

Mega Cities

Introduction

The purpose of this document is to propose an overview on what it is called “mega-cities”, and to try to give a comprehensive picture of what can be and will be the needs of these “mega-cities” in terms of energy and environment (e.g. sustainable energy, of climate change, etc.).

The world is becoming more and more urban. In the 1800’s, only 3 % of the world population lived in the cities. In the 1950’s, the percentage reached around 30 %. At the present time, it is more than 50 % of the population and the prediction indicates that probably two third of the world’s population will live in cities by the year 2030.

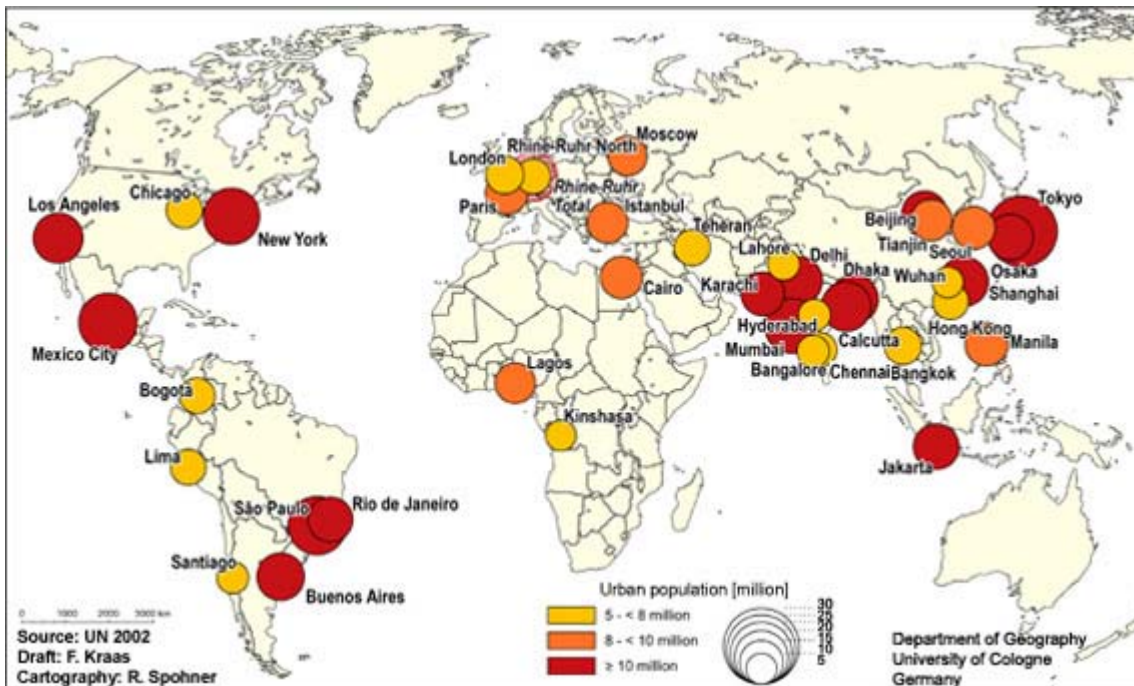
Globally, the Cities represent 2 % of earth’s surface, but use 75 % of its resources. In consequence, mega cities are concerned by the 3 following main dimensions :

- the social dimension (cultural diversity and variety, education, art, living conditions, transport, security, health care, innovation, ...)
- the economical dimension (work & mass unemployment, improvement of infrastructure, new technologies, decentralisation, repartition of wealth, capital equipments, ...)
- the ecological dimension (energy sources, sustainable development, air and water pollution, noise pollution, traffic jam, water supply, urban sprawl, urban environment protection, public transportation, waste management, ...)

Definition of Mega cities

There are numerous large and wide cities all around the world. At the present time the urban population is estimated to around 3.5 billion of inhabitants and will probably be more than 5 billion by 2030.

The term “mega-cities” was defined for metropolitan agglomerations which concentrate more than 10 millions of inhabitants.



In 2011, above 25 cities reached the level of more than 10 million of inhabitants (* see figures in annexe). The term “Mega-cities” has been a little bit enlarged. At the present time, it is considered as “mega-cities” the 40 most populated cities, and they formed an association “**C40**” to propose some common projects, collective actions and to share innovative solutions, for a sustainable developments.

These 40 “Mega-cities” represent a population of around 300 millions of residents, generate 18 % of global GDP and 10 % of global carbon emissions. Some definitions of mega-cities also add the component or criteria of population density.

The needs

Mega-cities will have to face different challenges of social, economic and ecologic dimensions, and should develop new solutions and actions, to answer to citizens to all their needs.

We focus on this paper on the two topics : environment and energy.

ENVIRONMENT

Harm, disease, discomfort of population or damage of environment can be caused by a poor management of environmental questions. Introduction of chemical or biological materials in air, soil and water can provoke many troubles and inconveniences.

Significant environmental problems in urban areas come from vehicle emissions, industrial discharges and fumes, traffic jam, combination of secondary pollutants (e.g. combination or chemical reactions from primary pollutants with sun or smog), etc.

Mega-cities are important to tackling climate change, being responsible for emitting 2.9 billion tonnes of carbon emissions, to take decisive action, doing it collectively, the potential impact will be huge.

The transport sector (public fleet – bus, boat, railways, underground transportation-, private transportation – taxis, cars-, roads and highway); correspond to around 300 millions tonnes of CO₂ emission per year, and it is the sector where greenhouse gases are increasing most faster.

