Pacific Economic Cooperation Council

ENVIRONMENTAL SUSTAINABILITY IN URBAN CENTERS

Efficiency and new technologies in the provision of urban services

A PECC INTERNATIONAL PROJECT 2009-2011

The Auckland and Perth Seminars

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ENVIRONMENTAL SUSTAINABILITY IN URBAN CENTERS:

Efficiency and new technologies in the provision of urban services

The Pacific Economic Cooperation Council (PECC) is an independent, multi-stakeholder organization committed to the promotion of cooperation and dialogue in the Asia-Pacific. Founded in 1980, PECC is a network of member committees composed of individuals and institutions dedicated to this mission. The Council is one of the three official observers of the APEC process. PECC provides a forum through which its members and broader stakeholders can influence the development of policies affecting the Asia-Pacific region. Currently, PECC has a total of 26 member committees representing the economies of Australia, Brunei Darussalam, Canada, Chile, China, Colombia, Ecuador, Hong Kong, Indonesia, Japan, Korea, Malaysia, Mexico, Mongolia, New Zealand, Pacific Islands Forum, Peru, The Philippines, Singapore, Chinese Taipei, Thailand, the United States, Vietnam, France Pacific Territories and institutional members: the Pacific Trade and Development Conference (PAFTAD) and the Pacific Basin Economic Council (PBEC).

This publication is an outcome of a two-year project carried out by PECC which brought together government officials, private operators, multilateral institutions and academics to discuss issues related to the environmental sustainability in urban centers, on efficiency and new technologies in the provision of urban services. While efforts are made to ensure that views of the PECC membership are taken into account, the opinions and facts contained in this report are the sole responsibility of the authors and do not necessarily reflect those of PECC member committees or their individual members.

PECC International Secretariat
29 Heng Mui Keng Terrace
Lobby A, Level 7
119620 SINGAPORE
T. +65 6737 9822
W. www.pecc.org
E. info@pecc.org

FOREWORD

It has been estimated that in May 2007, the world's urban population exceeded the rural population for the first time in human history. The Asia-Pacific region claims some of the most urbanized economies in the world, obviously Singapore at 100 percent, and Australia and Chile around 90 percent. The most populous economy, China, now has a bare majority urban population, and it is urbanizing very rapidly and faces some of the greatest urban challenges in the world. Even the Pacific island nations face stressful environmental issues where dense populations are crowded into resource-constrained areas with very limited fresh water lenses.

In this context, the PECC work program on "Environmental Sustainability in Urban Center" was highly timely. The agglomeration of population into urban centers is enormously efficient in many ways, providing dense concentration of economically productive activity. The more than 30 million people of greater Tokyo, for example, has a gross city product that is greater than the GNP of Canada or South Korea, and Seoul and Hong Kong each has a city product comparable to the national product of Vietnam, a country of almost 90 million. Urban centers also provide unparalleled cultural and educational opportunities. But they are also highly vulnerable to both natural and manmade disasters, and they have a huge impact on their immediate environment and indirect effects miles from the urban center.

The PECC project explored means of maintaining comfortable, rewarding urban living and working conditions while reducing the environment impact of urban centers to sustainable levels. The project explored a number of key related issues – water, energy use, social satisfaction, and urban governance. It examined both mega-cities as well as much smaller urban center in more fragile and demanding environments, such as that of Western Australia. Much of the thinking behind the project is that urbanization is an inevitable and continuing global trend, especially in the developing parts of Asia. The sustainability challenges associated with urbanization are daunting ones, but the main message is a hopeful one – that with innovations in environmentally-sound technologies in utilities and transport and with governance innovations as well (including appropriate pricing), urban centers can and should be drivers in leading the world toward a sustainable future.

By their very nature, urban centers will consume a high proportion of the world's resources in a concentrated place. However, information brought to the project suggests that there are many creative ways to consume resources more efficiently in urban areas and to "give back" to the rural environment by treating "waste" as a secondary resource. Water was given special attention as an often constrained resource. But it was shown that the supply can be expanded through increasingly energy efficient desalinization for coastal cities and through recycling of waste water for irrigation and industrial uses.

The project provided participants opportunities to share experiences from different disciplines and different environments. As with virtually all PECC activities, it brought together public servants, the business community, informed academic specialists, and activists from the NGOs. It involved conference settings, field trips, and many opportunities for informal dialogue. One of the greatest benefits of any such activity is its ability to raise awareness of both challenges and solutions, and hence this volume is designed to bring some of the input of the project to a larger, interested audience.

Discussions on technological innovations and new economic models were enriched through active participations from Veolia Environnement, Suez Environnement, and SITA Australia. While several PECC member committees have contributed to this two-year project, the France Pacific Territories committee (FPTPEC), which has initiated this project, the Australian committee (AUSPECC) and the New Zealand committee (NZPECC) in particular merit recognition for hosting these important seminars.

Charles E. Morrison
PECC Co-Chair

About PECC International Project on Environmental Sustainability in Urban Centers

The first seminar held in December 2009 in Auckland has demonstrated that prospects offered by renewable technologies in the field of water and energy are very promising and may help PECC economies to offer a sustainable urban development. Presentations made at the Auckland seminar have been made available on the PECC website for wider dissemination.

A number of recommendations have emerged from the first seminar: The international community as a whole, multinational enterprises and multilateral organizations are available to facilitate R&D and support the efforts of PECC economies towards sustainable development, reduction of greenhouse gas emissions, combating global warming, by supporting the development of renewable energies and cooperative programs for clean energies. Governments were called upon to support R&D technically and financially. It was also noted that because of their size, large firms can more easily benefit from best practices available on the market. Regulations should be framed to strike a balance between private interests and government responsibilities, since market forces cannot be the sole response. It was stressed that application of the "sobriety-efficiency-renewable scheme", could lead to better governance for the joint management of water and energy; this governance could be linked to international indicators, regional or industry recommendations, programs to foster innovation and plans to guarantee local access to water and energy.

The Perth seminar, the concluding one, has provided an impetus and raised visibility of the recommendations derived from the Auckland seminar. It has address the environmental challenges in urban growth to which large cites are faced and identify new technologies allowing for the development of sustainable cities worldwide: urban planning for environmental sustainability and for a more livable and more efficient city, clean transportation services.

The issue for a better governance to contribute to a better city has also been discussed. The issue of governance was first raised in Auckland then at the PECC General meeting last October in Tokyo; it is a core issue for environmental sustainability in urban centers. The Perth seminar has made proposals for best practices in the provision of public services that could serve as "guidelines" for a better protection of the environment of large cities in the PECC economies.

Recommendations fall under the following three headings:

- Criteria for a better urban life and city development
- Criteria for a cleaner urban transportation
- Criteria for a better city governance

This PECC publication is a contribution to international efforts to attain clean and more efficient cities. It has been made possible thanks to the many representatives from public agencies, private companies, and researchers dedicated to the common goal.

Professor Jean Luc Le Bideau, Vice Chair FPTPEC

Background and Executive Summary

In line with previous PECC work on infrastructure financing through PPPs (funding of infrastructure through public/private partnerships) and the more recent publication of the Guidelines on "Water management in island, coastal and isolated territories", FPTPEC in cooperation with AUSPECC, NZPECC and several other PECC economies, has launched over the 2009/2010 period a series of seminars on the development of renewable energies for more efficient use of water and energy in achieving sustainable development in urban services. This project was approved by the PECC General Assembly in May 2009 and has been conducted in cooperation with the World Water Council, the French Ministry for Ecology, Energy, Sustainable Development and Oceans, the ADB, SOPAC and international companies active in the water and energy management sector.

Most economies in the Asia Pacific have in the recent past experienced a strong economic growth coupled with a strong urban development and consequently have been confronted to a need for better and more efficient public services. The current economic and financial crisis may have some adverse impact on the regional rate of growth and the sustainability of public services. Avenues have to be explored to maintain efficient public services at a reasonable cost.

Water and energy are essential for life and economic development , they are inextricably linked, and, must be jointly managed and conserved. Water is essential for the extraction of fossil energy; at the same time energy is necessary for transportation and, treatment of water. Accordingly, sound policy coordination to achieve savings in both sectors and to better the management of water is essential as well as investing in renewable energies.

