of coal rakes and causing unnecessary expenditure on freight and avoidable overloading of Indian Railways network and creating other logistic problem. Transporting coal from such a long distance also increases transit loss thereby reflecting in the bottom line of generating utilities. Since the fuel price is generally pass through in the tariff, higher freight charges will certainly increase the tariff resulting in higher cost of electricity to the consumers. The situation thus needs to be rationalized to the extent feasible.

A solution to this problem could be the allocation of coal to Power Utilities from the nearby coal source to the extent possible to minimize transportation cost. Power Utilities located in coastal areas may be asked to use larger chunk of imported coal being nearest to the port subject to design limitations. Most of the coal mines of Coal India Ltd. are located in Central India giving almost an equal distance of coal transportation from coal mine to a majority of Power Stations. Therefore, the Power Utilities which are at a larger distance from ports may be allocated coal from the mines of Coal India only and be asked to use imported coal only in the case of shortfall to avoid unnecessary double movement of coal rakes.

It is accepted fact that the cost of imported coal is higher than domestic coal even after accounting for its higher GCV, at present rate it is almost two and half times costlier than domestic coal on heat value basis. This could be a deterrent to the Power Utilities at coastal areas which would be asked to use a higher chunk of imported coal as it will increase their cost of generation.

A case, therefore, exists for importing coal to bridge the gap between requirement and availability of domestic coal and the cost of the same to be equitably borne by all the power utilities. It may however be mentioned that the concept of pooling cost is to be applicable to power stations designed for domestic coal only. Imported coal based stations and stations linked to dedicated coal blocks are not to be considered in this pooling mechanism.

Pooled price is to be evaluated based on the heat value(Rs/Kcal) of the coal. CIL shall be responsible for importing coal and levying the pooled price on the various power utilities. This is reasonable in view of the fact that the New Coal Distribution Policy stipulates that CIL is responsible for meeting 100% of the normative requirement of coal of the power utilities, and import of coal may be resorted to the extent required.

7.1.1.6 Other strategies recommended for sustainable fuel supply to power projects

7.1.1.6.1 Demand side management of Coal

All the new units planned in12th plan (excluding which are already under construction) thrust to be given for super critical technology, which will result in saving of about 5-8 % of fuel requirement and correspondingly less emission. As, coal is increasingly becoming a scarce resource, India’s long term fuel security depends on its efficient utilization. In order to optimally utilize coal, efficient coal consumption (heat rate and auxiliary consumption) norms be used for according linkage (FSA).

7.1.1.6.2 Coal Linkages needs a holistic review

Coal supply sources & existing coal linkages for various Power Stations across the country need proper mapping & rationalization for easy transportation, quick movement, etc. While working out short-term linkages of coal to existing power stations as well as long-term linkages for future power projects, there is a need for broader review of all old Long Term Linkages by the representatives from Ministry of Coal, Power, Railways, Shipping and major Coal producing & Power generating companies, for evolving appropriate mechanism to correlate the coal production plan from mines of a particular zone with the zone where the Power Station / Project is located to ensure optimal coal movement and its utilization.

7.1.1.6.3 Regular meeting of Standing Linkage Committee(Long Term)

- The linkage of coal for 12th five-yr plan projects have not yet been granted so far, as such it will be difficult to achieve the generation target, as the project gestation period is not less than 4 years from the date of award of order for execution of the project, besides, the time required for getting environmental clearance after grant of coal linkage. Long term linkage of coal to all the projects of 12th Five Year Plan already recommended by the Ministry of Power, Government of India needs to be accorded. However, MOC may review the progress achieved by existing LoA awardees, thoroughly and may cancel LoAs where projects have failed to achieve requisite milestones.
- SLC(LT) meeting must be conducted regularly to address the grievances of coal consumers and resolution of dispute.
- This meeting should also review the implementation of decisions taken in the previous meetings.

7.1.1.6.4 Concerns Regarding New Coal Distribution Policy(NCDP)

- Coal India Limited is pursuing Power Utilities for signing of FSA for new units commissioned in year 2009-10 & after, with trigger value of 50% of ACQ quantities in stead of existing trigger value of 90% of ACQ. In this condition, the Fixed Cost Component of generation cost will increase as with 50% coal availability, the generation will also be at around 50% thereby the Fixed Cost will get distributed on power generated at 50% PLF as against at the normative level of PLF as determined by the Electricity Regulatory Commission. Besides the operation of units at lower PLF will increase the Station Heat Rate & auxiliary power consumption. This will also increase the variable cost of generation. If the imported coal is used to maintain the PLF as specified by Regulatory Commission to recover 100% Fixed Cost, the Variable Cost of generation will be very high. The net impact in either case will be of the order of 60-70 paisa per KWH.

- ACQ level be determined at 90% PLF level for all power plants. Uniform trigger level of 90% of ACQ be set across all power sector consumers such that coal is uniformly supplied to all the consumers and a level playing field is maintained among power sector generators.
- Given the supply deficit scenario and monopolistic nature of domestic coal market, it is essential that CIL treats all the projects on the same platform, irrespective of vintage of the plant or ownership structure, while determining ACQ levels and agreeing on trigger levels for penalty for short-supply.
- Efficiency norms to be used for all plants and such norms to be reviewed by an independent expert body (CEA or CERC).
- **New linkages to be given only to higher operating efficiency project- with super critical/ ultra super critical technology. It is recommended that during the 13th Plan, new power plant based on sub-critical technology should be an exception.**
- The LOA along with milestones has been finalized without the involvement of consumers and LOA does not guarantee the supply of coal and there is no firm commitment for supply of coal by coal supplier.
- The Coal India has specified number of milestones for execution of the power projects for commencement of coal supply. The Coal India should restrict to the major milestone of commissioning of the unit on oil firing. The Coal India should also bind themselves with their milestones to give confidence to the power developer that they will get the assured supply of coal immediately after synchronization of their unit on oil to secure their investments.
- Difficulties in submission of documentary proof for achievement of milestones :
  - ***Forest Clearance***: Coal Companies insist for NOC from State Forest Authority even when no forest land is involved for the project.
  - ***Commitment of Equity Investment:*** In some organisations, projects are financed in the equity: debt ratio of 30:70. No separate proposal for the equity investment is approved by the board, only investment decision is approved. Coal companies are not accepting extract of the annexure from the agenda.
  - ***Financial Closure***: In some companies, the loans are tied up on the strength of balance sheet; project specific loans are not tied up. As such there is no financial closure of individual project, which is not acceptable to coal companies.
  - ***Land Acquisition:*** Coal companies accept only Land Registration/ Transfer Deed/ Land Lease Agreement as documentary proof for completion of Land acquisition milestone. The list of documents as proof for land acquisition must also include possession Certificates/ "dhekal dhakani" forms/ "khatoni"/final compensation award letters.
- The Coal India should delete the clause of operation of Commitment Guarantees in case the power developer fails to achieve milestones. If Coal India desires to retain the clause for encashment, then they should encash the Bank Guarantees of power developer only when

Coal India is having sufficient coal with them. If Coal India is short of coal supply then they should not operate the Guarantee.

- No material changes should be made to the FSAs that existed at the time of announcement of NCDP. While there can be changes in the operational aspects, there cannot be changes in key risk parameters such as quantity, period of the agreement, quality, price, etc.
- A statement of cumulative contractual obligation of CIL, SCCL and their subsidiaries may be prepared. A framework may be developed for recommending issuance of a LoA. An essential input in this framework should be the existing cumulative contractual obligation of coal companies.
- FSA provisions may be revised in terms of:
  - Quantity Obligation: Minimum quantity obligation to be close to ~90% of the ACQ. Compensation for short supply/failure to lift the coal should be increased to 50% (from current 10%) of the base price of the coal.
  - Term: Term of FSA should be minimum 25 years, commensurate with useful life of power project.
- Consistent with stipulations of NCDP, subject to agreement by the buyer, CIL should import coal and meet its responsibility under FSAs.

7.1.1.6.5 Augmenting crushing of coal at mine to facilitate evacuation of Pit head coal

Due to inadequate crushing facilities almost about 50-60 million tone of coal is lying at Mine head. This Coal is getting deteriorated with time. Further loading of uncrushed coal also leads to unloading problems at plant and large rake detention time. To address this, crushing facilities needs to be augmented at mine end.

7.1.1.6.6 Use of washed coal

Use of washed coal should be encouraged as far as possible. It will save in transportation cost by preventing hauling unnecessary ash and this will increase the carrying capacity of rakes. Use of washed coal also addresses the problems of oversize coal and quality, being faced by power producers. Consumer gets consistent quality of coal and increases generation of the plant and Environment gains due to reduced ash, particulates, CO_2 emission. Use of washed coal is beneficial in terms of less maintenance of plant, less coal handling, less ash handling, less ash dyke area requirement, etc.

In this direction, CIL has come out with a tender for setting up of 20 washeries with a capacity of 111.1 MTPA on Build-Own-Maintain (BOM) basis. With these efforts, the capacity of coking coal washeries of CIL will increase from the existing 22.18 MTPA to 43.28 MTPA and the capacity of non-coking coal washeries will increase from the existing 17.22 MTPA to 107.22 MTPA. CIL intends to wash 90 per cent of the coal produced from new mines developed during the XII Five-Year Plan (2012-17).

MoEF has proposed an amendment to notification for use of beneficiated/ blended coal with less than 34% ash making it mandatory for projects located beyond 500 km from mines (presently it is beyond 1000 km). CIL will need to ensure adequate number of washeries to meet this stipulation before it is implemented. The cost of washed coal should be on the basis of actual cost and not on import price parity. For utilization of washery rejects, reject based power plants may be considered wherever techno-economically viable.

7.1.1.6.7 e-Auction of coal

As per NCDP, around 10% of total domestic coal production is allowed for e-Auction by CIL. It is to be ensured that before offering 10% quantity, FSA/MOU commitments are met with. The issue of rail connectivity to such mines from where coal for e-auction is sourced should be taken up immediately.

7.1.1.7 Coal Regulator

A need is being felt for long to institute an independent regulatory body to regulate the upstream allotment and exploitation of available coal blocks to yield coal, coal bed methane, coal-to-liquid and for in-situ coal gasification. The proposed Regulatory Body, as an interim measure, may approve coal price revisions, ensure supply of coal to the power sector under commercially driven long-term FSAs, facilitate the development of formulae/indices for resetting coal prices under long-term fuel supply agreements, monitor the functioning of the proposed e-auctions, ensure that the price discovery through e-auctions is free of distortions, regulate trading margins, develop a mechanism for adequate quantities of coal imports under long-term contracts to bridge the gap between supply and demand thereby assuring that the e-auctions and consequent price discovery does not take place in a supply constrained market and, finally, create the environment for a competitive coal market to operate.

Once a competitive market is developed, the role of Regulator in determining the prices would be to ensure a free and transparent market for coal. The Regulator must ensure that mines are planned, designed and developed in a scientific manner giving due importance to coal conservation thereby maximising percentage of coal recovery from geological blocks.

The Regulator must standardise norms of operation, establish benchmarks and ensure that coal companies raise their level of competence to be at par with international standards. The proposed Coal Regulator should also be entrusted with following aspects of coal mining:

- Coal Resources Management
- Safety, Health, and Employment in coal mines
- Prices, Taxes, Royalty, Value Added Tax, Property Tax, and Salary of Workers
- Environment Management
- Policy-Legal, Public Relations, Statistics, and Dispute Resolution
- Recommendation to CIL for issuance of LoAs
- Approval of mine plans including mine closure plans
- Optimization of current linkages to minimize Rail/Road transportation
- Oversight role on captive coal block auctions
- Dispute resolution - primary forum for :
    - dispute resolution among entities;
    - entities aggrieved due to decisions given by MOC/MOEF relating to mine closure, etc.

7.1.2 Lignite

Lignite reserves in the country have been estimated at around 40.9 Billion tonnes, most of which is found in the state of Tamil Nadu. About 82 % of the Lignite reserves are located in the State of Tamil Nadu & Pondicherry. At present only a small percentage of the total reserves of lignite have been exploited. Considerable scope remains for the exploitation of the lignite reserves and use of lignite in thermal power stations subject to cost-economics, particularly in the states of Tamil Nadu, Rajasthan and Gujarat having the limitations of transportation of coal to these regions. State-wise distribution of Lignite resources, Lignite Demand & Production Plan by M/s. Neyveli Lignite Corporation Ltd. (NLC) and Lignite Demand & Production Plan by State Electricity Board are shown in Table- 7.6 to 7.8

Table– 7.6
State-wise Lignite Reserves

State	Total[MT]
Tamil Nadu	33309.53
Rajasthan	4835.29
Gujarat	2722.05
Jammu & Kashmir	27.55
Others (Kerala, West Bengal)	11.44
Total	40905.86

Table -7.7
Lignite Demand & Production Plan by M/s. Neyveli Lignite Corporation Ltd. (NLC)

Item	2012-13	2013-14	2014-15	2015-16	2016-17	12th plan
Demand(MT)	25.60	26.12	25.91	25.37	27.26	**130.27**
Production (MT)	26.01	26.01	26.01	26.01	27.29	**131.33**
Demand-Production Gap (MT)	**0.41**	**-0.11**	**0.10**	**0.64**	**0.02**	**1.05**

Brief year-wise anticipated demand & production plan of Lignite by other State Electricity Boards and private companies (other than NLC) during 12th five year plan period are shown below (TABLE 7.8).

Table 7.8
Lignite Demand & Production Plan by State Electricity Board

Item	2012-13	2013-14	2014-15	2015-16	2016-17	12th plan
Rajasthan Rajya Vidyut Utpadan Nigam Limited						
Demand(MT)	8.4	8.4	10.5	10.7	10.7	**48.7**
Production (MT)	5.4	6.1	10.6	13.1	13.1	**48.3**
Demand-Production Gap (MT)	-3	-2.3	0.1	2.4	2.4	**-0.4**
Gujarat Industries Power Company Ltd.						
Demand (MT)	3.6	3.6	3.6	8.1	8.1	**27.0**
Production (MT)	3.6	4.2	5	8.4	8.4	**29.6**
Demand-Production Gap (MT)	**0**	**0.6**	**1.4**	**0.3**	**0.3**	**1.4**

- Immediate steps needed to augment lignite production considering large reserves of lignite in the country. The technology issues for efficient utilization of lignite resources need to be addressed.

7.1.3 Gas

As domestic gas is on the decline and international gas prices remain high and volatile, financial viability of gas-based power projects is a matter to re-think. A gas-based power plant makes sense over a coal based plant if landed gas cost remains below or at US$7 per mmbtu. If the gas prices rise above US$ 10-US$ 12, it leads to unviable economics for the power sector. In last one year, the spot natural gas prices have risen by 50%. This has turned power generation companies averse to the use of spot LNG. Unless new discoveries are made and exploration happens, new gas based capacities may not be considered.

- There is need for promotion of new gas based capacity in the country (at least 20,000 MW during 12th Plan) due to inherent advantages of gas power plants and also to reduce our carbon footprints.
- Presently gas based projects totaling to about 13,000 MW are already under construction. These projects can be commissioned during 11th Plan/early 12th Plan, if gas is made available.
- Gas supply to be made available for at least 20,000 MW new Capacity in the 12Th Plan.

7.1.3.1 Need For Capacity addition through Gas based stations

Load profile in the country and the role of gas based power in addressing the requirements reliably:

CERC has encouraged setting up of peaking capacities by prescribing peaking tariffs for different category of plants including pumped storage schemes. Hydel projects have taken much longer gestation period for development and construction and as a result hydro power share in the country's generation capacity mix has continuously slipped. It is in this context that gas-based generation can play an important role in meeting peak/intermediate load requirements far more reliably compared to other available options.

Shorter construction periods

Gas-based power plants can be constructed in a much shorter time-frame of 18-24 months relative to longer construction timelines involved in coal and hydel projects.

Lesser strain on resources – land and water:

Gas based plants require lesser land and water as compared to coal based plants or hydro capacities, where there is a possibility of large-scale people displacement.

Considerable environmental benefits relative to coal-based power:

Gas-based power is considerably cleaner when compared to coal-based power. CO_2 emissions from a modern combined cycle gas turbine (CCGT)/ combined cycle gas engines (CCGE) are only 0.35 kg/kwh in contrast with 0.83 kg/kwh from a 660 MW super critical unit.

Diversification of fuel supply / energy security risks:

Availability of domestic natural gas, though anticipated to increase substantially post commencement of production from KG-D6 gas finds, has declined in the recent months. However, a calibrated approach in gas-based capacity addition combined with the adoption of appropriate policies in the natural gas sector, still makes sense to diversify fuel supply risks resulting from excessive dependence on coal. Even if part of gas requirement is to be imported as LNG, it provides diversification of source countries from where energy is imported, thereby providing diversification of energy security risks.

7.1.3.2 Policy changes to be adopted to encourage gas based capacity addition

- Policy initiatives to incentivize gas based plants including Combined Heating & Cooling plants having high efficiency.
- Mandatory purchase of gas based power by DISCOMs and priority for gas allocation to CCHP plants.
- Constitution of task force under CERC to address issues related to setting up of Peaking and Reserve Plants.
- However, In the interest of consumers and in view of present financial health of DISCOMS, fixation of purchase obligation for gas based projects similar to RPO may not be tenable.
- Standard Bidding Documents (SBDs)– need to be adapted for gas-based power.

  - Duration of PPA: Duration of PPA is kept at 25 years, it needs to be brought down to 15-18 years, keeping in mind economic life of gas-based power plants. Further, normally gas is allocated for 5 Year period, as such signing of PPA need to be facilitated for 5 year period, to be reviewed from time to time in line with extension of gas allocation period upto the economic life cycle of 15-18 year of the plant.
  - Fuel risks pass-through: Current domestic and international market environment for natural gas suggests that there are far too many uncertainties with regard to availability and/or price of natural gas. Developers are not ideally placed to take those risks. Therefore fuel availability and price risks need to be borne by the procurers.
  - Take-or-Pay risk pass-through: Gas supply contracts are characterized by high level of Take-or-Pay obligations on fuel buyer. PPA needs to be suitably amended to alter current level (relatively low) of minimum off-take guarantees to suitably higher levels. It also needs to be ensured that gas-based plants do not face dispatch risks during their intended hours of operation (peak/ intermediate load).
  - Capital cost and heat rate under competitive bidding scope: Bidding would therefore be primarily on competitively discovering capacity charges and conversion (net heat rate) efficiencies.
  - Technical requirements for intermittent or peaking application: Bid invitation should specify these requirements as the very nature of application would influence the choice of fuel and technology. These are –
    - Capable of number of stop / starts in a day in other words to operate on Load Follow Principle
    - No effect on maintenance due to multiple stop / starts
    - 5 to 10 minutes time from start up to full load
    - 5 to 10 minutes shut down time from full load to zero
    - Black start capability

- No effect on efficiency due to part load operation of the plant
- High availability - >94%

7.1.3.3 Fiscal benefits to Gas based peaking plants:

Gas based peaking power if integrated into the total electricity generation system can lead to carbon reduction efficiencies even higher than renewables like wind or solar power. Hence it is suggested to extend the fiscal benefits to gas based peaking power projects at par with the renewable energy projects or Ultra Mega Projects. Specifically, zero customs duties & taxes and interest rate subsidy.

7.2 LAND & WATER

7.2.1 Land

Land acquisition in recent times has become a critical issue for the project developers. Land is increasingly becoming a scarce resource and availability of land is posing a serious challenge for future power plants. Problems have been compounded due to demand from other competing sectors and resistance from local population/ land owners. The optimum utilization of land has therefore, gained significance and in coming times challenges are to be encountered in land usage practices.

As most of the 12th Plan Thermal Power Projects (62625 MW out of total 75715 MW) are already under construction, land has already been acquired and only about 1300 acres is still left. For Hydro Projects also, no serious issue is understood to have been raised by developers.

7.2.1.1 Land Requirement for 13th Plan Thermal Power projects vs land availability

Tentatively, the capacity of thermal projects envisaged for 13th plan is expected to be of the same order as in the 12th plan for which nearly 64000 acres of land will be required.

7.2.1.2 Issues of concern

The issues that come in the way of land acquisition are mainly related to land records, forest clearances and R&R issues as listed below:

i) *Lack of land Records*: The lack of updated land records is the most common problem that is encountered during land acquisition. The problem gets compounded due to low average holding per person and large number of claimants.
ii) Issues related to compensation, price of land to be paid increases with scarcity.
iii) Lack of clarity about the status of occupiers who are not owners.
iv) *Right of way (ROW) for Ash/Water pipelines, coal conveyors and transmission lines*
v) Resistance from local people
vi) *MOEF clearance and acquisition of forest land coming in plant area and ROW.*
vii) Resettlement and rehabilitation of the project affected people (PAP).

7.2.1.2 Hydro Power Projects

7.2.1.2.1 Land Requirement for 12th plan Hydro Power Projects vs land availability

A total 83 number of schemes have been identified which may be developed to give benefits in 12th five year plan. Out of these, 17 numbers of schemes are under construction and no issues have so far understood to have been raised by the developers. The concurrence of CEA/State Govt. has been awarded to another 28 projects totaling to about 9298MW which may give benefit in the 12th plan.

7.2.1.2.2 Land Requirement for 13th plan Hydro Power Projects vs land availability

Tentatively, the capacity of hydro projects envisaged for 13th plan is around 15000 MW, for which land will be required.

7.2.1.2.3 Issues of concern

The general issues to be addressed are related to Resettlement and Rehabilitation, targeting solutions that provide relief to the asset-less rural poor, support the rehabilitation of displaced population. The resistance from local population and NGOs is also required to be addressed in specific cases.

7.2.1.3 Power Transmission Projects

Land is required for transmission towers and associated sub-stations in any transmission system. Many of such projects are getting delayed due to non availability of land and right of way. EHV transmission lines are normally few hundreds of kilometers long which pass through plain as well as hilly terrain involving forest land, National Parks, wild life sanctuaries and other ecological sensitive areas in some stretches. While carrying out survey for transmission lines these sensitive areas are avoided but in some cases it becomes unavoidable due to the location of power generating stations. Forest clearance is a lengthy process which involves approval from State Government as well as Central Government which takes about one year time. Further, under the Scheduled Tribes and other traditional Dwellers (Recognition of Forest Rights) Act 2006, written consent of concerned Gram Sabha is necessary before the land is diverted for transmission project. Sometimes, matter is taken before the Courts by the environmental activists. The number of Gram Sabhas involved in such long lines will also be substantial and obtaining their consent under Forest Rights Act (FRA) and linking the same with forest proposal is likely to delay the forest clearance significantly. Pending the consent of all Gram Sabha's, the forest proposals are not recommended by the State Governments which delays the project start manifolds. The other requirement/ conditions for obtaining forest clearance are the payment of cost of Compensatory Afforestation on degraded forest land twice the area and payment of Net Present Value (NPV).This may affect project completion schedule. Transmission line projects may also affect wild life and its habitats for which an impact assessment is made for identifying possible corrective measures.

7.2.1.3.1 Land Requirement for 12th plan

A tentative land requirement for 12th plan indicates a land requirement of around 9403 Hectares (23240 acres) for tower footings and around 21500 acres for sub stations.

There is a need for comprehensive National policy on land acquisition/ right of way for priority sector projects.

7.2.1.4 Suggestions/ Recommendations

a) *Comprehensive National Policy*: There is an urgent need for a comprehensive national policy on land acquisition/ right of way for priority sector projects and its thorough implementation at State level, focusing on the issues of latest land records, land bank system and a uniform mechanism for land compensation and R&R issues based on a realistic Social Impact Assessment. As per the Terms of Reference of Expert Appraisal Committee on Environment Impact Assessment of thermal power and coal mine projects, an action plan for identification of local employable youth for training in skills, relevant to the project for eventual employment in the project itself shall be formulated and numbers specified during construction and operation phases of the project. Such recommendation should be included in the R&R Bill

b) *Spare land with existing plants*: Existing plants in state sector are quite old and have liberally acquired larger land. This land can be used for expansion projects by the utilities themselves or by a external agency. A rough estimate indicates a capacity addition of 8000-10000MW may be feasible through this route, with minimal land acquisition and/ or ROW issues.

c) *Higher capacity units in place of older small size plants*: A large number of small capacity units are more than 30 years old and are inherently inefficient. These could be considered for retirement/ dismantling to unlock the land, which can be utilized for higher sized/ new technology efficient units. This exercise can be initiated in 12th plan and land thus freed can be utilized for projects in 13th plan period and beyond.

d) *Relaxing of MOEF Procedures:* Office Memorandum dated 31 March 2011 issued by MoEF stipulates requirement of obtaining stage-I forest clearance before obtaining environmental clearance. To avoid delays on this account MOEF may allow earlier procedure of having parallel clearance of the both.

e) *Adoption of Higher size Units:* In view of higher efficiency and low per MW land requirement for the higher size units, it is recommended to have more number of such units in the 13th plan and beyond.

f) *Shelf of site for projects:* Prospective sites should be identified beforehand so as to eliminate delays in obtaining clearances during execution of power projects. Shelf of prospective sites of more than 300,000 MW capacity as identified by CEA for faster execution of power projects could be given a review for implementation. States should earmark lands for power projects and State Energy Department should act as nodal agency for such activity.

g) *Dissemination of project success stories to gain public acceptance:* Adequate mechanism should be developed at state/ project level to highlight the success stories related to project achievements in the field on increased economic activity of adjoining areas, innovative handling of R&R issues and the accrued positive social impact for greater acceptance.

h) It is proposed that the compensation towards the land value may be paid on a market rate basis so that appropriate value/ compensation is paid to the landowners. It is also proposed that the compensation towards crops, trees and other structures may be made through a generous mechanism.

i) Land selection in first instance shall preferably be government barren land even if its location is bit in remote and same be applied to private land. As far as feasible, emphasis should be on barren, undulated, low productivity land which may be acquired without much resistance.

j) Timing of compensation after the damage/ digging of land is very important. If guidelines are issued regarding payment of part compensation in advance i.e. before executing the work on agriculture land with a promise that balance payment shall be paid after the assessment of revenue authorities will go a long way in reducing initial resistance at site.

k) Since damages covered under the Electricity Act, 2003 and Indian Telegraph Act, 1885 has not been defined in any of the act and is open to interpretation by respective authorities based on their understanding of situation/circumstances. It is proposed to obtain opinion of Attorney General or Solicitor General of India and got it notified through MoP. Such definition of damages will be very helpful in solving the present ambiguity especially in case of Transmission lines.

l) New Technology options and best practices should be adopted for minimizing land requirement, some suggested options are:

1. Transmission line with Steel Tubular Poles could be used in place of Steel Towers to reduce the right of way.
2. Right of Way could be optimized by adopting suitable alternative of multi-circuit or multi-voltage lines as applicable.
3. Due to Right of Way constraint in congested Metro cities XLPE cables could be used for short length.
4. Gas Insulated Substations / Compact Hybrid Substations could be adopted in place of conventional substations.
5. To maximize ash utilization for optimal land requirement
6. Develop compact layout for power plants for reducing the land required.

7.2.2 Water

Water is one of the key inputs to thermal power generation and of-late the availability of water has also become scarce. As much of the new generation capacity is envisaged near pit-heads, difficulties are being faced in selection of suitable sites due to non-availability of water, particularly in coal bearing states such as Orissa, Jharkhand and Chhattisgarh. The report dwells on various technical measures for reducing water consumption including inter alia use of dry ash disposal/ high concentration disposal system, use of efficient cooling towers, dry cooling, water optimization during plant operation as well as additional measures for conserving water and mitigating water shortage for power plants. The sub-group recommends that Ministry of Water Resource must take initiative for creation of new reservoir/dams on the potential rivers so as to tie-over the water shortage.

7.2.2.1 Constraints/policy support required.

In planning, implementation and operation of a project, the preservation of the quality of environment and the ecological balance should be a primary consideration. The adverse impact on the environment, if any, should be minimized and should be offset by adequate compensatory measures. The project should, nevertheless, be sustainable. The resources should be conserved and the availability augmented by maximising retention, eliminating pollution and minimising losses. For this, measures like selective linings in the water conveyance system, modernisation and rehabilitation of existing systems including tanks, recycling and re-use of treated effluents and adoption of traditional techniques like mulching or pitcher irrigation and new techniques like drip and sprinkler may be promoted, wherever feasible. Efficiency of utilisation in all the diverse uses of water should be optimised and an awareness of water as a scarce resource should be fostered. Conservation consciousness should be promoted through education, regulation, incentives and disincentives.

7.2.2.2 Suggestions/ Recommendations

Technical measures for reducing water consumption may be adopted as below:

i) Use of Dry ash disposal/ High concentration disposal system
ii) Use of efficient cooling towers, and adoption of higher cycle of concentration (COC) / Monitoring performance of cooling towers during operation.
iii) Dry cooling in cases where water is scarce.
iv) Water optimization during plant operation.
v) Use of municipal sewage water for thermal power station to the extent feasible.
vi) Creating awareness programme for Water Foot print (consumptive water) for various modes of power generation.

- Technical measures for reducing water consumption may be adopted.
- Creation of large reservoirs/ dams on potential rivers to retain flood waters.
- Coastal power plants to be encouraged.

7.3 TRANSPORT

Transport sector plays a vital role in the growth of Power Sector. The development of different transport sectors like Railways, Highways & Roads, Ports, Inland Waterways and Gas pipelines are key to achieve the capacity addition targets in XII five year plan. The total coal requirement for the power utilities by end of 12th Plan (2016-17) is estimated to be around 842 MMT (scenerio-1: 75% PLF) including domestic & Imported coal as also coal from the captive coal blocks. Apart from this, with the increase in Unit sizes to 660 MW, 800 MW and plus 1000 MW during 12th plan and beyond, heavy Over Dimensional Consignments (ODC) as never before will need to be transported from Ports (for imported equipment) and Indigenous Manufacturers to Project sites. This calls for bold initiatives, policy changes as well as adopting basic changes in load and handling specifications in Roads, Railways and Port sectors.

7. 3.1 Railways

The long-term strategy of Indian Railways is to segregate the freight and passenger movement through construction of Dedicated Freight Corridors (DFCs). At present two DFC projects i.e. Eastern DFC (Dankuni, WB - Ludhiana, Punjab) and Western DFC (JNPT, Mumbai- Dadri, UP) have been sanctioned. Apart from above Railways have also planned Gauge conversion, new railway lines, electrification of new routes and procurement of locomotives and wagons.

Broadly, Railways envisage the following targets for the medium and long-term goals (XII five year plan & beyond) towards creation of infrastructure and capacity build-up.

Table 7.10

Broad Category	Revised XI plan Targets	Vision 2020 Targets
Doubling including DFC	2500	**12,000 Kms.**
Gauge Conversion	6000	**12,000 Kms.**
New Lines	2000	**25,000 kms.**
Electrification	4500	**14,000 kms.**
Procurement of Wagons	62000	**289,136**
Procurement of Diesel locomotives	1019	**5334**
Procurement of Electric locomotives	**1205**	**4281**

To achieve, the projected high-growth targets, Railways need massive investments in capacity creation, network expansion and up-gradation and modernization. The existing trunk routes and other coal carrying routes are heavily saturated. Railways needs to strengthen its net work speedily to achieve this high growth scenario. The tentative estimates of Investments required by the year 2020 to deal with higher levels of freight traffic would be as under:

Table 7.11

Description	Investment (Rs)`
Bottleneck removal – Traffic facilities, freight bye-passes, logistic parks, etc.	23,000 cr
Capacity augmentation-	
New Line,	1,80,000 cr.
Doubling/Tripling/Quadrupling including DFC	1,30,000 cr.
Gauge conversion,	35,000 cr.
Electrification	12,600 cr.

Rolling stock -	
Freight wagons,	86,740 cr.
Diesel locomotives,	56,007 cr.
Electric locomotives	64,873 cr.
Technological up- gradation -	
Track renewal and 25 tonne axle load,	71,405 cr.
Bridges	8,000 cr.

The expansion plans detailed in the Vision 2020 documents of Railways gives a sense of confidence that to a large extent Railways will be able to meet Power Sector requirements for 12th Plan and beyond, provided of course that their expansion takes place as per their vision document.

7. 3.2 Inland Water Transport

Inland Waterways Authority of India (IWAI) has planned for the development, up-gradation, modernization and expansion of National Waterways / other Waterways during 12th plan period with an estimated investment of Rs. 10,460 Crores. Keeping this in view, there is a strong possibility of coal cargo movement through IWT becoming attractive to power companies especially if the contract of imported coal movement by IWT of 3.0 million tonnes per annum from Haldia to Farrakka Project of NTPC is a success. At present, ten thermal power stations are operational on the banks of Ganga and these are located in the States of West Bengal (7) and Bihar (3). Further eleven more Thermal Power Stations are proposed in Bihar and Uttar Pradesh with installed capacity of over 15000 MW. Their coal requirement is estimated to be around 70 million metric tonnes per annum, which can be met through IWT.

7. 3.3 National Highways

The National Highways comprise of only around 2% of the total Road Network in India but carry more than 40% of the Traffic. This makes route management of heavy Over Dimensional Consignments (ODCs) highly challenging and difficult. There are serious issues associated with ODC transportation through roads / highways like interpretation of Motor Vehicle Act differently in different states, inadequate strength of roads and Bridges enroute to the project sites, insufficient road width / carriage width in state highways, improper design of Toll Plazas built on the Highways, sharp curves/bends/gradients on roads and inadequate vertical clearance in underpasses in North Eastern states etc. These need to be addressed urgently including necessary fundamental changes in loading specifications of roads, highways and bridges for which specific recommendations have been given in the Report.

7.3.4 Existing & Proposed Gas Pipelines / Grid

- Natural gas is the fastest growing primary energy source amongst fossil fuels, projected to grow around 3-4 times between 2002-2025 at current consumption level. We have come a long way from the time when oil and gas were first discovered in India in 1886 in Assam and subsequently when the famous Bombay High field was discovered in 1974 in the Western Offshore.