Improving infrastructure, new transportation efficiency and technological enhancement will be essential for the next decades : more clean transportation (low emission vehicles like electrical one's, bio-fuel or new gasoline, compressed natural gas, clean fuel, smart cars, ...) and smart management of transport (management of congestion of traffic, cycle developments, mass transport, high speed services, restriction of access, ...).

Buildings accounts for 45 % of Mega-cities carbon emissions, but with a very wide discrepancy depending of the cities.

Reducing the waste will contribute to the sustainable development by less landfill waste, by decreasing the gas emissions or by recycling waste materials which can also be converted in energy (e.g. organic waste is in a significant proportion and can be transformed in compost). It is a way to develop new industries and employments. Gas capture from landfill is a major initiative done by the cities (methane emission for example).

Water efficiency to reduce the consumption of water, quality of water (water treatment) and decreasing waste water by a better management of the system and/or distribution of potable water are big challenges for the Mega-cities and the planet.

Water leaks can induce important costs because being reported on 3 dimensions : it costs because of waste of purify and treated water, it increases drought, and participates in greenhouse gas emissions.

So water efficiency and smart instrumentations, sustainable management of water, grey water recycling, retention and new means of water recovery will be the high priorities in the next years.

ENERGY

Renewable energy, energy efficiency and management of energy will be a great challenge for Mega-cities (for heat, cooling, electricity, gas or water).

In the building sector, different actions are on the way and have to be continued on energy efficiency or retrofit in residential dwelling, on energy harvesting, the improvement of insulation (new material like double or triple glazing, eco-materials, etc.), smart regulation, or global management system of energy and new lightning (e.g. LED). Distribution of energy with the aid of new high technological switches & management systems, shall be integrated in the new building generation.

On-site renewable energy generation is an option to reduce greenhouse gas emission. Mega-cities support the development of such renewable energies (e.g. solar, wind, geothermal, new fuels like bio-mass, etc.).

One of the main sources of greenhouse gas emissions from urban areas is generated by the consumption of fossil fuels. The increase of population will imply an increase demand of energy generation. Fossil fuels is on the way to be reduced. Energy supply can be divided in three parts : renewable energy, optimisation of energy generation, energy distribution. This will involve development of :

- PV, solar and thermal energies, energy from bio-mass, recycling of waste, wind farms, LED street and building lightning, ...

- reduction of distribution and transmission losses, development of smart grids (and integrated systems), smart instrumentation (new batteries and transformers, low voltage networks, etc.), smart lighting, ...

At the present time, the outdoor lightning in Mega-cities contributes to 19 % of electricity consumption. This point concerned the streetlight and the traffic light, mainly and is related to smart system of light management, development of new light technology, solar power streetlights, etc...

Transverse themes

Information and communication technology will answer to specific needs to improve distribution, reducing and transmission of energy, by a better and sustainable connectivity.

Wireless means and instrumentations will contribute to the reduction of greenhouse gas emissions and a better energy efficiency.

Conclusion

Metrology can significantly contribute to the Mega-cities requirement and Mega-cities proposed actions in term of energy and environment :

- by accurate and reliable measurements to assess and reduce greenhouse gas emission and participate to the surveillance of climate change
- by accurate and reliable measurements on water for a better quality, distribution of water by independent means
- by accurate and reliable instrumentations to manage energy efficiency, energy generation and distribution
- by the development and accurate of new and renewable energy sources
- by participating to pre-normative R&D in energy and environment

References

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- "Mega-cities project"
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The 27 Mega-Cities (*Source: Th. Brinkhoff: The Principal Agglomerations of the World, 2012-04-01*)

	Mega-city	Country	Continent	Population
1	Tokyo	Japan	Asia	34 500 000
2	Guangzhou	China	Asia	25 800 000
3	Seoul	South Korea	Asia	25 600 000
4	Jakarta	Indonesia	Asia	25 300 000
5	Shanghai	China	Asia	25 300 000
6	Mexico City	Mexico	America	23 200 000
7	Delhi	India	Asia	23 000 000
8	New York City	United States of America	America	21 500 000
9	São Paulo	Brazil	America	21 100 000
10	Karachi	Pakistan	Asia	21 100 000
11	Mumbai	India	Asia	20 800 000
12	Manila	Philippines	Asia	20 700 000
13	Los Angeles	United States of America	America	17 600 000
14	Osaka	Japan	Asia	16 800 000
15	Beijing	China	Asia	16 400 000
16	Moscow	Russia	Europe	16 200 000
17	Cairo	Egypt	Africa	15 700 000
18	Kolkata	India	Asia	15 700 000
19	Buenos Aires	Argentina	America	14 300,000
20	Dhaka	Bangladesh	Asia	14 000 000
21	Bangkok	Thailand	Asia	13 800 000
22	Tehran	Iran	Asia	13 500 000
23	Istanbul	Turkey	Europe/Asia	13 400 000
24	Lagos	Nigeria	Africa	12 700 000
25	Rio de Janeiro	Brazil	America	12 700 000
26	London	United Kingdom	Europe	12 600 000
27	Paris	France	Europe	10 600 000

The C40 Mega-Cities : Addis Ababa, Athens, Bangkok, Beijing, Berlin, Bogotá, Buenos Aires, Cairo, Caracas, Chicago, Delhi NCT, Dhaka, Hanoi, Houston, Hong Kong, Istanbul, Jakarta, Johannesburg, Karachi, Lagos, Lima, London, Los Angeles, Madrid, Melbourne, Mexico City, Moscow, Mumbai, New York City, Paris, Philadelphia, Rio de Janeiro, Rome, São Paulo, Seoul, Shanghai, Sydney, Tokyo, Toronto, Warsaw.