These seminars were intended to identify and promote the use, in public infrastructure, of less energy-intensive technologies emitting less carbon, producing less or no waste, facilitating wastewater and solid waste recycling and bettering the quality of urban environment.

This initiative had a threefold objective:

a) Respond to the questions of PECC member economies, which, confronted with the credit crunch, the increase in energy and raw material prices and the growing awareness of the need to promote sustainable urban development, must endeavour to implement technologies using less energy and less expensive energies in order to compensate for increasing prices and depletion.

b) Emphasize: The cost/benefit advantages of technologies currently used in public infrastructure as opposed to new, less energy-intensive technologies, with less carbon emissions, producing little or no waste, facilitating the recycling of used water and waste and improving the quality of the environment.

The prospects offered by renewable technologies (solar, wind, biomass) and new emerging technologies (wave, tidal stream) to meet energy demands at competitive prices.

c) Remain aligned with item 5 (*Planning the City for Tomorrow)* of the seven national priorities identified in the report "Investing in the Future", prepared by FPTPEC Chair, Mr. Michel Rocard, and Mr. Alain Juppé, of which our work could be considered as an immediate and direct result.

The Auckland Seminar

The first seminar held in December 2009 in Auckland has demonstrated that prospects offered by renewable technologies in the field of water and energy are much promising and may help PECC economies to offer a sustainable urban development.

This Auckland seminar stemmed from the idea that as the availability of water and energy condition life just as much as economic development, and as both sectors are interconnected, it is necessary to research ways to economise both and manage water resources better. It mainly emphasized the following:

— The need to integrate water and energy into urban and territorial development policies.
— The need to invest in renewable energies such as hydroelectricity, wind turbines, marine and geothermal energies.

The seminar worked on 5 main research focal points:

a) The prospects of better water and energy management
b) Governance in the water and energy sectors
c) Satisfying energy needs
d) The "energy footprint" on water and the "water footprint" on energy
e) The selection and diffusion of innovative technologies.

The prospects of better water and energy management

Work has begun, by way of an introduction, on the presentation of New Zealand's willingness to develop renewable energies to the level of 90% in the years to come, by focusing on hydraulic energy (already 53% of local available energy), geothermal energy (already 10%) and wind power. As in other economies, however, the limited number of authorisations granted in this field is curbing the development of this diversification. Moreover, wind power has proven to be lacking in the flexibility required to adapt to both daily and seasonal fluctuations of needs.

A presentation was given, in counterpoint, on what is being done in Europe, where the objective is to reach 20% of renewable energy by 2020 , considering the current 8.5%. The ambition is to reduce greenhouse gas emissions and gas and oil imports. The European Action Plan will cost between €13 and €18 billion per year, in other terms €30 per European citizen. Accomplishing this ambition implies a threefold commitment of moderate consumption, efficiency of the technologies implemented, and the development of renewable energies. There are several obstacles, however: the implementation cost, acceptability of constraints and of the price to be paid by the consumer, inequality of price due to an excessive number of subsidies. On the other hand, the issue of investment sources and of solidarity between economies is raised. The French experience of public-private partnerships resulting in hydroelectric concessions, agreements between electricity producers and local authorities as well as public bodies involved in water management can serve as an example in this regard.

Regional examples presented indicated the involvement of PECC economies in the development of renewable energies: China declares itself in favour of green growth and orderly water and energy management for agriculture while at the same time guaranteeing water access to economies situated downstream. China has implemented a renewable energy development plan; installed windpower capacity doubled each year between 2004 and 2008 and China is in second position behind the USA for this type of energy. However, the windswept regions do not correspond to the densely populated regions,

thus creating transport problems. The same goes for solar energy, largely developed in Tibet which is sparsely populated. The lack of well-trained technicians is also a hindrance to the development of renewable energies in China. The use of biomass comes up against the difficulty of collection. China is displaying strong political commitment in the development of renewable energies, which currently do not exceed 10% (excluding hydroelectricity) and nuclear power, two major programmes on a worldwide scale. As opposed to other economies, funds to develop renewable energies are available. Nevertheless, coal (providing 70% of energy) will remain the main energy source until at least 2050.

In the United States, in the State of California, emphasis is being placed on the desalination of sea water, due to the lack of available water from the Colorado River. New methods of water production and recycling must be implemented in order to meet the growing demand of the region with the highest per capita consumption level in the world.

Towards more governance in the water and energy sectors

The parallel between water and energy management and company management is striking, but for all that there cannot by one single answer. A UN agency could possibly be the body to coordinate responsibilities between multilateral institutions and States. Could the WTO intervene to find a solution to cross-border conflicts, to subsidies leading to imbalances in the water trade, to a better approach to the "water footprint"? Direct water trade is limited but there are indirect implications to be taken into account: farmers are the largest consumers of the resource and economies with intensive production (agricultural and industrial) and high water consumption must become more efficient in its use.

Criteria in favour of effective governance could be developed, i.e. better anticipation, transparency of funding and of invitations to tender, fighting corruption, conflict management and the development of synergies.

These good governance methods would help resolve water use conflicts, as shown by the example in Chile where rare water resources in the North are sought after by local populations and large mining interests while in the South the problem is not water availability but rather land. Governance should help to find a balance between water allocation and quality, between the former centralised management model and a new decentralised management model.

How to satisfy energy needs and reduce energy consumption

Until now, water and energy were taken into account separately by both governments and individuals. Fossil fuels have allowed humanity to develop for over two hundred years. The energy market that was initially controlled by northern economies has become worldwide. Available resources are now being counted in tens of years and climate change is calling for a limit to greenhouse gases. Only new regulations and the development of innovations will allow us to face this challenge.

On the other hand, water is abundant but its irregular distribution cannot meet local demand in a satisfying manner throughout the world. Better water management is necessary, especially in wasteful and highly polluting water-intensive agriculture. 65% of water is used in agriculture and livestock farming with huge differences between the quantities of water necessary to produce beef, chicken or vegetables. It is necessary to re-examine links between water and energy at both global and local levels: constraints are global whereas management of the national water/energy mix and water management are local. Demographic growth, urbanisation and economic development result in a growing demand for water and energy. Traditional energy reserves are becoming depleted and climate change will lead to increased water shortages.

The “energy footprint” on water and the “ water footprint” on energy

The share of energy consumed to produce, treat and transport water will increase from 5% to 20% of the total energy produced in the years to come. Water is essential for the extraction of fossil energies and for electricity and hydroelectric energy production. At the same time, energy is necessary for pumping, irrigation, and for the transport of water as well as its treatment (desalination, recycling, etc.) As water production requires more and more energy it will be necessary to determine the quality of water desired by consumers and public bodies involved in water management and for what use, and the optimisation of costs will be necessary.

Some 7 million people live in the Pacific Islands, where per capita consumption is higher than in industrialised economies due to major leaks in the water network, exceeding 50%. Some 10% of the population has tap water and is connected to a sewerage network. The pumping of water represents 35% of the Islands’ energy bill; desalination is used as a last resort, given its high energy cost and the technical difficulties involved. In order to reduce the energy footprint, more efficient use, reduction of network leaks and the recycling of water should become exemplary policies.

There can also be conflicts in relation to water use. In California, for example, there is opposition between agricultural and recreational use of water as well as between farmers and fishermen. We may have to choose between eating fish and eating hamburgers…

In China, conflicts stem from water transfers towards large cities, especially Beijing, and from the downstream effects of dams on local populations and neighboring economies through which there are only limited flows of often bad quality water.

In order to alleviate these difficulties, the Chinese government implemented three plans between 2001 and 2005 (Beijing, Talimu River and Hai River) aimed at saving water and encouraging economic development. An integrated water management system now covers 49% of water in China. Several Chinese cities such as Mianyang, Guilin and Beijing have implemented policies concerning water conservation, recycling, carbon emission reduction and the development of green zones, and are about to become “eco-cities”, according to the Chinese expert.

The centralised supervision of national water resources seems necessary in order to minimise problems. However, major political changes in terms of governance could create disturbances, with the example of the recognition of indigenous rights in Chile. Likewise, local solutions can spark off border conflicts if they are not considered in a global way.