- With developing gas market, timely development of gas pipelines across the country for realization of social and economic benefits of natural gas usage has become a priority. Such trunk gas pipelines when integrated with the existing gas pipelines shall ultimately lead to the National Gas Grid. The indicative National Gas Grid shall consist of the existing pipelines, authorized / planned pipelines and their links to the remote and under-developed areas.

- EGOM (Empowered Group of Ministers) have formulated Gas Utilization Policy for distribution and utilization of domestic gas in the country and have allocated priority for KG D6 gas allocation to existing gas based / liquid based stations, connected with gas pipelines. For better utilization of generation capacities, presently running on liquid or under- utilized, it is necessary to connect them preferably as a part of trunk/ spur pipeline network.

7.3.4.1 Existing Gas Pipelines

The present gas pipeline infrastructure in the county is around **12000 km** with design capacity of around **283 MMSCMD**. The existing main trunk pipelines are as under:

- **GAIL:** Owns and operates around 8000 km pipelines including spur lines (mainly HVJ-GREP-DVPL including DVPL-GREP up gradation and DUPL-DPPL) with design capacity around 150 mmscmd.

- **Reliance Gas Transportation Infrastructure Ltd. (RGTIL)** : Owns and operates around 1400 km long East - West Pipeline (EWPL) - (Kakinada-Hyderabad-Uran-Ahmedabad) with design capacity of 80 MMSCMD.

- **Other major regional players:**

- **Gujurat State Petronet Ltd (GSPL)** :Owns & operates ~ 1200 km pipelines with design capacity of 40 MMSCMD.

- **Assam Gas Company Ltd (AGCL)** : Owns & operates ~ 500 km pipelines with design capacity of 8 MMSCMD.

7.3.4.2 Authorized Gas Pipelines: Ministry of Petroleum and Natural Gas in 2007 authorized following nine new trunk pipelines with total length of approx. 8700 km with design capacity of about **209 MMSCMD**.

(A) GAIL :

- Dadri-Bawana-Nangal (600 ksm)
- Chainsa-Jhajjar-Hissar (400 kms)
- Jagdishpur-Haldia (2000 kms)
- Dabhol-Bangalore (1400 kms)
- Kochi-Kanjirrkod-Bangalore (1100 kms)

(B) RGTIL :

- Kakinada-Haldia (928 kms)
- Kakinada-Chennai (577 kms)

- Chennai-Bangalore-Mangalore (538 kms)
- Chennai-Tuticorin (585 kms)

These pipelines are under different stages of development.

7.3.4.3 Establishment of PNGRB: The Petroleum and Natural Gas Regulatory Board (PNGRB) Act 2006 provides for the establishment of an independent regulatory board (PNGRB) as a downstream regulator to regulate the activities of companies related to refining, processing, storage, transportation, distribution, marketing and sale of petroleum, petroleum products and natural gas and City Gas Distribution(CGD). The board has been established and started functioning w.e.f. June 2007. The PNGRB have formulated several regulations pertaining to gas transportation. PNGRB is authorising entities for laying pipeline on basis of competitive bidding through EOI route. PNGRB has received 06 EOIs for setting up of additional gas pipelines. These are (as per PNGRB website):

(i) Mallavaram (A.P.) – Vijaipur (M.P.) – Bhilwara (Rajasthan)
(ii) Mehasana (Gujarat) to Bhatinda (Punjab) via Jaipur (Rajasthan)
(iii) Bhatinda (Punjab) to Srinagar (J & K)
(iv) Surat to Paradip
(v) Durgapur to Kolkata
(vi) Kakinada to Srikakulam

7.4 PORTS

Ports are critical part of transportation infrastructure of our country. India has about 6000 km. of natural peninsular coastline. There are 12 major and 176 minor ports in India.

Major Ports

The capacities of all the Major Ports are projected to rise from the existing level of 616.73 Million Tonnes (as on 31.03.2010) to 1328.265 million tonnes by the end of 12th Five Year Plan (2016-17) and to 1459.535 million tonnes in 2019-20. This capacity is excluding the capacities at the anchorage points of the Ports. In addition to above, Central Government plans to commission two more Major Ports, one each on Andhra Coast & West Coast, which will also entail additional capacity in Major Port segment.

Non Major Ports

Recognising the critical importance of ports to cater to the future increase in maritime traffic, the maritime states initiated the process of development of ports in their States. The eight maritime States have estimated that the cargo traffic from non-major ports will increase from the existing 288.80 million tonnes in 2009-10 to 402.50 million tonnes in 2011-12, 987.81 million tonnes by the end of 12th Five Year Plan in 2016-17 and 1280.13 million tonnes by 2019-20. During 2009-10 to 2019-20, Cargo traffic in the maritime states (Non major ports) is projected to grow at Cumulative Annual Growth Rate (CAGR) of 16.06%.

Keeping in view the estimated capacity addition of 75,715 MW, the coal quantity to be imported by the end of 12th plan works out to about 121 MT for 15 % blend and including the requirement for power plants that would be operating completely on imported coal. Based on the Maritime Agenda for Ports, issued by the Ministry of Shipping, major and non major ports together are targeted to handle 476.04 Million Tonnes of Thermal and Coking coal combined by the end of 12th Plan. Moreover in order to augment the capacity and enhance productivity levels at major ports, several initiatives are being taken by the Ministry of Shipping including modernisation of port infrastructure, construction of new berths/ terminals, expansion/ up-gradation projects for berths and dredging, installation of new and modern equipment, mechanisation of cargo handling operations and automation through computer aided systems. However improving / augmenting rail and road connectivity especially last mile connectivity will need special attention particularly as it involves close coordination and interface between Roads, Railways and Port Authorities.

7. 4.1 Suggestions/ Recommendations

- Adequate coal unloading arrangement at Ports to be ensured to handle imported and domestic coal required for power stations (approximately 150 MT).
- On the East Coast, coal handling facilities to be augmented at Paradip and Vizag Ports. This will be necessary to evacuate coal from mines in Orissa as rail routes are congested.
- All major and important minor ports should be mechanised by augmenting crane capacities, silos, conveyors & wagon tipplers.
- Draft at various ports to be increased to handle Panamax or Capsize vessels.
- RO-RO berths should be created atleast in two major ports namely Kandla on the west coast and Paradip on the east coast for unloading ODCs.
- Road connectivity to ports to handle ODCs has to be ensured

7.5 MANUFACTURING CAPACITY AND CONSTRUCTION AGENCIES

Adequate domestic manufacturing capacities & capabilities for main plant equipment would be available to meet the demand of the 12th Plan capacity addition programme as a result of the push given by the Government for indigenous manufacturing of main plant equipment during the 11th Plan. To ensure energy security it is vital that the manufacturers give reliable services as well as spares during the life time operation of the Plant; accordingly it is essential that a level playing field is provided to manufacturers so that a healthy competition ensures competitive prices and quality equipment. A number of 11th Plan projects have not been able to achieve full load operation within stipulated time from synchronization due to non-readiness of the balance of plant.

7.4.1 Main Plant Equipment

In the category of coal based power plant, switch-over to super critical technology is envisaged for all the new capacities coming up in 13th Plan and beyond.

Based on the encouragement from Government of India for setting up domestic manufacturing facilities, a number of new manufacturers have come forward for setting up manufacturing facilities for Steam Generators and Turbine Generators. These include:

1. L&T-MHI
2. Toshiba-JSW
3. Alstom-Bharat Forge
4. Ansaldo-Gammon
5. BGR-Hitachi
6. Doosan
7. Thermax-Babcock
8. Cethar Vessel- Riley Power

In addition, BHEL has also augmented its capacity from 6,000 MW per annum in X Plan to 15,000 MW per annum and is in the process of augmenting its capacity further to 20,000 MW per annum by March 2012.

From the information provided by the manufacturers, it has emerged that following domestic capacities shall be available for steam generators and turbine generators.

	By 2013-14	By 2014-15
SG (MW)	26,500	40,500
TG (MW)	30,020	35,020

7.4.2 Balance of Plant (BoPs)

Balance of Plants such as Coal Handling Plant, Ash Handling Plant, Water Treatment / DM Plant, Cooling Towers, CW System, Chimney, Plant electrical and switchyard etc. have been identified as critical items for timely commissioning of thermal power projects. BoPs have been and continue to be a critical area for achieving capacity addition targets. To mitigate risk associated with BOP systems recommendations/ suggestions have been made in the report that include standardisation of BOP systems, reviewing the qualifying requirements to ensure quality vendors and large vendors for faster execution of projects, mandating a central organization to maintain a dynamic data base with regard to BOP orders and their liquidation.

Use of conventional technologies in civil works has been responsible to some extent for delays in completion. The latest methods of civil construction with mechanised equipment and man power mobilization need to be adopted. The vendors have to be encouraged to adopt new erection technologies to reduce the erection and commissioning cycle. An institutional mechanism to develop skilled man power for construction & execution of projects has also been stressed upon.

7. 5.3 Suggestions/ Recommendations

The recommendations of the sub-group relating to manufacturing capacity and construction agencies are as follows;

- Developers may execute BOPs on EPC basis.

- A web based portal need to be designed and managed for all information relating to BOP vendors viz. orders at hand, their implementation status etc. so that developer of projects can take an informed decision.
- In second phase the BOP vendors and Construction agencies could be rated based on their performance.
- Work in hand / Bid Capacity etc. should find place in bid documents.
- MOP/CEA to suggest an 'implementation mechanism' to enforce technical standards notified by CEA.
- Training of Skilled/ Semi-skilled workers for Power project requirements to be taken by EPC Contractors, Developers as well as the Manufacturers.

7.6 MATERIALS

There are several inputs which are required for setting up of power projects which involves supply of Main Plant Equipment as well as Erection / Construction activity. Materials such as Steel, Cement, Copper, Aluminium etc. are the key inputs needed for power projects. The huge capacity addition plan requires that all key inputs are made available matching the schedule of implementation of the Power projects.

7.6.1 Material Requirements for Generating Stations

Following norms for Cement for Thermal Projects were considered keeping in view the norms developed by CEA and historical data for NTPC's Plants:

Table 7.12

MT per MW

Material	Thermal	
	Coal Based	Gas based
Cement	150	60
Structural Steel	85	29
Reinforcement Steel	45	24

Based on the projections and the data received from CEA the average requirement of materials per MW for the Hydro projects works out to be as under:

Table 7.13

MT per MW

Material	Hydro
Cement	956
Structural Steel	34
Reinforcement Steel	93

Based on the assessment of Nuclear Power Corporation (NPCIL), requirement of Steel, Cement and other materials for nuclear projects is considered at 130% of the requirement of coal based projects for planning purposes. Considering the above, the material requirement for Nuclear Projects as provided by CEA is as given under:

Table 7.14

Lakh MT

Material	12th Plan	13th Plan
	2800 MW	5600 MW
Cement	5.46	10.92
Structural Steel	3.09	6.19
Reinforcement Steel	1.64	3.28

The Norms for Cement and Reinforcement Steel for Power system network which have been considered based on historical data of PowerGrid are as follows:

Table 7.15

MT per ckt Km

Line	Cement	Reinforcement Steel
765 KV	56	**11**
HVDC	26	**6**
400 KV	21	**9**
220 KV	8	**3**
132 KV	**5**	**1**

As per the details provided by BHEL the average requirement of castings and forgings for a 500/660/800 MW sets is as given below:

Table 7.16

MT per Set

Equipment	Weight of Castings	Weight of Forgings
Turbine	384	235
Generator	3	130
Total	**387**	**364**

Based on the norms given above, the requirement of various materials for the power sector during 12th Plan has been worked out as follows:

Table 7.17

Lakh MT

Material	12th Plan
	75785 MW
Cement**	217.39
Structural Steel**	102.48
Reinforcement Steel	46.85
CRGO Steel (as per IEEMA)	11.5

Castings*	0.36
Forgings*	0.34
Special Steel for Sub-Stations	5.0
Steel for Conductors in Transmission system Lines	4.9
Aluminium	15.75
Copper (as per IEEMA)	12.5
Zinc	2.6
Thermal Insulation#	2.37
Tubes & Pipes#	6.78
Thick Boiler Quality Plates (Imported)*	0.92

*Excluding Nuclear & Hydro #Excluding Nuclear
** Excluding Distribution system networks & power and distribution transformers

The consumption of cement for the power projects during the 12th Plan is going down as compared to 11th Plan due to fall in the planned share of Hydro Electric Power.

The main inputs for manufacturing power plant equipment are castings & forgings, steel plates, structural steel, copper, CRGO/CRNGO etc. While Steel, Cement, Copper, Aluminum etc. are the key inputs needed for erection & commissioning and transmission & distribution networks. Consumption norms have been worked out based on consumption pattern for the completed projects during the past and also for projects under execution. Prima facie there is no likely shortage of key materials except for CRGO, and thicker steel plates. Further, there is an inadequate indigenous manufacturing capacity in the country for Tubes & Pipes especially for alloy steel tubes & Pipes (T91/P91, T92/P92 grades), which needs to be augmented. Some indigenous capacity for heavy castings & forgings which are critical for power generating equipments, are being planned by a major private sector manufacturer and are expected to come up in near future. Presently no facility exists in the country for short circuit testing facility for transformers. The recommendations of the sub-group relating to key materials are as follows:

There is no shortage of key materials except CRGO Steel, higher grade CRNGO and thick boiler steel plates.

However the following measures should be taken:

- Need to set up plant for producing CRGO
- Indigenous capacity for tubes and pipes to be augmented
- Need to create short circuit testing facility for transformers
- Indigenous manufacturing facility for gas insulated substation to be augmented
- Indigenous capacity for thicker boiler quality plates needs to be created
- Mandatory BIS Certification requirement may result in supply constraints of CRGO and thicker Boiler quality plates. This issue needs to be addressed.

8.0 CONCLUSION AND RECOMMENDATIONS

Based on various inputs given different teams, the Conclusion and Recommendations in terms of Key inputs are summarized as follows:

FUEL

Since coal is our major source of energy and would remain the mainstay of future energy requirement, domestic coal production needs a boost as also acceleration of exploration activities for finding out new coal reserves in our country.

Domestic Coal Supplies:

- To sustain the capacity addition proposed in the 12th Plan, coal availability to power sector must be increased by domestic coal companies to 688 million tons by the end of 12th Plan.
- As per present projections of CIL/SCCL and expected coal production from captive coal blocks, the domestic coal availability is likely to be 550 million tonnes, thus indicating a huge gap in demand & supply. CIL/SCCL will need to step up its production as also to take action to arrange imported coal as per new coal distribution policy of Ministry of Coal.
- Coal sector needs to be immediately opened up for private sector investment also, to ensure that the coal production rate is matched with the rate of growth in thermal power generation.
- Coal Regulator needs to be in place to ensure higher coal productivity at least cost.
- Need to upgrade coal mining equipment and practices in the already working mines for better productivity.
- Concerns of developers regarding Fuel Supply Agreement (FSA) need to be addressed urgently. Coal companies need to guarantee 100% of the normative requirement and FSA for 90% of ACQ be signed without delay.
- Coal crushing capacity to be augmented at mines.
- MoEF has proposed an amendment to notification for mandatory use of beneficiated/ blended coal with less than 34% ash for projects located beyond 500 km from mines (presently it is beyond 1000 km). CIL to ensure adequate number of washeries to meet this stipulation before it is implemented.
- The cost of washed coal should be on the basis of actual cost of washing instead of import price parity. Issue of coal rejects utilization also needs to be addressed sooner.
- Coal should be sold through e-auction only after meeting the full demand of power sector. The issue of rail connectivity to such mines from where coal for e-auction is sourced should be taken up immediately.
- **Coal Price Pooling may be considered to optimize coal transportation and also to encourage acceptance of imported coal.**

Captive Coal Blocks:

- Coal blocks still falling in Category ‘A’ need to be immediately brought under Category ‘B’ including coal blocks in Hasdeo Arand coal field for UMPP and other ongoing power projects.
- New captive coal mines need to be allocated for competitive bidding by state utilities at lowest price of power (Case-II) instead of auctioning proposed by Ministry of Coal.

- Allocation as well as De-allocation of captive coal blocks should be by the Inter-Ministerial Committee as for coal linkages.
- The issues of additional benefits requested by coal bearing states need to be addressed on urgent basis as some of the captive coal block developers are facing problems including, interalia, land acquisition.
- The time lines prescribed for captive coal block development to be made more realistic.
- In the draft Mines and Minerals (Development and Regulation) Bill 2011, the sharing of profits by local populace from the coal mines has been proposed. However in case of captive coal mines, since there is no sale of coal but only of power produced, the profit sharing should be linked to royalty payable which could be adjusted from the pretax profits as any other revenue expenditure.

Lignite

- Lignite reserves in the country have been estimated at around 40.9 billion tonnes, out of which about 82 % are located in the State of Tamil Nadu & Pondicherry. At present only a small percentage of the total reserves of lignite have been exploited. Immediate steps needed to augment lignite production considering large reserves of lignite in the country. The technology issues for efficient utilization of lignite resources need to be addressed.

Gas

- New gas based projects totaling about 12204 MW are under construction out of which 8782 MW have been recommended for gas allocation in the 11th Plan. These projects would require about 47 MMSCMD gas at 75% PLF. The gas supply to these projects needs to be ensured.
- Gas supply is also to be made available to atleast 10,000 MW additional Capacity in the 12th Plan not only to ease pressure on domestic coal but also to encourage Green Power.

LAND & WATER

Land

Land is increasingly becoming a scarce resource and availability of land is posing a serious challenge for future power plants. The optimum utilization of land has therefore, gained significance and in coming times challenges are to be encountered in land usage practices. Sub Group 7 recommends the following for Land use and acquisition:

- Land to be acquired with a view of not only project development but also the livelihood issues of the original land owners.
- Minimizing land requirement pressure for new projects by use of spare land within existing plants.
- Review of MoEF procedures for expeditious project clearances.
- Higher capacity units in place of older small size units
- Adoption of higher size units.
- Shelf of sites for projects i.e. land bank needs to be created.
- New technology options to be adopted for minimizing land requirement.
- CEA may undertake another exercise in consultation with various stakeholders to further optimize land requirement for Power projects.

- Land acquisition by States need to be done expeditiously in a time bound manner, considering that a large percentage of Power is allocated / committed to the Home State from the Power project.

Water

With all round development in the country and vast growth of thermal power stations, the availability of water has become scarce. As drinking and irrigation water uses have got priority in allocation of water over industrial use and power generation, the thermal power plants are facing constraints in availability of adequate fresh water. Following are the main recommendations of the Sub Group regarding Water Requirement.

- Technical measures for reducing water consumption may be adopted.
- Creation of large reservoirs/ dams on potential rivers to retain flood waters.
- Coastal power plants to be encouraged.

TRANSPORT

The development of Transport infrastructure in different transport sectors like Railways, Highways & Roads, Inland Waterways and Gas Pipelines is essential to achieve the capacity addition targets in 12th five year plan and beyond. The main recommendations on Transport sector are:

- Railways are transporting about 60% of the total off-take of domestic coal.
- The percentage share will remain the same during the 12th plan.
- Railways to confirm their coal evacuation capacity from each coal field.
- Railways to augment their capacity to evacuate coal from major coal fields namely North Karampura, Ib Valley, Talcher and Mand Raigarh.
- For smooth and faster evacuation of coal, coal conveyors should be used to transport coal from mine to rail head with automatic loading in wagons.
- Railway to expedite proposed Dedicated Freight Corridors to segregate freight and passenger traffic.
- Railways to ensure rail connectivity to all ports having coal unloading facilities.
- NTPC and Inland Water Ways Authority of India (IWAI) would be signing an agreement for transportation of 3 MT of imported coal to Farakka TPS. Other thermal projects located on the banks of Ganges in West Bengal and Bihar should also explore the same.
- Roads and Highways need to be augmented for transportation of Over Dimensioned Consignments (ODC) for supercritical units.
    - Amendment in Motor Vehicle Act to accommodate heavy consignments above 49 MT and inclusion of hydraulic axle trailers.
    - Review of load classification for Roads & Bridges by IRC/ MoRTH to accommodate ODCs beyond 100 MT.
    - Single window clearance and one time payment for ODC movement.
    - Proper design of Toll Plazas built on highways.
- Changes in Road design in North Eastern & Hill states to minimise sharp curves/gradients in roads and have sufficient vertical clearance in underpasses.

- Proper Approach Roads to be provided for Hydro Projects.

PORTS

Ports are critical part of transportation infrastructure of our country. India has about 6000 km. of natural peninsular coastline. There are 12 major and 176 minor ports in India.

The main recommendations for augmenting Ports and related infrastructure are:

- Adequate coal unloading arrangement at Ports to be ensured to handle imported and domestic coal required for power stations (approximately 150 MT).
- On the East Coast, coal handling facilities to be augmented at Paradip and Vizag Ports. This will be necessary to evacuate coal from mines in Orissa as rail routes are congested.
- All major and important minor ports should be mechanised by augmenting crane capacities, silos, conveyors & wagon tipplers.
- Draft at various ports to be increased to handle Panamax or Capsize vessels.
- RO-RO berths should be created atleast in two major ports namely Kandla on the west coast and Paradip on the east coast for unloading ODCs.
- Road connectivity to ports to handle ODCs has to be ensured

MANUFACTURING CAPACITY AND CONSTRUCTION AGENCIES

Adequate manufacturing capacity of Main Plan Equipment including that for large super-critical thermal set shall be available indigenously to meet the capacity addition requirement of the Country during 12th Plan as projected by CEA. As regards Balance of Plants (BOP), Construction Agencies and Construction equipment/ Construction techniques, the capacities and capabilities have to be further developed and enhanced.

Main Plant Equipment

1) Implementation of Technical standards

An implementation mechanism for meeting the technical standards as notified by CEA needs to be devised for adherence by the Manufacturing agencies.

2) Centralised agency to coordinate for various clearances/ availability of inputs

The Committee recommends formation of a centralized agency with representatives from nodal Ministries/ Departments responsible for these inputs to expeditiously resolve the issue.

3) Demand projection for development of key inputs

In order to attract these vendors, Govt. has to encourage them to develop their capacities and capabilities for power sector, for which they should have optimistic projections of the demand.

4) Standardisation

Standardization of technical specifications i.e. design basis, equipment parameters, material specification, Quality plans etc., to the extent will enable batch production of equipments expediting their delivery.

5) Logistics & Road Connectivity

12th Plan capacity addition is mainly based on large size super critical sets. This large size super critical plant equipment involves movement of heavy/ ODC consignments on domestic roads and bridges. In order to meet the tight project schedules, smooth and uninterrupted movement of the equipment from manufacturer's works/ port to the project site is very critical. The development of the project should also involve development of the roads/ bridges up to project site.

6) Single window for granting permits/ clearances for movement of the consignments across the States.

In order to reduce the transportation time and timely delivery at site, single window concept for clearances of consignments and hassle free movement of the goods at National/ State/ District/ Tehsil check nakas is recommended to be provided.

7) Availability of raw material domestically

Government should encourage indigenous manufacturing of critical raw materials such as Special steels like CRGO & CRNGO, thicker boiler quality steel plates and high pressure tubes and pipes by providing incentives and policy support.

8) Lower rating sets for remote Sites

Considering the logistics constraints, large size super critical sets may not be feasible for all locations. As such, lower rating / sub critical sets should also continue for which coal allocation may be made available.

Balance of Plants (BOP)

1) **Standardization**

The variations in engineering practices delay the finalization of design of equipment and result in serious financial implications. Standardization of engineering / design practice in plant layout and equipment rating / selection is expected to reduce delays in project execution.

2) Faster Document Approval for BOP engineering

The delay in the finalization of engineering document and approval procedures in a BOP package has been affecting delivery schedules. The concept of e-documentation may be adopted using latest IT tools for speedier approval.

3) Ensure Availability / Development of skilled manpower

The availability of skilled and semi-skilled manpower for project execution has been an area of concern. Both the developer and the contractor(s) have to jointly make efforts for providing training and necessary skill sets to local people to improve their employability.

4) Timely ordering for BOP packages

Timely placement of orders for BOP by utilities and also the bought out items by the BOP vendors will minimize the delays in BOP supplies.

5) **Review of Qualification Requirements**

Qualification requirements for the BOP vendors may be reviewed from time to time, in order to align with the industry situations. This will ensure quality vendors and a larger vendor base for a faster execution of projects.

6) Concept of Functional Specification

The concept of functional specification to the extent feasible (say in respect of major components) may be adopted, keeping in view the commitment of vendor by way of guaranteed performance and liquidated damages clauses provided in the contract.

7) Ensuring clarity of inputs to vendors

Ambiguity in site inputs to the vendor delays the process of engineering and placement of orders. It is emphasized that clear site inputs / fronts shall be made available to the developers.

(8) **Adoption of latest techniques in project execution**

Latest methods of civil construction with mechanized equipment and manpower mobilization needs to be adopted.

(9) **Technological up gradation of BOP**

There have been no significant technological changes in the BOP equipment and designs for a long time. New design changes and materials may be adopted for an optimal functioning and reduced redundancies for a cost effective solution.

(10) **Mechanism for capacity assessment of BOP suppliers**

There has been a bunching of orders with a few suppliers, with a result of delayed deliveries due to their limited capacities. There is an urgent need to develop mechanism for capacity assessment of BOP vendors.

(11) **Following EPC approach**

EPC contracts have merits over the multiple package contracts. Multiple package poses problems of micro level monitoring and interfacing issues resulting in delays. The EPC packages are priced slightly higher, but the cost is compensated by the timely completion.

(12) **Proper interface between various vendors and consultants**

The interface between various vendors has to be ensured to have proper matching equipment design and sequential supplies

Construction Agencies and Equipment

1) Construction Techniques

Latest methods of civil construction with mechanized equipment and manpower mobilization needs to be adopted. Vendors should be encouraged to adopt new erection technologies to reduce the erection and commissioning cycle.

2) Tools and Plants

New tools and tackles may be adopted for optimum functioning and reduce redundancies for a cost effective solution.

3) Bridging skill gaps

Industry is facing severe shortage of skilled manpower like welders (especially High Pressure welders), fitters, turners, masons, carpenters etc. Following is recommended:

(i) Creation of adequate number of new modern technical training institutions under government sector and facilitation in creation of the same under private sector.

(ii) PPE manufacturers and Developers will have to take a lead in Training and skill enhancement of manpower through encouragement and facilitation of plant visits, live projects, internship, guest lectures and other means of industry interaction with students and faculty of technical institutions.

(iii) An institutional mechanism for setting up Regional Skill Development Centers by pooling resources from Power Developers, Manufacturers and Contractors to enable a substantial increase in the availability of trained and skilled manpower.

MATERIALS

There is no shortage of key materials except CRGO Steel, higher grade CRNGO and thick boiler steel plates. The following measures should be taken:

- Need to set up plant for producing CRGO.
- Indigenous capacity for tubes and pipes to be augmented.
- Need to create short circuit testing facility for transformers.
- Indigenous manufacturing facility for gas insulated substation to be augmented.
- Indigenous capacity for thicker boiler quality plates needs to be created.
- Mandatory BIS Certification requirement may result in supply constraints of CRGO and thicker Boiler quality plates. This issue needs to be addressed.

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Chapter-8

FINANCIAL ISSUES IN POWER SECTOR FINANCING

8.0 INTRODUCTION

Power generation capacity along with the associated power infrastructure in India has increased substantially over the years. Though the current annual per capita power consumption in India has increased to over 717 kilo watt hours (kWh), it is still very low when compared to the estimated per capita annual consumption of over 1,200 kWh in China and nearly 13,300 kWh in the United States of America. Without adequate energy of desired quality, the 8% economic growth achieved in the recent past cannot be sustained and the economic growth targets envisaged by the Government over the next decade may not be achievable.

The government has been setting ambitious targets for the power sector during the five year plans to manage the demand-supply mismatch. However, the planned capacity additions vis-à-vis actual capacity addition achieved during the last four plan periods has varied in the range of 50-60%. Fund availability is one of the key factors that play a crucial role in determining the quantum of capacity addition.

This chapter provides estimates of the total investment requirement during the 12th Plan and the quantum of funds available from various sources to meet the same. Further, the chapter highlights various financial issues namely quantum and tenor of funds, cost of funds, etc. related to availability of funds for power sector. Policy issues that could impede the flow of funds to the Power Sector, such as, concerns related to land acquisition, fuel security related issues, environment issues, poor financial health of power distribution companies etc. have also been covered in the chapter.

In view of the above mentioned issues, various Policy measures such as introduction of specialized long tenor debt fund, dedicated fund for financing power projects in North Eastern sector, take-out financing schemes, credit enhancement scheme by IIFCL, modification in IRDA/ PFRDA guidelines, various tax incentives on investments, etc. have also been suggested in this Chapter.

8.1 FINANCIAL PERFORMANCE OF POWER SECTOR DURING 11TH PLAN

The 11th Plan fund requirement for the power sector was Rs. 10,31,600 crore. The All India Expenditure in Power for 11th Plan has been about Rs. 707,278 crore. The year wise details of 11th Plan expenditure with sector wise break up in respect of Generation, transmission and distribution are given in **Appendix 8.1 and 8.2.**

The details of projected fund requirement and actual expenditure during 11th Plan are as follows:

Table 8.1

Projected fund requirement v/s likely expenditure during 11th Plan

S. No.	Segment	Outlay (Rs. crore)	Likely Expenditure (Rs. crore)*	Achievement (%)
1.	Generation (including Nuclear#, NCES, Merchant and Captive)	566,396	479,620	84.68%
2.	Transmission	140,000	122,991	87.85%
3.	Distribution (including DDG)	307,000	100,000	32.57%
4.	R&M	15,875	3,564	22.45%
5.	HRD	462	83	17.97%
6.	R&D	1,214	352	29.00%
7.	DSM	653	668	102.30%
	Total	**1,031,600**	**707,278**	**68.56%**

Source: CEA & Working Group report of 11th Plan

#Source: Department of Atomic Energy Annual Accounts
**Generation includes nuclear, NCES, merchant and captive power projects*
** Transmission includes 33 kV and above inter and intra state transmission lines*
** Distribution is inclusive of sub-transmission lines upto 33 kV levels and DDG*
**includes actual and projected expenditure up to FY 2011-12*

As can be observed from above, the expenditure incurred on generation, transmission and distribution is in deviation to the rule of 2:1:1. This deviation can be attributed to the inclusion of sub-transmission lines and system upto 33 kV levels under the classification of distribution.

The Gross Budgetary Support (GBS) expenditure in respect of CPSUs during 11th Plan is expected to be about 2228 Cr against allocation of Rs 3000 Crore.

8.1.1 Transmission

In the transmission sector, a total of Rs. 122,991 crore of the estimated fund requirement of Rs. 1,40,000 crore for 11th Plan were utilized.

Table 8 2

Transmission - 11th Plan - Fund Requirement & Utilization

(Figures in Rs. crore)

S. No.	Sector	Estimated Fund Requirement	Anticipated Fund Utilization
1	Central	75,000	56,370
2	State	65,000	66,379
	Total *	**140,000**	122,991*

Source: CEA & Working Group report of 11th Plan

* Includes Rs. 242 Cr in Private Sector which was not envisaged earlier.

8.1.2 Distribution

Financial requirement for the 11th Plan for the distribution sector had been worked out as Rs.3,07,000 crore. The expenditure incurred during the first 4 years of 11th Plan period in the distribution sector is about Rs. 75,000 crore. On the basis of the ongoing works under distribution schemes, a total expenditure of Rs. 1,00,000 crore is expected to be made at the end of 11th Plan. The target was estimated on a normative basis including spill-over of 10th Plan.

However, low investment in the distribution sector has been a matter of concern. The lack of adequate investment may lead to delays in capacity augmentation/ replacement of obsolete equipments which may adversely impact the performance of the distribution sector.

8.2 PHYSICAL TARGET FOR 12TH PLAN

8.2.1 Generation (Conventional Sources)

The fund requirement during the 12th Plan for generation (conventional sources) projects is on account of balance payment in respect of projects likely during last year of 11th Plan, projects likely during the 12th Plan and funds for advance action in respect of 13th Plan projects. Therefore, details of likely capacity addition corresponding to these projects are as follows:

i. Planned capacity addition during 2011-12

During the year 2011-12 a capacity of 17,601 MW is expected to be commissioned. Type –wise details are as furnished in **Appendix 8.3**

ii. Planned capacity addition for 12th Plan

The planned capacity addition during 12th Plan is 75,785 MW. The year wise and type details of capacity likely during the 12th Plan are furnished in **Appendix 8.3.**

iii. *Advance action for 13th Plan*

It has been estimated that thermal power projects with a total capacity of 93,456 MW are expected to yield benefit in 13th Plan. In line with project implementation schedule, construction work on a part of the targeted capacity will begin during the 12th Plan. The year wise details of capacity addition during 13th Plan are given in **Appendix 8.3.**

8.2.2 Generation (Non-Conventional Energy Resources)

Details of 12th Plan target of Grid Interactive RE projects are furnished in the table below:

Table 8.3

12th Plan Tentative Targets for Grid Interactive RE Projects

(Figures in MW)

Sources / Systems	Target for 12th Plan
Wind Power	11,000
Biomass Power Baggasse Co-generation Biomass Gasifiers	2,100
Small Hydro (up to 25 MW)	1,600
Solar Power	3,800
Total	**18,500**

Source: MNES

8.2.3 Captive power plants

The expected capacity addition in captive power plants during 12th Plan has been estimated at around 13,000 MW.

8.2.4 Transmission

The expected transmission capacity addition during 12th Plan is 1,09,440 ckm which is expected to result in the total transmission capacity of 3,79,011 ckm by the end of 12th Plan. Significant capacity expansion is expected in 765kV AC transmission system. The total Inter Regional transmission capacity addition for 12th Plan has been planned at about 38,000 MW.

