Concept paper for an IPCC Expert Meeting on Human Settlement, Water, Energy and Transport Infrastructure – Mitigation and Adaptation Strategies

(Submitted by Working Group III Co-Chairs)

1. The case for an expert meeting

Cities and other human settlements are at the forefront of climate change. As large emitters of GHG emissions, they significantly contribute to climate change. Simultaneously, due to their concentration of population and infrastructure assets, cities are especially vulnerable to the impacts of climate change. Infrastructure investments in the near future will determine the emission paths of cities in the long-run. Hence, cities are a point where adaptation is necessary and mitigation is possible, in a context of sustainable development.

Gaps in AR4. While urban planning is referenced in AR4 at times, there is no comprehensive survey on the role which urban planning can play in adaptation and mitigation, let alone a quantitative overview of the possible contributions of different measures and their costs. Encompassing strategies for urban areas are not discussed. Neither are there estimates on current GHG emissions related to infrastructure. If infrastructure is mentioned, only case studies are presented, stating nothing about general applicability. AR4 states that a credible assessment on general adaptation prospects and on mitigation in the transport sector is limited due to the number and scope of available studies of mitigation potential and cost [AR4,WGII,7.6.7; AR4, WGIII,5.ES].

The Expert Meeting. Therefore, the issue of human settlements and infrastructure should be further explored in an expert meeting that will feed into the AR5. However, due to the outcome there may also be the case for a Special Report on the issue.

2. The Issues

2.1 Human Settlements and Climate Change

Urban population. The world's urban population is 3.2 billion (48,6%) [UN, World Urbanization Prospects: The 2007 Revision], 0.6 to 1.2 billion (10-23% of world population) are estimated to live in near[1] coastal regions [AR4,WGII,7.4.2.4].

Urban emissions. Cities are major emitters of GHG emissions. The scale of emissions is in large parts determined by the infrastructure and, in part, by the way it is used. The main sources are direct emissions from energy generation from fossil fuels for (residential and non-residential) buildings, vehicle use and industry as well as indirect emissions from the generation of electricity for different purposes.

Human settlements and climate change. AR4 discusses the effects of sea-level rise on coastal settlements, physical infrastructure and water supplies. The vulnerability of urban areas to sea level rise is greatly increased when coinciding with increasingly frequent extreme weather events such as storms causing coastal and river flooding [AR4,WGII,6.4.2.3]. According to SRES in all BAU scenarios over 100 million people will be flooded annually (in case of an above 40cm rise) [AR4,WGII,6.4.2.3]. Further stress is put upon cities by Urban Heat Island (UHI) effects or the loss of permafrost. These impacts go beyond urban areas, since these areas mostly play a leading role in regional and global economy [AR4,WGII,7.4.2.4]. Climate change further has an impact on infrastructure being common to all human settlements such as buildings, transportation networks, water supply, wastewater infrastructure and energy facilities [IPCC Technical Report VI].

[1] up to 100m elevation, maximum of 100km distance from coast

The vulnerability to climate change is especially high in urban areas that are already under distress due to problems typical of the mega-cities in developing countries (scarcity of water, governance structure, unmet resource requirements, congestion, poverty, political and economic inequality, insecurity, growth, aging infrastructure) [AR4,WGII,7.4.2.4]. Especially mega-cities and rapidly growing mid-sized cities in developing countries are already today near their threshold of sustainability [AR4,WGII,7.4.3]. Informal urban settlements in developing countries are especially vulnerable [AR4,WGII,7.4.2.4].

Adaptation. Key adaptation issues are strategies to reduce stresses and impacts, the comparison of costs and benefits and limits to adaptation. Ways to adapt are: Introduction of advance warning systems, public awareness and capacity building, institutional structure facilitating collective action, economic systems allowing access to alternatives, contingency planning, risk management and financing and investment in physical infrastructure [AR4 WGII,7.6.7] to increase resilience [AR4,WGII,7.6.4]. Many coastal cities need improved embankment, barrages [AR4,WGII,6.4.2.3] and storm drainage systems [AR4,WGII,7.6.4]. Adaptation requires long lead times [AR4,WGII,7.6.4].

Mitigation. Within existing infrastructures, there is some scope for technical optimization as well as changes in lifestyle. However, in order to achieve a significant change in emissions levels a change in infrastructure will be necessary.

A distinguishing feature of infrastructure assets such as buildings, roads, energy and water networks is their longevity. That is, once investments are made they determine the emission level for decades. This has implications for the necessary policy design as well as for the owners of the infrastructure assets and for investments in new infrastructure (private or public), respectively. That is, structural change requires reliable long-term policies and land-use planning in order to avoid premature capital depreciation. From an investor's point of view, these long investment cycles bear an additional regulatory risk in addition to the risk that emerges from the impacts of climate change itself. This regulatory risk emerges from the societies' mitigation efforts in order to curb climate change. Carbon pricing, for instance, may devaluate emission intensive assets, such as coal-fired power plants (UNEP FI 2002). Against this background, the rapid urbanization in many developing countries constitutes a particular challenge.

2.2 Sectoral Views

Transport. The transport sector is responsible for 23% of the world's energy-related CO2 emissions (2004) and has the highest growth rate among the end-user sectors. Public transport systems, promotion of non-motorized transport, transport demand management (TDM), heavily taxed motor fuels, increase of biofuel, electricity and hydrogen based transportation, esp. for individual transport, other technological advances, policies ensuring application of those technologies, fuel economy regulations and increases in efficiency can contribute to GHG mitigation [AR4,WGIII,5.ES]. Uncertainties involved are the world oil supply and price, the price of carbon in ETS and technological progress (e.g. improved batteries).

Energy Infrastructure. In the case of energy, the future energy grids need to be designed to integrate large shares of renewable, i.e. intermitting energy. That requires the so-called smart grids and super grids and storage systems (air pressure, water storage).

Water. Through climate change the intensity and frequency of extreme weather events increases, leading to an increase of precipitation, sea-level rise, storms and floods. This causes saline intrusion, a change in water tables and a worsening of water availability and quality. The degree of impact varies regionally and is especially severe in semi-arid developing countries, on rivers fed by glacier melt and seasonal snow melt, in coastal megacities and more general in coastal lowlands. The situation is worsened by the population growth in many developing countries causing a higher demand for adequate, safe water access. Thus, substantial investment in infrastructure, such as coastal facilities, ports, water supply, storm water drainage systems and sewers is needed for adaptation. This needs to be combined with sustainable water and land-use management providing buffers for water and taking climate variability into account. The following gaps in AR4 need to be filled: The impact of climate change on water quality needs to be better understood. Water-related consequences of different policies

need to be analysed as well as the impact of water management on other policies. Further, profound approaches of risk analysis have to be developed. [IPCC Technical Report VI: 4.5, 4.6.2, 6.2.6, 7.4, 8.2, 8.3]

3. Infrastructure policy framework as the nexus of adaptation and mitigation in the context of sustainable development.

With the exception of dykes and other flood barriers, most infrastructures – especially urban ones – are not exclusively dedicated to mitigation of or adaptation to climate change. Instead, they are built to serve human needs such as housing, energy, water, transport, communication a.s.o. Additional characteristics such as being low carbon intensive or being "climate impact proof" are new or changing side constraints that were not relevant before. The consideration of these new/modified constraints would be a relevant component of revised policy frameworks for infrastructure development in human settlements.

Therefore, the creation of an appropriate infrastructure is at the heart of sustainable development. Revised policy frameworks for infrastructure development in human settlements would include the need to build infrastructure that accomplish the following requirements: (i) low carbon intensity (ii) "climate impact proof" and (iii) provision of the required services.