Selection and diffusion of innovative technologies

Several possibilities have been proposed to select technologies and encourage their diffusion by operators: multinational firms seem the most suitable, by virtue of their worldwide operations, for capturing innovation, identifying new technologies and adapting them in order to incorporate them into their production process. Multinationals must know how to be technology integrators; with a business culture that is turned towards innovation and performance, they can transmit information better than anyone on new technologies (i.e. water recycling) in order to gain the end user’s acceptance which is often readier than that of elected representatives.

Partnerships are also a means of transmitting good practices. For example, the joint R&D programme between the EU and China facilitates R&D and technical cooperation between the two regions. Through the Clean Energy Center, this partnership allows China to benefit from EU experience (i.e. the **5 Cs**: **C**limate **C**hange, **C**ompetition, **C**onvergence, through **C**ooperation).

Progress in the field of geothermal research in New Zealand, Chile, Australia and Iceland requires high-level investment and involvement by governments as is the general case in the development of new technologies. Geothermal research indicates that conventional geothermal resources are running out and that it is now necessary to dig between 3 and 5 wells in order to find an exploitable source (New Zealand, Chile). It is now necessary to dig wells that are 5km-deep as opposed to 1-2km previously. The problem is above all access to land and the rights pertaining to it.

The exploitation of marine resources also implies a high degree of commitment from governments, whether for the development of tidal energy, wave energy, offshore wind turbines, ocean geothermal energy, energy produced from differences in salinity and/or the temperature of marine depths, or the production of fresh water by osmotic pressure without any energy source. Co-financing is necessary to move from the modelling phase to implementation in the field and to encourage the production of reduced emission energies to curb climate change. In the case of marine energies, the cost of development is high due to the cost of collecting bathymetric data and of the investigation of the marine depths in potential sites, not to mention opposition from fishermen and recreational users of the seas.

Conclusions

A number of recommendations have emerged from the Auckland seminar: The international community as a whole, multinational enterprises and multilateral organizations, are available to facilitate R&D and support the efforts of PECC economies towards sustainable development, reduction of greenhouse gas emissions, combating global warming, by supporting the development of renewable energies and cooperative programs for clean energies. Governments were called upon to support R&D technically and financially. It was also noted that because of their size, large firms can more easily benefit from best practices available on the market. Regulations should be framed to strike a balance between private interests and government responsibilities, since market forces cannot be the sole response. It was stressed that application of the "sobriety-efficiency-renewable scheme" could lead to better governance for the joint management of water and energy; this governance could be linked to international indicators, regional or industry recommendations, programs to foster innovation and plans to guarantee local access to water and energy.

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The issue for a better governance to contribute to a better city has also been discussed. The issue of governance was first raised in Auckland then at the PECC General Meeting in October 2010 in Tokyo; it is a core issue for environmental sustainability in urban centers.

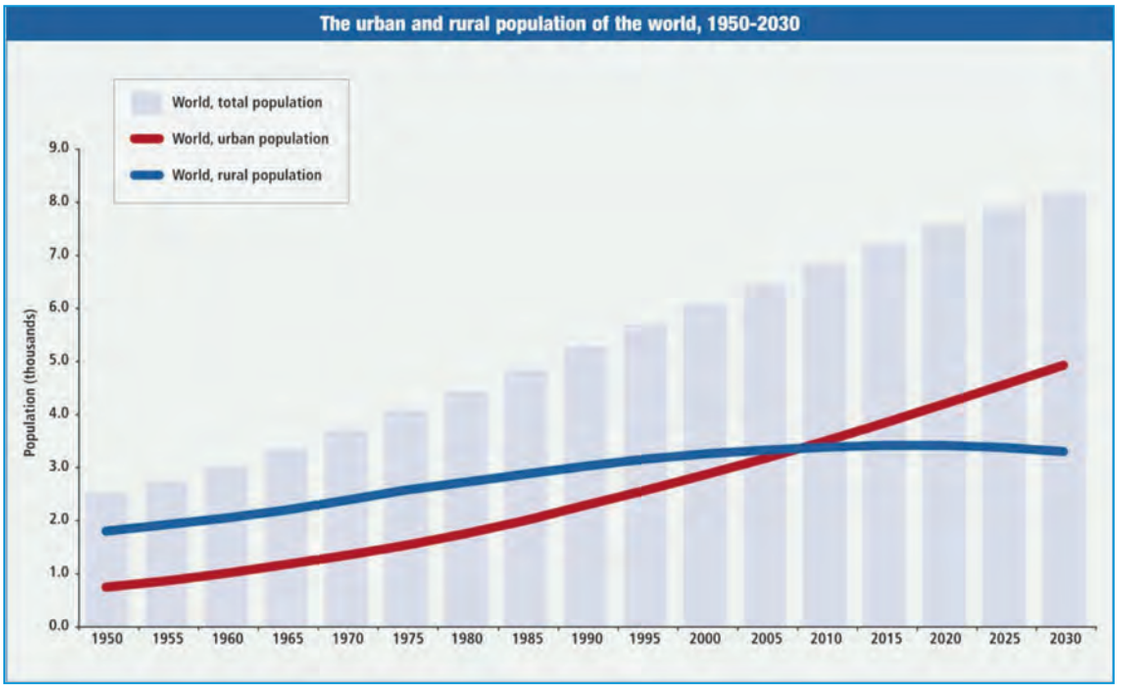
As a concluding session, the Perth seminar has permitted to identify proposals for best practices in the provision of public services that could serve as "guidelines "for a better protection of the environment of large cities in the PECC economies. Representatives from public agencies, private companies, researchers working in the field have participated in the Perth seminar to bring light on the experiences conducted in their home economy.

Discussions at the seminar have been rich and have conducted to a number of proposals and recommendations.

Rapid urbanization and climate change

Confronted by various forms of climate changes and natural disasters there is a need to rethink and reevaluate the way people live, manufacture, and consume. Most important, people need to change the way they behave on a daily basis. And this applies most critically to those living in urban areas containing dense populations, pollution, and traffic congestions.

At present, approximately half of the world population of 6.8 billion live in urban areas. By 2030, according to the United Nations projections, 1.5 billion more people will live in urban areas raising the proportion of urban population from 50% to 60% vis-à-vis rural population. Approximately 99% of the global population growth in the next two decades will be in urban areas. Urban expansion will take place mostly in the Asia Pacific region and by 2030, about 400 new cities will be created in China alone.



(Courtesy of ADB presentation)

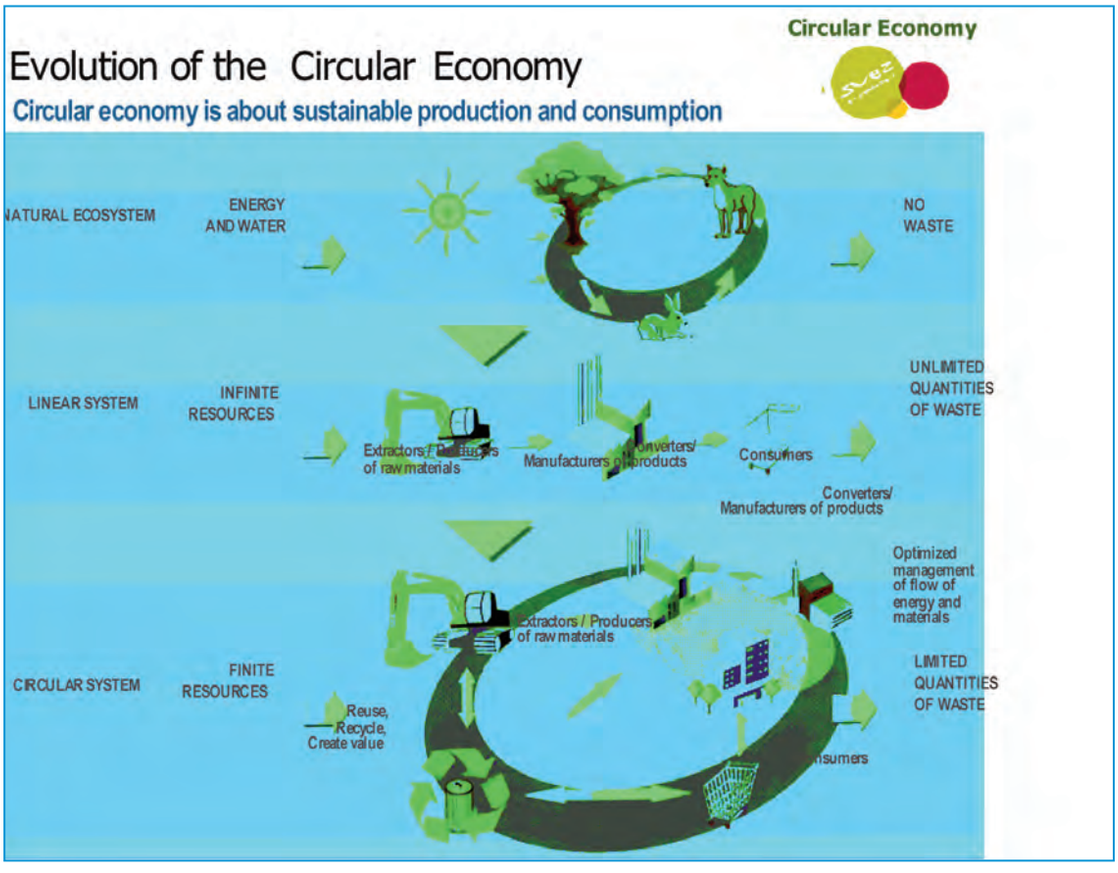
Rapid urbanization will continue and with the limited resources it is crucial to innovate technologies that are smart and adopt policies that are efficient in order to cope with this trend. Urban planners have to look for integrated solutions including urban design, planning and the management of facilities. Over 99% of the global growth are located in urban cities and more than 65% of if the Asian cities.