8.2.5 Distribution

According to CEA, during the 12th Plan, an expansion of 1,35,000 ckm, 5,60,000 ckm and 6,10,000 ckm of 33kV lines, 11kV lines and LV lines have been estimated. The new transformation capacity is expected to be about 88,000 MVA and distribution transformer capacity is expected to increase by 1,05,000 MVA.

8.3 DEVELOPMENT OF POWER SECTOR IN THE NORTH-EAST REGION

8.3.1 Generation

The total fund requirement for generation capacity addition in NER and Sikkim has been calculated to be Rs. 54,215 crore. The cost per MW assumed for the purpose is 10% higher than average all India cost for setting up projects of similar nature.

8.3.2 Transmission and Distribution

Central Transmission Utility in consultation with CEA has designed Transmission and Distribution schemes in NER and Sikkim to evacuate the power generated from projects in this region. Fund requirement for Transmission and Distribution schemes in NER and Sikkim, with likely benefits during 12th Plan, has been estimated at around Rs. 26,392 crore.

Brief details of the transmission and distribution schemes are as follows:

Table 8.4

Transmission and Distribution schemes in NER and Sikkim

(Figures in Rs. Crore)

S.No.	Scheme Name	Fund requirement
1	Strengthening of transmission and distribution in NER and Sikkim	11,348
2	Transmission – Lower Subansiri HEP and Kameng HEP	11,130
3	Transmission – Pallatana GBPP to regional group point	1,770
4	Transmission – Pallatana GBPP regional system strengthening	2,144
	Total	**26,392**

Source: CEA

8.4 FUND REQUIREMENT FOR 12TH PLAN

The fund requirement for 12th Plan has been estimated under the following broad categories:

a) Generation Projects (conventional Utility) likely during last FY of 11th Plan i.e. 2011-12
b) Generation Projects (conventional Utility) planned for 12th Plan
c) Advance action during 12th Plan for Generation Projects (conventional Utility) planned for 13th Plan
d) Generation Projects based on Non Conventional Energy Sources
e) R&M of Power Plants
f) Captive Power Projects
g) Transmission
h) Distribution
i) Research and Development
j) Demand Side Management and Energy Efficiency (DSM & EE)
k) Human Resource Development

Fund requirement for Generation Projects has been computed on the basis of normative per MW cost of different types of generation projects viz. thermal, hydro and nuclear. The above costs, based on the FY 2011-12 price levels, are listed in **Appendix 8.4.** Year-wise requirement of funds during the gestation period of the power projects has also been detailed in **Appendix 8.4.**

Based on the past trend, it has been observed that around 10% of total project expenses in a power project are incurred post-commissioning i.e. during the first year of commercial operations. Accordingly, 10% of total fund requirement for projects likely to be commissioned during 2011-12 will be required during 12th Plan.

Fund requirement for Generation Projects 12th Plan have been computed on the basis of per MW cost and the phasing of total expenditure of different types of generation projects viz. thermal, hydro and nuclear as in **Appendix 8.4.**

For fund requirements of advance action of 13th Plan projects, total fund requirement that will be required during 12th Plan is based on the past trend of expenses incurred during the initial years of construction. The assumptions with regards to cost per MW and phasing schedule are given in **Appendix 8.4.**

Fund requirement for Captive power projects has been estimated based on per MW cost furnished in **Appendix 8.4.**

The estimated expenditure for R&M for 12th Plan is expected to be Rs. 31,887 crore, which includes Rs. 28,000 crore for R&M of thermal power plants and Rs. 3,887 crore for R&M of hydro power plants.

Fund requirement for inter and intra state transmission lines (33 kV and above) is expected to be Rs. 1,80,000 crore .

Fund requirement for distribution (including sub-transmission lines upto 33 kV levels) has been estimated at Rs. 3,06,235 crore. Funds under APDRP and RGGVY approved schemes have been allocated to central and state sector in the ratio of 90:10. Further, the sector wise break up of remaining funds have been made on the basis of energy sold by power distribution companies as provided in the report on “Performance of State Power Utilities”. As per the data, the percentage share of power utilities in private sector has been estimated at 7.90% and the remaining 92.10% has been allocated to state power utilities.

An outlay of Rs. 1,500 crore is expected for the National Perspective Plan on R & D, with Rs. 1,300 crore for Research & Development and Rs. 200 crore for “Power Academy”. An outlay of Rs. 50 crores is projected for Research Scheme on Power (RSOP) which is managed by CPRI on behalf of Ministry of Power (MoP). In addition, an overall allocation of Rs. 2,618 crore is sought for Capital Projects, augmentation of test facilities, R&D infrastructure and establishment of new facilities at CPRI. Thus the total estimated expenditure for R&D during 12th Plan is expected to be Rs. 4,168 crore.

The outlay for various Demand Side Management (DSM) and Energy Efficiency programmes proposed by Bureau of Energy Efficiency for the 12th Plan is Rs 7,482 crore.

Funding for Human Resource Development (HRD) has been estimated based on the infrastructure cost of establishing new Institutes. An outlay of Rs. 4,108 crore has been proposed for this purpose in the 12th Plan.

Details of the Fund Requirement during the 12th Plan are as Summarised below:

Table 8.5

Capacity Addition & Fund Requirement for 12th Plan projects

S. No.	Capacity Addition	Allocation of cost towards 12th Plan (Rs. Crore)			
		Centre	State	Private	Total
1.	**11th Plan (2011-12)**				
a)	Generation –capacity addition	5,174	1,485	5,100	11,759
A	**Sub-Total 11th Plan**	**5,174**	**1,485**	**5,100**	**11,759**
2.	**Generation – 12th Plan capacity addition**				
a)	Thermal	48,650	55,734	1,73,117	2,77,500
b)	Hydro	35,183	8,024	6,952	50,159
c)	Nuclear	26,600	-	-	26,600
B	**Sub-Total 12th Plan**	**1,10,433**	**63,758**	**1,80,069**	**3,54,260**
3.	**Advance action for 13th Plan**				
a)	Thermal	40,440	14,805	80,577	1,35,822
b)	Hydro	28,132	612	11,216	39,960
c)	Nuclear	96,800	-	-	96,800
C	**Sub-Total 13th Plan**	**1,65,372**	**15,417**	**91,793**	**2,72,582**
4.	**Sub-Total generation (A+B+C)**	**2,80,979**	**80,660**	**2,76,961**	**6,38,600**
5.	**Captive Power Projects**			65,000	**65,000**
6.	**R&M of Power Plants**	19,847	12,040		**31,887**
7.	**Transmission**	1,00,000	55,000	25,000	**1,80,000**
8.	**Distribution**	48,191	2,38,082	19,963	**3,06,235**
9.	**Research & Development**	4,168			**4,168**
10.	**DSM & EE**	7,482			**7,482**
11.	**Human Resources Development (Training Infrastructure)**	4,108			**4,108**
	Fund Outlay (4 to 11)	**4,64,774**	**3,85,782**	**3,86,924**	**12,37,480**

Source: CEA

Fund requirement for RE projects in 12th Plan have been computed on the basis of per MW cost of different types of RE projects which are based on the FY 2011-12 price levels and listed in **Appendix 8.4.** The total fund requirement for RE projects in 12th Plan has been calculated as below:

Table 8.6(a)

Fund requirement for RE projects in 12th Plan

S. No.	Type	Total cost (Rs. crore)
1.	Biomass	10,500
2.	SHP	8,000
3.	Solar	49,400
4.	Wind	67,200
	Total	**1,35,100**

Hence, the total fund outlay for 12th Plan has been calculated as below:

Table 8.6(b)

Particulars	Total cost (Rs. crore)
Total fund outlay except RE projects	12.37,480
Fund outlay for RE projects	1,35,100
Total fund outlay for 12th Plan	**13,72,580**

The year wise fund requirement during 12th Plan is given in the table below:

Table 8.4(c)

Year wise fund requirement during 12th Plan

(Figures in Rs. Crore)

Financial Year	2012-13	2013-14	2014-15	2015-16	2016-17	Total
Fund requirement	2,36,996	2,42,335	2,72,042	3,02,770	3,18,436	**13,72,580**

8.5 FUND AVAILABILITY

Debt: Equity (D/E) ratios for central, state and private sector have been taken based on the current lending norms for funding of power sector. The details are as given below:

Table 8.5

Debt equity ratios

Sector	Debt	Equity
Centre	70%	30%
State	80%	20%
Private	75%	25%

The possible sources of funding are commercial banks, public financial institutions, dedicated infrastructure/power finance institutions, insurance companies, overseas markets, bilateral/ multilateral credit, bond markets and equity markets. The sources of funds, expected funds mobilization and financial & policy issues have been detailed in subsequent sections.

8.5.1 Current norms and trends

8.5.1.1 Commercial banks / Infrastructure Finance Companies

As per the prevalent guidelines/ prudential norms, the financing limits applicable for banks/ IFC are as follows:

8.5.1.1.1 Exposure Ceilings of banks for Individual/ Group Borrowers

As per the prudential norms stipulated by RBI, the credit exposure to single borrower and group shall not exceed 15% and 40% respectively of Bank's capital funds (Tier I & Tier II capital).

Credit exposure to single borrower may exceed the exposure norm of 15% of the bank's capital funds by an additional 5% (i.e. up to 20%) provided the additional credit exposure is on account of infrastructure.

Credit exposure to borrowers belonging to a group may exceed the exposure norm of 40% of the bank's capital funds by an additional 10% (i.e. up to 50%), provided the additional credit exposure is on account of extension of credit to infrastructure projects.

Banks may, in exceptional circumstances, with the approval of their Boards, consider enhancement of the exposure to a borrower up to a further 5% of capital funds subject to the borrower consenting to the banks making appropriate disclosures in their Annual Reports. As per the guidelines on exposure norms, the banks may further fix internal limits for aggregate commitments to specific sectors / industries.

Some banks also have an internal policy cap broadly on the following lines:

i. Maximum term loans not to exceed 30% (of total time / term deposits / total non food advances) at any time
ii. Terms loans per industry at a maximum of 10% of non-food advances
iii. Maximum limit for infrastructure advances at 7% of non-food advances

As per RBI's report published in June, 2011, advances to infrastructure exhibited strong growth of above 40 per cent in 2010-11. The share of infrastructure lending in total advances consequently increased to 12.9 per cent in March 2011 as against 11 per cent in March, 2010. Credit to the power sector accounted for about 42 per cent of aggregate infrastructure credit. During the last five years, exposure of scheduled commercial banks to the power sector grew at a CAGR of 35% p.a.

8.5.1.1.2 Exposure Ceilings of Financial Institutions for Individual /Group Borrowers

As per the prudential norms, the credit exposure to single borrowers shall not exceed 15% of capital funds of the IFC. However, the exposure may exceed by additional 5% (i.e. up to 20%) provided the additional credit exposure is on account of infrastructure projects. IFC may, in exceptional circumstances, with the approval of their Boards, consider enhancement of the exposure to a borrower up to a further 5% of capital funds (i.e. 25% of capital funds for infrastructure projects and 20% for other projects).

The credit exposure to the borrowers belonging to a group shall not exceed 40% of capital funds of the IFC. However, the exposure may exceed by additional 10% (i.e. up to 50%) provided the additional credit exposure is on account of infrastructure projects. IFC may in exceptional circumstances, with the approval of their Boards, consider enhancement of the exposure to a borrower up to a further 5% of capital funds (i.e. 55% of capital funds for infrastructure projects and 45% for other projects). The IFC may fix internal limits for aggregate commitments to specific sectors.

8.5.1.2 Insurance Companies

While considering the other major category of investment institutions i.e. the insurance companies, it may be observed that the Insurance Regulatory and Development Authority of India (IRDA) have mandated the pattern of investments to be followed by the various insurance companies. Investments in government securities, approved securities, approved investments and in infrastructure and social sectors have been prescribed in the Insurance Act, 1938 and the regulations have been framed there under. IRDA has also specified that every insurer carrying on the business of life insurance shall invest and at all times keep invested its controlled fund (other than funds relating to pension and general annuity business and unit-linked life insurance business) in the prescribed manner.

As per the fourth amendment to investment regulations in 2008, IRDA has specified the following limits for the investments that are to be maintained by life insurance companies. The limits for investments by life insurance companies are provided below:

Table 8.6

Limits for investments by Life Insurance Companies

S.No.	Type of Investment	% of fund
i)	Government securities or other approved securities	Not less than 50%
	-Government securities	Not less than 25%
ii)	Investments as specified in Section 27A of Insurance Act, 1938 and Approved Investments subject to Exposure/Prudential norms	
a)	Infrastructure and Social Sector by way of investments in Bonds/debentures of HUDCO, National Housing Bank, Housing Finance Corporations, Asset Backed Securities with underlying housing loans	Not less than 15%
b)	Others to be governed by Exposure Norms. (Investments in `Other than in approved Investments' in no case exceed 15% of the Fund)	Not exceeding 35%

Source: Insurance Regulatory and Development Authority

For general insurance companies, IRDA has specified sectoral caps for investments as follows:

Table 8.7

Limits of Insurance specified for General Insurance companies

S No.	Type of Investment	Percentage
i)	Government Securities or other approved securities	Not less than 30%
	-Government securities	Not less than 20%
ii)	Housing and Loans to State Government for Housing and Fire Fighting equipment	Not less than 5%
iii)	Investments in Approved Investments	
	a) Infrastructure including Bonds/Debentures, Equity and Asset Backed Securities with underlying infrastructure assets	Not less than 10%
	b) Others to be governed by Exposure Norms. However the investments in `Other than in Approved Investments' in no case exceed 25% of the Assets	Not exceeding 55%

Source: Insurance Regulatory and Development Authority

The aggregate investment of life insurance in Housing and Infrastructure on March 31, 2010 was at Rs. 73,439 crore compared to Rs. 66,673 crore on 31st March 2009. This was a decline from 8.97% of the investments in traditional products of life insurance companies in 2009 to 8.29% in 2010.

The infrastructure investments of non-life insurers as on March 31, 2010 were Rs. 10,373 crore compared to Rs. 8,980 crore on 31st March 2009. This was an increase from 15.25% of total investments of non-life insurers in 2009 to 15.63% in 2010.

8.5.1.3 Overseas Markets: External Commercial Borrowing (ECB)

As defined by RBI, ECB can be accessed by a borrower under two routes, namely, (i) Automatic Route and (ii) Approval Route. ECB for investment in infrastructure sector up to USD 500 million falls under the Automatic Route i.e. it will not require RBI/ government approval. Borrowers can raise ECB from internationally recognized sources such as international banks, international capital markets, multilateral financial institutions, export credit agencies and suppliers of equipment, foreign collaborators and foreign equity holders.

The following rules apply in regards to the amount and maturity of ECBs raised through automatic route *(Source: Reserve Bank of India)*:

a) ECB up to USD 20 million or equivalent in a financial year with minimum average maturity of three years.
b) ECB above USD 20 million and up to USD 500 million or equivalent with a minimum average maturity of five years.
c) ECB up to USD 20 million can have call / put option provided the minimum average maturity of three years is complied with before exercising call / put option.

All-in-cost includes rate of interest, other fees and expenses in foreign currency except commitment fee, pre-payment fee, and fees payable in Indian Rupees. Moreover, the payment of withholding tax in Indian Rupees is excluded for calculating the all-in-cost.

Table 8.8

Ceilings for ECB Lending

Minimum Average Maturity Period	All-in-cost Ceilings over six month LIBOR*
Three years and up to five years	300 basis points
More than five years	500 basis points

Source: Reserve Bank of India

* For the respective currency of borrowing or applicable benchmark.

While the above norms are expected to balance the interests of the country and the borrower, and ensure adequate supply of funds, the same need to be appropriately channelized towards the power sector, either in the form of syndicated debt, tied financing / supplier's credit, or assistance from multilateral agencies. Further, rising cost of domestic borrowing could lead to an increase in demand for ECBs amongst Indian companies. However, the availability of long-term funds in overseas markets is an area of concern, with the lenders generally preferring to limit their exposure to shorter term tenors of up to 5 years.

8.5.1.4 Multilateral Agencies

Some of the concerns that need to be addressed, related to funding of projects from multilateral agencies, such as World Bank, Asian Development Bank etc. are:

- Significant emphasis on Environment and Social Issues with added costs of audits and certifications.
- Comparatively lengthy and time consuming appraisal and due diligence exercise, conducted by multilateral agencies.

The above can be attributed to the requirement on the part of multilateral agencies regarding the risk profile of the project and past experiences of the progress of power sector reforms in the country. Further, inadequate returns due to poor financial health of the SEBs; implications of announcements of free power by state governments; lack of comprehensive payment security mechanism etc. are acting as deterrents to advancement of financing by multilateral agencies to the sector in a big way.

8.5.1.5 Bond Market

The Indian Financial system does not have large active and liquid debt market. The Corporate Debt Market in India is in its infancy both in terms of microstructure as well as market outcomes. Primary market is dominated by financial sector and relatively small amount of funds are raised by manufacturing and other service industries. While Indian firms are still seeking bank finance as the path to fulfil the funding requirement, the government securities market has grown exponentially during last decade due to many structural changes introduced by the government and RBI to improve transparency in the market dealings, method of primary auctions, deepening the market with new market participants like primary dealers, borrowings at market determined rates, and creating technology platforms to recognize the institutional characteristics of the market. However, secondary market activities in corporate bonds have not picked up as in the case of government securities. Efforts of Securities Exchange Board of India (SEBI) and the stock exchanges to bring the trading to electronic stock exchange platforms have not yielded desired results.

The Indian debt market is dominated by government securities, which constituted more than 75% of the total debt outstanding at the end of June, 2011. In terms of trading activity, government securities are the most liquid and contribute more than 80% of the trading volume of the debt market. Presently trading activity in the G-Sec market is also very concentrated (in terms of liquidity of the outstanding G-Sec.) with the top 10 liquid securities accounting for a majority of the daily volumes.

The primary market in corporate debt is basically a private placement market with most of the corporate bond issues being privately placed among the wholesale investors i.e. the banks, mutual funds, provident funds & other large investors like LIC, etc. The proportion of public is/sues in the total quantum of debt capital issued annually has substantially decreased in the last few years.

8.5.2 Estimated Funds Mobilization

The details of the major sources of financing and estimated quantum of funds are mentioned in subsequent sections.

Table 8.9

Major sources of financing and funds mobilization

(Figures in Rs. Crore)

Sources of Funds	12th Plan estimations
Equity	
By promoters for IPPs, IPTCs	80,481
By promoters for NCES & Captive	56,780
Internal Resources	126,226
Total Sources of Equity (A)	**263,487**
Debt	
Scheduled Commercial Banks (SCBs)	270,455
PFC	178,259
REC	175,950
Other IFC	36,427
Bonds/Debentures	140,541
Multilateral/Bilateral Credits/ECBs	90,755
Insurance companies	28,899
Total Sources of Debt (B)	**921,286**
Total Sources of Debt and Equity (C=A+B)	**1,184,773**

8.5.2.1 Sources of equity

Internal resource, mobilization by Public Sector Enterprises (PSEs) in 12th Plan have been estimated at Rs.1,26,226 crore. The estimate has been made on the basis of the Internal & Extra Budgetary Resources (I&EBR) data. The details of the same have been provided in **Appendix 8.5.**

For IPPs, IPTCs, NCES and Captive power projects it has been assumed that the required equity has been/ will be tied up to the satisfaction of lenders as these projects will achieve Financial Closure on non-recourse basis.

8.5.2.2 Sources of debt

8.5.2.2.1 Banks

The following assumptions have been used to estimate fund availability from banks during 12th Plan:

- The Non-food Gross Bank Credit (GBC) has been increasing at a decreasing rate in the last three years – a drop from 22.3% in 2008 to 16.7% in 2010. The average growth rate of the same has been assumed at 15% for the duration of the XII five-year plan.
- The share of advances to Industry in GBC has increased from 38.7% in 2007 to 43.1% in 2010 and the same has been assumed to be 44% during XII five year plan.
- The share of advances to power sector in the above has increased from 10% in 2007 to 14.36% in 2010 and same has been assumed to be stable at 15% during XII five year plan.

On the basis of above assumptions, the funds available from banks during 12th Plan have been estimated at Rs. 2,70,455 crore. The calculations are provided in **Appendix 8.7.**

8.5.2.2.2 PFC

The funds available from PFC for 12th Plan have been estimated at Rs. 1,78,259 crore. The assumptions are provided in **Appendix 8.8.**

8.5.2.2.3 REC

The funds available from REC for 12th Plan have been estimated to be Rs. 1,75,950 crore. The assumptions are given in **Appendix 8.9.**

8.5.2.2.4 Other IFC

The major IFCs other than PFC and REC are Infrastructure Development Finance Company Limited (IDFC), Larsen and Tubro Finance and PTC India Financial Services Ltd. The projected funding by IDFC for 12th Plan power projects is Rs. 30,000 crore which is about 80% of its incremental loan book in 12th Plan. Assuming similar ratios for the other two companies, the total funds available from the IFCs for 12th Plan power projects has been calculated as Rs. 36,427 crore. The calculations have been shown in **Appendix 8.10.**

8.5.2.2.5 Bonds/Debentures

Bond and Non-Convertible Debenture (NCD) issuances grew at a CAGR of 18% from Rs. 99,222 crore in FY 2007 to Rs. 1,94,948 crore in FY 2011. During the same period, bond issuances by Power sector companies (excluding IFC) increased at a CAGR of 38% from Rs. 5,275 crores to Rs. 19,025 crores. While the year on year growth rates for bond issuances has been volatile due to the impact of economic crisis, the percentage of bond issuances by Power sector companies to the overall bond issuances has been in the range of 7-10%.

Going forward, the growth rate of bond and NCD issuances during 12th Plan has been assumed at a conservative rate of 9% p.a., while the growth rate of bond issuances by Power sector companies is expected to moderate to around 10% p.a. Based on these assumptions, the total bond and NCD issuances in the terminal year of 12th Plan are expected to be around Rs. 3,27,000 crore with bond issuances by Power sector companies at around Rs. 33,704 crore i.e. around 10% of total bond and NCD issuances. The funds available from Bond issuances during 12th Plan have been estimated at around Rs. 1,40,541 crore. The details of the same have been provided in **Appendix 8.11.**

8.5.2.2.6 Multilateral/ Bilateral Credits/ ECBs

The total outstanding amount of multilateral credits, bilateral credits and ECBs increased from Rs. 303,800 crore in March 2004 to Rs 412,076crore in March 2007 (*Source: RBI*).The CAGR of the same has been computed as 10.7%. Assuming the same trend to continue, the total inflow of funds through these routes has been calculated to be Rs. 4,53,777 crore.

Based on the industry reports (*Source: McKinsey*), 24% of the total external borrowings have been assumed to be channelled towards infrastructure investments, out of which, 20% (83% of external borrowing to infrastructure) are assumed to be channelized to power sector. Hence, the total funds available through these routes have been calculated to be Rs. 90,755 crore. The details of the same have been provided in **Appendix 8.12.**

8.5.2.2.7 Insurance companies

The following assumptions have been used to estimate fund availability from life and non-life insurance companies

- **Life insurance companies:**
    - The total investments of life insurance companies grew from Rs. 743,602 crore in March 2009 to Rs. 873,536 crore in March 2010 which is a growth of about 17.5%. The growth rate of these investments has been assumed to be 15% per annum till FY 2017.
    - In FY 2009 and FY 2010, about 9% of total investments of life insurance companies have been in housing and infrastructure sector. The same trend has been assumed to continue till FY 2017
    - 25% of the total investments of housing and infrastructure sector have been assumed to be allocated to power sector

- **Non-life insurance companies:**

  - The total investments of non-life insurance companies grew from 58,893in March 2009 to 66,372in March 2010 which is a growth of about 12.7%. The growth rate of these investments has been assumed to be 12.5% per annum till FY 2017.
  - In FY 2009 and FY 2010, about 15.5% of total investments of non-life insurance companies have been in housing and infrastructure sector. The same trend has been assumed to continue till FY 2017
  - 25% of the total investments of housing and infrastructure sector have been assumed to be allocated to power sector

On the basis of the above assumption, fund availability for power sector during 12th Plan from life and non-life insurance companies has been estimated at Rs. 28,899 crore. The calculations are provided in **Appendix 8.6.**

8.5.3 Fund mobilization from special schemes

In addition to the sources of debt and equity mentioned above, funds are available from the following special schemes:

8.5.3.1 Gross Budgetary Support (GBS)

GBS to Central Sector power PSEs has been estimated at Rs. 2,473.26 crore during 12th Plan. In addition fund infusion through GBS under planned schemes has been estimated at Rs. 1,77,368 crore. The details are given at **Appendix 8.5.** Funds under NEF scheme amounting to around Rs. 22,000 crore will be provided as interest subsidy and thus have been excluded for estimation of fund availability.

8.5.3.2 Credit Enhancement Scheme

The credit enhancement scheme of Government of India through India Infrastructure Finance Company Limited (IIFCL) could help infrastructure project developers access funds at a cheaper rate based on a guarantee. It would also release bank funds to lend to industry and retail borrowers.

The scheme envisages IIFCL guaranteeing the bonds being issued by the Infrastructure Company or SPV and subscribing to 25% of the bonds issued. It is expected that the IIFCL guarantee will be backed by an insurance cover by Asian Development Bank (ADB) to the tune of 50% of IIFCL's exposure and the remaining 50% will enjoy government guarantee by virtue of sovereign guarantee of IIFCL. As a result of the credit enhancement, the SPV's rating is expected to improve from BBB to AA, making it investment grade which is the minimum acceptable level for pension and insurance funds. With the participation of pension and insurance funds, the twin benefits of longer tenor and stable interest rate could accrue to power projects while the ALM issues of banks could also be resolved.

The scheme is expected to be launched on a pilot basis for which IIFCL has set aside a target of Rs 5,000 crore which translates to around Rs 20,000 crore of funding assuming that IIFCL will subscribe to 25% of the bonds issued. Out of these, Rs 10,000 crore (50%) have been assumed to be available for funding of power sector.

8.5.3.3 Infrastructure Debt Fund

Ministry of Finance, Govt of India has proposed to establish India Infrastructure Debt Fund as a specialized long-term debt fund to cater to the needs of the infrastructure projects being set up through Public Private Partnership (PPP) route. The proposed fund could be structured as a trust or as company as mentioned below:

- As a trust sponsored by a financial sector entity like Mutual Funds (regulated by SEBI) and would have to invest 90% of its assets in the debt securities of infrastructure companies or special purpose vehicles (SPVs) across all infrastructure sub-sectors. Minimum investment by trust-based fund would be Rs. 1 crore with Rs. 10 lakh as minimum size of the unit.

- As a company by IFCs or banks (regulated by RBI) with a minimum capital of Rs. 150 crore. Such a fund would be allowed to raise resources through rupee or dollar denominated bonds of minimum 5 year maturity. These bonds could be traded among the domestic and foreign investors.

The fund is expected to garner resources from domestic and off-shore institutional investors, especially insurance and pension funds.

As stipulated in the fund guidelines, the debt fund would only lend to projects that meet the following criteria:

- Completed at least one year of commercial operations without any material default in debt service or in the performance of their obligations under the respective project agreements

- Awarded through competitive bidding as they would carry the assurance of a sustainable price discovery

The fund would enable the project companies to substitute their existing debt by long-term bonds at comparatively lower interest rates. The restructuring of project debt would also release a large volume of the present lending capacity of the commercial banks, thus enabling them to lend more to new infrastructure projects.

The infrastructure debt fund is expected to provide an additional debt of Rs. 50,000 crore for infrastructure projects and help bridge the likely gap in debt financing. Out of these, Rs. 25,000 crore (50%) has been assumed to be available for power sector.

8.6 ADEQUACY OF FUNDS

On the basis of the fund requirement and availability estimated in previous sections, the debt shortfall has been computed at around Rs. 97,444 crore and the equity shortfall has been computed at around Rs. 90,363 crore, implying a total funding shortfall of Rs. 1,87,807 crore.

After incorporating funds available from GBS and special schemes, the total funding available is detailed below:

Table 8.12

Assessment of adequacy of funds during 12th Plan

(Figures in Rs. crore)

Particulars	Amount
Funds Required	**13,72,580**
Equity Required	3,53,850
Total sources of Equity	2,63,487
Equity available /(shortfall) (A)	**(90,363)**
Debt Required	10,18,730
Total sources of Debt	9,21,286
Debt available /(shortfall) (B)	**(97,444)**
Total Funds available /(shortfall) before considering impact of Special Schemes (A+B)	**(187,807)**
Funding by GBS	
GBS to CPSEs	**2,473**
GBS to plan schemes	**1,55,368***
Sub-Total (C)	**1,57,841**
Funding from other Sources	
Credit Enhancement Scheme	10,000
Infrastructure Debt Fund	25,000
Sub-Total (D)	**35,000**
Total funds available /(shortfall) (E=A+B+C+D)	**5,034**

** Funds under NEF scheme amounting to around Rs. 22,000 crore will be provided as interest subsidy and thus have been excluded for estimation of fund availability.*

A low economic growth scenario has also been considered for estimating the availability/ shortfall of funds in case of adverse economic situation. The quantum of debt available from various sources in such a scenario has been compared with the base case estimation and results are tabulated in **Appendix 8.13**. The underlying assumptions involved in the calculations are also provided in **Appendix 8.14**.

The shortfall in availability of funds in the low economic growth scenario has been computed to be Rs. 1,40,528 crore vis-à-vis fund surplus of Rs. 5,034 crore in the base case scenario. The details of the same are provided as follows:

Table 8.13

Shortfall estimation in case of low economic growth

	(Figures in Rs. crore)
Particulars	**Amount**
Funds Required	**13,72,580**
Equity Required (D/E – 70:30)	3,53,850
Total Equity Available	2,63,487
Equity available /(shortfall) (A)	**(90,363)**
Debt Required (D/E – 70:30)	10,18,730
Total Debt Available	7,75,723
Debt available /(shortfall) (B)	**(2,43,007)**
Additional funds from GBS and other sources (C)	**1,92,841***
Total funds available /(shortfall) (D=A+B+C)	**(1,40,528)**

** Funds under NEF scheme amounting to around Rs. 22,000 crore will be provided as interest subsidy and thus have been excluded for estimation of fund availability.*

Further consideration may be given to the fact that the adequacy of funds for investment in the power sector has to be determined in conjunction with the financial and policy constraints prevalent in the economy.

8.7 FINANCIAL ISSUES

8.7.1 Quantum of Funds

Banks and Infrastructure Finance Companies (IFCs) are the predominant sources of financing. Balance sheet size of many Indian banks and IFCs are small vis-à-vis many global banks. Credit exposure limits of banks and IFCs towards power sector exposure is close to being breached. Any future exposure seems to be severely constrained by balance sheet size, their incremental credit growth and lack of incentives to lend to power sector. The desirability and sustainability of sectoral exposure norms of the banks in the future may be examined in view of the massive exposure of the banks and projected fund requirements for the power sector.

Further, any downgrade in the credit rating of power sector borrowers would adversely impact the ability of the major NBFCs viz. PFC and REC to raise large quantum of funds at a competitive rate from domestic as well as international capital markets. In such a scenario, the sources of funds available for power sector projects are expected to be further constrained.

8.7.2 Tenor of Funds

The capital intensive nature of power projects requires raising debt for longer tenor (more than 15 years) which can be supported by life of the Power Project (around 25 years). However, there is wide disparity between the maturity profiles of assets and liabilities of banks exposing them to serious Asset Liability Maturity mismatch (ALM). Accordingly, the longest term of debt available from any bank or financial institution is for 15 years (door-to-door) which could create mismatch in cash flow of the Power project and may affect the debt servicing. Options like re-financing may be explored to make funds available for the power project for a long tenor.

Though maturity profiles of funds from insurance sector and pension funds are more suited to long gestation power projects, only a miniscule portion is deployed in power sector. Appropriate fiscal incentives need to be explored to channelize savings. New debt instruments and sources of funds viz. Infrastructure Debt Fund, Clean Energy Funds etc. may be identified for the purpose of infrastructure financing.

8.7.3 Cost of Funds

Cost of Rupee funding is high as compared to foreign currency funding. In a competitive bidding scenario, higher cost of borrowing could adversely affect the profitability and debt servicing of loan. External Commercial Borrowings (ECBs) for power projects is not well suited due to issues relating to tenor, hedging costs, exposure to foreign exchange risks etc. Project financing by multilateral agencies (World Bank, Asian Development Bank) has been low due to various issues.

While bond offerings are a lower cost option to raise funds vis-à-vis syndicated loans, corporate bond market for project financing is virtually absent in India. The credit rating of the power projects being set up under SPV structure is generally lower than investment criterion of bond investors and there is a need for credit enhancement products.

8.8 POLICY ISSUES

8.8.1 Concerns Regarding Land Acquisitions

In light of recent court rulings relating to land acquisition for projects, developers have voiced their concerns in this regard. Also, the availability of land and right of way that are critical for the power project are emerging as a major issue for the developers. There is a need for uniform land acquisition policy framework across the country that could address all the issues relating to land acquisition that is equitable to all the stakeholders.

8.8.2 Fuel security and related issues

Coal produced in 2010 was 526 million tonnes and about 77% of the coal produced is consumed by Power Plants. An incremental demand of 350-400 mtpa has been estimated for 12th Plan, of which about 50% is expected to be met by domestic supply. Accordingly, coal imports are estimated to reach a level of around 200 mtpa by the end of 12th Plan.

Coal based projects accorded Letter of Assurance (LoA) by Coal India Ltd. (CIL) are to the tune of 30,000 MW. However, a majority of LoAs are yet to be converted into binding Fuel Supply Agreement (FSA) as CIL has expressed inability to commit coal for all the projects under implementation. Lack of binding FSA adversely impacts fuel security and bankability of the project and lenders are unwilling to finance power projects without a binding FSA.

In order to meet the coal shortfall, most of power sector players are acquiring coal assets abroad. However, if the cost of imported coal is passed through to the beneficiary states/ UTs, it results in high power tariffs due to which the end users viz. Discoms are not willing to off-take the power. Further, IPPs are moving towards tariff bidding regime from cost plus regime and the ability of IPPs to absorb cost of imported coal is limited. Hence, lenders have voiced concern regarding the long term viability of imported coal based power projects.

Further, considering technical aspects, CEA has advised that the boilers be designed to blend domestic and imported coal in the ratio of 70:30 or higher. However, CIL has proposed fuel supply agreement with only 50% commitment of domestic coal and the balance requirement to be met through imports. The above issue needs to be addressed in such a way that the technical requirements and commercial agreements are aligned.

Captive coal blocks allocated by Ministry of Coal to various power project developers may not be implemented as per the envisaged implementation schedules due to issues relating to land acquisition and environmental concerns. The delay in development of captive coal blocks is also hindering the financing of end use power projects.

While most of the 12th Plan power projects have achieved financial closure, the above mentioned issues viz. lack of binding FSA, high cost of imported coal and delays in according statutory clearances to captive coal blocks are expected to impact financial closure of 13th Plan power projects.

8.8.3 Environmental Issues

Inordinate delays in environmental clearances may lead to cost escalation and in exceptional circumstances to abandonment of the Project. Credit off-take in the sector is hampered/ delayed as many projects are unable to achieve timely compliance of Conditions Precedent to disbursement.

8.8.4 Financial Health of Power Distribution Companies

The financial health of distribution utilities in the country is a matter of concern. The increase in financial losses of Discoms in the last few years could partly be attributed to high levels of Aggregate Technical and Commercial (AT&C) losses as well as inability of power tariffs to recover the cost of supply. If the present trend continues, projected losses in the year 2014-15 will be Rs 1,16,089 crores as per the study conducted by M/s MERCADOS for the XIII Finance Commission.

Owing to poor financial health of Discoms, the Discoms may not be able to borrow funds from lenders which could adversely impact investment in the power sector. The financial health of Discoms would adversely impact their ability to pay for power procured from IPPs. In such a scenario, lenders are not willing to lend to generation and transmission projects of IPPs and IPTCs respectively.

Unless appropriate steps are taken now to curtail the mounting financial losses of the utilities, it may lead to breach of conditions agreed under the Fiscal Responsibility and Budget Management (FRBM) framework, apart from adversely impacting financial health of States and might even jeopardize the investment in the entire power sector.

8.8.5 Regulatory Issues

The bidding for power projects through Case I route is sporadic and inconsistent, hence the whole bidding process may be reviewed with respect to bidding mechanism, frequency and timing of bid, efficacy etc.

Moreover, the lenders are able to establish the bankability of a project only when there is a firm power purchase agreement in place with the Power Distribution Companies (Discoms) for major quantum of power to be generated by the project. Delays in bidding for power projects through Case I route could lead to delay in establishing bankability of a project and may lead to delays in targeted capacity addition.

Further, bidding for power projects through Case I and Case II routes envisages that a part of the risk on account of fuel cost will be borne by the project developer. Power projects coming up on imported coal could be adversely impacted by the recent changes in fuel pricing as witnessed in Indonesia and Australia. The new Indonesian mining laws make it mandatory that coal prices be based on international market rate. Similarly, Australia is planning a levy on general additional revenues from exports of coal as well as to impose a carbon tax. Both these measures could adversely impact the financial viability of imported coal based power projects.

8.8.6 Concerns regarding funding Renewable Energy (RE) Projects

For the lenders, RE projects are also considered as power projects and there is no separate sub-sectoral allocation. Consequently, RE projects have to compete with conventional power projects for borrowings from banks. Moreover, the lenders do not have any compulsion or incentive for financing RE projects. In lenders' view, the financial viability of a conventional power project is quite apparent vis-à-vis RE project. The funds available with many Indian banks are limited due to their low capitalisation; these banks are expected to cater to the needs of all classes of borrowers from retail to SMEs to large industries. By financing just a few projects, their sectoral limits in a particular sector get exhausted. Since RE projects have no separate sectoral limits they are the worst hit. As a result, conventional power projects are crowding out the RE projects in the debt market.

Most of the RE capacity in India has been set up to exploit tax incentives and was financed on full recourse basis. Though a number of small and independent developers are implementing RE projects on a non-recourse basis, lenders are not comfortable with such developers regarding their ability to infuse necessary equity, poor project preparation, bankability of projects etc. Also, the information relating to past performance of standalone RE projects is hardly available to the mainstream lenders, which otherwise would have helped in improving lenders' comfort regarding RE projects. Moreover, there are no credit enhancement products in the Indian debt market which could enhance the comfort of project lenders. In the absence of familiarity and comfort, lenders prefer conventional power projects over the renewable projects.

8.8.7 Concerns regarding funding of projects in NE Region

Overall development of power sector in the NE region has been very slow. The reasons for the slow pace of power project execution are as follows:

- Hydro electric project sites are inaccessible and have very difficult approach/ maintenance of access roads
- Difficulties faced in obtaining environment & forest clearance, land acquisition, R&R issues
- Geological surprises
- Inadequate Survey & Investigation
- Law and Order issues

8.9 RECOMMENDATIONS & IMPLEMENTATION STRATEGY

8.9.1 Policy Measures for Equity Participation

Modifications in IRDA/PFRDA policy framework: The discussions should be held with IRDA/PFRDA for making suitable modifications in their policy framework so as to channelize long term funds available with insurance companies/NPS/EPFO to PEFIs.

IPO by Power companies: Profit making central/ state utilities in generation as well as transmission & distribution sector like NHDC, NLC, etc. should be encouraged for supply of PSU stock in the market by way of IPOs/ FPOs (Follow-on Public Offer)/ offer for sale.

8.9.2 Sector Specific Funds

From time to time, Government of India (GoI) introduces sector specific funds with specific objective of making funds available to a particular sector from the respective fund. Some of these funds which can be considered potential source of funds for the infrastructure sector are:

8.9.2.1 Specialized Debt Funds for Infrastructure Financing

Creation of specialized long-term debt funds to cater to the needs of the infrastructure sector; a regulatory and tax environment that is suitable for attracting investments is the key for channelizing long-term funds into infrastructure development.

RBI may look into the feasibility of not treating investments by banks in such close-ended debt funds as capital market exposure. IRDA may consider including investment in SEBI registered debt funds as approved investments for insurance companies.

8.9.2.2 Long tenor debt funds

Insurance Companies, Financial Institutions should be encouraged/provided incentives to invest in longer dated securities to evolve an optimal debt structure to minimize the cost of debt servicing. This would ensure lowest tariff structure and maximum financial viability. Option of a moratorium for an initial 2 to 5 years may also reduce tariff structure during the initial years.

8.9.3 Hydro Power Viability Fund

In case of hydro power projects, the cost of generation in the initial 4-5 years is comparatively much higher than in the later years. It is suggested that for long term Power Purchase Agreement (PPA) contracts, a component (say 25%) in the tariff of hydro power projects for the first five years after start of commercial operation is deferred and not recovered from the buyers but is added in the tariff from 11th to 15th years. To operationalise such schemes, lenders will need to initiate a scheme which finances the deferred component of the power tariff of the first five years and recovers its money during 11th to 15th year of the operation. For this, a fund can be set up by IFCs which cater to payments and receipts. The responsibility of developing and operating the hydro project viability fund can be vested with financial intermediaries like PFC etc. This will also rationalize the gap between the tariff of hydro and thermal in the initial years of operations. Any extra financing cost incurred on such viability gap financing should also be permitted as a pass through in the tariff by regulators.

8.9.4 Viability Gap Fund (for Remote areas)

The power projects that are listed under in generation or transmission and distribution schemes in remote areas like North-eastern region, J&K etc and other difficult terrains need financial support in the form of a viability gap for the high initial cost of power which is difficult to be absorbed in the initial period of operation. A scheme may be implemented in the remote areas as a viability gap fund either in the form of subsidy or on the lines of hydro power development fund, a loan which finances the deferred component of the power tariff of the first five years and recovers its money during 11th to 15th year of the operation may be introduced. Any extra financing cost incurred on such viability gap financing should also be permitted as a pass through in the tariff by regulators.

8.9.5 Policy Measures for financing RE Projects

In light of the concerns mentioned earlier, it can be suggested that some sort of interest subsidy may be offered or make concessional refinancing available to RE project lenders for encouraging financing to RE sector.

Further, in light of the fact that conventional power projects are crowding out the RE projects in the debt market, RBI may consider funding to RE Projects as a separate sector for the purpose of computing sectoral exposure limits.

8.9.6 Policy Measures for Take-out financing for ECB Lenders

RBI has stipulated guidelines for Take-out Financing through External Commercial Borrowings (ECB) Policy.

The guidelines stipulate that the corporate developing the infrastructure project including Power project should have a tripartite agreement with domestic banks and overseas recognized lenders for either a conditional or unconditional take-out of the loan within three years of the scheduled Commercial Operation Date (COD). The scheduled date of occurrence of the take-out should be clearly mentioned in the agreement. However, it is felt that the market conditions cannot exactly be anticipated at the time of signing of document and any adverse movement in ECB markets could nullify the interest rate benefit that could have accrued to the project. Hence, it is suggested that tripartite agreement be executed closure to project COD and instead of scheduled date of occurrence of the take-out event, a window of 6 or 12 months could be mentioned within which the take-out event should occur.

Further, the guidelines stipulate that the loan should have a minimum average maturity period of seven years. However, an ECB of average maturity period of seven years would entail a repayment profile involving door-to-door tenors of eight to ten years with back-ended repayments. An analysis of past ECB transactions indicates that ECB with such a repayment profile may not be available in the financial markets. Further, the costs involved in hedging foreign currency risks associated with such a repayment profile could be prohibitively high. Hence it is suggested that the minimum average maturity period stipulated should be aligned to maturity profiles of ECB above USD 20 million and up to USD 500 million i.e. minimum average maturity of five years as stipulated in RBI Master Circular No.9 /2011-12 dated July 01, 2011.

8.9.7 Policy Measures for financing power projects in NE Region

In light of the concerns mentioned in earlier sections, the following policy measures can be suggested:

- Geological survey & investigation works, preparation of DPR, approvals and clearances from various organizations including MoEF have to be taken up in a time bound manner. A well formulated time-frame for concerned authorities to respond to applications for approvals and clearances will alleviate the concerns of the lenders.
- A comprehensive plan for adequate road and power evacuation network needs to be formulated taking into consideration various development projects. Such a move is expected to substantially mitigate the construction and power evacuation risk of the projects.
- Non availability of construction materials like cement steel etc and long procurement time makes the Hydro Projects costly and unviable. Setting up of industries for construction material including cement industry may be encouraged in the North Eastern Region.
- Lending to power projects in NE could be brought under the ambit of priority sector for encouraging financing to power projects in NE sector.
- Power generation and transmission projects in NE sector could be financed through a dedicated NE fund. The mechanism of operation of this fund has been discussed in the next section.

8.9.8 Policy Measures for improving the health of state sector utilities

- The state governments should ensure that the accounts of a financial year are audited by September of the next financial year, henceforth. Computerization of accounts would be undertaken on priority, if not done already.
- The states should ensure that the distribution utilities file their Annual Tariff Revision Petition every year, by December – January of the preceding financial year to the State Regulators as stipulated by the National Tariff policy.
- The Annual Tariff Revision Petition should be filed before the SERC, keeping in view the increase of the Power purchase cost (which accounts for nearly 70-80% of the Cost of supply) and states will ensure that the difference between ARR and ACS is not only bridged but is positive to generate internal surpluses which can be used for network expansion and maintenance.
- The state governments should ensure automatic pass through in tariff for any increase in fuel cost by incorporating the same in the regulations, as provided in Section 62(4) of Electricity Act, 2003. (State Governments can issue directions to SERCs under Section 108 of the Electricity Act, 2003).

- The state governments should not only clear all the outstanding subsidies to the utilities, but ensure advance payment of subsidy as per the Section 65 of the Electricity Act, 2003 in future.
- The state governments should ensure payment of all outstanding dues from various departments of state government and institutions to the distribution utilities or release payments from the State budget directly.
- The state governments should consider converting loans due from the state governments to the distribution utilities as state government equity to ensure capital infusion and improvement in net worth of utility.
- The state governments should take effective steps to reduce AT&C losses to less than 15% by administrative measures, curbing pilferage of electricity and by setting up special police stations and special courts to deal exclusively with power theft related cases, if not done already.
- States should immediately initiate steps to appoint distribution franchises in urban areas through competitive bidding.
- States should immediately invite bids for meeting the uncovered generation capacity gap viz-a -viz the requirement in their States by the end of 12th Plan. The process will be completed by March, 2012.
- States should create a unit in their states for integrated planning of generation, transmission and distribution to meet the future requirement of their states.

8.9.9 Policy Measures for accelerating flow of debt investment in power sector

Exposure to State/Central Entities: In view of huge capacity addition targets and role being played by State/Central power entities, there is a need to have higher exposure ceilings for lending to State/Central sector entities (State/Central entities and joint sector entities promoted by state and/or central entities), so as to ensure availability of sufficient funding to such entities for development of Indian power sector as well as for growth of Indian economy. At present, PFC and REC has an exposure ceiling 100% to 150% of Net Worth for State/Central entities in power sector.

In this regard, exemption, granted to PFC and REC from RBI's Prudential Regulations in case of State/Central entities, may be continued till the end of 12th Plan i.e. March 31, 2017.

Combined Exposure Ceilings: RBI exposure norms applicable to IFCs allow separate exposure ceilings for lending and investment. Further, there is also a consolidated cap for both lending & investment taken together.

In project funding, the IFCs are mainly funding the debt portion and funding of equity is very nominal. Therefore, the consolidated ceiling as per RBI norms may be allowed as overall exposure limit with a sub-limit for investment instead of having separate sub-limits for lending and investment. This will leverage the utilization of unutilized exposures against investment. It is well justified since lending is less risky as compared to equity investment. This will provide additional lending exposure of 5% of owned funds in case of a single entity and 10% of owned funds in case of single group of companies, as per existing RBI norms.

UMPP: Government of India has launched an initiative for development of Ultra Mega Power Projects (UMPPs). Each UMPP has been envisaged with capacity of 3500 MW or more. A total of 16 (sixteen) UMPPs have so far been identified and out of those, 4 (four) of these have already been transferred to the successful bidders. As each UMPP is likely to cost around Rs.20000 crore and would require around Rs.15000 crore as debt component considering D/E ratio of 75:25. Such a huge debt requirement could not be met with present RBI exposure norms of 25% of owned funds in case of single borrower and 40% in case of group of companies.

It is recommended that a special dispensation may be considered by commercial banks for UMPPs in respect of exposure limit as at the time of transferring UMPP all clearances are available, escrow account is opened in favour of developers and PPAs are signed. Considering the above, there is a need to allow relaxed exposure ceilings for funding to UMPPs.

Exposure linked to Capital Funds: RBI Exposure ceilings for IFCs are linked to 'owned funds' while RBI exposure norms as applicable to Banks & FIs allow exposure linkage with the total regulatory capital i.e. 'capital funds' (Tier I & Tier II capital). Exposure ceilings for IFCs may also be linked to capital funds on the lines of RBI norms applicable to Banks. It will enable to use the Tier II capitals like Reserve for bad and doubtful debt created under Income Tax Act, 1961, for exposures.

Provisioning for Government Guaranteed Loans etc: RBI norms provide for 100% provisioning of unsecured portion in case of loan becoming 'doubtful' asset. Sizeable loans of Government IFCs like PFC and REC are guaranteed by State Governments and not by charge on assets. On such loans, 100% provisioning in first year of becoming doubtful would be very harsh and can have serious implication on the credit rating of IFC. Therefore, for the purpose of provisioning, the loans with State/Central Government guarantee or with undertaking from State Government for deduction from Central Plan Allocation or Direct loan to Government Department may be treated as secured.

Loan-wise Provisioning: As per RBI norms, the provisioning for NPAs is required to be made borrower-wise and not loan-wise if there is more than one loan facility to one borrower. Since Government owned IFC's exposure to a single State sector borrower is quite high, it would not be feasible to provide for NPA on the total loans of the borrowers in case of default in respect of one loan. Further, the State/Central sector borrowers in power sector are limited in numbers and have multi-location and multiple projects. Accordingly, default in any loan in respect of one of its project does not reflect on the repaying capacity of the State/Central sector borrowers. A single loan default may trigger huge provisioning for all other good loans of that borrower. This may distort the profitability position. Therefore, provisioning for NPAs in case of State/Central sector borrowers may be made loan-wise.

Restructuring/Renegotiation/Rescheduling(R/R/R): RBI norms applicable to IFCs provide for R/R/R of principal/interest with or without sacrifice not more than once before commencement of commercial production of the project. On the other side, RBI norms applicable to Banks provide that loan will not be classified as NPA if it fails to commence commercial operations within 2 years from original Commercial Operation Date (COD). Further, the bank norms also provide for additional period of 2 years (i.e. total 4 years) in case of reasons for extension of COD is arbitration proceedings/ court case and additional period of 1 year (i.e. total 3 years) in case project is delayed for other reasons beyond the control of promoters.

In case of consortium financing, if separate asset classification norms are followed by IFCs as compared to other consortium lenders which are generally banking institutions; the asset classification for the same project loan could differ amongst the consortium lenders leading to issues for further disbursement etc.

Accordingly, there is a need of allowing IFCs to extend the COD within prescribed period from original COD, without any limitation on the number of times. It is also felt that the prescribed period from the original COD may be kept higher in case of projects involving higher gestation period. For example, hydro projects require high gestation period particularly due to its geographical situation and vulnerability due to implementation issues especially related to R&R. Accordingly, the prescribed period may be higher in case of hydro projects.

Notwithstanding, requirement of re-examination of project for its viability, provision to the extent of shortfall in security available etc. at the time of restructuring, as presently applicable as per RBI norms applicable to IFCs may continue to be applicable.

State/Central entities generally approach for extension of scheduled COD of the project for the reasons like procedural delays, minor breakdown, right of way problems etc. Such requests are normally agreed to, and moratorium & repayment schedule are also extended along with project completion dates. It may be mentioned that such extension of repayment schedule in respect of State/Central entities does not reflect on the problems with the repayment of loans, as the borrowers are generally big entities with large multi-location asset base.

Accordingly, such extension of scheduled COD of the project in respect of State/Central sector entities without sacrifice of either principal and/or interest may not be treated as R/R/R.

Capital Adequacy Ratio (CAR): Prudential Norms relating to requirement of capital adequacy are not applicable to Government owned IFCs. However, on the other side, it has been prescribed as an eligibility requirement for an Infrastructure Finance Company (IFC) being 15% (with minimum 10% of Tier I capital). Accordingly, Government owned IFCs are also required to maintain the prescribed CAR. Considering the better comfort available in case of Government owned IFCs, it is felt that RBI may consider stipulating relaxed CAR requirement for Government owned IFCs. It will help such Government owned IFCs in better leveraging.

Risk Weights for CAR: RBI prudential norms applicable to IFCs require 100% risk weight for lending to all types of borrowers. However, it is felt that risk weight should be linked to credit rating of the borrowers. On this premise, a 20% risk weight may be assigned for IFC's lending to AAA rated companies.

Similarly, in case of loans secured by the Government guarantee and direct lending to Government, the IFCs may also assign risk weight in line with the norms applicable to banks. Accordingly, Central Government and State Government guaranteed claims of the IFC's may attract 'zero' and 20% risk weight respectively. Further their direct loan/credit/overdraft exposure to the State Governments, claims on central government will attract 'zero' risk weight. It may be mentioned that RBI vide its letter dated 18.03.2010 advised PFC and REC that State Government guaranteed loans, which have not remained in default for more than 90 days, may be assigned a risk weight of 20%.

ECB: As per extant ECB Policy, the IFCs are permitted to avail of ECBs (including outstanding ECBs) up to 50% of their owned funds under the automatic route, subject to their compliance with prudential guidelines. This limit is subject to other aspects of ECB Policy including USD 500 million limit per company per financial year. These limits/ceilings are presently applicable to all IFCs whether in State/Central or Private Sector.

Government owned IFCs are mainly catering to the funding needs of a single sector, like in Power sector where the funding requirements for each of the power project is huge. These Government owned IFCs are already within the ambit of various supervisory regulations, statutory audit, CAG audit, etc. It, is, therefore, felt that the ceiling of USD 500 million may be increased to USD 1 billion per company per financial year for Government owned IFCs. Further, the ceiling for eligibility of ECB may also be increased to 100% of owned funds under automatic route for Government owned IFCs to enable them to raise timely funds at competitive rates from foreign markets. Thus, these measures will ensure Government owned NBFC-IFCs to raise timely funds at competitive rates thereby making low cost funds available for development of the infrastructure in India.

8.10 IMPLEMENTATION MECHANISMS

Some of the implementation mechanisms aimed at channelizing more funds into the power sector, based on the recommendations made in this report have been discussed ahead.

8.10.1 Policy Interventions & Financial Measures for Reducing Funding Gap

8.10.1.1 Tax incentives on investments

A higher economic growth can only be sustained through investment in the infrastructure sector. For garnering additional funds for the sector, there is a need to introduce additional investment limit of Rs. 50,000 per year for infrastructure bonds under Section 80C of the Income Tax Act, 1961 over and above existing limit of Rs. 1,00,000. Assuming a subscriber base of 13 million (approx. 33% of the total tax payer base of 40 million), the amount mobilized is estimated as Rs. 39,000 crore p.a. Assuming a 50% flow to the power sector out of the above, the mobilization over 5 years is estimated at Rs. 97,500 crore. The loss of tax revenue from this step would be compensated by higher tax revenue in future due to higher GDP growth rate. Such a step can be supported at this junction as we expect higher tax collection as a result of a growing economy.

8.10.1.2 Institutional / Regulatory Interventions

- Payment security mechanism
    a. Commitment of escrow upfront as in case of successful UMPPs to be provided
    b. Alternatively, to provide access to large industrial consumers on payment of wheeling charges, in case of default, as adequate security in lieu of ESCROW.

- Uniform rules for cross subsidy and additional surcharges to be levied by SEB on sale of power by an IPP in that state to a third party

- In line with the National Electricity Policy, states should be encouraged to follow Intra – State ABT regime such that they are eligible for 14% return on equity. This would encourage better discipline even within the states and shall enhance internal resources for deployment in R&M/capacity expansion.

8.10.2 Fiscal and other Measures to enable cheaper power

- The effective tax rate for the business of lending to infrastructure sector after the likely advent of Direct tax code from FY12 is projected to go up from about 27% to 30% due to withdrawal of exemptions under 36(1)(viii) and 36(1)(viia)(c) of Income Tax, 1961. Hence infrastructure lending would be subjected to maximum tax rate. Though concessions for developers in infrastructure space would continue, all benefits for infrastructure lending are proposed to be removed. This would force lenders to pass this additional tax burden in the lending rates which would enhance the cost of borrowing for infrastructure projects.

  Since the need of the hour is to arrange low-cost funds for infrastructure sector, there is a strong case for levying MAT for infra lending rather than the normal corporate tax or to restore the tax concession already available to these financial institutions.

- Excise duty on power generation, transmission & distribution equipment (which is currently at 14%) should be reduced and gradually phased out for generation projects with an installed capacity of more than 1,000 MW and for inter-state transmission lines. This is required, as power sector has no advantage of “cenvat” credit as there is no excise on power, which increases the cost of power.

- The import duty relaxation presently available for generation equipments may also be extended to include all equipment related to power transmission, distribution metering and energy conservation so that the supply of equipments at reasonable cost is available to continue with Distribution reforms which are being supported by schemes like APDRP etc.

- Existing Income tax exemption for power sector projects under section 80IA expiring in March 2012 to be extended till March 2017, i.e. end of 12th Plan period.

- Additional depreciation of 20% (WDV) under IT Act is available for investments in plant and machinery in industries other than power. Same depreciation should be made available to power industry also.

- Technology transfer for developing and enhancing existing manufacturing facilities in India needs to incorporate in equipment procurement contracts. As a first step, the domestic manufacturing obligations on the line of bulk-tendering carried out by NTPC for 800 MW and 660 MW sets could be stipulated for the power projects being awarded for the benefit of

13th Plan. Such a step will ensure that indigenous vendor development is facilitated for high-tech supplies in future.

8.10.3 National Electricity Fund (NEF)

The poor state of distribution sector requires investment for replacement of obsolete equipment and technology upgradation. During budget speech of 2008-09, Government of India (GoI) had announced the creation of NEF. Under this scheme, it was proposed that interest subsidy would be extended to the Distribution Utilities which would be linked to reforms. This is expected to reduce the burden of servicing the interest on the utilities.

The proposed scheme is envisaged to provide interest subsidy for over 15 years with an estimated outlay of Rs. 63,750 crore. The amount of Rs. 22,000 crore has been estimated for 12th Plan under NEF, assuming an average interest subsidy of 5% per annum which is expected to be provided from the funds allocated for distribution.

8.10.4 Dedicated fund for financing Power projects in NE sector

Power projects in NE sector could be financed through a dedicated NE fund. Since the benefits of optimal utilization of mineral and water resources of NE would accrue to the whole country, establishing such a fund could channelize the funds collected from the country as a whole and release capital resources of banks/ GoI grants for community level developmental work in NE region.

Further, project developers could be further incentivised to set up projects in the NER through fiscal incentives like waiver on Minimum Alternate Tax (MAT). It may be emphasised that MAT credits are utilized by a project developer between 5th and 10th year of the project cycle. Hence, MAT waiver would not impact the total tax payments but would only increase upfront equity returns to the project developer.

8.11 CONCLUSION

1. On the basis of envisaged capacity mix, proposed capacity addition schedule and associated project cost, the total funds required during 12th Plan have been estimated at Rs. 13,72,580 crores with a Debt requirement of Rs. 10,18,730 crore and Equity requirement of Rs. 3,53,850 crore.

2. The availability of Debt and Equity during the same period have been estimated at Rs. 9,21,286 crores and 2,63,487 crores respectively implying a total funding shortfall of Rs. 1,87,807 crore.

3. After incorporating funds available from GBS and special schemes, the shortfall in availability of funds in low economic growth scenario has been computed to be Rs, 140,528 crore vis.a.vis fund surplus of 5,034 crore in the base case scenario.

4. While most of the 12th Plan power projects have achieved financial closure, fuel related issues viz. lack of binding FSA, high cost of imported coal and delays in according statutory clearances to captive coal blocks are expected to impact financial closure of 13th Plan power projects.

5. Further, appropriate steps are required to be taken to curtail the financial losses of the utilities and improve the investment climate in the power sector.

6. Due to the above reasons, mobilization of debt to power sector projects will continue to be challenge that needs to be addressed with suitable measures.

7. Further various policy measures like Hydro Power viability fund, measures for financing RE projects and take-out financing for ECB lenders have been suggested so as to improve fund availability for the sector.

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Appendix 8.1

All India Expenditure for 11th Plan (Generation, Transmission & Distribution)

(Figures in Rs. crore)

Sector	Segment	2007-08	2008-09	2009-10*	2010-11*	2011-12*	Total
Centre							
	Generation	18,675	26,199	28,179	21,752	32,066	126,872
	Transmission	6,772	8,282	10,872	13,167	17,277	56,370
	Distribution	61	76	107	9	145	399
	Sub-Total	**25,508**	**34,557**	**39,157**	**34,929**	**49,489**	**183,640**
							-
State							-
	Generation	17,371	24,066	24,821	20,672	29,403	116,333
	Transmission	7,773	9,459	10,823	16,908	21,416	66,379
	Distribution	18,184	20,860	12,394	3,282	31,361	86,081
	Sub-Total	**43,328**	**54,384**	**48,038**	**40,862**	**82,179**	**268,792**
							-
Private							-
	Generation	15,119	24,790	33,175	40,836	38,531	152,451
	Transmission	71	171	-	-	-	242
	Distribution	2,180	3,356	2,695	364	4,926	13,521
	Sub-Total	**17,370**	**28,318**	**35,870**	**41,200**	**43,457**	**166,214**
							-
Total							-
	Generation	51,165	75,055	86,175	83,260	100,000	395,655#
	Transmission	14,616	17,913	21,695	30,075	38,693	122,991
	Distribution	20,425	24,292	15,196	3,655	36,432	100,000
	Total	**86,206**	**117,260**	**123,065**	**116,991**	**175,125**	**618,646**

Source: CEA/Planning Commission

Appendix 8.2

All India Expenditure in Power for 11th Plan

(Figures in Rs. crore)

Segment	**Amount**
Generation	395,655
Captive Power Projects	30,000
Renewable Energy Sources	40,000
Nuclear Power Projects[1]	13,965
Sub-Total Generation	**479,620**
Transmission	**122,991**
Distribution	**100,000**
R&M	**3,564**
HRD	**83**
R&D	**352**
DSM	**668**
Grand Total	**707,278**

Source: CEA/Planning Commission

[1] *Source: Annual accounts of DAE*

Appendix 8.3

Capacity Addition Programme (in MW)

A. Capacity addition Programme during FY 2011-12 is given as follows:

Particulars	FY 2012
Hydro	**1,990**
Thermal	**13,611**
Coal	12,375
Gas	851
Lignite	385
Nuclear	**2,000**
Total	**17,601**

Source: CEA

B. Projected Yearly Capacity addition Programme during 12th Plan is given as follows:

Particulars	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	Total
Hydro	1,370	1,808	2,077	2,530	1,419	**9,204**
Thermal	14,671	13,070	13,555	12,575	9,910	**63,781**
Coal	13,685	12,970	13,555	12,575	9,910	62,695
Gas	986	100	-	-	-	1,086
Nuclear	-	-	-	1,400	1,400	**2,800**
Total	**16,041**	**14,878**	**15,632**	**16,505**	**12,729**	**75,785**

Source: CEA

C. Projected Yearly Capacity addition Programme during 13th Plan is given as follows:

Particulars	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	Total
Hydro	1,964	2,497	2,426	2,430	2,689	**12,006**
Thermal	17,400	14,790	10,960	11,365	8,935	**63,450**
Nuclear	4,900	4,900	3,100	3,450	1,650	**18,000**
Total	**24,264**	**22,187**	**16,486**	**17,245**	**13,274**	**93,456**

Source: CEA

Appendix 8.4

Assumptions for Estimation of Cost of Projects

Assumptions for estimating cost of power projects

(Figures in Rs. crore per MW)

S.No.	Type of Generation project	Cost
1	Thermal generation projects	6
2	Hydro generation projects	8
3	Nuclear projects	10
4	Captive	5
5	Solar	13
6	Wind	6
7	Other RES	5

**The above costs are based on the FY 2011-12 price levels*
 # 10% higher costs have been assumed for projects in NE region.