The development of large cities in the Asia Pacific region leads to environmental issues : Asian economies have consumed over 75% of their ground water, leakages account for more than 50% . 90% of waste water is rejected into the ocean in Asia, 85% in Latin America, 80% in south East Pacific. There is an urgent need to respond to water challenges, to move towards “eco-cities”, as an urban model consuming less water and less land, better managing the whole water cycle and limiting the water footprint (stop the underpricing of water , save water and look for new sources). The more

prosperous is the city, the more waste is created; urban planner shave to look for a deeper integration of urban services to bring synergy; innovation at the city level will come from integration. Innovation will conduct to new economic models for building, transportation, waste and water management.

Circular economy and sustainable cities

There will be increasing scarcity of water and other natural resources if all continues as business as usual: demand for water increases by 2% per annum as water supply decreases by 40%; this calls for more reuse and treatment of waste water. . The non-sustainable trajectories for energy and the environment are made clear simply by glancing at the graphs showing population growths, oil prices, CO_2 concentration in the atmosphere, and the global energy consumption levels. It is imperative for all actors – e.g. utilities, government, regulators, industry, manufacturers, and customers - to collectively move towards an energy-efficient and cost-effective 'circular economy.' Moving away from the conventional linear system whereby infinite resources led to unlimited quantities of waste after consumption, people will now need to move into a circular system where finite resources, met by efforts to reduce, reuse and recycle lead us to the optimization of energies and resources yielding limited quantities of waste and more energy recovery. Significant advances have been made in developing new technologies and implementing initiatives to realize circular economy as a solution whereby waste transforms into a feedstock in its next life. Circular economy is less energy, low emission, high efficiency. Increased efficiency in the use of water conducts to reduce demand, reduce water losses, secure new sources of water, and the recovery of energy through the recapture of used water. In addition, recycled water can be used for irrigation, industrial use and aquifer recharge. Sludge can be reused for agriculture. 60% of waste water is recycled in the EU, 80% is the goal.



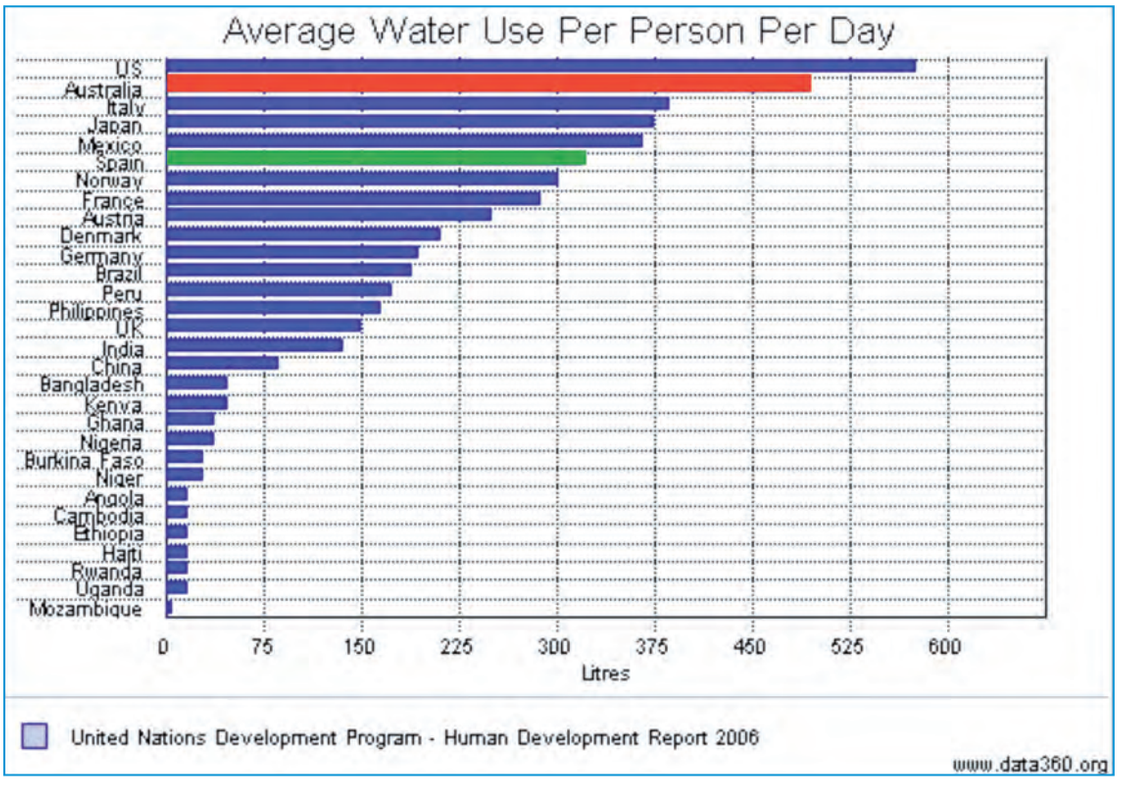
In order to realize circular economy, it needs to be made obvious to the end-users and consumers how much they are saving and what the personal benefits are from reducing and recycling. Water and

energy consumption per household must be made convenient and easy to monitor. Waste separation and disposal also need to be convenient and easy to follow. Installation of smart grids and smart meters are increasingly promoted as a solution but due to high cost of initial investment and concerns over privacy, there are still significant barriers to widely adopting them in the US and Europe.

Climate change and water supply

Climate changes have resulted in Australia overall experiencing extreme weather conditions with the east coast receiving extraordinarily high rainfalls and the west getting the lowest ever recorded. In the case of Western Australia, the current population of 2.36 million is set to double to 4.3 million by 2058. In recent years, WA has seen its southwestern region getting drier and its northeastern region wetter each year. Also in South Australia, which is positioned at the bottom of Australia's river system, its future is predicted with higher temperatures, lower rainfall, and more frequent droughts and thus climate change constitutes a central concern for its 30-year urban sustainability plan.

At the same time, the demand for water has increased three-fold between 1980 and 2005 throughout Australia. In 2010 demand for water increased by 7% in the mining industry in WA , and by 4% in agriculture. Australia ranks second to the United States in the world for the highest daily consumption of water per capita.



With the drying trend in Perth, irrigation takes up as much as 39% on average at Australian households which typically include a European-style garden. The first step to managing the water challenges is to mitigate the increasing demand. Veolia Environnement prioritizes reducing the water footprint and moving away from a culture of supply management to demand management. Water is still considerably cheap in Australia and the objective is to adopt more "cost-reflective pricing" in water supply throughout the economy. The first step to encouraging people to save water is to enable

them to monitor and control water consumption through installation of household water meters and remote meter-reading systems.