Assumptions for allocation of cost towards 12th Plan

Phasing of expenditure of generation projects during the project construction period, which are expected to be commissioned in 12th Plan is given as follows:

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Thermal	15%	25%	30%	30%	0%	**100%**
Hydro	15%	15%	20%	25%	25%	**100%**
Nuclear	10%	20%	30%	25%	15%	**100%**

Phasing of expenditure of generation projects during the project construction period, which are expected to be commissioned in 13th Plan is given as follows:

Particulars	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Thermal	20%	30%	25%	25%	0%	**100%**
Hydro	20%	25%	25%	15%	15%	**100%**
Nuclear	20%	25%	25%	15%	15%	**100%**

Appendix 8.5

Fund requirement and availability for central sector

Internal and Extra Budgetary Resources of PSEs

(Figures in Rs. crore)

S. No.	Name of PSE	Internal Resources	Bonds/ Debentures	ECB/Supplier's credit	Others	Total IEBR
1	NTPC	71,806.20	91,918.30	55,888.00	-	**2,19,612.50**
2	PGCIL	30,609.00	57,425.00	14,000.00	-	**1,02,034.00**
3	NHPC	13,150.12	14,161.92	-	-	**27,312.04**
4	SJVNL	3,466.58	-	2,931.59	4,001.83	**10,400.00**
5	THDCIL	1,295.20	-	2,923.72	2,562.94	**6,781.86**
6	NEEPCO	1,362.58	-	181.30	4,322.91	**5,866.79**
7	DVC*	4,536.85	1,500.00	-	8,472.80	**14,509.65**
	Total	**1,26,226.53**	**1,65,005.22**	**75,924.61**	**19,360.48**	**3,86,516.84**

Source: I&EBR Data, MoP

Gross Budgetary Support (GBS) during 12th Plan

(Figures in Rs. crore)

Sl. No.	Scheme Name	Amount
1.	GBS to CPSEs	**2473.26**
2.	GBS to Plan Schemes	
a.	Distribution	
i.	R-APDRP	9,924
ii.	R-APDRP - additional requirement of funds for ongoing projects sanctioned during 11th Plan	9,900
iii.	Smart Grid	5,000
iv.	Research & Development (Rs. 5 Cr annually)	25
v.	RGGVY	59,391
vi.	Inclusion of Productive Load Scheme	30,970
vii.	Feeder separation Scheme	10,000
viii.	National Electricity Fund	22,000
ix.	Human Resources Development Plan	150
x.	Scheme for replacement of inefficient pump sets by energy efficient pump sets in Agriculture Sector	15,000
	Sub-Total Distribution	**162,360**
b.	DSM	7,482
c.	R&D	3,418
d.	HRD (Training Infrastructure)	4,108
	Sub-Total (GBS to Plan Schemes)	**177,368**
	Grand Total	**179,841**

Appendix 8.6

Sources of funds – Insurance Companies

Life Insurance

Actual

(Figures in Rs. crore)

Particulars	2008	2009	2010
Life Insurance Investments	632891	7,43,602	8,73,536
Growth of Life Investments		*17.49%*	*17.47%*
of which Infrastructure Investments	63,262	66,673	72,492
as % of Total Investments	*10.00%*	*8.97%*	*8.30%*

Source: IRDA

Projected

(Figures in Rs. crore)

Particulars	2011	2012	2013	2014	2015	2016	2017
Life Insurance Investments	1,004,566	1,155,251	1,328,539	1,527,820	1,756,993	2,020,542	2,323,623
Growth of Life Investments	*15.00%*	*15.00%*	*15.00%*	*15.00%*	*15.00%*	*15.00%*	*15.00%*
of which Infrastructure Investments	90,411	103,973	119,569	137,504	158,129	181,849	209,126
as % of Total Investments	*9.00%*	*9.00%*	*9.00%*	*9.00%*	*9.00%*	*9.00%*	*9.00%*

Net funds available from Life Insurance companies during 12th Plan: 25% x (2,09,126 – 1,03,973)= **Rs. 26,288 crore**

Non-life Insurance

Actual

(Figures in Rs. crore)

Particulars	2008	2009	2010
Non-life Insurance Investments	56,280	58,893	66,372
Growth of Non- Life Investments		*4.64%*	*12.70%*
of which Infrastructure Investments	7,660	8,980	10,373
as % of Total Investments	*13.61%*	*15.25%*	*15.63%*

Source: IRDA

Projected

(Figures in Rs. crore)

Particulars	2011	2012	2013	2014	2015	2016	2017
Non-life Insurance Investments	74,669	84,002	94,502	106,315	119,604	134,555	151,374
Growth of Non-Life Investments	*12.50%*	*12.50%*	*12.50%*	*12.50%*	*12.50%*	*12.50%*	*12.50%*
of which Infrastructure Investments	11,574	13,020	14,648	16,479	18,539	20,856	23,463
as % of Total Investments	*15.50%*	*15.50%*	*15.50%*	*15.50%*	*15.50%*	*15.50%*	*15.50%*

Net funds available from Non-Life Insurance companies during 12th Plan: 25% x (23,463 – 13,020) = **Rs. 2,611 crore**

Total funds available from Insurance companies during 12th Plan = 26,288 + 2,611 = Rs. 28,899 crore

Appendix 8.7

Sources of funds – Banks (including syndicated loans)

Actual

(Figures in Rs. crore as on last Friday of FY)

Particulars	2007	2008	2009	2010
Non-food Gross Bank Credit (GBC)	18,01,240	22,02,890	26,02,290	30,37,318
Growth in GBC		*22.30%*	*18.13%*	*16.72%*
of which advances to industry	6,97,339	8,66,875	10,54,390	13,09,814
% of GBC	*38.71%*	*39.35%*	*40.52%*	*43.12%*
of which advances to power sector	73,158	95,067	1,24,447	1,88,147
% of advances to industry	*10.49%*	*10.97%*	*11.80%*	*14.36%*

Source: RBI

Projected

(Figures in Rs. crore projected as on last Friday of FY)

Particulars	2011	2012	2013	2014	2015	2016	2017
Non-food Gross Bank Credit (GBC)	35,23,289	40,51,782	46,59,550	53,58,482	61,62,254	70,86,592	81,49,581
Growth in GBC	*16.0%*	*15.0%*	*15.0%*	*15.0%*	*15.0%*	*15.0%*	*15.0%*
of which advances to industry	15,50,247	17,82,784	20,50,202	23,57,732	27,11,392	31,18,101	35,85,816
% of GBC	*44%*	*44%*	*44%*	*44%*	*44%*	*44%*	*44%*
of which advances to power sector	2,32,537	2,67,418	3,07,530	3,53,660	4,06,709	4,67,715	5,37,872
% of advances to industry	*15.00%*	*15.00%*	*15.00%*	*15.00%*	*15.00%*	*15.00%*	*15.00%*

Net funds available from banks during 12th Plan: 5,37,872-2,32,537= **Rs. 2,70,455 crore**

Appendix 8.8

Sources of funds – PFC

Assumptions

1. Profit After Tax (PAT) is estimated to grow by 15% p.a.
2. FY 2010-11 : Figures of PAT , Net worth, RBDD per Audited Standalone Financial Results
3. FY 2011-12 : Funds of ~Rs. 3433 crore is mobilized from FPO which will save interest cost @9.50% for 10 months with effective tax rate assumed as 27%
4. FY 2011-12 : Disbursement is based on MoU Target
5. It is assumed that transfer to RBDD will be 5% of PAT
6. It is assumed that minimum Capital Adequacy Ratio(CAR) of 17% will be maintained during 12th Plan period
7. It is assumed that Risk Weighted Assets (RWAs) constitute only Loan assets since Fixed Assets and current Assets forms small portion of RWAs.
8. It is assumed that recovery from borrowers will be 10% of previous year loan assets
9. It is assumed that Short Term Disbursement will be 13% of total disbursements
10. It is assumed that no money will be raised through issue of fresh equity shares

Appendix 8.9

Sources of funds – REC

Assumptions

1. FPO considered in the year 2014-15, fresh Equity equivalent to 10% of the Paid up capital as on March 31, 2014 to be raised @ 1.31 times of projected Book value of ` 195.60 as on 31.03.2014, i.e. Rs. 257/-.
2. Dividend payout is presumed to be that as per the Govt. of India guidelines.
3. Growth in disbursements taken @ 15% from 2012-13 and gradually reduced to 14%, 13%, 12% and 12% for the year 2013-14 to 2016-17. Further, it has been assumed that out of total disbursements, 85% will be long term disbursements and 15% will be short term.
4. Recoveries of outstanding loans as on 31.03.2011 considered on actual basis and for future disbursements it is considered 15% STL to be recovered over the next 3 years and balance in 10 instalments, 51% (60% of 85%) for the schemes whereby moratorium period is over.
5. Outstanding borrowings repayments considered on actual basis and in fresh mobilization, repayment considered 10% at the end of 1 year, 35% at the end of3 years, 40% at the end of 5 years and 15% at the end of more than 7 years.
6. Adhoc Provision for Doubtful debts on standard assets made @ 0.25% for Loan assets as on 31.03.2011, the provision amount adjusted from reserves and for the additions during the year 2011-12 onwards same adjusted from the profit of the relevant year.
7. Addition to Reserve for Bad Debt u/s 36(1)(viia) of I-Tax Act assumed @ 2% of Income from Long Term Financing, which is assumed to be 90% of Total Income, (as in year 2010-11).
8. For Capital adequacy ratio, State Govt. guaranteed loans as on 31.03.2011 considered to be reducing @20% over the previous year balance. For fresh disbursements, it is presumed that 20% of the Loans will be secured by way of State Govt. Guarantees.
9. The existing Income Tax and regulatory provisions applicable to REC are presumed to continue over the next 6 years.

Appendix 8.10

Sources of funds – Other Infrastructure NBFCs

(Figures in Rs. crore)

IFC	L&T finance	PFS	IDFC	Total
LoanbookasonMarch31,2011	6,694.22	675.59	37,652.32	**45,022**
Growth in Loan Book p.a.	15.00%	15.00%	15.00%	
LoanbookasonMarch31,2017	13,464.47	1,358.85	75,732.26	**90,556**
Incremental Lending for 12th Plan	6,770.25	683.26	38,079.94	**45,533**
Of which lending to Power Sector	80%	80%	80%	
Incremental Lending to Power Sector for 12th Plan	5,416.20	546.61	30,463.96	**36,427**

* Source: IDFC

1. IDFC has indicated a 15% p.a. growth in loan book for 12th Plan period which amounts to incremental loans at around Rs. 38,000 crore.
2. As informed by IDFC, around 80% of incremental loans are expected to flow into power sector.
3. Incremental lending to Power Sector by IDFC for 12th Plan has been estimated at around Rs. 30,000 crore.
4. Similar numbers have been assumed for other IFCs also.

Appendix 8.11

Sources of funds – Bonds/Debentures

Actual

(Figures in Rs. crore)

Year ended March 31,	2007	2008	2009	2010	2011
Total Bonds & NCDs issuances	99,222	1,29,717	1,78,261	1,91,865	1,94,948
% growth y-o-y		31%	37%	8%	2%
Power Sector bond issuances	5,275	3,468	12,571	16,324	19,025
% growth y-o-y		-34%	262%	30%	17%
Power Sector as % of all bonds/ NCDs	5%	3%	7%	9%	10%

Source: Prime Database

Projected

Year ended March 31,	2012	2013	2014	2015	2016	2017
Total Bonds & NCDs issuances	2,12,493	2,31,618	2,52,463	2,75,185	2,99,952	3,26,947
% growth y-o-y	9%	9%	9%	9%	9%	9%
Power Sector bond issuances	20,928	23,020	25,322	27,855	30,640	33,704
% growth y-o-y	10%	10%	10%	10%	10%	10%
Power Sector as % of all bonds/ NCDs	10%	10%	10%	10%	10%	10%

Net funds available from bond issue during 12th Plan = sum of bond issue amount from FY 2013 to FY 2017 =Rs**. 1,40,541 crore**

Appendix 8.12

Sources of funds – Multilateral/Bilateral Credits/ ECBs

1. Actual

(Figures in Rs. crore)

Particulars	2004	2005	2006	2007
Outstanding amount	303,800	335,315	335,802	412,076
% growth		*10.37%*	*0.15%*	*22.71%*

Source: RBI

CAGR = ((412,076/303,800) ^ (1/3)-1) x 100 = 10.70%

2. Projected

FY 2008- FY 2011

(Figures in Rs. crore)

Particulars	2008	2009	2010	2011
Outstanding amount	456,168	504,978	559,011	618,825
% growth	*10.70%*	*10.70%*	*10.70%*	*10.70%*

FY 2012- FY 2017

(Figures in Rs. crore)

Particulars	2012	2013	2014	2015	2016	2017
Outstanding amount	685,039	758,338	839,481	929,305	1,028,741	1,138,816
% growth	*10.70%*	*10.70%*	*10.70%*	*10.70%*	*10.70%*	*10.70%*

Net funds available from Multilateral/Bilateral Credits/ ECB during 12th Plan = 20% x (11,38,816 – 6,85,039) =**Rs.90,755crore**

Appendix 8.13

Debt Availability in Low Economic Growth Scenario

(figures in Rs. crore)

Source	Base Case Estimation	Low Economic Growth Scenario
SCBs	270,455	221,364
PFC	178,259	151,520
REC	175,950	149,558
Other IFC	36,427	30,343
Bonds/Debentures	140,541	125,261
Multilateral/Bilateral Credits/ECBs	90,755	74,502
Insurance companies	28,899	23,176
Total Debt Available	**921,286**	**775,724**

Appendix 8.14

Underlying assumptions for Low Economic Growth Scenario

Institution	Sensitivity Parameter	Base Case Assumption	Low Economic Growth Scenario
SCBs	Annual growth of Non-food gross bank credit	15%	13%
PFC	Projected Long Term Disbursements	100%	85%
REC	Projected Long Term Disbursements	100%	85%
Other IFCs	Annual growth in Loan Book	15%	13%
Bonds/Debentures	Annual growth in Bond issuances by Power Sector	10%	7%
Multilateral/Bilateral Credits/ECBs	Annual growth in external debt outstanding	10.7%	9.5%
Life Insurance companies	Annual growth of life insurance investments	15%	13%
Non-Life Insurance companies	Annual growth of non-life insurance investments	12.5%	10.5%

Chapter -9

HUMAN RESOURCE DEVELOPMENT

9.0 INTRODUCTION

Human Resource Development and capacity building, in the present power scenario, demands a very comprehensive and pragmatic approach to attract, utilize, develop and conserve valuable human resources. Training, re-training and career prospects are some of the important elements of human resources development.

Technically trained manpower comprising of skilled engineers, supervisors, artisans, and managers etc. is required in every sphere of the power supply industry. Growing concern over environmental degradation and depletion of the conventional energy sources has made the task of electricity generation even more challenging and therefore quality standard of the manpower is becoming increasingly essential. The technical knowledge acquired from engineering colleges, polytechnics, industrial training institutes and other technical institutions provides the basic foundation, but the same needs to be supplemented with applied engineering skills in the various spheres i.e. power generation, its transmission and distribution aspects. All these skills are to be regularly updated to cope with the rapidly advancing technologies and very often the speed of obsolesce overtakes the rate of acquisition of particular skill and knowledge.

The HRD/Training needs of Technical, Non-Technical and Supporting Staff should be addressed keeping in view the National Training Policy for the Power Sector.

9.1 REVIEW OF PROGRAMME & ACHIEVEMENTS DURING 11th PLAN

As per the report of the Working Group on Power for 11th plan, the total manpower at the end of 11th Plan was estimated at 11.63 lakhs. Overall training load during 11th Plan was estimated at 4.65 lakh man-months/year. As per CEA data, it has been estimated that only 0.33 Lakh man-months/Yr training load was achieved by 68 institutes during the year 2008-09. During the year 2010-11, the training infrastructure available has been estimated at 0.82 lakhs man-months/yr for about 70 training institutes.

Some of the major achievements pertaining to capacity building during 11th Plan are:

(a) Distance Learning Certificate Programs on Power Distribution Management for JEs/ AEs level
(b) Certificate of Competency in Power Distribution (CCPD)
(c) Adoption of 69 ITIs by CPSUs/Private organizations
(d) Training under Distribution Reforms, Upgrades and Management (DRUM)
(e) C&D Employees Training
(f) Franchisee Training
(g) Training under R-APDRP etc.

9.2 ASSESSMENT OF REQUIREMENT OF MANPOWER

9.2.1 Manpower availability in 11th Plan

The original targeted Capacity addition for 11th Plan was 78,700 MW (excluding renewables) and it is now expected that during this Plan a total capacity addition of about 74,374 MW (including renewables) may take place. The additional manpower requirement for this capacity addition is estimated to be 331.90 thousands out of which 254.54 thousands will be technical and 77.37 thousands will be non-technical. The total manpower by the end of 11th Plan shall be of the order of 1163.56 thousands, out of which 881.10 thousands (75%) will be technical and 282.47 thousands (25%), non-technical. Man/MW ratio at the end of 11th Plan works out to 5.63.

9.2.2 Manpower requirement in 12th Plan

For a capacity addition of 94,215 MW(including renewable) in the 12th Plan, the additional manpower requirement shall be of the order of 407.67 thousands out of which 312.92 thousands will be technical and 94.75 thousands will be non-technical. The total manpower by the end of 12th Plan shall be 1425.79 thousands, out of which 1083.88 thousands (76%) will be technical and 341.91 thousands (24%) will be non-technical. Man/MW ratio at the end of 12th Plan works out to 4.74. Details of the manpower required during 12th Plan and likely status at the end of 12th Plan are furnished in table 9.1 and 9.2 below:

Table-9.1

Manpower Projection for 12th Plan

(In Thousands)

S No	Area	Capacity Addition (MW)	New Recruitment			Total Manpower			Total Capacity (MW)
			Tech	Non-Tech	Total	Tech	Non-Tech	Total	
1	Thermal	82211*	42.18	13.06	55.24	151.97	51.05	203.02	238744
2	Hydro	9204	12.20	3.44	15.64	59.19	21.94	81.13	52095
3	Nuclear	2800	3.07	1.31	4.38	13.03	5.84	18.87	10080
4	Power System								
	Transmission		5.98	2.09	8.07	30.83	9.95	40.78	
	Distribution		249.49	74.85	324.34	828.86	253.13	1081.98	
	Total	**94215**	**312.92**	**94.75**	**407.67**	**1083.88**	**341.91**	**1425.79**	**300919**

**Includes Capacity addition of 18,500 MW from Renewable Energy*

Table 9.2

Capacity & Manpower at the end of 12th Plan

Capacity in MW and Manpower in Thousand

Sector	12th Plan					
	Capacity at the beginning of 12th Plan	Manpower at the beginning of 12th Plan	Reduced Manpower due to Retirement etc.	Capacity addition during 12th Plan	Additional Manpower rqmt during 12th Plan	Manpower at the end of 12th Plan
	C 1	C 2	C 3 = 87.5%* C 2	C 4	C 5	C 6 = C 3 + C 5
Thermal	156533	168.90	147.79	82211	55.24	203.02
Hydro	42891	74.84	65.49	9204	15.64	81.13
Nuclear	7280	16.56	14.49	2800	4.38	18.87
Sub-total	**206704**	**260.30**	**227.76**	**94215**	**75.26**	**303.02**
Transmission	-	37.38	32.71	-	8.07	40.78
Distribution	-	865.88	757.65	-	324.34	1081.98
Grand Total	**206704**	**1163.56**	**1018.12**	**94215**	**407.67**	**1425.79**

9.2.3 Manpower requirement in 13th Plan

For a capacity addition of 1,23,900 MW(including renewable) in the 13th Plan, the additional manpower requirement shall be of the order of 547.78 thousands out of which 419.04 thousands will be technical and 128.74 thousands will be non-technical. The total manpower by the end of 13th Plan shall be 1795.34 thousands, out of which 1367.43 thousands (76%) will be technical and 427.91 thousands (24%) will be non-technical. Man/MW ratio at the end of 13th Plan works out to 4.23. Details of the manpower required during 13th Plan and likely status at the end of 13th Plan are furnished in Table 9.3 and 9.4 respectively.

Table-9.3
Manpower Projection for XIII Plan

(In Thousands)

S No	Area	Capacity Addition (MW)	New Recruitment			Total Manpower			Total Capacity (MW)
			Tech	Non-Tech	Total	Tech	Non-Tech	Total	
1	Thermal	93900*	48.17	14.92	63.09	181.15	59.59	240.74	332644
2	Hydro	12000	15.90	4.48	20.39	67.70	23.68	91.37	64095
3	Nuclear	18000	19.76	8.42	28.19	31.16	13.54	44.70	28080
4	Power System								
	Transmission		7.10	2.49	9.59	34.08	11.19	45.27	
	Distribution		328.10	98.43	426.53	1053.35	319.92	1373.26	
	Total	**123900**	**419.04**	**128.74**	**547.78**	**1367.43**	**427.91**	**1795.34**	**424819**

Table-9.4
Capacity & Manpower at the end of XIII Plan

Capacity in MW and Manpower in Thousand

Sector	XIII Plan					
	Capacity at the beginning of XIII Plan	Manpower at the beginning of XIII Plan	Reduced Manpower due to Retirement etc.	Capacity addition during XIII Plan	Additional Manpower rqmt during XIII Plan	Manpower at the end of XIII Plan
	C 1	C 2	C 3 = 87.5%*C 2	C 4	C 5	C 6 = C 3 + C 5
Thermal	238744	203.02	177.65	93900	63.09	240.74
Hydro	52095	81.13	70.99	12000	20.39	91.37
Nuclear	10080	18.87	16.51	18000	28.19	44.70
Sub-total	**300919**	**303.02**	**265.14**	**123900**	**111.67**	**376.81**
Transmission	-	40.78	35.68	-	9.59	45.27
Distribution	-	1081.98	946.74	-	426.53	1373.26
Grand Total	**300919**	**1425.79**	**1247.56**	**123900**	**547.78**	**1795.34**

**Includes Capacity addition of 30,500 MW from Renewable Energy*

9.2.4 A summary of likely manpower at the end of 11th, 12th & 13th Plan is furnished in the following table 9.5 below:

Table 9.5

Manpower under various Plans

S No	Plan	Capacity at the beginning of Plan (MW)	Capacity addition during Plan (MW)*	Capacity at the end of Plan (MW)	Manpower at the beginning of Plan (In Thousands)	Reduced Manpower due to retirement etc. (In Thousands)	Manpower required for Capacity addition of Plan (In Thousands)	Manpower at the end of Plan (In Thousands)	Man/MW at the end of Plan
C 1	C 2	C 3	C 4	C 5 = C 3 + C 4	C 6	C 7 = 87.5%* C 6	C 8	C 9 = C 7 + C 8	C 10
1	11th	132330	74374	206704	950.47	831.66	331.90	1163.56	5.63
2	12th	206704	94215	300919	1163.56	1018.12	407.67	1425.79	4.74
3	13th	300919	123900	424819	1425.79	1247.56	547.78	1795.34	4.23

** Includes Capacity addition from Renewable Energy*

9.2.5 Man/MW ratio

The Man/MW ratio during various plans, based on above projections of capacity addition and corresponding requirement of manpower during 11th, 12th & 13th Plan is given below:

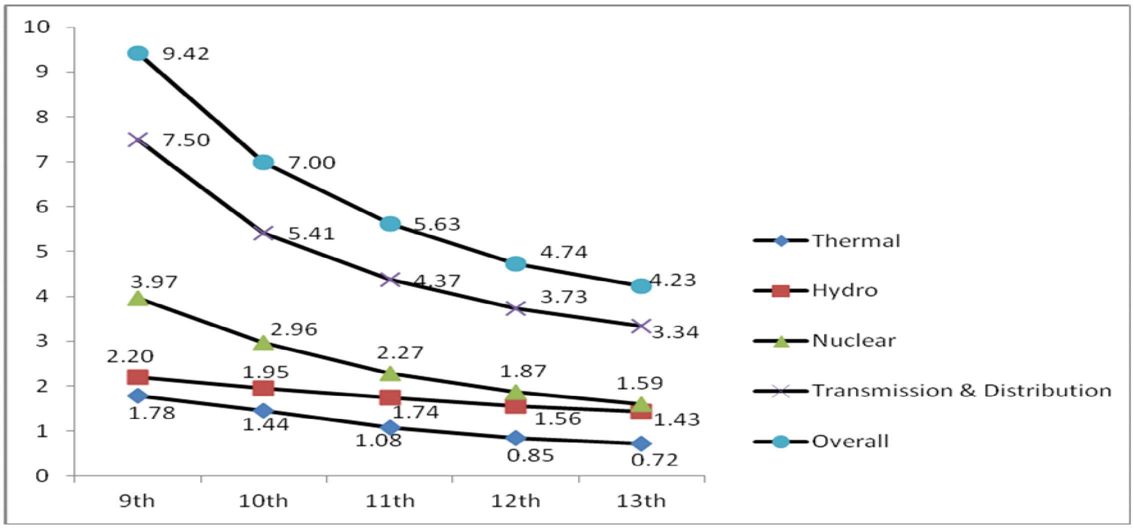
Table-9.5

Man/MW Ratio at the end of various Plan Periods

End of Plan Period	Thermal	Hydro	Nuclear	Transmission & Distribution	Overall
9th	1.78	2.20	3.97	7.50	9.42
10th	1.44	1.95	2.96	5.41	7.00
11th	1.08	1.74	2.27	4.37	5.63
12th	0.85	1.56	1.87	3.73	4.74
13th	0.72	1.43	1.59	3.34	4.23

The above reducing trend is depicted in the following graph:

Man/MW Ratio at the end of various Plan Periods



9.3 MANPOWER AVAILABILITY

On the basis of the total number of technical institutions operational, it can be seen that at all the three levels i.e. graduation, diploma and ITI, there are sufficient number of students passing out each year. However the skill set required for the power sector in few areas does not match the needs of the industry.

Table 9.7
Manpower Availability vs. Requirement

Colleges	Total Colleges	Annual Intake in lakhs	Total for 5 years (lakhs)	Manpower Requirement for 12th Plan (lakhs)
Engineering	3617	11.30	56.50	0.58
Management	4058	4.15	20.75	-
Polytechnics	540	0.93	4.65	0.56
ITI	8039	11.15	55.75	1.99
Total	**16254**	**27.53**	**137.65**	**3.13**

From the above analysis it is observed that sufficient number of Engineers, Managers and Diploma holders are available. However, in respect of lower level skills like that of ITI, there are certain gaps in numbers of skills as explained below.

Our ITIs and other vocational training institutions have to be augmented for providing certain skill sets like High Pressure Welders, Fabricators, Fitters, Binders, Drillers, Plumbers, Electricians, Linemen, Heavy Machine Operators, Operators-Crane, Dozer, Dumper, Excavation, Bar Benders, Piling Rig Operators etc. who would be required in huge number for the Erection & Commissioning Activities for the Thermal, Hydro, Nuclear Plants and Transmission & Distribution areas. The quality and range of their training will keep pace with the changing needs of the economy and opportunities for self-development.

9.4 TRAINING NEED ASSESSMENT

9.4.1 Training Strategy

To fulfill the above needs, training to the power sector personnel is provided in the following categories:

i) O&M Training to all existing employees engaged in O&M of generating projects (Thermal, Hydel, Gas) and Transmission & Distribution System as per statutory requirements under the Gazette Notification of September 2010 issued by CEA ranging from 4 Weeks to 30 Weeks.

This inter-alia includes the following:- Classroom Training
- Simulator Training for Thermal and Hydel
- On-Job Training

ii) Induction level training for new recruits for 1 month (Technical & Non-Technical) is considered a must in the power sector.

iii) Refresher/Advanced training of 5 Days in a year to all existing personnel of varying degrees in various specializations in line with National Training Policy for Power Sector.

iv) Management training of 5 Days in a year to the senior Executives/Managers in India/Abroad in line with National Training Policy for Power Sector.

The Group has come to the conclusion that the most important component of the strategy should be "Training for All" irrespective of the level in the hierarchy. At least one-week of training in a year must be provided to every individual. Five days training per annum per technical person based on National Training Policy is being implemented selectively at some utilities. This needs to be strictly implemented.

9.4.2 Training Facilities

9.4.2.1 Training Institutes Recognized by CEA

During the 10th Plan, there were, 51 training institutes recognized by CEA under various power utilities. About 20 new institutes were recognized by CEA during the 11th Plan. A total of 72 training institutes under various power utilities have been recognished by CEA.

9.4.2.2 Various Organizations which have provided training in 11th Plan in Power Sector are briefly described below:

(i) National Power Training Institute
(ii) Power Management Institutes (PMI) & Various training Institutes of NTPC
(iii) Various training Institutes of NHPC, SJVNL, THDC etc.
(iv) Various training Institutes of Power Grid
(v) Various training Institutes of State/Private Generating Utilities
(vi) Various training Institutes of State Transmission Utilities
(vii) Various training Institutes of State/Private Distribution Utilities

9.4.2.3 Various Schemes under the 11th Plan towards Training were operative like Training under Distribution Reforms, Upgrades and Management (DRUM), C&D Employees Training, Franchisee Training, Training under R-APDRP etc.

Salient features/achievements of these Schemes are discussed below:

Table 9.8
Salient features of Schemes

Scheme	11th th Plan			12th Plan	
	No. of employees trained (A/B/C/D Level wise)	**Amount sanctioned**	**Amount disbursed**	**Target No. of employees to be trained**	**Target Amount for investment (Rs.)**
DRUM	A&B 31000 C&D 3200	Rs.16.8 crore	Rs. 13.5 Crore (Amount disbursed for only 27500 Participants)	5000	Approx 2 Crore
RGGVY C&D	57446	Rs 18.75 Crs	Rs 10 Crs	75,000 (Cumulative for 11th & 12th Plan)	Rs 22.5Cr (Cumulative for 11th & 12th Plan)
RGGVY Franchisee	32,717	Rs 10 Cr	Rs 4.12 Cr	50,000 (Cumulative for 11th & 12th Plan)	Rs 25 Cr (Cumulative for 11th & 12th Plan)
R-APDRP Part C	(A&B) 650 (C& D) 16370	Rs. 200 crore	Approx Rs. 7.9 crore to be disbursed on receipt from GOI	Approx 32,000	90 crore (includes exchange programmes etc.)

Short-term programs with multiple program themes Course Curriculum centrally developed under DRUM were delivered through institutional spread of 20 Training Institutions

Structured Training for C&D Level Distribution employees and Franchise development programs were initiated under RGGVY.

9.4.3 Review of Training in 11th Plan

Salient achievements of some of the Organizations during 11th Plan are described below:

9.4.3.1 National Power Training Institute

National Power Training Institute (NPTI), under the Ministry of Power, Govt. of India is a National Apex body for Training and Human Resources Development in Power Sector.

NPTI has trained over 1,80,000 Power Professionals in regular Programs over the last 4 decades. NPTI operates on an all India basis with manpower strength of 379 including 107 officers through its nine Institutes in different zones of the country.

9.4.3.2 Manpower Training and Academic Programs

NPTI conducts following industry interfaced academic programs:-

- Two-Year MBA in Power Management approved by AICTE
- Four-Year B.Tech./B.E Degree in Power Engineering approved by AICTE
- One-Year Post Graduate Diploma Course in Thermal Power Plant Engineering
- One-Year Post Diploma Course in Thermal Power Plant Engineering
- One-Year Post Graduate Diploma in GIS and Remote Sensing (RS)
- Nine Months Post Graduate Diploma Course in Hydro Power Plant Engg.
- Six Months O&M of Transmission and Distribution System for Engineers

9..4.3.3 Power Training Simulators

NPTI has one 500 MW Thermal Training Simulator, Two Nos of 210 MW Thermal training Simulators, one 430 MW (2x143 MW Gas Turbine and 1 x 144 MW Steam Turbine) Combined Cycle Gas Turbine Simulator, one No of Hydel Simulator and one No of Load Dispatch Simulator.

9.4.3.4 Power Management Institute (PMI) & other training institutes of NTPC

The Power Management Institute (PMI), NTPC's apex training and development centre has been imparting training in the fields of management development, construction and O&M of power plants and information technology . NTPC has 11 No of training institutes at its Project Sites spread all across the country. NTPC has a Training Infrastructure to provide Training of 18,856 Man-Months per Year.

9.4.3.5 Training Institutes of NHPC

NHPC has Training Institutes at its Project Sites with a training infrastructure to provide training of 720 Man-Months per Year.

9.4.3.6 Training Institutes of PowerGrid

PowerGrid has Training Institutes at its Regional locations/Project Sites. They have a training infrastructure to provide training of 1917 Man-Months per Year.

9.4.3.7 Neyveli Lignite Corporation

Neyveli Lignite Corporation has a Training Institute at Neyveli. They have a Training Infrastructure to provide Training of 2407 Man-Months per Year.

9.4.3.8 Other Training Institutes

Names of some other leading Training Institutes which are providing training in Power Sector are indicated below:

(a) Reliance Energy Management Institute, Mumbai
(b) Jindal Institute of Power Technology, Raigarh, Chattisgarh
(c) Evonik (Steag), Noida
(d) Gujarat Energy Training & Research Institute, Vadodara

9.4.9 Distance Learning Certificate Programs on Power Distribution Management for JEs/ AEs level

Advanced Certificate in Power Distribution Management (ACPDM) - Course was developed by IGNOU in association with NPTI and delivered by IGNOU through multiple regional centres spread across the country. The course is meant for Graduate Engineers/Diploma holders, or Science/Commerce/Art Graduates or Equivalent with two years experience in Power Utilities or the Electricity Sector.

9.4.10 Certificate of Competency in Power Distribution (CCPD)

The course is meant for Technicians/Equivalent Trade or manpower working in Power Sector (sponsored candidates) or General Candidates or Private electricians at least 8th Pass (non-sponsored). The course started in August, 2009 and is presently being conducted at Durgapur, Nagpur & Guwahati Institutes of NPTI.

9.4.11 Adoption of ITIs

During the Power Sector conclave held during July 2007, following recommendations were concluded:

(a) Adoption of ITIs by Power Industry

(b) Integration of ITIs by power industry to enhance the basic skills of workforce

Table 9.9
Status of ITIs adopted by CPSUs

S No	CPSUs	ITI adopted by aid from CPSU		Being adopted		New ITI's being set up through CPSU	Total
		Existing	New	Existing	New		
1	DVC	5	4				9
2	NEEPCO	2					2
3	NHPC	11					11
4	NTPC	17				8	25
5	PGCIL	4					4
6	SJVNL	2					2
7	THDC	2					2
8	NHDC	1					1
	Total	**44**	**4**	**0**	**0**	**8**	**56**

Table 9.10
Status of ITIs adopted by Private developers

S No	Project Developer	ITIs adopted
1	Tata Power	4
2	Jindal Power	5
3	Reliance Energy	2
4	O&M solutions	1
	Total	**12**

9.5 CAPACITY BUILDING DURING 12TH PLAN

Training may be given to personnel in the power sector as detailed below:

9.5.1 O&M Training

As per CEA'sGazette Notification of September 2010 issued by CEA, Engineers, Supervisors and Technicians engaged for O&M of Power Projects (Thermal, Hydel, Gas) and T&D have to mandatorily undergo training ranging from 4 weeks to 30 weeks.

9.5.2 On-job Training Facility

On the job training is also now mandatory for all trainees who are being given training in O&M of Generation Projects (Thermal, Hydel, Gas) and Transmission & Distribution. This training varies from 2 weeks to 16 weeks.

Notification from MoP/CEA is proposed so that Trainees being given Training by NPTI can be given On-Job training as per the Gazette notification issued by CEA.

9.5.2.1 Induction Training

All technical personnel at the time of induction should be given at least 1 month induction training.

9.5.2.2 Refresher/Advanced Training

Refresher/Advanced Training must be arranged for each individual on promotion, which calls for performing new/different roles and working conditions.

A mix of Technical, Commercial and Management capabilities of 1 week is proposed.

9.5.3 Management Training

Continuous development of Executives/Managers, especially at the transition period of their career and in the context of constantly changing business environment is of utmost importance. Executives in Finance and Management with non-technical background should also be provided technical orientation through suitable training programs. For this a training of 1 week is proposed.

9.5.4 Simulator Training

As per the Notification, Simulator training of 2 weeks is a must for Operation and Maintenance personnel of Thermal and Hydro plants. This is included in O&M training above. For safe and efficient functioning of manual and automatic equipment, personnel have to be trained on Simulators.

9.5.5 Training in Renewable Sources of Energy

Since the nature of energy system itself is likely to change in the future, it is essential that renewable energy be integrated into traditional engineering curriculum.

Apart from above, it is proposed that specialized training of at least 1-2 months should be given in various renewable energy technologies like solar, wind, bio-mass, small hydel etc.

9.5.6 Training in Demand Side Management, Energy Efficiency and Energy Conservation

Training for Energy Managers and Energy Auditors, Top Level Industry personnel, Operators, Farmers, Drivers, General Public & Youth should also be provided in respect of DSM, Energy conservation & Energy efficiency. Energy conservation should also be a part of course curriculum for students.

9.5.7 Power System Operators Training & Certification

System Operators & Engineers should be given regular refresher training and the new entrants should be given exhaustive training of 3 months. This training shall be required to be given to about 250 – 300 trainees every year during the 12th Plan.

9.5.8 Capacity Building under R-APDRP

It is envisaged that around 50,000 employees of various state power distribution utilities will be trained under Part C of R-APDRP scheme with focus on enhancing skills at various levels for efficient management and operation. A provision of Rs. 200 crore has been kept in R-APDRP for capacity building, franchise development and training. It is recommended by the Sub-Group that training infrastructure development of distribution sector at an estimated investment of Rs 2700 crore may be allocated under this scheme for training during the 12th Plan.

9.5.9 National Training Program for Electricity Distribution Franchisee and C&D Employees under RGGVY

It is recommended to continue the training of skill development for existing and potential Franchisees and also to C&D Employees of Power distribution Utilities under RGGVY in 12th Plan as well.

9.5.10 HRD and Technical Competence Building due to Technology Advancement and R &D

In order to match the growth rate, technology advancement and R&D needs both skilled manpower as well as highly qualified research personnel are required to sustain a steady growth in technology development. Thus, emphasis needs to be laid upon skill development of such Manpower.

9.5.11 Introduction of Training on Attitudinal Changes / Behavioural Sciences

It is recommended that training on Attitudinal Changes / Behavioural Sciences may be introduced in the curriculum of induction level training as well as retraining programs. After undergoing such training, the personnel develop a sense of belongingness to the organization.

In addition to technical Skills, Power Professionals need to have soft skills like Communication Skills, Time Management, Team Work, Technical Writing, Ethics etc.

9.5.12 Training in Information Technology

Information technology has pervaded all spheres of life. Adequate training according to the job requirement should be provided in the field of information technology. Use of IT should be promoted and maximum number of personnel should be made computer literate.

9.5.13 Opportunities for Higher Studies

Subsequent to the introduction of advanced technology and its widespread use in power sector, Utilities should facilitate its employees by way of up gradation of their qualifications for both technical & non-technical personnel for developing expertise in their area of functioning.

9.5.14 Training of Non-Technical Officers and Staff

It has been noticed that in the technology centered organizations like Power Utilities, the training of Non-technical officers and staff is often neglected/ignored. Training of non-technical officers and staff should be done on regular intervals in the functional skills/Management areas in association with the concerned Institutes as per needs.

9.5.15 HRD and Capacity Building for Power Generating Stations

It is proposed to have a capacity building program for the Executives, Engineers, and Operators of Thermal Power Stations in both State and Central Sectors in the areas of Energy Management and Energy Audit during 12th and 13th Plans.

9.5.16 Training for Nuclear Power Personnel

Due to stringent safety requirements and other national and international regulations, every person working in Nuclear Power Sector is exposed to very specialized training. To meet the multi-disciplinary needs, the Department of Atomic Energy (DAE) has built in-house training facilities both for professionals and non-professionals.

9.5.17 Training Abroad

Live liaison should be made with the concerned authorities to depute the eligible personnel for training in the developed countries to keep them updated with the latest global developments.

9.5.18 Hot Line Maintenance Training

There is a great demand from various Utilities for Hot Line maintenance Training. There is an urgent need for augmentation of Training Capacity as this type of Training is presently being imparted by only one institute.

9.5.19 Vocational Training for Youths & Project Affected Persons (PAPs) near Project sites

Training institutes of projects should impart vocational training to youths and Project Affected Persons (PAPs) of neighborhood to make them employable.

9.5.20 Training through Distance learning education & Web based Training

Since it may not be possible for all the Persons engaged in Construction and O&M of Power Projects, knowledge upgradation & training is suggested through correspondence and also by way of Web based Training.

Other measures for development of Human Resource are as follows:

(a) Adoption of ITIs

Already many CPSUs have adopted ITIs. It is proposed that more ITIs should be adopted by CPSUs.

(b) Need for written Training Policy by every Utility

Every Central Sector, State Sector & Private Sector utility should have a written Training Policy indicating how the Organisation proposes to meet its Training needs.

(c) Provision for Training budget

In line with the National Training Policy for the Power Sector, every organization should have a training budget starting from 1.5% to 5% of annual salary budget.

9.6 TRAINING INFRASTRUCTURE REQUIREMENTS VIS-À-VIS AVAILABILITY DURING 12TH PLAN.

Overall training load during 12th Plan is estimated as 2473.41 thousand man-weeks/year. The available training infrastructure is 1945.69 thousand man-weeks/year. Thus, there is a deficit of training infrastructure for 527.72 thousand man-weeks/year.

Training Load

Training requirement for 12th and 13th Plans have been worked out with the following assumptions:

i) O&M Training to all existing employees engaged in O&M of generating projects (Thermal, Hydel, Gas) and Transmission & Distribution System as per statutory requirements under the Gazette Notification September 2010 issued by CEA ranging from 4 Weeks to 30 Weeks.

This inter-alia includes the following:
- Classroom Training
- Simulator Training for Thermal and Hydel
- On-Job Training

ii) Induction training of one month to all freshly recruited technical and non-technical persons.

iii) Minimum one-week training (Refresher/Managerial) every year for all technical and non-technical personnel in line with National Training Policy for Power Sector.

The requirement of Training has been summarized in following tables.

Table 9.11

Classroom Training Infrastructure Requirement vs Availability for 12th Plan (For O&M of Generating Projects and T&D system as per CEA norms)

			(Infrastructure in Thousand-Man-Weeks/Year)		
S No	Area	Training Load / Classroom Infrastructure required	Classroom Infrastructure available	Surplus (+) Deficit (-)	Cost (Rs Crs)
TECHNICAL					
1	**Thermal (O&M)**	**316.86**	**255.64**	**-61.22**	**470.93**
	Engineers	175.07	133.66	-41.42	318.58
	Operators	25.53	34.35	8.82	-67.83
	Technicians	116.26	87.64	-28.62	220.18
2	**Hydro (O&M)**	**109.50**	**31.72**	**-77.79**	**598.35**
	Engineers	82.87	18.43	-64.44	495.67
	Operators	5.92	2.75	-3.17	24.39
	Technicians	20.72	10.54	-10.18	78.29
3	**Power System**				
	Transmission	**38.72**	**45.13**	**6.41**	**-49.34**
	Engineers	18.56	11.14	-7.42	57.07
	Operators	16.83	6.15	-10.68	82.16
	Technicians	3.33	27.84	24.51	-188.57

				(Infrastructure in Thousand-Man-Weeks/Year)	
S No	Area	Training Load/ Classroom Infrastructure required	Classroom Infrastructure available	Surplus (+) Deficit (-)	Cost (Rs Crs)
	Distribution	**369.67**	**20.71**	**-348.96**	**2684.34**
	Engineers	71.28	4.04	-67.24	517.25
	Operators	66.31	5.19	-61.12	470.17
	Technicians	232.08	11.48	-220.60	1696.91
	Total	**834.75**	**353.20**	**-481.56**	**3704.27**

Table 9.12
Simulator Training Infrastructure Requirement vs Availability (Thermal & Hydro Simulators as per CEA Norms) for 12th Plan

S No	Area	Simulator Training required (Thousand-Man-Weeks/Year)	Simulator Infrastructure available (Thousand-Man-Weeks/Year)	Surplus (+) Deficit (-) (Thousand-Man-Weeks/Year)	Cost (Rs Crs)
1	Thermal	33.43	4.58	-28.86	245.95
2	Hydro	17.76	0.45	-17.31	157.34
	Total	**51.19**	**5.03**	**-46.17**	**403.29**

Table 9.13
Total Cost for adding Classroom Infrastructure & Simulators

S No	Particulars	Cost (Rs Crs)
1	Cost for adding Classroom Infrastructure	3704.27
2	Cost for adding Simulators	403.29
	Total	**4107.56**

Table 9.14
Summary of additional Training Infrastructure Cost for meeting CEA Norms (In Rs Cr)

S No	Particulars	Thermal	Hydro	Transmission	Distribution	Total
1	**Trg to Engineers**	318.58	495.67	57.07	517.25	**1388.57**
2	**Trg to Operators**	-67.83	24.39	82.16	470.17	**508.89**
3	**Trg to Technicians**	220.18	78.29	-188.57	1696.91	**1806.82**
	Sub-Total (A)	**470.93**	**598.35**	**-49.34**	**2684.34**	**3704.27**
4	**Simulator Trg (B)**	245.95	157.34	-	-	**403.29**
	TOTAL (A+B)	**716.88**	**755.69**	**-49.34**	**2684.34**	**4107.56**

Table 9.15

Total Training Infrastructure Requirements vis-à-vis Availability & Annual Training Fees Cost

S No	Particulars	Annual Requirement (Thousands-Man-Weeks/Year)	Availability (Thousands-Man-Weeks/Year)	Deficit (Thousands-Man-Weeks/Year)	Annual recurring Cost towards Training Fees (Rs Crs)
A	**TECHNICAL PERSONNEL**				
1	Estimated Overall Training Load for 12th Plan				
a	O&M Training as per CEA norms	1862.12	1334.40	-527.72	1862.12
b	Induction Training @ 4 weeks/Yr	250.33	250.33	0.00	250.33
c	Refresher Training @1 week/Yr	173.42	173.42	0.00	173.42
d	ManagementTraining (In India/Abroad) @ 1Week/Yr	43.36	43.36	0.00	43.36
	Sub-total A	**2329.23**	**1801.51**	**-527.72**	**2329.23**
B	**NON-TECHNICAL PERSONNEL**				
a	Induction Training @ 4 weeks/Yr	75.80	75.80	0.00	75.80
b	Refresher Training @1 week/Yr	54.71	54.71	0.00	54.71
c	ManagementTraining (In India/Abroad) @ 1Week/Yr	13.68	13.68	0.00	13.68
	Sub-total B	**144.18**	**144.18**	**0.00**	**144.18**
	Total (A + B)	**2473.41**	**1945.69**	**-527.72**	**2473.41**

9.7 FUNDING

9.7.1 Funding for Classroom Training Infrastructure for Engineers, Supervisors and Operators

The infrastructure requirement for class-room training for engineers, supervisors and operators has been calculated as 834.75 thousand-man-weeks per year. The infrastructure available for class-room training for engineers, supervisors and operators has been estimated as 353.20 thousand-man-weeks per year. Therefore, there is a deficit of 481.56 thousand-man-weeks per year of class room infrastructure.
The cost of setting up a new institute, which can accommodate 100 trainees or augmenting an existing Institute is Rs. 40 crore approximately excluding cost of land. This would provide training equivalent to 5.2 thousand man-weeks per year. The new infrastructure to be created shall broadly include the following:

i) Construction of Building which shall include Class-rooms, Office Chambers of Faculty, Conference Rooms, various Labs, Computer Labs, Audio-visual equipments, Library, etc.
ii) Construction of Hostels for accommodating trainees.
iii) Staff Quarters, Guest Houses etc.

Therefore to create the infrastructure required to cater to the training load deficit of 481.56 thousand man weeks per year during 12th Plan, an investment of Rs. 3704.27 crore shall be required, which is equivalent to setting up of 92 new Institutes or augmenting existing Institutes.

9.7.2 Funding for Thermal Simulator Infrastructure

As per the Gazette Notification, September 2010 of CEA, Persons working in the O&M of Thermal Power Plants have to undergo 2 weeks Simulator training. The infrastructure available for Simulator training has been calculated based on the existing Simulators available in the country, which is 4.58 thousand-man-weeks per year. The infrastructure requirement has been calculated as 33.43 thousand-man-weeks per year. Therefore, there is a deficit of 28.86 thousand-man-weeks per year of Simulator infrastructure.

The cost of setting up a new Simulator is Rs. 6.00 crore approximately. Considering a batch size of 16 and total number of 22 batches in a year, one training simulator can provide 0.704 thousand-man-weeks in a year. Therefore to create the Simulator infrastructure required for deficit training requirement of 28.86 thousand-man-weeks per year during the 12th Plan, the Simulator infrastructure cost has been calculated as 245.95 crore. Thus 41 Simulators are required to meet the training requirement.

9.7.3 Funding for Hydro Simulator Infrastructure

As per the Gazette Notification, September 2010 of CEA, persons working in the O&M of Hydel Power Plants have to undergo 2 weeks Simulator training. The infrastructure available for Simulator training has been calculated based on the existing Simulators available in the country, which is 0.45 thousand-man-weeks per year. The infrastructure requirement has been calculated as 17.76 thousand-man-weeks per year. Therefore, there is a deficit of 17.31 thousand-man-weeks per year of Simulator infrastructure.

The cost of setting up a new Simulator is Rs. 4.00 crore approximately. Considering a batch size of 10 and total number of 22 batches in a year, one training simulator can provide 0.44 thousand-man-weeks in a year. Therefore, to create the Simulator infrastructure required for deficit training requirement of 17.31 thousand-man-weeks per year during the 12th plan, the Simulator infrastructure cost has been calculated as Rs. 157.34 crore. Thus 39 Simulators are required to meet the training requirement.

9.7.4 Additional Sanction and Appointment of Trainers and Administrative/Support staff

For every 15 trainees, 1 faculty and 2 administrative/support staff are required to carry out the training activities. Therefore, additional manpower has to be sanctioned and appointed to run the new training institutes and meet the training requirements of the power sector. Total deficit of Training needs for O & M of Generation, Transmission & Distribution Projects during the 12th Plan is estimated at 527.72 Thousands-man-weeks/yr. This inter-alia implies that additional manpower of 2028 which shall consist of 669 number of trainers and 1359 numbers of administrative/support staff shall be required. Assuming an average annual salary of one person as Rs. 8 lakhs, approx. annual salary bill shall be. Rs. 162.24 crore.

9.7.5 Funding for Training

Funding has been estimated based on the infrastructure cost of establishing new Institutes.

Training load for every year is estimated to be 2473.41 thousand-man-weeks. Assuming training fee and lodging & boarding charges of Rs. 10,000/- per trainee per week, the total annual expenses for the training works out to approx. Rs. 2473.41 crore.

Following is the summary of the capital expenditure and annual recurring expenditure:

Table 9.16
Summary of Capital & Annual recurring expenditure

Item	Funds required in 12th Plan in Rs. crore for establishment of new Training Infrastructure (A)	Annual Training Cost in Rs. crore towards Cost of Training Fees (B)
Classroom Infrastructure for Engineers	1388.57	
Classroom Infrastructure for Supervisors	508.89	
Classroom Trg. Infrastructure for Technicians	1806.82	
Sub-total for class rooms Training Infrastructure	**3704.27**	
Thermal Simulator Infrastructure	245.95	
Hydro Simulator Infrastructure	157.34	
Subsidy towards training fee		2473.41
Total	**4107.56**	**2473.41**

9.7.6 Justification for Funding

Capacity addition in power sector is a highly capital intensive investment. The delivered cost of 1 MW of power works out to approximately Rs. 12 Crore per MW as per the following broad break-up:

Generation capacity addition cost for 1 MW = Rs. 6-8 crores

Establishment of T&D infrastructure for 1 MW = Rs. 6 crores

In the 12th Plan, a capacity addition of about 75,000 MW is planned. Thus, capacity addition of about 75,000 MW shall cost about Rs. 11 lakh crores including T&D system.

In the financial year 2010-11, generation in the country was 811.148 BU. Assuming that the expenditure on training improves a PLF of 1% per annum and reduces AT&C losses by 1%, the additional energy available shall be 2% of 811.148 BU, which works out to 16.223 BU. Assuming that the average cost of supply is Rs. 4.67 per unit, additional 2% power available shall be worth Rs. 7576.14 crores.

It is to mention that presently the average PLF of Central Sector Power Plants is 83.1% and that of State Sector Power Plants is 63.93% and some of the power plants are even operating at PLF greater than 90%. Thus, there is ample scope of improvement of PLF.

Further presently average annual AT&C losses are around 28%, while the ideal figure should be about 10 - 15%. Thus, there is also ample scope of reduction of AT&C losses.
While PLF increase of 1% and AT&C loss reduction of 1% has been assumed, a possibility exists that actual improvement may be much more also.

1 MW of a power project at 80% PLF can generate an annual energy of 7.008 MU. Thus, extra power availability of about 2% amounting to 16,223 MU is equivalent to 2315 MW of capacity addition, investment of which shall cost Rs. 27,780 crores @ Rs. 12 crore per MW.

From the above, it can be seen that the investment of Rs. 4108 crores made for creating additional training infrastructure is paying for itself and leads to an avoided capacity addition of 2315 MW costing Rs. 27,780 crores. Thus, investment in training infrastructure is justified.

The investment in training infrastructure is leading to extra power availability costing Rs. 7576.14 crores while annual recurring expenditure towards cost of Training fees is Rs. 2473.41 crores. Thus annual recurring expenditure towards cost of Training fees is justified.

Extra investment in training will lead to extra power availability as explained above leading to increase in productivity and GDP of the country.

Thus, above investment in creating additional training infrastructure and annual recurring expenditure towards cost of Training fees is justified.

Table 9.17

Justification for Funding for creating Training Infrastructure assets

Particulars	Quantum	Unit
MU generated by a 1 MW Power Project at 80% PLF per Year	7.008	MU
MU Generated in the Country during FY 2010-11	811148	MU
2% Additional energy available in MU by expenditure on Training (1% by improvement in PLF & 1% by reduction in AT&C loss)	16223	MU
Equivalent avoided Capacity addition in MW for 16223 MU	2315	MW
Avoided cost of Capacity addition in Rs Crs @ Rs 12Crs/MW	27780	Rs Crs
Investment proposed in creating Additional Training Infrastructure (Rs Crs)	4108	Rs Crs
Savings	**23672**	**Rs Crs**

Table 9.18

Justification for incurring annual recurring expenditure towards cost of Training fees

Particulars	Amount	Unit
Annual Training Cost/Yr	2473.41	Rs Crs
2% Additional energy available in MU by expenditure on Training (1% by improvement in PLF & 1% by reduction in AT&C loss)	7576.14	Rs Crs
Annual Saving	**5102.73**	**Rs Crs**

Above analysis shows that expenditure for creating Training Infrastructure assets and incurring annual recurring expenditure towards cost of Training fees is justified.

9.8 RECOMMENDATIONS

It is proposed that all Central Sector Utilities, all state Sector Utilities and all IPPs should create sufficient Training Infrastructure for providing O&M training as per the norms stipulated in notification of September 2010 issued by CEA. Additional training Infrastructure should also be created by Organizations like NPTI & Training Institutes of other Utilities and they should also augment their existing Training Institutes for meeting the increased training requirements of the Power Sector. It is also proposed that all existing nine Institutes of NPTI should be augmented for which estimated cost for augmentation per Institute is Rs. 50.00 crore and for nine institutes it works out to Rs. 450 crore, for which necessary Plan funding may be provided by Ministry of Power.

The following options are available for meeting the funding arrangements.

i) As per National Training Policy each organization should allocate training budget between 1.5% to 5% of annual salary budget.

ii) Each utility engaged in generation and transmission could set aside 0.25% of profit annually for meeting the training expenses.

iii) Training infrastructure for distribution could be funded through R-APDRP.

iv) Funds could be sought under the National Skill Development Program of Ministry of Human Resource Development for meeting the Training requirements.

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Chapter -10

DEVELOPMENT OF POWER SECTOR IN NORTH-EASTERN REGION

10.0 INTRODUCTION

As per the demarcation of Regional Power Grids of India , the North Eastern Regional Grid of the country comprises of 7 States; namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura ; while State of Sikkim is the part of the Eastern Regional Power Grid . It is a land-locked Region with ninety eight percent of its border being international. The land -locked area which constitutes 8 percent of the total area of the country is connected with the main land through chicken-neck across West Bengal.

In view of the slow growth of the region, special focus has been laid on economic development of North-Eastern Region and Sikkim. Accordingly strategies have been formulated for removal of infrastructure bottlenecks and creating a conducive environment for overall progress of the region including private investment etc

10.1 GENERATION PLANNING FOR NORTH-EASTERN REGION

10.1.1 Review of Capacity Addition Programme during 11th Plan

As per the Mid Term Appraisal, Planning Commission had set a generation capacity addition target of 663 MW in NER and 1209 MW in the state of Sikkim during the Eleventh Plan. Out of this target 21 MW has been achieved in NER and 510 MW in Sikkim upto 30.9.2011. Capacity addition of 126 MW is likely to be achieved in NER during balance period of 2011-12. The State-wise details of capacity addition target and achievement (as on 30.09.2011) during Eleventh Plan are given in Table 10.1 below:

Table 10.1

Capacity Addition during 11th Plan

Target v/s Achievement in North-Eastern Region and Sikkim

(All figures in MW)

S.N	State	Target	Achievement as on 30.09.2011
i	Assam	537	**0**
ii	Arunachal Pradesh	0	**0**
iii	Meghalaya	126	**0**
iv	Tripura	0	**21 (Baramura GT-not included in Target)**
v	Manipur	0	**0**
vi	Nagaland	0	**0**
vii	Mizoram	0	**0**
ix	**Total(NER)**	663	**21**
x	Sikkim	1209	**510**

10.1.2 Installed Capacity as on 30.09.2011

The total Installed Capacity of NE Region (excluding Sikkim) as on 30.09.2011 was 2329MW comprising 1116 MW hydro and 990 MW thermal (including gas and diesel) and 223 MW from Renewable Energy Sources. The total Installed capacity of Sikkim as on 30.09.2011 was 201 MW comprising 75MW hydro and 79MW thermal (including gas and diesel) and 47 MW from Renewable Energy Sources. The State-wise details of Installed Capacity (including shares from Central Sector Projects) as on 30.09.2011 are given in Table 10.2 below:

Table 10.2

(All figures in MW)

State	Hydro	Thermal				Renewable Energy Sources	Total
		Coal	Gas	Diesel	Total		
Assam	430	60	441	21	522	27	979
Ar. Pradesh	98	0	21	16	37	79	214
Meghalaya	231	0	26	2	28	31	290
Tripura	62	0	182	5	187	16	265
Manipur	81	0	26	45	71	5	157
Nagaland	53	0	19	2	21	29	103
Mizoram	34	0	16	52	68	36	138
Central Unallocated	127	-	56	-	56	-	183
Total(NER)	**1116**	**60**	**787**	**143**	**990**	**223**	**2329**
Sikkim	75	74	0	5	79	47	201
NER+ Sikkim	**1191**	**134**	**787**	**148**	**1069**	**270**	**2530**

10.1.2.2 Actual Power Supply Position during April- September, 2011

The State-wise actual power supply position during April-Sept, 2011 is given in table 10.3 below:

Table 10.3

Power Supply Position during April-Sept, 2011

State	Peak (MW)		Peak Shortage / Surplus		Energy (MU)		Energy Shortage / Surplus	
	Demand	Met	(MW)	(%)	Requirement	Availability	(MU)	(%)
Assam	1112	1014	-98	-8.8	3195	3022	-173	-5.4
Ar. Pradesh	113	108	-5	-4.4	289	263	-26	-9.0
Meghalaya	319	262	-57	-17.9	978	745	-233	-23.8
Tripura	194	191	-7	-6.3	485	457	-28	-5.8
Manipur	111	104	-3	-2.9	275	248	-27	-9.8
Nagaland	106	103	-3	-2.8	305	275	-30	-9.8
Mizoram	77	67	-10	-13.0	193	171	-22	-11.4
Total(NER)	**1920**	**1698**	**-222**	**-11.6**	**5720**	**5181**	**- 539**	**-9.4**
Sikkim	100	95	-5.0	-5.0	171	170	-1	0.6

The State-wise actual power supply position during 2010-11 is given in table 10.4 below:

Table 10.4
Power Supply Position during 2010 - 2011

State	Peak (MW)		Peak Shortage(-) / Surplus(+)		Energy (MU)		Energy Shortage(-) / Surplus (+)	
	Demand	Met	(MW)	(%)	Requirement	Availability	(MU)	(%)
Assam	971	937	-34	-3.5	5403	5063	-340	-6.3
Ar. Pradesh	101	85	-16	-15.8	511	436	-75	-14.7
Meghalaya	294	284	-10	-3.4	1545	1352	-193	-12.5
Tripura	220	197	-23	-10.5	882	801	-81	-9.2
Manipur	118	115	-3	-2.5	568	505	-63	-11.1
Nagaland	118	110	-8	-6.8	583	520	-63	-10.8
Mizoram	76	70	-6	-7.9	369	315	-54	-14.6
Total(NER)	**1913**	**1560**	**-353**	**-18.5**	**9861**	**8992**	**-869**	**-8.8**
Sikkim	106	104	-2	-1.9	402	402	0	0

10.1.3 Generating capacity addition programme in North Eastern Region/ Sikkim during 12th Plan

The capacity addition requirement during 12th Plan on All-India basis is 75,785 MW comprising of 9,204 MW hydro, 63,781 MW thermal (62,695 MW coal based and 1,086 MW gas based) and 2,800 MW nuclear. The likely hydro capacity addition of 9,204 MW during 12th Plan includes 4,177 MW in North-Eastern Region and Sikkim (2,810 MW capacity addition in NER and 1,367 MW in Sikkim). Likely gas based capacity addition of 1,086 MW during 12th Plan on All-India basis includes 926 MW capacity additions in NER. Further, the coal based projects likely to be commissioned during 12th Plan, includes 250 MW coal based capacity addition in the State of Assam thus likely thermal capacity addition in North-Eastern Region is 1,176 MW. Total likely Capacity addition in North-Eastern Region and Sikkim during 12th Plan is 5,353 MW. Details of State-wise capacity addition during 12th Plan are given in Table 10.5 below:

Table 10.5
State-wise Likely Capacity Addition during 12th Plan

State	Hydro (MW)	Thermal (MW)				Total (MW)
		Coal	Gas	Total	Nuclear	
All India	9204	62695	1086	63781	2800	75785
Total(NER)	**2810**	**250**	**926**	**1176**		**3986**
Assam		250	100	350		350
Ar. Pradesh	2710					2710
Meghalaya	40					40
Tripura			826	826		826
Mizoram	60					60
Sikkim	**1367**					**1367**

List of Projects likely to be commissioned in North-Eastern Region and Sikkim during 12th Plan are given in Table 10.6 below:

Table 10.6

S. No.	Project Name	State	Sector	Capacity (MW)
1	Bongaigaon TPP	Assam	C	250
2	Monarchak	Tripura	C	100
3	Tripura Gas	Tripura	C	726
4	Namrup CCGT	Assam	S	100
	Total Thermal			**1176**
4	Pare	Ar. Pradesh	C	110
5	Kameng	Ar. Pradesh	C	600
6	Subansiri Lower	Ar. Pradesh	C	2000
7	Tuirial	Mizoram	C	60
8	New Umtru	Meghalaya	S	40
9	Bhasmey	Sikkim	P	51
10	Jorethang Loop	Sikkim	P	96
11	Rangit-IV	Sikkim	P	120
12	Teesta-VI	Sikkim	P	500
13	Teesta-III	Sikkim	P	600
	Total Hydro			**4177**
	Total NER+Sikkim			**5353**

10.2 TRANSMISSION PLANNING FOR NORTH-EAST

10.2.1. Comprehensive Scheme for Strengthening of Transmission and Distribution System in NER and Sikkim

Based on the recommendation of CEA and in consultation with each state of NER and Sikkim, Powergrid has prepared detailed project reports for comprehensive schemes for strengthening of transmission, sub transmission and distribution system in each state of NER and Sikkim and also for inter-state transmission system in NER in June 2010. The estimated cost of the above schemes is about Rs. 11,348.5 crores. The schemes were to be implemented in two phases by 2015-16. The state wise break-up for cost of Transmission, Sub-transmission and Distribution schemes is given in Table 10.7 below.

Table 10.7

(Rs Crores)

Sl. No.	States	Transmission & Sub Trans (132 kV & above)		Distribu-tion	Sub-Total	Consultancy	Total
		Phase-I	Phase-II				
1	Inter-State	44.49	250.23	00	294.72	39.01	333.73
2	Ar Pradesh	959.23	466.77	217.14	1643.14	217.49	1860.63
3	Assam	711.74	940.55	741.72	2394.00	316.87	2710.87
4	Manipur	196.88	185.52	260.21	642.61	85.06	727.67
5	Meghalaya	920.50	0.00	283.85	1204.35	159.41	1363.76
6	Mizoram	263.37	222.17	145.01	630.55	83.46	714.01
7	Nagaland	915.77	00	152.08	1067.85	141.34	1209.19
8	Tripura	612.72	229.19	284.55	1126.46	149.10	1275.56
9	Sikkim	730.70	00	287.59	1018.29	134.78	1153.07
	Total	**5355.40**	**2294.43**	**2372.15**	**10021.97**	**1326.51**	**11348.48**

The funding for the schemes is under consideration by Government of India. In order to improve the power infrastructure in NER and Sikkim, the schemes need to be implemented expeditiously.

10.2.2 Transmission System Associated with Lower Subansiri HEP (2000 MW) and Kameng HEP (600 MW) in Arunachal Pradesh

Transmission system for evacuation of power from Lower Subansiri HEP and Kameng HEP in Arunachal Pradesh and hydro electric projects in Bhutan namely Punatsangchu-I (1200 MW), Punatsangchu-II (990 MW) and Mangdechu (720 MW) was evolved in a comprehensive manner. The power from these projects would be evacuated to Northern and Western regions over +/- 800 kV, 6000 MW HVDC Bipolar line from Biswanath Chariyalli to Agra. The implementation of HVDC Bipole was deferred because of delay in implementation of Lower Subansiri HEP. Now the construction of 1815 km HVDC line is in progress and construction of converter terminals at Biswanath Chariyalli (3000 MW), Alipurdwar (3000 MW) and Agra (6000 MW) has also been awarded. The estimated cost of the scheme is 11,130 crores. The scheme is expected to be commissioned in early 12th plan.

10.2.3 Transmission System for Evacuation of Power from Pallatana Gas Based Station (726.6 MW) and Bongaigaon TPS (750 MW)

The above generation schemes were originally scheduled for commissioning during 11th plan but are now anticipated during early 12th plan. Transmission system associated with Pallatana GBPP and Bongaigaon TPS was evolved in a comprehensive manner. The main trunk line for evacuation of power from the Pallatana project is being implemented by North East Transmission Company limited (NETC) a joint venture of OTPC, POWERGRID, AEGCL, Govt. of Tripura, Government of Mizoram, Govt. of Manipur and Government of Meghalaya. System strengthening scheme for delivery of power to the beneficiaries of the projects is being implemented by POWERGRID. The details of associated transmission schemes are given below.

(a) Evacuation lines from Pallatana GBPP to Regional grid point (Under NETC scope)
Pallatana-Silchar 400 kV D/C line
Silchar-Bongaigaon 400 kV D/C line

The scheme has been awarded by NETC and is expected to be commissioned by early 12th plan. The transmission lines are traversing through forest area and best efforts are being made to obtain forest clearance expeditiously. The estimated cost of the scheme is Rs. 1,770 crores.

(b) Regional System Strengthening scheme for delivery of power to beneficiary states (under POWERGRID scope)

Transmission lines

i) Bongaigaon TPS - Bongaigaon 400kV D/C line
ii) Silchar - Badarpur (PG) Switching Station interconnecting 132kV D/C line
iii) LILO of Kathalguri-Misa 400kV S/C at Mariani (New) (charged at 220kV)
iv) Pallatana - Surajmaninagar (TSECL) 400kV D/C line (charged at 132kV)
v) Silchar – Purba Kanchan Bari (TSECL) 400kV D/C line (charged at 132kV)
vi) Silchar – Melriat (New) 400kV D/C line (charged at 132kV)
vii) Melriat (New) – Melriat (Mizoram) interconnecting 132kV D/C line
viii) Silchar – Imphal (New) 400kV D/C line (charged at 132kV)
ix) LILO of Loktak – Imphal (POWERGRID) 132kV S/C line at Imphal (New)
x) Mariani (new) - Mokokchung (POWERGRID) 220kV D/C line

xi) Mokokchung (POWERGRID) - Mokokchung (Nagaland) 132kV D/C line (with Zebra conductor)
xii) Pasighat – Roing 132kV S/C line (on D/C tower)
xiii) Roing – Tezu 132kV S/C line (on D/C tower)
xiv) Tezu – Namsai 132kV S/C line (on D/C tower)
xv) Silchar- SIrkona 132kV S/c line
xvi) Silchar – Hailakandi 132kV S/c line

Substations

i) 2x200 MVA, 400/132kV New S/s at Silchar
ii) 220 kV New Switching Station at Mariani
iii) 2x50 MVA, 132/33 kV New S/s at Melriat (New) (upgradable to 400kV)
iv) 2x50 MVA, 132/33 kV New S/s at Imphal (New) (upgradable to 400kV)
v) 2x50 MVA, 220/132 kV New S/s at Mokokchung
vi) 2x15 MVA, 132/33 kV New S/s at Roing
vii) 2x15 MVA, 132/33 kV New S/s at Tezu
viii) 2x15 MVA, 132/33 kV New S/s at Namsai

The essential elements of the scheme have already been awarded by POWERGRID and are expected to be commissioned by early 12th plan. The estimated cost of the scheme is Rs. 2,144 crores. The implementation of the scheme would strengthen the transmission system in Manipur, Mizoram, Tripura and Arunachal Pradesh.