As presented by the Water Department of WA, the next steps being taken to meet the increasing demand are identifying new sources of water such as groundwater, stormwater, setting up additional rainwater tanks and building a second desalination plant while boosting the water management efficiency.

Sanitation and water management

Some of the practical examples to achieve efficient water management include *Suez Environnement'*s initiatives to reduce demand, reduce water losses, secure new water sources, optimize energy recovery, and reuse water.

For example, water leaks are now more efficiently monitored by the installed sensors which detect noise from the leaking areas of the pipes in real time. This method has resulted in saving 1.2 million cubic meters of water just in Dijon, France in 2007. A better use of data should be made; fixed leakage detectors, smart meters for real time information, remote meters reading with leaks alert on smartphones could help to reduce water losses.

The water shortage problem is also compounded by the water transportation problems. Water losses during its transport to the consumers can be as high as 50% in the networks of Colombo, Delhi, and New Orleans. However, as pointed out in *Degremont* analysis, as much as 40% of the world population lives less than 100 km from the sea coastline. Out of 70 cities in the world with more than 1 million inhabitants with no access to additional fresh water, 42 are located on a coast. Increasing the supply of drinking water through the process of desalination would seem one logical solution to coping with water shortage. The technology is becoming more efficient and viable. Used only in the Gulf economies in the past, desalination is now expanding rapidly in other parts of the world. Significant improvement has also been made in recent years toward achieving "green desalination plants" whereby the drinking water production becomes carbon neutral and the level of needed energy greatly reduced.

Waste management

Urban household wastes are expected to expand rapidly. Solid wastes will expand from 12.7billion tons per year to 27 billion tons between 2000 and 2050. This goes far beyond the treatment capacity currently available.

It will first take a mindset change. Waste is no longer just a waste; it is a secondary resource. What used to be burned or thrown out as waste are actively recycled and reused to produce new materials or returned to the economic cycle in the form of recovered energy, products, and new sources to build infrastructure. Taking signals from various stakeholders including the local, regional governments, the market, and individual consumers, SITA Environmental Solutions has seen fast expansion in their Organics division over the years which is essentially a manufacturing/ processing business, an evolution from the days SITA was known just for its waste collection and treatment services. An "open data" programme would be suitable to release information on city services and on the environmental impact of the city .

In the same fashion, Veolia Environnement claims that the wastewater that goes through a treatment plant today will go through a 'biorefinery' by 2020 and yield not only treated wastewater but also bio material and bio energy in the near future. This means, instead of simply removing the pollutants from used water, resources will be extracted, starting with water, followed by energy, organic and mineral matters.

Urban transportation and oil demand

While transport is a key driver of development, there are serious issues in the sector for Asia that need to be tackled. For example, motorization is doubling every 5-7 years, congestion costs 2-5% of Asian GDP and another 2-5% of GDP for road accidents. Energy use on transport in Asia accounts for 30% of world energy and as much as 23% of GHG emissions is coming from the transport sector. In 2006, the global oil production has reached its peak and ever since, there has been inexorable rise in oil prices reaching as high as USD 147 per barrel in the last two years.

By 2008, the 'peak fossil fuel power investment' had occurred, i.e. the global renewable power investment recorded higher than fossil fuel for the first time in modern history. Another chapter has been opened by moving from an oil-dependent era to the next where people will increasingly depend on gas and renewable energies, more on public rather than private transportation means. In the United States as well as Australia, the private car dependency has peaked in 2004 showing decline in more recent years while the usage of public transportation is showing significant increase.

The Asian Development Bank (ADB), in recognition of the changing trends in the transport sector in the region, has embarked on very different transport initiatives since 2010. In the past, ADB's support in the road sector has focused on improving access, enhancing economic opportunities and increasing mobility especially for remote rural communities. At present, ADB's portfolio includes scaling up operations and promoting underground railway systems in urban areas, mainstreaming climate change, improving cross-border transport and logistics, as well as supporting road safety and social sustainability. As a result, the proportion of urban transport lending is projected to increase enormously from 1% in 2009 to 30% in 2020.

On the other hand, according to 2009 data, more cars were sold in China than in the US. One solution is to aim to produce more energy-efficient vehicles that are also light, those that use gasoline-electric hybrid fuels or simply run on electricity. Transport sector is the biggest emitter of greenhouse gas in France and the conversion to electric cars is anticipated to help France achieve its Grenelle objective of bringing down GHG emission by 20% by 2020. The technology and infrastructure are all available. The main challenge is to effectively enhance training and knowledge sharing.

As the cities become denser, the fuel usage per capita for public transportation decreases. Sustainable, resilient, and smart cities in the future will adapt to new challenges and circumstances to become eco-friendly, carbon-neutral cities.

At present, 82 cities in China are building or planning to build underground train systems. China has committed to achieving 15% renewable energy by 2020 and plans to realize 6 zero-carbon cities are underway.

Integrated approach

Many cities will grow into the size of mega-cities within the next decade. The cities will consume most energy in the transport and housing sectors and the trend will require major breakthroughs in energy generation, supply and distribution. Urban services and utilities are all interconnected and interdependent. Each confronts various climate change problems and fossil fuel shortages. Therefore, a holistic, systemic approach will be necessary to build the infrastructures and implement public services that can meet the increasing demand for energy and urban mobility. Reduce energy use for urban development call for more efficient buildings, and public transportation, lower pollution emission, water recycling and land and planning framework.

At present, as much as 80% of global energy consumption derives from cities or due to transport of goods between cities and at least half of greenhouse gas emissions are emitted in and by cities. With this in mind, EDF (Electricité de France) prioritizes enhancing the power grid reliability, improving the network's overall quality, and favors renewable energies and energy demand management by end-users. This also means instilling new energy culture, flexibility and emphasizing on the reduction of green house gas emissions on the demand side.

Urban governance

According to UN-HABITAT, "good urban governance, based on the principle of urban citizenship, affirms that no man, woman or child can be denied access to the necessities of urban life, including adequate shelter, security of tenure, safe water, sanitation, a clean environment, health, education and nutrition, employment and public safety and mobility." Good governance is a combination of capacity and capability on the one hand and legitimacy on the other. Much of recent metropolitan governance has shown tendency to focus too much on technical and organizational skills and not enough on the skills and culture of collaboration and engagement required to ensure that the communities grant the 'license to operate.' To gain legitimacy is to achieve participatory governance engaging multi-stakeholders in the government, the private sector, and the civil society.

City managers have found that one of the main challenges is the collection, analysis and publication of accurate data on the different aspects of urban environment at a regular interval. Reasons vary from lack of financial, human, and institutional capacities but more could be done to educate and train the city officials and community residents of the urgency and available means to tackle the problems threatening urban sustainability. Difficulties arise also when urban managers try to reach consensus among large populations covering large space with their own emotional attachments and concerns about new initiatives and projects that are geared towards long-term sustainable urban planning.

Thereafter, another key is to better communicate the scientific assessment and policy initiatives to the general public in an integrated manner. Without effective communication and engagement with the individual end users, gaps between sustainable usage and expectations will grow. It can be said that less emphasis lies on leadership and more on the knowledge sharing enabled through alliances between local governments and communities in problem-solving and future planning.

New challenges emerge when addressing the situations where the consequences of one local government's decisions have ramifications beyond its own boundary. The engagement of local and regional communities in the circular economy is crucial as are the resource sharing and joint activities amongst councils that enable effective intergovernmental relations.

One also sees the need to apply new approaches and priorities in urban governance as new eco-cities emerge, engineered and constructed under circumstances that are quite different from the way conventional cities were built.

Environmental sustainability for cities needs governance, all levels of government and civil society are to be involved into the process. New technologies are needed to build green infrastructure and develop new models for services provision leading to a larger integration of urban services. Cities are not oriented yet towards new technologies, regional governance is required to develop integrated technologies as demonstrated by the city of Perth in the field of green transportation. The involvement of civil society is a crucial element.

New Eco City Developments	Eco expansion of Existing Cities
Characteristics	***Characteristics***
Developed in isolated location	Technology driven
Partners with local businesses with similar business models	Location is of prime importance to attract majority of people
Residents have similar values	Intensive planning to foster communities and sell the idea
Technology driven	Integration of eco values with present infrastructure
Governed by "green" rules and regulations	Importance of partnerships between public, private and the civil society
Aims in being a self-sustainable city	
Disadvantages	***Disadvantages***
Difficult to integrate to existing cities	Slow change
Values might be compromised with growth	Often not "green" enough to the radicals
Not comfortable for living due to isolation	The power might be centralised too much on the government. Not enough delegation during the actual implementation
Eco-values are compromised after leaving the city premises	

Some of them built over centuries, remodeling and retrofitting major cities into environmentally sustainable cities are proving to be extremely costly to local governments. Public-private partnership are seen as the only viable way, but even these initiatives have been marred by occurrences of corruption and mismanagement with lack of good governance, transparency and accountability on the part of both public authorities and private entrepreneurs in some instances around the world.

Barriers to turning major cities into environmentally sustainable cities:
— Lack of consensus among community residents
— High cost of building ESCs
— Inadequate human and institutional capacity for planning and implementation

Conclusion

History has shown that people learn to adapt and cope when faced with dire situations. Climate change and fossil fuel energy shortage will lead mankind to speed up the technological advances and adopt new ways of life that will allow us to sustain life.

Over the last couple of decades, people have come to a very different perspective in the way they

view the importance of environmental protection. In the traditional mindset, protecting the environment and "greening" the products or buildings meant costly and unwelcome initiatives that impede economic development. Significant improvements have been made in the technological advancements to allay such fears. Green technologies have not only opened up enormous potentials in the green growth industry, but are also proving to be increasingly conducive to the existing economic sectors and to the larger picture of reality. It is no longer just the environmentalists insisting on greening the livelihoods but the also the economists who are promoting green industry and radical changes to our daily behavior. Long past are the debates about greening being the right thing to do for ethical and moral reasons; it is really about survival and absolute necessity.

At the same time, as more cities turn eco-efficient, people will be offered zero-carbon living as an option in the near future. And for cities to become eco-cities, they must reduce their water footprint, carbon footprint, and energy footprint. For this to be realized, people will need reliable tools for assessing their own footprints, new solutions to urban water and sanitary supplies, as well as appropriate public policies to save natural resources. Innovative approaches are required of developing new technologies, innovations will be critical for better data management and sharing knowledge, as well as innovation in business offers and contractual arrangements. Most of these innovation potential lie at the intersection of several industrial and economic sectors. Recovery of energy from wastewater treatment and production of biomass materials from waste treatment plants are such examples.

From the seminar discussion, best practices in the field could be pointed out:

— Use less energy for water and less water for energy: the water /energy nexus
— Promote the reuse of waste into new secondary raw materials: accelerate the development of recycled materials into new products
— Develop an economy at the city level with low energy/low carbon emission and high efficiency
— Look for integrated solutions based on new economic models and open data.
— Develop governance at the city level and increase reliance on the local government and the involvement of civil society.

Prof . Jean Luc Le Bideau, Vice-Chair FPTPEC
Ms Jessica Yom, PECC International Secretariat

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PART ONE: THE DEVELOPMENT OF SUSTAINABLE CITIES

Chapter 1. Environmental Sustainability in Urban Centers

JC Philbé
Director, EDF South Asia Division, EDF South East Asia
Bangkok, Thailand

A majority of the world's energy consumption takes place in cities or due to the transport of goods between cities. At least half of greenhouse gas emissions are emitted in and by cities where up to 80% of energy is consumed. With growing urban population and increasing standards of living the contingent of energy consumed in cities will drastically increase if nothing is done.

Energy is one of the key elements and drivers to describe the development in the future. The challenge is to transform the existing energy system into one which will become sustainable and will integrate largely energy efficiency, demand side management and renewable energy sources.

This will be a paradigm change requiring breakthrough in the energy supply and distribution itself but also on energy demand in every city sectors, namely transport, housing, industry, and service sectors like water supply, waste management and treatment.

The main services in a city which are playing a major role in the implementation of climate change measures are interconnected and therefore cannot be regarded separately. Moreover, the political, social in conjunction with economical aspects play a major role as well.

For that reason, climate challenge can only be tackled within a complete, integrated and long-term approach. In other words a transversal approach: where it is needed to look at the city structure/density, urban growth, fossil fuel scarcity, renewable resources, decentralized generation, local demand taking into account the political and social perspectives.

The involvement of local stakeholders, interacting with existing trends and conditions, is a key of success to generate the right strategies, deliverables and outcomes to be translated into political decision-making.

Some projects by EIFER (research institute in partnership between EDF and University of Karlsruhe)

- ***Shaping of the future of the metropolises: Hyderabad example***

Hyderabad recorded 6.4 million inhabitants in 2001 and by 2021 a total of 13.6 million is projected. This enormous population growth exacerbates the task of urban services and infrastructural provision, and hinders attempts to reduce poverty. Hyderabad has set up the following vision for its development: "A smart and globally competitive city with opportunities for all its people in a safe, stable, liveable, prosperous and people friendly environment". The implementation of this strategy is a tremendous challenge.

The project aimed to uncover the potentials for increased energy efficiency by means of

innovative technological & management concepts embedded in a holistic planning process.

Large impacts often stem from changes in people's everyday small decisions: how they decide to travel to work and to the shops, how they choose to organize their neighbourhoods and buildings, what they choose to recycle, how they use water.

The combination of these small, everyday decisions, both conscious and unconscious, with large, planned decisions, is shaping how environmental benefits, and environmental burdens and risks, are differently experienced by different social groups and in different areas.

It is with this in mind that urban infrastructure systems were explored in its interrelation to others, impacts on the urban development and sustainability.

Looking at the infrastructure of the existing city there is an enormous potential in the development of harmonized and combined approach of energy and urban structure. If the city develops in the manner of western metropolises, it might grow five-fold by the year 2020. Similar growth predictions can be made for the energy, water, or the traffic sectors. This is putting a lot of pressure on today made decisions in cooperation of concerned stakeholders.

The example of Hyderabad opens up various potentials for the development and implementation of innovative models and scenarios.

These projects could serve as outstanding multipliers for future urban development on a local and national scale. New strategies for the reduction of energy consumption can achieve a significant impact if executed within these projects.

- ***Cities and energy***

Buildings concentrate a large proportion of global energy demand. Approximately 40 per cent of the global energy end-use takes place in buildings and they account for more than 15 per cent of global green house gas emissions.

The fabric of our cities today has been shaped predominantly by issues relating to land use and ownership, transport and finance rather than ecological factors.

Analysis by sectors is required as well as going beyond the parameters of insulation and building type analysis to find where possible efficiencies lie.

At the building scale, the common sense understanding is that the more compact building types like apartment-blocks outperform small-scale individual building units such as detached, single family housing. However, this becomes more complex at the urban scale where building volumes impact negatively on solar gains and the trade-offs between shading and massing need to be better understood.

This research project is taking the established discourse on heat energy demand and building typologies to the next, larger scale allowing to explore trade-offs and scaling effects at the neighbourhood level.

For this investigation, different building configurations were identified, represented and processed by a model in each of the four largest European cities, London, Paris, Berlin and Istanbul. The calculations enabled the consideration of influential factors at differing scales: climatic conditions, exposition to sun radiation, spatial and physical dimensions, environmental context and furthermore.

One of the main targets for the project development is the generalization from urban fragments to the metropolitan level.

Through such kind of analysis, the assessment of the heat energy demand is enriched by the possibility to identify urban relevant dimensions and give so a wider scope of analysis. Thus the theme of energy consumption comes nearer to the planning community and non specialists of the field of energy research.

The different urban tissues are no more aggregated and behold their specificity which makes our cities so different from each other. The results are not limited to the chosen urban tissues and can be generalized to the whole metropolitan area.

It has been proved the feasibility of the approach and the importance that such a methodology has when coming into matters of land-use management, infrastructural planning and local actions related to decentralized energy production or renewable energy resources, needing specific local solutions.

- ***Urban dynamics and energy demand***

The local developments of energy efficiency are characterised by highly diversified reactions in different scales to complex interrelations: growth but also shrinking are becoming increasingly unevenly distributed, within city and regions. There is often polarity between prosper and developing places and streets/quarters/towns with negative development trends.