10.2.4 Transmission System for New Hydro Projects in Arunachal Pradesh

The following hydro projects developers have applied to the CTU for Grid connectivity / Long Term Access in Arunachal Pradesh:

Table 10.8

Sl. No	LTA Applicant / Project	Basin	Installed Capacity (MW)	LTA / Connectivity (MW)	Applied for
A.	**Lohit Basin**				
1	Athena Demwe Power Ltd	Lohit	5x342 + 1x40 =1750	1750	Connectivity
			Sub total (Lohit Basin)	**1750**	
B.	**Siang Basin**				
1	Jayprakash Power Ventures Ltd (JPVL) (Lower Siang)	Siang	Ph-I : 5x300=1500 Ph-II : 4x300=1200 Total = 2700	2700	LTOA
2	Siyom Hydro Power Project	Siang	6x166.6=1000	1000	Connectivity
3	Tato II Hydro Power Project	Siang	4x175=700	700	Connectivity
4	Naying DSC Power Ltd	Siang	4x250=1000	1000	Connectivity
			Sub total (Siang basin)	**5400**	
C.	**Tawang Basin**				
1.	Bhilwara Energy Ltd (Nyamjang Chu HEP)	Tawang	6x130=780 20% (Continuous Over Load)	780	Connectivity
2.	Energy Development Company Ltd (EDCL)	Tawang	Tashu-1 : 3x8 =24 Tashu-1(Lower) : 3x16.6 =50 Tashu-2 : 3x30 =90	164	Connectivity & LTA
3.	NHPC Ltd (Tawang-I)	Tawang	3x200=600	600 + 10% O/L = 660	Connectivity & LTA

Sl. No	LTA Applicant / Project	Basin	Installed Capacity (MW)	LTA / Connectivity (MW)	Applied for
4.	NHPC Ltd (Tawang-II)	Tawang	4x200=800	800 + 10% O/L = 880	Connectivity & LTA
			Sub total (Tawang basin)	**2484**	
D.	**Kameng Basin**				
1.	KSK Dibbin Hydro Power Pvt Ltd	Kameng	2x60=120	120	Connectivity & LTA
2.	Patel Hydro Pvt Ltd	Kameng	Gongri : 3x48=144 Saskang Rong :2x22.5=45 Meyong : 2x19=38 Diggin : 2x23=46	273	Connectivity & LTA
3.	Adishankar Khuitam Power Pvt. Ltd.	Kameng	3x22 = 66	66	Connectivity
4.	SEW Nafra Power Corporation Ltd	Kameng	2x60 = 120	132	Connectivity
5.	Energy Development Company Ltd (EDCL)	Kameng	9 Projects	391	Connectivity & LTA
6.	GMR Londa Hydro Power Pvt Ltd.	Kameng	3x75 = 225	225	Connectivity
			Subtotal (Kameng basin)	**1207**	
			Total	**10841**	

In addition to the above, following projects are also in the pipe lines, which have been taken in to account for planning.

Table 10.9

S. No.	Name of Project	Basin	Installed Capacity (MW)
A. Siang Basin			
1.	Tato-I	Siang	120
2.	Hirong	Siang	500
3.	Pauk	Siang	120
4.	Heo	Siang	210
		Sub Total (Siang Basin)	**950**
B. Twang Basin			
1.	Mago Chhu	Twang	96
2.	Nykcharongchu	Twang	96
3.	Rho	Twang	141
4.	New Melling	Twang	96
		Sub Total (Twang Basin)	**429**
C. Kameng Basin			
1.	Utung	Kameng	100
2.	Nazong	Kameng	60
3.	Dinchang	Kameng	360
		Sub Total (Kameng Basin)	**520**
		Total (additional Projects)	**1899**
		Total (LTA / Connectivity + Additional Projects)	**12740**

Most of the above generation projects are in the process of getting forest clearance after which the process of land acquisition would begin. As such, the projects are likely to materialize in the 13th plan period.

Tentative transmission system for all the above projects which have applied for Grid connectivity and Long Term Access as well as for additional projects mentioned above has been planned. The proposed transmission system envisages establishment of basin wise pooling stations for pooling of power from generation projects in individual basins, which may further be pooled at a bigger pooling station for onward transfer to load centres in various regions through high capacity HVDC / EHVAC transmission lines.

The basin wise pooling stations which have been provisionally identified are given below:

Siang Basin	400/220kV Kamki PP (Siang PP-1) 400/220kV Siang PP-2
Tawang Basin	400/220kV Tawang PP-1 220/132kV Tawang PP-2
Kameng Basin	400/220kV Dinchang pooling station (Kameng PP-1) 220/132kV Kameng PP-2
Subansiri Basin	400kV Sila Pathar pooling station (for pooling of power from generation projects in Siang and Lohit basin)
Upper Assam	400kV Rangia/Rowta pooling station (for pooling of power from generation projects in Kameng and Tawang basin)

Broadly the planned transmission system consists of three parts.

I) Immediate evacuation system for transfer of power from individual generating station to nearest basin wise pooling station/s

II) Common transmission system from basin Pooling station/s to bigger pooling station

III) Bigger pooling station to Load centres in other region through HVDC / EHVAC lines

10.2.5 Future Development of Transmission System in North Eastern Region

Large no. of hydro generating stations, are anticipated in North Eastern Region, during 13th plan period. These would be a major source of power to the North Eastern Regional constituents. In order that NER constituents would be able to draw power from these projects, adequate system strengthening would be required in NER constituent states. Therefore, it is important that transmission development in the NER states is also taken up hand in hand in a phased manned with the development of the hydro projects so that the transmission network in the region is also strengthened.

With the above in view, a tentative system strengthening transmission plan for 13th plan in NER is given below:

IV) Rangia / Rowta Pooling Station – Azara 400kV D/c line (high capacity)

V) Azara – Byrnihat 400kV D/c line (high capacity)

VI) Byrnihat – Silchar 400kV D/c line (high capacity)

VII) Silchar – Surajmaninagar 400kV D/c line (high capacity)

VIII)Surajmaninagar – Melriat 400kV D/c line (high capacity)

IX) Melriat – Imphal 400kV D/c line (high capacity)

X) Imphal – Kohima 400kV D/c line (high capacity)

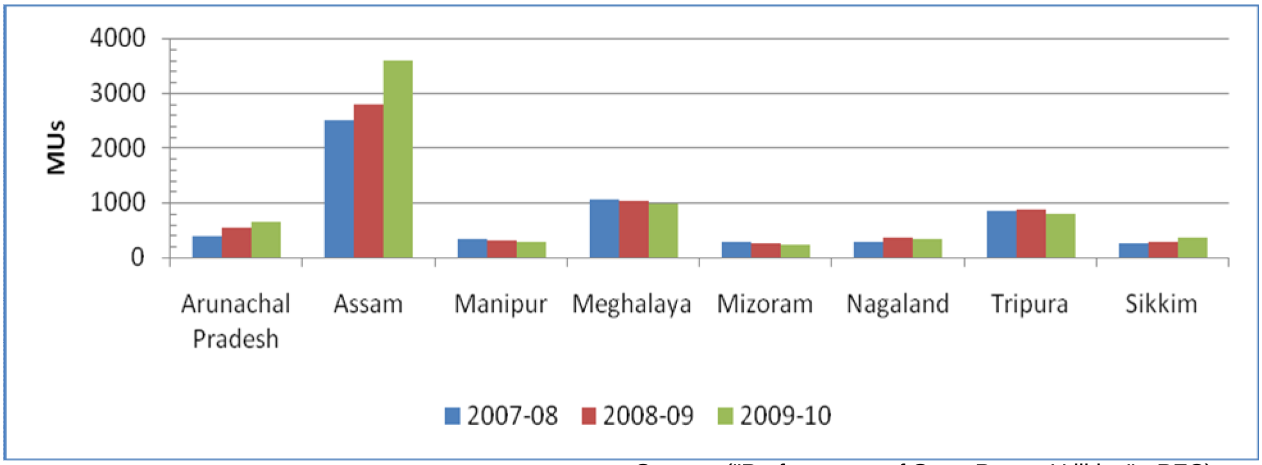
XI) Kohima – Mariani 400kV D/c line (high capacity)

XII) Mariani – Silapathar Pooling Station 400kV D/c line (high capacity)

10.3 DISTRIBUTION IN NORTH EASTERN REGION (NER)

Distribution system in North-Eastern Region varies widely from state to state. Assam continues to dominate the consumption in MUs followed by Meghalaya. The consumption of Assam appears to be increasing over the last three years. This could be because of more economic activity in Assam, vis-à-vis neighbouring states.

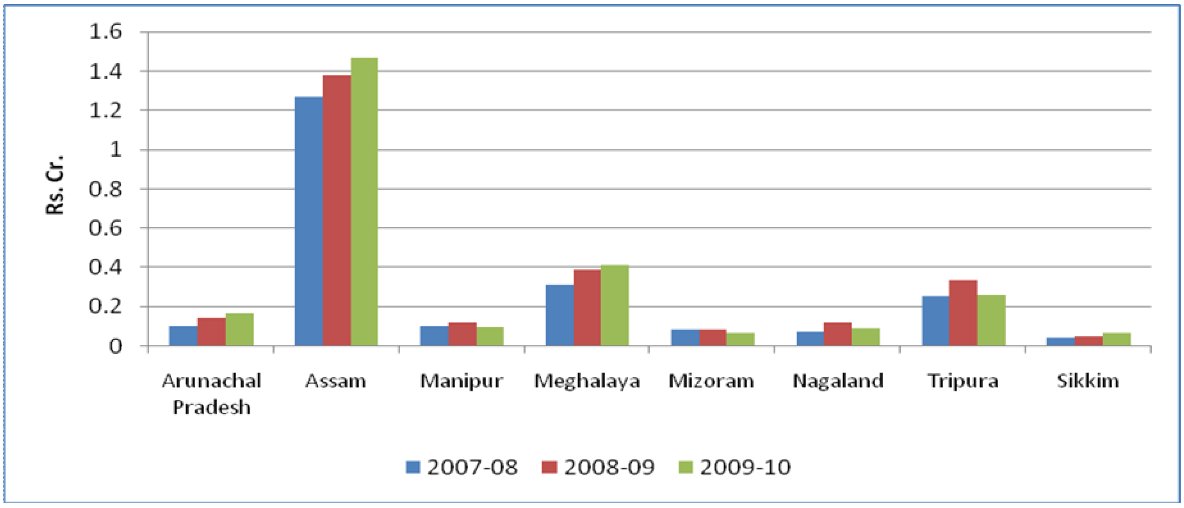
Consumption of Power in North-Eastern Region (MU)



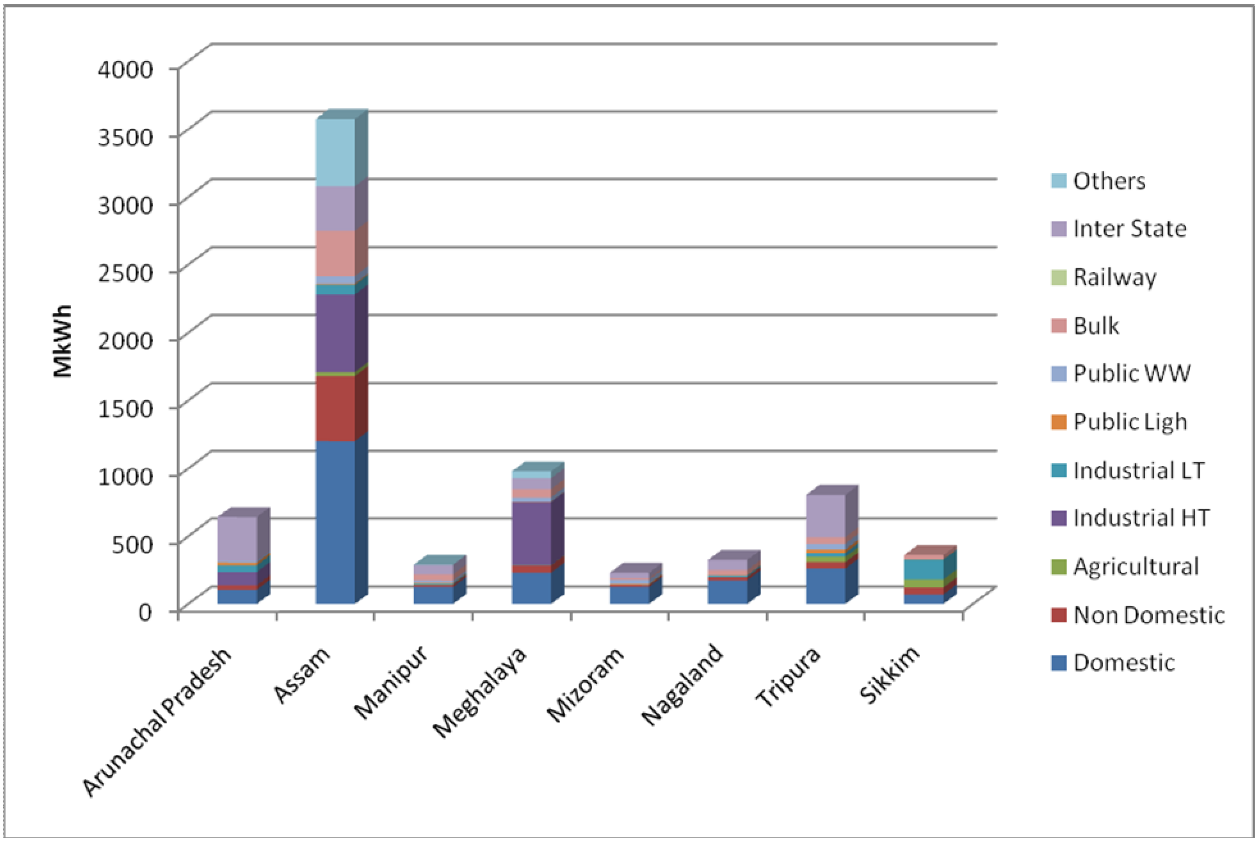
Source: ("Performance of State Power Utilities" - PFC)

State-wise energy sold in the Region during the last three years and the Consumer Category wise Sale of Power in Mkwh in 2009-10 for the region are shown in the graphs below:

Sale of Energy in North Eastern Region (Rs. Cr) during last three years



Consumer Category wise Sale of Power in MkWh in North Eastern Region during 2009-10



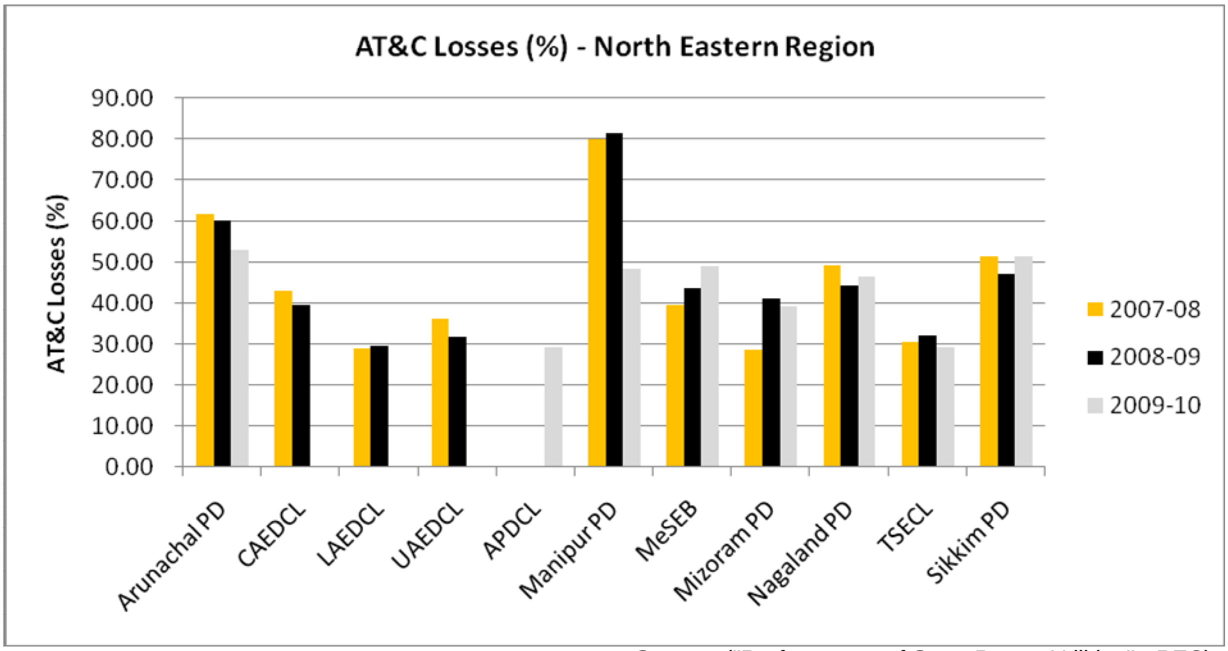
(Source: ("Performance of State Power Utilities" - PFC))

It is observed from the above that Domestic sector is a dominant category in most of the states. However, Meghalaya and Sikkim have significant consumption in the Industrial category as compared to their overall portfolio. The states of Arunachal Pradesh and Tripura have Inter-state power sale arrangement owing to the Generation available in these states. Hence this accounts for the highest sales of their portfolio followed by Domestic category.

10.3.1 AT&C Losses

The AT&C losses recorded for the North Eastern Region has been the highest amongst all other regions of the country. In the year 2007-08, the losses stood at 40.32% whereas the national average was 29.45%. In the year 2008-09, the losses stood at 40.70% whereas the national average was 27.74%. In the year 2009-10, the losses stood at 36.44% whereas the national average was 27.15%. The State-wise AT&C losses for the region over the three years 2007-08, 2008-09 and 2009-10 are as shown in the below figure.

AT&C Losses – Utility wise



Source: ("Performance of State Power Utilities" - PFC)

It is observed that the AT&C losses in 5 out of the 8 States have shown a decreasing trend from 2008-09 to 2009-10. Details of the same are as follows:

Table -10.10
AT&C Loss trends in North Eastern Region

State	Loss Levels in 2009-10 as compared to that in 2008-09
Arunachal Pradesh	Decreased by more than 4%
Assam	Decreased by 2 – 4%
Manipur	Decreased by more than 30%
Tripura	Decreased by 2 – 4%
Meghalaya	Increased by more than 4%
Mizoram	Decreased by 2 – 4%
Nagaland	Increased by 2 – 4%
Sikkim	Increased by 2 – 4%

(Source: "Performance of State Power Utilities" - PFC)

10.3.2 Status of Reforms and Restructuring

As on 21st April 2010 the status of reforms and restructuring of the North Eastern States is shown below. The utilities of Assam, Meghalaya and Tripura have been unbundled in this region. However, in the other States, the process is either in progress or has not been initiated. The utility of Assam has adopted Multi Year Tariff as per the recommendations of the National Tariff Policy 2006.

Table 10.11

Status of reforms and restructuring in North Eastern Region

Sl. No.	Milestones	Arunachal Pradesh	Assam	Meghalaya	Manipur	Mizoram	Nagaland	Tripura	Sikkim
1	**SERC**								
a	Constituted	√	√	√	√	√	√	√	√
b	Operationalisation	√	√	√	√	√	√	√	√
c	Issuing Tariff Orders		√	√				√	
2	**Unbundling/ Corporatisation**								
a	Unbundling/ Corporatisation - Implementation		√	√				√*	**
b	Privatisation of Distribution								
3	**Distribution Reform**								
a	Multi Year Tariff/ ARR Order issued		√						
b	Open Access Regulations		√	√	√	√		√	

("Performance of State Power Utilities" - PFC)

*Tripura Power Dept. is corporatized as Tripura State Electricity Corporation Ltd. **Steps have been initiated towards corporatization/unbundling

10.3.3 Financial performance

The profitability status of the States as on 2009-10 is tabulated as under. Except Sikkim, all other State Utilities have shown a financial loss.

Table -10.12

Profitability of Utilities in North Eastern Region

State	Profit/(Loss) without subsidy (Rs. Cr.)	Profit/(Loss) on subsidy received basis (Rs. Cr.)
Arunachal Pradesh	(33)	(33)
Assam	(339)	(339)
Manipur	(106)	(106)
Meghalaya	(69)	(56)
Mizoram	(130)	(130)
Nagaland	(111)	(111)
Tripura	(48)	(33)
Sikkim	1	1
Total	**(835)**	**(808)**

(Source: Performance of State Power Utilities" - PFC)

Except Sikkim, the projected Net Profits at current tariffs for the next few years indicates financial losses for all States in the region. Assam shows a consistently decreasing trend.

Status of R-APDRP – Part A

Status of the R-APDRP Part-A in different states of the region is given below:

Table 10.13

R-APDRP status for NE Region

State Name	No. of Towns	Sanctioned Cost	Disbursement
Arunachal Pradesh	10	37.67	11.30
Assam	67	173.76	51.97
Manipur	13	31.55	9.47
Meghalaya	9	33.98	10.21
Mizoram	9	35.12	10.55
Nagaland	9	34.58	10.37
Sikkim	2	26.30	7.89
Tripura	16	35.20	10.33
Total	**135**	**408.16**	**122.09**

(Source: CEA)

As far as R-APDRP Part B is concerned, most of the NE states are yet to make progress. However, it is observed that for Part B, Sikkim has covered 2 towns aggregating to Rs.68.46 cr. of sanction fund and corresponding Rs.20.54 cr. of disbursement.

10.3.5 Status of RGGVY

The status of the projects sanctioned under RGGVY is as under:

Table 10.14

RGGVY status for NE Region – Projects Sanctioned

State	No. of Projects	No. of Districts	No. of un-electrified villages covered	No. of electrified villages covered	No. of un-electrified h/h covered (Incl. BPL)	No. of BPL households covered	No. of Projects
Arunachal Pr.	16	16	2129	1756	76407	40810	537.69
Assam	23	23	8525	13330	1414828	991656	1659.99
Manipur	9	9	882	1378	192148	107369	357.79
Meghalaya	7	7	1943	3536	188648	116447	290.41
Mizoram	8	8	137	570	44334	27417	104.25
Nagaland	11	11	105	1152	142992	69900	111.17
Sikkim	4	4	25	418	28166	11458	57.10
Tripura	4	4	160	642	228759	194730	131.46
Total	**82**	**82**	**13906**	**22782**	**2316282**	**1559787**	**3249.86**

(Source: RGGVY Website)

The physical progress of projects under RGGVY is as under:

Table 10.15

RGGVY status for NE Region – Physical Progress

		Electrification of un-electrified villages			Electrification of BPL households		
State	**Implementing Agency**	**Sanctioned Coverage**	**Revised Coverage (Provisional)**	**Cumulative Achievement (As on 31.07.2011)**	**Sanctioned Coverage**	**Revised Coverage (Provisional)**	**Cumulative Achievement (As on 31.07.2011)**
Arunachal Pradesh	Power Department	2129	2129	918	40,810	40,810	17,910
Assam	ASEB	6874	6817	5554	765,977	838,686	515,847
	POWERGRID	1651	1481	1235	225,679	152,846	139,394
	Total Assam	8525	8298	6789	991,656	991,532	655,241
Manipur	Power Deptt	882	882	307	107,369	107,369	11,518
Meghalaya	MeSEB	1943	1866	151	116,447	109,478	36,295
Mizoram	Power Deptt	137	137	59	27,417	27,417	10,508
Nagaland	Power Deptt	105	105	72	69,900	69,899	22,033
Sikkim	Power Deptt	25	25	23	11,458	11,458	8,240
Tripura	TSECL	127	127	83	58,708	59,008	29,891

(Source: RGGVY Website)

Further, the Position of Fund released under RGGVY is tabulated as under:

Table 10.16

RGGVY status for NE Region – Funds Released

State	**Cumulative Funds released**		
	Loan (Rs. Cr.)	**Subsidy (Rs. Cr.)**	**Total (Rs. Cr.)**
Arunachal Pradesh	0.00	636.06	636.06
Assam	189.21	1675.65	1864.86
Manipur	24.71	217.47	242.27
Meghalaya	27.96	250.64	278.60
Mizoram	23.97	214.26	238.24
Nagaland	19.44	170.17	189.62
Sikkim	13.31	119.71	133.02
Tripura	12.86	103.77	116.63
Total	**311.46**	**3387.73**	**3699.3**

(Source: RGGVY Website)

10.4 DSM STRATEGIES AND INITIATIVES IN NORTH EASTERN STATES

(a) The North Eastern Region States have designated State Designated Agencies (SDAs) to ensure implementation of the Energy Conservation Act in their respective states. During 11th plan, financial support was provided to all the North Eastern Region SDAs under the scheme of "providing financial assistance to the State Designated Agencies for strengthening their institutional capacities and capabilities". The following energy conservation activities have been carried out by the North Eastern SDAs during 11th Plan.

- Creation of IT infrastructure
- Creation of database for Energy Managers / Energy Auditors and Designated Consumers
- Organizing workshops / training programmes
- Creation of awareness through electronic media / print media
- Undertaking of Demonstration Projects on Energy Efficiency
- Investment Grade Energy Audits of the Govt. Buildings

- LED Village campaign

SDAs in the North Eastern Region have established a separate website highlighting energy efficiency measures undertaken in their states. All these SDAs have linked their websites with that of Bureau of Energy Efficiency and with other SDAs to facilitate ease of information exchange.

Workshops/ training programmes involving the Energy Managers/ Energy Auditors and Designated Consumers appraising about their roles as per the mandate of the Energy Conservation Act 2001 have been organized by the North Eastern Region SDAs.

Media/ awareness campaign in all these states has been undertaken. The major focus area were promotion of energy efficiency through electronic and print media, translation of BEE materials to local languages, awareness campaign in schools/ colleges, and through brochures, banners etc.

The Energy Conservation Day is celebrated in Nagaland, Mizoram, Meghalaya and Tripura with due recognition given to those who have taken the lead in promoting the cause of energy efficiency in the State.

The SDAs of Assam, Mizoram, Nagaland, Tripura, Arunachal Pradesh and Meghalaya have identified Government buildings for Investment Grade Energy Audits (IGEA). The IGEA of Govt. Buildings was conducted by the empanelled ESCOs/ Audit Firms of the Bureau of Energy Efficiency. The findings of the IGEA of Govt. Buildings are to be implemented through the ECSO mode.

The states of Assam, Nagaland, Tripura and Mizoram have successfully implemented demonstration projects on energy efficient street lighting system to showcase the effectiveness of the most energy efficient device/ technology through a practical demonstration.

A nationwide LED VILLAGE CAMPAIGN was launched in 2009-10. The objective is to showcase the new technology for lighting using LED so that a comparison can be demonstrated between LED and incandescent bulbs. Assam, Nagaland, Arunachal Pradesh, Tripura, Mizoram and Meghalaya have already completed the project in their respective states.

The state of Assam, Nagaland, Arunachal Pradesh, Tripura, and Mizoram has constituted their SECF in their states and Rs. 2.00 crores have been provided to each of the above states. The scheme is for support of Rs. 66 crores as contribution by BEE to SECF to invest in Energy Efficiency projects. The effort will be to create a pool of financially sustainable activities for SDAs which can augment the fund.

(b) New DSM & Energy Efficiency initiatives in 12th Plan

In order to identify the potential availability in different States and UTs, a National level study was undertaken in the year 2009-10. The identified energy saving potential in various areas like Agriculture, Municipality, Commercial Buildings and SMEs for Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland, Sikkim and Tripura is 413.8 MU, 18.96 MU, 96.7 MU, 29.82 MU, 33.5 MU, 29.7 MU, 35.8 MU and 70 MU respectively. Therefore to harness this potential every state should have its sector specific energy saving plan for the 12th Plan period and subsequent implementation.

In the North Eastern Region the SDAs are in the process of preparation of Sector Specific Annual Energy Savings Plan. The focus areas in the North Eastern states are, Domestic, Commercial buildings and Municipalities. Nagaland has already prepared the Action Plan and the next step is to implement the action plans in 12th five year plan to achieve the sector wise saving targets.

Furthermore, energy conservation awareness programmes through print and electronic media, seminars and workshops for the stake holders, implementation of up demonstration projects and LED village campaign would be carried out for the energy conservation movement in the North east Region during 12th Plan period.

10.5 RESEARCH AND DEVELOPMENT IN NORTH – EASTERN REGION

Special attention is needed for the development of the eight States of the NE Region of the country through a separate R&D Programme on renewable energy. The important areas of R&D are biogas plants, solar thermal systems, solar photovoltaic systems, remote village electrification, small hydro projects, wind energy systems, village energy security projects and energy parks.

Small Hydro Power

Small hydro projects in the North Eastern Region are to be developed both in grid connected as well as decentralized mode.

Wind Monitoring Stations

There is a need to take up more projects in the area of Wind. There is lot of potential for development of Wind Energy in this area. R&D proposals from North eastern states in all thrust areas of Research in Power Engineering, which are aimed at improving the socio-economic conditions of these states will be encouraged and given preferential status under the 12th Plan.

Scholarship for Engineering Education in North East:

It is proposed to institute Scholarship schemes in some of the Engineering colleges in North East, institute Cash incentive schemes for students and encourage students to take up Masters and Doctoral Programmes in Engineering.

Effort will be made to set up training centres, Centres of Excellence in the area of Renewable energy and other areas of Power sector in an effort to improve the socio-economic conditions in these states.

The R&D programmes will be undertaken in close cooperation with IIT – Guwahati, NIT – Silchar and NIT – Agartla. These institutions shall be the nodal centres, and some of the Engineering colleges will be associated with R&D and Training Centres. Centre of Excellence in 'Renewable Energy and Distributed Generation' shall be established in NE region, taking the expertise available at IIT-Guwahati. It is also proposed to develop a pilot plant based on 'Geothermal Thermal technology' in this region.

10.6 ISSUES CONCERNING KEY INPUTS FOR NORTH-EASTERN REGION OF INDIA

10.6.1 Fuel:

(a) Coal :

Out of all 7 North-Eastern States, Assam, Meghalaya, Arnachal Pradesh and Nagaland are endowed with moderate coal reserves. Though the coal occurrences are reported from four states of North Eastern Region, the actual coal exploitation activity is confined to states of Assam (Margherita Area) and Meghalaya (Simsong U/G) only.

Coal Resources in North-Eastern Region:

Meghalaya tops among all these North-Eastern States in terms of coal reserves with 577 MT out of total 1076 MT. Assam comes next with 387 MT. State-wise status shown below :

Table 10.17

in Million Tonnes

State	Geological Resources of Coal [*As on 01.04.09*]			
	Proved	Indicated	Inferred	Total
Arunachal Pradesh	31	40	19	90
Assam	348	36	3	387
Meghalaya	89	17	471	577
Nagaland	9	0	13	22
Total	**477**	**93**	**506**	**1076**

North-Eastern Coalfields [NEC] is a unit of Coal India Ltd. (CIL) operating in the states of Assam, Meghalaya, Nagaland and Arunachal Pradesh.

Quality of Coal:

North-Eastern coal is of low ash content and high Sulphur content with Calorific Value ranging from 5500 to 7500 K.Cal/Kg. NEC coal are soft and friable and hence very difficult to extract lump coals during mining. Because of friable nature of coal and slack, generally record high ash content due to admixture of dirt bands. The coals are used in various sectors, like power, cement, paper, brick burning, and other local industries.

Production of coal:

Coal production from NEC coal mines during last five years and projection for the next five years are as follows:

Table 10.18

in Million Tonnes

Coal from North-Eastern Coalfields [NEC]											
Sources	Coal Production [Last 5 yrs.]					2011-12 Likely	Likely Coal Production [12th. Plan]				
	2006-07	2007-08	2008-09	2009-10	2010-11		2012-13	2013-14	2014-15	2015-16	2016-17
Total production	1.001	1.101	1.009	1.113	1.100	1.12	1.12	1.12	1.12	1.12	1.12

Source : CIL

Coal Based Power Generating Capacity:

Though coal-based installed capacity of the Region is 60 MW at Bongaigaon Thermal Power Station (BTPS), but there is no generation as the plant. This plant commissioned in 1981-85, has since been scrapped due to corrosion problem and high cost of production.

Considering, high Sulphur content of NEC coal, the best way to utilize the coal is by installing desulphurisation process and in fluidized bed combustion in a Power Plant.

NTPC has taken up construction of 750 MW [3X250 MW] coal-based generation capacity addition in the Bongaigaon Thermal Power Plant in Assam out of which first unit is envisaged to be commissioned in the 12th plan. Entire coal of NEC will be utilized in this plant. For the balance requirement, coal will be made available by CIL from its coal mines of eastern part of India.

(b) Gas-based Thermal Power:

Presently, installed capacity of gas-based generation in the region is 787 MW. ONGC owns significant natural gas reserves in the North-Eastern state of Tripura. However, these natural gas reserves are yet to be commercially developed due to low industrial demand in the North-Eastern region. The complexities of logistics and attendant costs limit the economic viability of transportation of gas to other parts of the country where gas is in deficit. In order to optimally utilise the gas available in Tripura, ONGC in Joint Venture with Tripura State and IL&FS proposes to initially develop a 726.6 MW Combined Cycle Gas Turbine (CCGT) thermal power plant close to its gas fields in the state of Tripura and Assam.

10.6.2 Transport Infrastructure in North East India

Infrastructure development is a fundamental prerequisite for realizing the vision of progress towards peace and prosperity and for creating an investment climate and market development in the North East**.** Transport infrastructure is of great importance in the region to strengthen its integration within itself, with the rest of the country and its neighbours, as well as to transport people and goods more effectively within and out of the region. It is a vital input for the proposed shift from subsistence agriculture to cash crop based farming, as well as the planned development of industry and the service sector. Most of the area in the region is hilly and undulating with low population densities, accompanied by low per area production of goods. In the hilly terrain like NER (except in Assam and some parts of other states) development of inland waterways is expensive. Similarly, rail connectivity in such a terrain is not only time consuming but would need prohibitive investments, probably beyond the means of the nation. It is road connectivity which would play a dominant role in fulfilling the transportation needs of the public. Air connectivity would also play a role for a limited segment of people and goods.