The project aims to develop methods to analyse the change of urban functional use and the related energy demand. It locates and visualizes local energy demand through an approach by sectors (household, tertiary, industry) and develops simulation tools for regional development and building refurbishment cycles and their impact on the energy demand.

One of the major challenges is to harmonize the representation, static and dynamic, of the households, tertiary and industry sectors in order to define comparable energy demand quantities at the same spatial and temporal scale.

The modelling approach is based on the knowledge that local characteristics based on accessibility to infrastructures and composition of the local neighbourhoods are essential to describe the development of cities or regions. Technical, physical or socio-economical phenomena are thus synthesized within the spatial transition rules of the model, including their complex interaction among time and space.

Energy infrastructure, building stock information, activities and firm locations are integrated to give a comprehensive picture of the energy demand side of a metropolitan region not only from the quantitative point of view, but also from the geopolitical one. The possibility to integrate more detailed datasets with socioeconomically attributes has been ensured.

This approach to energy relevant matters has been proved to be highly valuable.

- ***E-mobility infrastructure allocation***

The development of electric vehicles will have large impacts on the energy system. On the one hand, the energy system has to stay stable despite a new demand and on the other hand it opens new possibilities in optimising generation, distribution and storage of electricity.

The aim of the project was to give an orientation for the localisation of charging infrastructure for 500 vehicles in the cities of Stuttgart and Karlsruhe considering the demand resulting from the present transport system.

The main factors that play a role in the planning of a charging infrastructure for electric vehicles are identified: technologies of charge, pricing, energy storage, distances, battery technology, charging behaviour and station localisation.

The methodology consists of two steps. First, on the "macro-scale", the charging points are distributed throughout the city taking into account the localisation of activities, the possibilities of parking and the modal split. It allows a localisation of charging points regarding different hypotheses linked with the charging time.

Then on the "micro-scale", the localisation is done on the street level with an accuracy of 100 m coming out of a localisation analyse regarding city landscape and technical aspect of parking.

The model makes the development of an initial charging infrastructure possible. It permits direct consultancy with city councils, in order to support strategic decisions for localisation of charging points as well as further analyses of urban mobility and energy demand.

- ***Demand side management***

European utilities are faced with new challenges in electricity service supply including: maintaining reliable electricity supply while meeting competitive business goals, managing market deregulation and addressing the social issues with equal access to energy assets and services.

Smart grids will provide solutions at local and regional level to increase power grid reliability by reducing peak demand, combat climate change and augment energy efficiency.

The PREMIO platform communicates with a mix of distributed resources to manage local and regional peak demand, supervise electricity supply, increase energy efficiency and help customers make informed choices about their energy use. Electrical consumption reduction is solicited from an upstream operator and can correspond to periods of high power demand or to high GHG emissions from power generators.

The PREMIO architecture was designed to allow a response both at a regional and local level to precisely address the stress on a given area of the network.

Towards sustainable cities

Around the world, the concept of "sustainable city" becomes a reality in the context of projects aiming at making the city more "intelligent". Hundreds of initiatives on all continents also show the universal dimension of this concept.

The concept is yet not well defined: eco-cities, smart cities, smart grids, each having its own definition and being applied differently in each city. What is important is the move towards sustainable cities, with the stakeholders of cities from urban planning to services to citizens.

Cities have to be renewed from an integrated vision with numerous and quickly increasing requirements of safety, health, environment and energy within a context of increasing economy and social complexity. Only the innovation can overcome it while improving the attractiveness, the economic dynamism of territories, and the quality of life of the city-dwellers.

EDF Group has for example already led some prospective studies to design what could be in France a residential sector without GHG emission.

Five major fields have to be investigated:

- Energy in cities: urban morphology (building height, density, orientation), user mix (industry, residential), spatial planning, end-use mixes, urban modelling tools for master planning focusing on energy, and mobility and transport infrastructure.

- Energy grids: smart grids for electricity, heating and cooling, new methods for network planning, smart electrical and thermal grids, demand side management (load shifting), integration of decentralised renewable energy sources.

- Active buildings: building automation, innovative building design concepts, retrofitting, building as energy storage, interaction of the building and the smart grid, renewable energy production on very low energy buildings

- Supply technologies: new concepts for renewable energy use in cities, , cascade use of resources, energy storage, tools for the development of hybrid systems, multi-technology approaches.

- City integrated energy management: combining information technology and energy management

This paper detailed some research projects on sustainable cities and tried to prove the importance of starting with a systemic approach, looking at the needs and resources today and tomorrow, and optimizing networks and infrastructures in an integrated vision. We have to renew our approaches to cities and that is why demonstration projects are so important, with strong research capabilities working on real cities.

In such an evolving context and considering the various challenges ahead, cities offer major opportunities for effective and imaginative responses to energy planning and climate change.

Chapter 2. Living in Cities Today: Results of Survey Conducted by the Veolia Observatory of Urban Lifestyles in 7 Megacities Worldwide in 2010

*(Text issued from "*Cities for Living 2010, Veolia Observatory of Urban Lifestyles*")*

Joachim Bitterlich
Excutive Vice President of International Affairs
Veolia Environnement
Paris, France

In 2008, the Veolia Observatory of Urban Lifestyles initiated an in-depth analysis of the relationship of urban residents to their city. Now it is pursuing the same goal globally, by spotlighting the environmental challenges facing major urban centers. TNS Sofres designed the survey to shed light on the major trends and phenomena at work, as well as to stress more specific but equally instructive local attitudes.

The 2011 survey was administered from March to April 2010 with 7,128 people over age 15 in 7 cities: Beijing, Cairo, Chicago, London, Mumbai, Paris and Sao Paulo. Each sample was selected using the gender, age and socioeconomic class/income quota method.

By polling residents of seven cities on five continents, the Observatory is a powerful means of comparing experiences, concerns and predictions for the future in different spots on the planet. More unexpectedly, it is also a way to craft cross-national profiles.

Trying but beloved cities

Urbanites deal with problems in their daily lives while simultaneously praising cities as the ideal place to live, work and start a family.

Cities, an obvious choice

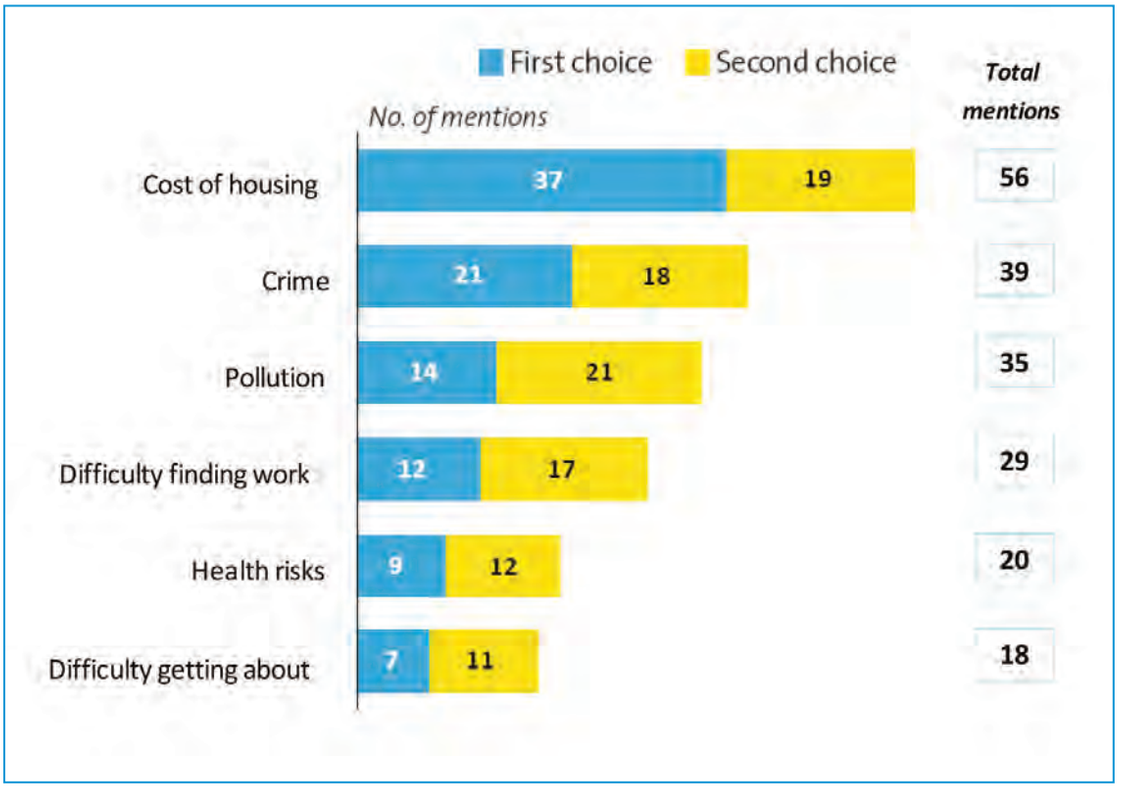
A large majority of urban dwellers (80%) are satisfied with the city they live in. Although there are disparities among the seven cities surveyed, the figures are good, even very good, in every one of them. Cairo and Sao Paulo, though ranking at the bottom, still post a nearly 70% satisfaction rate. Mumbai boasts a record figure of 95%. In addition, 58% think their city's image is attractive to people who do not live there and also find their city beautiful.