(a) HIGHWAYS, ROADS AND BRIDGES:

A comparison of the road network of the region with the network in the rest of the country indicates that the road network per capita is significantly higher in NER relative to the rest of the country. This is an expected outcome given the hilly terrain and the low density of population. However, road length per unit area is higher only in Assam, Nagaland and Tripura and not in the other hill states. Since this would have been a more accurate indicator of the ease of passenger and freight traffic movement, one can conclude that road infrastructure is relatively deficient in the NER states. This is particularly true for the hill states as other modes of travel are either too expensive or difficult to provide. State Governments have also been asking repeatedly for converting state highways into national highways to strengthen the road infrastructure.

In the Eleventh Plan, under the various interventions of the Department of Road Transport and Highways, a very massive road construction initiative has started. Many National and State Highways are proposed to be widened and the completion of this initiative has the potential to change the connectivity quality in the North Eastern Region.

A large number of HE Projects have been allotted for development in NER especially in Arunachal Pradesh. Therefore, development of infrastructure (roads and bridges), to have easy access to the project sites, is considered crucial to accelerate the hydro power development in NER.

In Arunachal Pradesh 11 out of 16 districts are planned to be connected by proposed Trans-Arunachal Highway in a total length of 1644 km joining Tawang on western side to Bogibeel Bridge on eastern side passing through Bomdila, Nechipu, Seppa, Ziro, Daporiza, Aalong, Pangin, Pasighat, Roing, Mahadevpur, Changlang, Khonsa, Kanubari & Bimlapur being taken up by Border Roads Organization (BRO), State Government and MoRT&H. Remaining 5 districts are also proposed to be connected to the Trans Arunachal Highway through double lane roads by BRO (3 districts) and State Government (2 districts) in a total length of 847 Km.

(B) EXISTING CONSTRAINTS

Bridges:

a) Bridges are weak / having low bearing capacity to carry Heavy cargo more than 20-25 MT. At some locations, Bailey Bridges are placed causing restriction of not only weight (upto 20 MT) of Cargo, but also width of cargo upto 3.5 metres.

b) Some bridges are located over a river flowing throughout the year. Construction of bypasses of such bridges is not only difficult, but time consuming also.

Roads:

a) Bends/ Curves: The roads are through hilly region having sharp bends / curves / S-bends / U-turns, which is difficult to negotiate for longer (more than 12 metres) consignments.

b) Gradients: The road gradients at many locations are beyond acceptable limits of 1 in 25 to 1 in 30 for ODC consignments.

c) Camber at bends: Cambers provided at sharp bends are generally for high speed vehicles. For vehicles carrying heavy lifts & moving at lower speed, sharp bends should be avoided & should be replaced by bends with suitable camber.

Underpass :

Vertical clearance at underpass at two locations in Tripura between Assam-tripura Border & Agartala, where overhead railway lines are passing is 4.96 metres & 5 metres, thus restricting the movement of ODC with height more than 3.8 metres on the trailer with height about 1.1 metre.

Timing of Movement of Cargo:

In some section of roadways in Tripura like Manu – Ambassa – Teliamura movement of vehicle carrying Cargo / passenger is restricted from 8 am to 4.30 pm. During night time convoy movement is totally banned.

Movement of ODC Through Bypasses :

For effecting transportation of ODC, bypasses are constructed across the weak bridges. However, it is not possible to use bypasses during monsoon season as it is washed away due to heavy rains / rise in water flow of the river during monsoon. Further, construction of bypasses sometimes calls for relocation of hutments / inhabitants requiring compensations to be paid.

10.6.3 Railways

In general, rail is the best method of mass transportation in the country, but rail networks are generally difficult and expensive to set up in hill areas, which accounts for the absence of railway lines in Arunachal Pradesh, Manipur, Meghalaya, and Mizoram. Tripura and Nagaland have railway routes in their plain areas, while Assam has a large railway network. Even so, the track density in terms of both population and area even in the plain areas of the North East is much lower than the national average.

There has been only a marginal or no increase in the density of tracks per lakh of population in most of the states in the NE region as compared to an almost five-fold increase at the national level. Even the increase witnessed in the plains of Assam is much lower than the national average. It may also be noted that most of the states in the region do not have a rail line connecting them to any major rail junction. Finally, while there has been some conversion of metre gauge to broad-gauge, Assam still has a large number of single-track routes which cannot accommodate any increase in rail frequencies.

There are some obvious short-run projects which need completion at the earliest. For example, the Bogibeel rail bridge across the Brahmaputra was commissioned in 1996 as a ten-year project but the work started only in 2002. This rail-cum-road bridge has implications for connectivity not only for Assam but also for Arunachal and Meghalaya. Similarly, there is an urgent need for a rail link into Sikkim.

The more important issue from the long-term point of view is strategic planning that will develop the rail network with the aim of increasing inter-state connectivity. Some useful rail links are already under planning and a few of them have almost been completed and are likely to be broad gauged. These are: Jiribum to (near) Imphal and Dimapur to (near) Kohima. Another line from Azara (near) Guwahati airport to Bunnia in Meghalaya is in progress. A broad gauge railway line along the Indo-Bangladesh international border in Meghalaya linking the western and southern parts of Assam can also be considered. This will open the mineral resources of Meghalaya for development.

Ministry of Railways is working on various important projects going in the North Eastern Region that include interalia (i) Kumarghat to Agartala, (ii) Jiribam to Tupul, (iii) Dimapur to Zubza, (iv) Azra to Byrnihat, (v) Dudhnoi to Depa, (vi) Harmuti to Itanagar, (vii) Mahilaguri to Jogighopa, and (viii) Bogibeel Rail-cum-Road Bridge; four are for gauge conversion - Lumding - Silchar, Rangiya - Murkongselek, Kathakal - Bairabi, Haibargaon - Mairabari and Senchoa Junction - Silghat Town and one is for doubling the line – New Guwahati – Digaru.

10.6.4 Inland Water Transport

Until the construction of roads, inland waterways in the Brahmaputra and the rivers in the Barak Plains were the commonly used medium of transport. During British rule, as the tea industry grew, these rivers became important carriers of trade. NER has about 3,839 km. of navigable river routes, with the Brahmaputra having the longest navigable stretch in the region. Other important rivers are: Buridhing, Katakhal, Subansiri, Disang and Gangagdar.

Most of the waterways in NER are in Assam, and are used for ferry, commercial and rescue services and as crew-training centres. Most of the cargo is transported on the Brahmaputra and consists manly of tea, coal, bamboo, rice, jute, sugar and urea . The movement of cargo on the Brahmaputra is continuously growing from 29,414 tons in 1996-98 to 8,91,522 tons in 2003-04.

Inland water transport (IWT) offers a shorter and cheaper route for transport of bulk commodities and project cargo . It is operational even during the flood season and offers large employment potential. The development of IWT in NER has a strategic and economic imperative. The Brahmaputra river from Dhubri to Sadiya (891km.) was declared as National Waterway-II in 1988. Declaration of Barak River from Lakhipur to Bhanga (121 km.) as National Waterway-VI is under process. On NW-II, IWAI has taken up river conservancy works (Rs.12.30 crore), maintenance of floating terminals at Dhubri, Jogighopa, Pandu, Tezpur, Silghat, Jamguri, Neamati, Bogibeel, Saikhowa and Sadiya, **coal handling terminal** at Jogighopa, night navigational aids from Dhubri to Pandu, 24 hours navigation facilities including setting up of DGPS stations at Jogighopa, Tezpur and Dibrugarh and construction of a permanent terminal at Pandu. Upstream cargo from Kolkata to Pandu mainly includes bitumen, steel, pipes, cement, detergent and batteries. Downstream cargo on NW-II includes gypsum, tea, jute, **coal** and diesel (Numaligarh Refinery). The potential is much more. Cargo moment on NW-II is projected to increase from 0.75 btkm. to 4.87 btkm. by 2024-25.

(a) Water Routes on which Assam IWTD Operates Ferries are:

- Sadia-Saikhowa Connected with Arunachal Pradesh directly
- Neamati-Kamalabari Connected with Nagaland by the shortest route
- Jaleswar-Dhubri Dhubri-Fakirgang Connected with Meghalaya by the shortest route

In recent years there has been an attempt by IWTD, Assam to provide passenger ferry services. It has introduced 32 cargo cum passenger ferry services on the Brahmaputra and its tributaries where no other mode of transport is available. A project to open 88 additional such ferries is under implementation. Other projects under NEC are working to improve river channels. The major strength of inland water transport in the plain areas of NER is the presence of several, perennial rivers, which present the cheapest mode of transportation generating the least amount of pollution. The lack of facilities for night navigation, mechanical handling, insufficient cargo vessels and terminals will need to be addressed.

One of the problems of NER is the difficult access from the rest of the country. Consequently, commodities transported by land tend to be fairly high in cost. It is here that the river network can be used to transport commodities into NER. The list of goods for which river transportation could be effectively used includes coal, petro-chemicals, fertilizers, cement, tea, forest products and other bulky items . It is necessary that suitable measures be taken up for increasing the absorption capacity of IWAI on a priority basis.

10.6.5 Land Acquisition

In connection with implementation of HE projects, the land acquisition is being done under the existing land acquisition laws and procedures of the concerned States. However, quite often, due to non-availability of land records, many claimants come forward for seeking claims against the same land. The claims in such cases are settled by Deputy Commissioners by involving village communities. The State Governments should provide all necessary assistance for land acquisition for the projects.

(a) Environment and Forest Clearances.

Forest conservation Act 1980 requires that compensatory afforestation should be done in non-forest area equivalent to the area of forest diverted for non-forest use. Government of Arunachal Pradesh (GoAP), represented that this provision posed a big constraint as state already has 81% of its area covered by forest and availability of non-forest land for afforestation is a problem. GoAP therefore suggested for providing some special dispensation under Forest Conservation Act regarding compensatory afforestation. MoEF informed that Forest Conservation Act, 1980 provides that if non forest land is not available for compensatory afforestation, the compensatory afforestation may be carried in double the area of degraded forest. As per information provided by the MoEF, the state of Arunachal Pradesh has degraded forest area of 15 lakh hectares (as per State of India's Forest Report 2009) which can be used for compensatory afforestation.

The state level environment and forest clearances take a long time resulting in delay in implementation of projects. The State Governments should facilitate environment and forest clearances of projects at state level. In order to speed up the process, a Single Window Clearance Mechanism under Chief Secretary of the State may be constituted. The Committee will also monitor and expedite other issues pending with the State Government. A time schedule for various steps involved in these clearances at the state level may be firmed up and implemented.

MoEF has desired that in view of uniqueness of the fragility of eco systems in the NER, due importance needs to be given to environment and forests concerns while planning the hydro power projects. In addition it has been suggested that Environment Impact Assessment (EIA) studies may be taken up basin wise in place of individual project to know the downstream impact on development of projects in cascading manner and minimum release required to maintain aquatic life downstream so as to expedite environment clearance of projects. MoEF has already awarded such study for Lohit basin to WAPCOS (I) Ltd. And and a draft in addition, the EIA Study for Siang and Subansiri basins, has been taken up by CWC in consultation with CEA and MoEF. Studies in other basins may also be taken up subsequently by CWC.

10.7 FUND REQUIREMENT FOR DEVELOPMENT OF POWER SECTOR IN THE NORTH-EAST REGION - CONCERNS REGARDING FUNDING

10.7.1 Generation

Tentative capacity addition programme of 5,353 MW has been envisaged in NER (including Sikkim) for the 12th Plan. This comprises of 4,177 MW hydro and 1,176 MW of thermal power. The total fund requirement for generation capacity addition in NER and Sikkim has been estimated to be Rs. 54,215 Crore. The cost per MW assumed for the purpose is 10% higher than average all India cost for setting up projects of similar nature.

10.7.2 Transmission

Central Transmission Utility in consultation with CEA has designed Transmission and Distribution schemes in NER and Sikkim to evacuate the power generated from projects in this region. Fund requirement for Transmission and Distribution schemes in NER and Sikkim, with likely benefits during 12th Plan, has been estimated at around Rs. 26,392 crore.

Brief details of the transmission and distribution schemes are as follows:

Table:10.19
Transmission and Distribution schemes in NER and Sikkim

(Figures in Rs. Crore)

S.No.	Scheme Name	Fund requirement
1	Strengthening of transmission and distribution in NER and Sikkim	11,348
2	Transmission – Lower Subansiri HEP and Kameng HEP	11,130
3	Transmission – Pallatana GBPP to regional group point	1,770
4	Transmission – Pallatana GBPP regional system strengthening	2,144
	Total	**26,392**

Source: CEA, Details of the schemes are given in section 10.2

10.7.3 Distribution

Investments in NER States during 12th Plan

Rural Electrification

The investment required under the RGGVY for the NE Region is tabulated as under:

Table 10.20

Investments required under RGGVY – NE Region

Head	Number	Rs. Lakh	Rs. Cr
Habitation remaining	30,000	6	1,800
Habitation >50 <100	15,000	4	600
Leftout BPL HH	2,36,000	0.03	70.8
Pumpsets (Assam)	2,50,000	1.63	4,075
Total			**6,545.8**

R-APDRP

The R-APDRP estimates for the 12th Plan for the NE Region is as under:

Table 10.21

Investments required under R-APDRP – NE Region:

Part-A		Part-B		Total
Towns	Rs. Cr	Towns	Rs. Cr	Rs. Cr
59	68.27	59	295	363.27

Overall development of power sector in the NE region has been very slow. The reasons for the slow pace of power project execution are as follows:

- Hydro electric project sites are inaccessible and have very difficult approach/ maintenance of access roads
- Difficulties faced in obtaining environment & forest clearance, land acquisition, R&R issues
- Geological surprises
- Inadequate Survey & Investigation
- Law and Order issues

(a) Policy Measures for financing power projects in NE Region

In light of the concerns mentioned in earlier sections, the following policy measures can be suggested:

- Geological survey & investigation works, preparation of DPR, approvals and clearances from various organizations including MoEF have to be taken up in a time bound manner. A well formulated time-frame for concerned authorities to respond to applications for approvals and clearances will alleviate the concerns of the lenders.
- A comprehensive plan for adequate road and power evacuation network needs to be formulated taking into consideration various development projects. Such a move is expected to substantially mitigate the construction and power evacuation risk of the projects.
- Non availability of construction materials like cement steel etc and long procurement time makes the Hydro Projects costly and unviable. Setting up of industries for construction material including cement industry may be encouraged in the North Eastern Region.
- Lending to power projects in NE could be brought under the ambit of priority sector for encouraging financing to power projects in NE sector.
- Power generation and transmission projects in NE sector could be financed through a dedicated NE fund. The mechanism of operation of this fund has been discussed in the next section.

(b) Dedicated fund for financing Power projects in NE sector

Power projects in NE sector could be financed through a dedicated NE fund. Since the benefits of optimal utilization of mineral and water resources of NE would accrue to the whole country, establishing such a fund could channelize the funds collected from the country as a whole and release capital resources of banks/ GoI grants for community level developmental work in NE region.

Further, project developers could be further incentivised to set up projects in the NER through fiscal incentives like waiver on Minimum Alternate Tax (MAT). It may be emphasised that MAT credits are utilized by a project developer between 5th and 10th year of the project cycle. Hence, MAT waiver would not impact the total tax payments but would only increase upfront equity returns to the project developer.

10.8 MANPOWER ASSESSMENT FOR NORTH-EASTERN REGION

10.8.1 Manpower Assessment for 11th Plan

For the North-Eastern region the envisaged capacity addition is expected at 663.2 MW for the 11th Plan. The estimated total Manpower (Technical and Non-Technical) added during the 11th Plan against this capacity addition has been calculated at 2,920 as shown in the following tables.

Table 10.22
Capacity Addition in North East during 11th Plan

Particulars	Central Sector	State Sector	Total
Thermal	500	37.2	537.2
Hydro	-	126	126
Total	**500**	**163.2**	**663.2**

Table 10.23
Additional Manpower required in North-East due to envisaged Capacity Addition of 663.2 MW in 11th Plan and HV, EHV & UHV Transmission Line Lengths of about 639 Ct.kms and an estimated 15.96 Lakhs Distribution Consumers

S No	Particulars	Technical Manpower		Non-Technical Manpower		Total Manpower reqd
		Central	State	Central	State	
1	**Thermal Generation**	270.00	27.53	80.00	10.04	**387.57**
2	**Hydro Generation**	-	173.88	-	28.98	**202.86**
3	**Power System**					
	Transmission	34.90	-	12.22	-	**47.12**
	Distribution					
	Hilly	-	319.31	-	95.79	**415.10**
	Plains	-	1436.90	-	431.07	**1867.97**
	Sub-total	-	1756.21	-	526.86	**2283.08**
	Total	**304.90**	**1957.62**	**92.22**	**565.89**	**2920.63**

10.8.2 Manpower Assessment for 12th Plan

During the 12th Plan a capacity addition of 5353 MW is envisaged. Taking into account 10% reduction in manpower norms with respect to 11th Plan for Thermal & Hydro because of up gradation and technological advances additional manpower is estimated to be 21587 as shown in the following tables:

Table 10.24

Capacity Addition during 12th Plan

Particulars	Total
Thermal	1176
Hydro	4177
Nuclear	-
Generation Capacity Addition (MW)	**5353**

Table 10.25

Additional Manpower required in North-East due to envisaged Capacity Addition of 5,353 MW in 12th Plan and HV, EHV & UHV Transmission Line Lengths of about 5254 Ct.kms and an estimated 1.08 Crore Distribution Consumers

S No	Particulars	Technical Manpower	Non-Technical Manpower	Total Manpower reqd.
1	**Thermal Generation**	**1140.99**	**416.31**	**1557.30**
2	**Hydro Generation**	**3490.02**	**581.67**	**4071.69**
3	**Power System**			
	Transmission	**287.06**	**100.47**	**387.53**
	Distribution			
	Hilly	**2177.79**	**653.34**	**2831.13**
	Plains	**9800.05**	**2940.02**	**12740.07**
	Sub-total	**11977.84**	**3593.35**	**15571.19**
	Total	**16895.91**	**4691.80**	**21587.71**

10.8.3 Training needs for North-Eastern Region

There is a general consensus about the shortage of talent in the North East Region and not fully developed Infrastructure being the constraints for speedy growth. At present, there are only a few Institutes to cater to the mandatory training requirements as per the recent CEA Gazette notification. Therefore, these urgent needs have to be addressed by establishing a separate multi-disciplinary Institute in the North-East. A Hydro Power Training Institute having necessary training tools including operation simulators need to be established in the North Eastern Region. The already set-up Training Institute of NPTI at Guwahati may be considered for this purpose.

There are certain gaps in respect of some specific technical skills at the ITI level. ITIs and other vocational training institutions should be augmented for skills which would be required for the Erection & Commissioning activities for the Thermal, Hydro and Transmission and Distribution areas.

10.9 STEPS TO BE TAKEN TO OVERCOME THE PROBLEMS BEING FACED IN PROJECT IMPLEMENTATION IN NER.

- The Survey & Investigation works, preparation of DPR, clearance from various organizations including MoEF have to be taken up and a time bound programme for clearance of hydro projects from various agencies including MoEF has to be formulated.

- A comprehensive plan for adequate road network needs to be formulated taking into consideration various development projects including remote located hydro power station sites**.**

- Non availability of construction materials like cement, steel etc and long procurement time makes the Hydro Projects costly and unviable. Setting up of Industries for construction material including Cement Industry may be encouraged in the North Eastern Region.

- Availability of power in NE Region reduces during winter season due to reduction in generation from hydro projects. NE Region has shortage of power during winters even during off-peak hours, therefore, NE Region should have base load generation capacity i.e. thermal generation or adequate allocation from central sector thermal stations of Eastern Region.

10.10 CONCLUSIONS / RECOMMENDATIONS

i) A clear, coherent and sustainable power policy may be made especially for the NER which will take into account the special characteristics and needs of the Region. High capacity hydel & thermal power projects with associated transmission lines should be developed in the NE region for - First meeting the demand of the North-Eastern Region, and thereafter for other part of the country.

ii) CIL should take up development of new coal mines particularly in Assam and Meghalaya to meet the coal requirement for new thermal power projects being proposed in the NE region.

i) The issue of gas availability and pricing may be appropriately addressed for exploiting the substantial gas reserves in the Region for power generation.

iv) In planning road networks under SARDP particular attention should be given to roads, bridges and underpasses with adequate design capacity considering transportation of heavy ODCs to power projects.

v) Much more attention should be given to inland water routes as a method of connectivity within the region, the existing potential of which is largely untapped.

w) Special attention is needed for the development of the eight States of the NE Region of the country through a separate R&D Programme on renewable energy.

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ACRONYMS

ACRONYMS	EXPANSION
AAAC	All Aluminium Alloy Conductor
ABS	Asset Backed Securities
ABT	Availability Based Tariff
AC	Alternating Current
ADB	Asian Development Bank
AG&SP	Accelerated Generation & Supply Programme
AHWR	Advance Heavy Water Reactor
AIIMS	All India Institute of Medical Sciences
ALM	Asset Liability Mismatch
ALTM	Airborne Laser Terrain Mapping
AMD	Atomic Minerals Directorate
APC	Auxiliary Power Consumption
APDRP	Accelerated Power Development & Reform Programme
APH	Air Pre Heater
APM	Administered Price Mechanism
APY	Akshay Prakash Yojna
AREP	Accelerated Rural Electrification Programme
AT&C	Aggregate Technical & Commercial
BARC	Bhabha Atomic Research Centre
Bcum, BCM Bm^3	Billion cubic meter
BE	Budget Estimates
BEE	Bureau of Energy Efficiency
BFP	Boiler Feed Pump
BHEL	Bharat Heavy Electricals Ltd.
BIMSTEC	Bay Of Bengal Initiative For Multi-Sectoral Technical & Economic Co-orporation
BOOL	Built Own Operate Lease
BOOT	Built Own Operate & Transfer
BOT	Built Operate & Transfer
BPCL	Bharat Petroleum Corporation Limited
BPR	Business Process Re-engineering
BSEB	Bihar State Electricity Board
BSES	Bombay Suburban Electric Supply
BU	Billion units or Billion Kwh
C&I	Control & Instrumentation
CAD & CAM	Computer Aided Design & Computer Aided Management
CAGR	Compounded Annual Growth Rate
CBIP	Central Board of Irrigation & Power
CBM	Coal Bed Methane
CCEA	Cabinet Committee On Economic Affaires
CCGT	Combined Cycle Gas Turbine
CD	Compact Disc

ACRONYMS	EXPANSION
CDAC	Centre for Development of Advance Computing
CDM	Clean Development Mechanism
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
CFBC	Circulating Fluidized Bed Combustion
CFL	Compact Florescent Lamp
CFL	Compact Fluorescent Lamp
CFRI	Central Fuel Research Institute
CIDC	Construction Industry Development Council
CIL	Coal India Ltd.
CIRE	Centre For Insurance Research & Education
ckm	Circuit Kilometer
CLA	Central Loan Assistance
CMPDIL	Central Mine Planning & Design Institute Limited
COE	Centre Of Excellence
CPP	Captive Power Producer
CPRI	Central Power Research Institute
CPSU	Central Public Sector Undertaking
CRGO	Cold Rolled Grain Oriented
Crs	Crores
CS	Central Sector
CSIR	Council for Scientific and Industrial Research
CSMRS	Central Soil & Materials Research Station
CTU	Central Transmission Utilities
CVD	Counter Veiling Duty
CWC	Central Water Commission
CWS	Circulating Water System
D/C	Double Circuit
D/E	Debt : Equity
DAE	Department of Atomic energy
DC	Direct Current
DCB	Domestic Commercial Banks
DDG	Decentralised Distributed Generation
DFI	Domestic Financial Institution
DG Set	Diesel Generating Set
DGH	Director General Hydro Carbon
DISCOM	Distribution Company
DMLF	Data Management & Load Forecasting
DONER	Development of North Eastern Region
DOPT	Department of Personnel & Training
DPR	Detailed Project Report
DPRS	Distributed Renewable Power System
DRUM	Distribution Reform Upgrade Management
DSM	Demand Side Management
DST	Department of Science & Technology
DSTATCOM	Distribution Static Compensation

ACRONYMS	EXPANSION
DTR	Distribution Transformer Metering
DVC	Damodar Valley Corporation
DVR	Dynamic Voltage Restorer
E&F	Environment And Forest
EA 2003	Electricity Act 2003
EAB	External Aided Borrowing
EAP	External Aided Projects
EC	Energy Conservation
ECB	External Commercial Borrowing
ECBC	Energy Conservation Building Code
ECIC	Energy Conservation & Information Centre
ECIL	Electronic Corporation of India Ltd.
ECL	Eastern Coal Fields Limited
EGEAS	Electric Generation Expansion Analysis System
EHV	Extra High Voltage
ENS	Energy Not Served
EPC	Engineering Procurement Contract
EPS	Electric Power Survey
ERC	Electricity Regulatory Commission
ERDA	Electric Research & Development Association
ERS	Emergency Restoration System
ESCO	Energy Service Company
ESP	Electro Static Precipitator
FACTS	Flexible Alternating Current Transmission System
FAUP	Fly Ash Utilisation Programme
FBC	Fluidised Bed Combustion
FMIS	Finance Management Information System
FO	Forced Outage
FOR	Forum Of Regulators
FPO	Follow-on Public Offer
FSTA	Fuel Supply And Transport Agreement
FY	Financial Year
GAIL	Gas Authority Of India Limited
GBS	Gross Budgetary Support
GCV	Gross Calorific Value
GDP	Gross Domestic Product
GHG	Green House Gas
GIS	Gas Insulated Substation
GOI	Government Of India
GPS	Geographic Positioning System
GR	General Review
GSPC	Gujarat State Petroleum Corporation
GT	Gas Turbine
GVA	Gega Volt Ampere
GVP	Grameen Vidyut Pratinidhi
GW	Gega Watt

ACRONYMS	EXPANSION
GWe	Gega Watt (Electrical)
HBJ	Hazira-Bijapur-Jagdishpur (pipeline)
HEP	Hydro Electric Project
HFO	Heavy Fuel Oil
HPS	Heavy Petroleum Stock
HRD	Human Resource Development
HRT	Head Race Tunnel
HSD	High Speed Diesel
HSIL	High Surge Impedance Loading
HT	High Tension
HVDC	High Voltage Direct Current
HVDS	High Voltage Distribution System
IBF	Input Based Franchisee
ID	Induced Draft
IEBR	Internal and Extra Budgetary Resource
IEEMA	Indian Electrical & Electronics Manufacturers' Association
IEP	Integrated Energy Policy
IGCAR	Indira Gandhi Centre for Atomic Research
IGCC	Integrated Gasification Combined Cycle
IIFCL	India Infrastructure Financial Corporation
IISC	Indian Institute of Science
IIT	Indian Institute of Technology
IOCL	Indian Oil Corporation Limited
IPO	Initial Public Offer
IPP	Independent Power Producer
IPR	Intellectual Property Rights
IR	Internal Resources
IRDA	Insurance Regulatory And Development Authority
IS	Indian Standard
ISCC	Integrated Solar Combined Cycle
ISO	International Standard Organisation
ISPLAN	Integrated System Planning
IT	Information Technology
KAPS	Kalpakkam Atomic Power Station
kCal	Kilo Calorie
kg	Kilogram
KKNPP	Kudankulam Nuclear Power Project
kV	Kilo Volts
kW	Kilo Watt
kWh	Kilo Watt hour
LEP	Life Extension Programme
LF	Load Factor
LILO	Loop In Loop Out
LNG	Liquefied Natural Gas
LOA	Letter Of Award
LOLP	Loss of Load Probability

ACRONYMS	EXPANSION
LP	Linear Programming
LRVI	Loss Reduction & Voltage Improvement
LSHS	Low Sulphur Heavy Stock
LT	Low Tension
LWR	Light Water Reactor
M&E	Monitoring And Evaluation
MAPS	Madras Atomic Power Station
MBS	Mortgage Backed Securities
MCFC	Mother Carbonate Fuel Cell
Mcm, Mcum, Mm^3	Million cubic meter
MFGs	Micro Financing Institutions
MHD	Magneto Hydro Dynamics
MMSCMD	Million Metric Standard Cubic Meter per Day
MNP	Minimum Need Programme
MNRE	Ministry of New & Renewable Energy
MoEF	Ministry of Environment & Forest
MoP	Ministry of Power
MOU	Memorandum Of Understanding
MT	Million Tonne
MToe	Million Tonnes Oil equivalent
MTPA	Million Tonnes Per Annum
MU	Million Units
MVA	Mega Volt Ampere
MW	Mega Watt
Mwe	Mega Watt (Electric)
MYT	Multi Year Tariff
NABRD	National Bank For Agriculture & Rural Development
NAPS	Narora Atomic Power Station
NCL	Northern Coal Fields Limited
NCPS	National Capital Power Station
NDT	Non Destructive Test
NEA	Nepal Elecricity Authority
NEC	North Eastern Council
NELP	New Exploration Liscencing Policy
NEP	National Electricity Policy
NFC	Nuclear Fuel Complex
NGOs	Non-Governmental Organisations
NHAI	National Highways Authority Of India
NHPC	National Hydroelectric Power Corporation
NICMAR	National Institute Of Construction Management & Research
NIT	National Institute Of Technology
NLC	Neyveli Lignite Corporation
NMDC	National Mineral Development Corporation
NML	National Metallurgical Laboratory
NO_X	Oxides of Nitrogen

ACRONYMS	EXPANSION
NPC	National Productivity Council
NPCIL	Nuclear Power Corporation of India Ltd.
NPTI	National Power Training Institute
NSC	National Steering Committee
NTC	Nuclear Training Centre
NTP	National Tariff Policy
NTPC	National Thermal Power Corporation
O&M	Operation & Maintenance
OCGT	Open Cycle Gas Turbine
OGIP	Original Gas In Place
OIL	Oil India Limited
ONGC	Oil & Natural Gas Commission
PAFC	Phosphoric Acid Fuel Cell
PC	Pulverized Coal
PCRA	Petroleum Conservation Research Association
PFBC	Pressurised Fluidized Bed Combustion
PFC	Power Finance Corporation
PFR	Preliminary Feasibility Report
PGCIL	Power Grid Corporation of India Ltd.
pH	Hydrogen Ion concentration
PHWR	Pressurised Heavy Water Reactor
PIB	Public Investment Board
PIC	Programme & Implementation Committee
PIE	Partnership In Excellence
PLF	Plant Load Factor
PMGY	Pradhan Mantri Gramodaya Yojna
PMI	Power Management Institute
PMO	Prime Minister's Office
PPA	Power Purchase Agreement
PPM	Parts Per Million
PPP	Public Private Partnership
PRI	Panchayati Raj Institute
PRC	Project Review Committee
PRM	Project Review Meetings
PS	Private Sector
PSC	Production Sharing Contract
PSP	Power Supply Position
PSS	Pumped Storage Schemes
PSTI	Power System Training Institute
POSOCO	Power System Operation Corporation Ltd
PSU	Public Sector Undertaking.
QIB	Qualified Institutional Bidder
R&D	Research & Development
R&M	Renovation & Modernisation
RAPP	Rajasthan Atomic Power Project
RAPS	Rajasthan Atomic Power Station

ACRONYMS	EXPANSION
RBI	Reserve Bank Of India
RCC	Roller Compacted Concrete
REA	Rural Electricity Agency
REB	Regional Electricity Board
REC	Rural Electrification Corporation
REDB	Rural Electricity Distribution Backbone
RES	Renewable Energy Sources
RFP	Request For Proposal
RFQ	Request For Qualification
RGGVY	Rajiv Gandhi Grameen Vidyutikaran Yojna
RHE	Rural Household Electrification
RIDF	Rural Infrastructure Development Fund
RIL	Reliance Industries Limited
RLA	Résiduel Life Assesment
RM	Reserve Margin
ROE	Return on Equity
RSOP	Research Scheme On Power
S/C	Single Circuit
SAARC	South Asian Association for Regional Corporation
SCADA	Supervisory Control & Data Acquisition
SCCL	Singereni Collieries Company Limited
SDA	State Development Agency
SEB	State Electricity Board
SECL	South Eastern Coal Fields Limited
SERC	State Electricity Regulatory Commission
SGC	State Generation Corporation
SHG	Self Help Group
SLR	Statutory Liquidity Ratio
SMEs	Small And Medium Enterprises
SOG	Sanctioned & Ongoing
SO_X	Oxides of Sulphur
SPIC	Southern Petro India Chemicals Ltd.
SPM	Suspended Particulate Matter
SPM	Single Point Metering
SPS	Single Point Supply
SS	State Sector
SSB	Solid State Breakers
SSTS	Solid State Transfer Switches
ST&D	Sub Transmission Distribution
STOA	Short Term Open Access
STPP	Super Thermal Power Project
STPS	Super Thermal Power Station
T&D	Transmission & Distribution
TAPP	Tarapur Atomic Power Project
TAPS	Tarapur Atomic Power Station
TCF	Terra cubic Feet

ACRONYMS	EXPANSION
Tckm	Thousand Circuit Kilometre
TCSC	Thyristorised Controlled Series Compensation
TERI	The Energy Research Institute
TG	Techo Generator
TIFAC	Technology Information Forecasting & Assessment Council
TOD	Time Of Day
TOU	Time of Use
TPS	Thermal Power Station
U	Up rating
UCIL	Uranium Corporation of India Ltd.
UI	Unscheduled Interchange
UMPP	Ultra Mega Power Project
UN	United Nations
UNDP	United Nation Development Programme
UPCL	Uttaranchal Power Corporation Limited
UPPCL	Uttar Pradesh Power Corporation Limited
UT	Union Territory
VAMBAY	Valmiki Ambedkar Awas Yojna
VEI	Village Electrification Infrastructure
VEMB	Village Electricity Management Board
WAMS	Wide Area Monitoring System
WBPDCL	West Bengal Power Development Corporation