Three factors can explain the overwhelming popularity of cities:

- **Their city: that is where they live and that is where they are going to stay.** Some 63% of urbanites chose to live in a city. Moreover, a large majority (82%) has been living in the same city for more than 10 years and 47% own their own homes. They like the urban lifestyle so much that 72% of those surveyed would like their children to grow up in the city they live in. Responses are nearly unanimous in Beijing and Mumbai, at 94% and 93%. In contrast, the residents of Paris (58%) and London (51%) are more divided.
- **A "prevailing" sense of trust and mutual support**. While it is difficult to measure, the trust people have in their neighbors is central to urbanites' perception of their quality of life in cities. Some 72% believe that, generally speaking, they can trust one another. Sao Paulo residents are less certain about this (40%). Mutual support is also a shared value for 69% of city dwellers.

- **Urban services work well. Transit is reviewed positively.** Some 74% believe that it is easy to get around in their city and 75% rate public transit systems as good. With respect to energy-related services, 82% think that their city is fairly well lit at night and 90% that the electric power grid performs well. On the topic of water management, 78% think that the tap water they drink is of good quality and 80% are satisfied with wastewater disposal. Finally, 77% say they live in a city with good waste collection services.

Figure 2-1. Main issues faced by their city housing prices, crime, pollution, jobs



Daily challenges

Some 37% of urban residents say they had no choice about living in a city, for family or career reasons. There are wide disparities among the cities: fewer than 60% of Sao Paulo and Cairo residents report they chose to live in the city, versus more than 80% in Mumbai. Some 65% of those who did not choose the city are its harshest judges. Satisfaction seems to be linked partly to whether or not the choice to live in a city was voluntary. People who did not choose city life have the hardest time projecting their future in the city and "imagining" their ideal urban environment. Those least satisfied with their city are also and primarily the least affluent households (75%) and people who spend over two hours a day in transit (76%).

Dissatisfactions surface and expectations emerge

First, cities are not safe enough. A safe city is a city in which people go out, businesses locate, families move in and collective services can operate under good conditions. For 89% of urban residents, a safe city is the top criterion for living well in an urban environment. Yet 39% of them single out crime as one of the main problems their city must deal with. Inhabitants of London, Chicago and

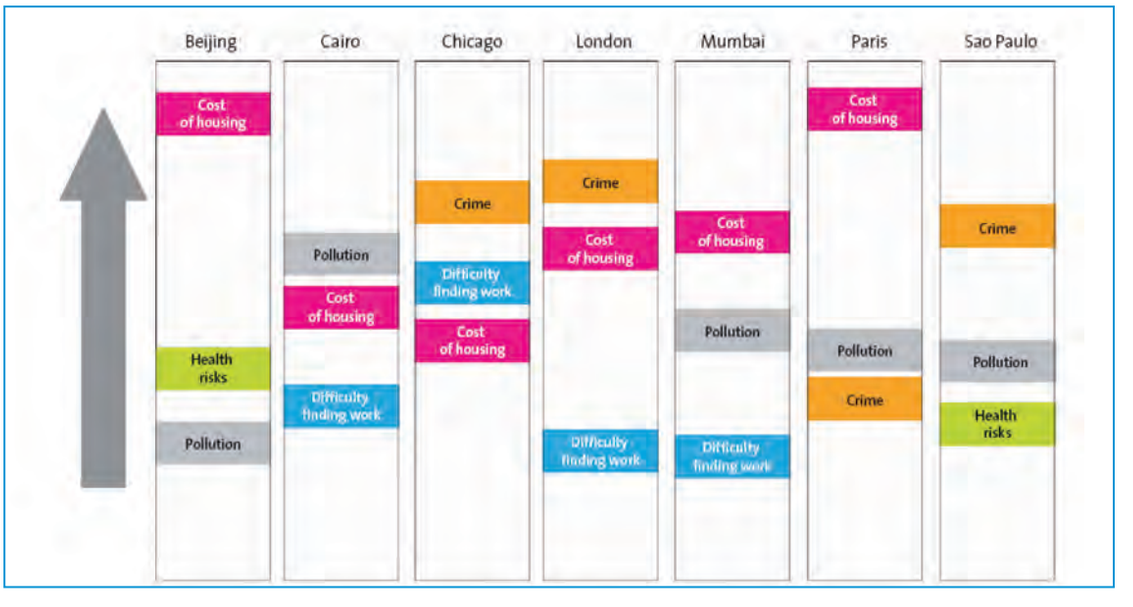
Sao Paulo even consider it the top priority. Safety takes priority in judging the quality of city life. Urban residents most sensitive to safety include those over the age of 50 and people who commute for more than two hours a day.

Secondly, high cost of living and scarce jobs. Some 53% of people who live in cities consider the cost of living there high. More than 70% of Londoners say so, versus 42% of Mumbai residents. And when asked about the price of housing, 62% think it is too high. The most virulent on the subject are Parisians (78%) and Londoners (76%), while the least affected are Cairo residents (50%). Moreover, the question of employment weighs heavily on the morale of urbanites. Cities are supposed to be the place to go to find work. However, more than a third of the people surveyed think their city offers few job opportunities and 40% say there are few interesting jobs near their home.

Third, unequal cities, inequality in the city. Because they are less likely to have chosen their city than the upper classes (59% vs. 69%), the least affluent social classes are less satisfied with their life (75% vs. 86%). Indeed, the lowest-income respondents perceive their city as a greater threat to their safety (40% vs. 52%) and do not think it offers many jobs (28% vs. 42%), despite the fact that 88% of them consider that important (versus 76% in the upper bracket) and suffer from the cost of living. Seventy-eight percent of them think the city is expensive, versus 68% of the affluent. Finally, they are harsher in their view of public transit quality (49% vs. 58%).

Inequality among cities. Transportation, especially public transit, reflects a number of expectations. Some 66% of city residents think the transportation system works well. However, in Sao Paulo and Cairo, it is deemed a priority for action. Generally speaking, 89% think that having good public transit is the second most important criterion for living well in the city. There is a wide divide among cities on the topic of cleanliness: 76% of city dwellers rate it as important, 68% of Sao Paulo residents consider their city dirty, Londoners are more divided with 49% positive opinions, while the cities of Paris (63%), Chicago (79%) and especially Beijing (83%) are considered clean. Moreover, there is a clear gap between Western cities and those in emerging economies when it comes to waste collection. Some 76% to 84% of Paris, Chicago and London residents are satisfied, while about 60% of Mumbai, Beijing and Sao Paulo residents say the same. The living environment and sense of belonging to a city suffer from the daily routine.

Figure 2-2. Each city has its own set of concerns: local particularities come out (Question: In your opinion, which of the following is the main issue faced by your city?)



My life, our city

Urbanites primarily aspire to stay afloat and are looking for a smoother-flowing daily routine, space and tranquility. They also sense that their city is changing and that they must be on the front lines of the action.

Expectations for daily life

Each day has its share of demands. So the expectations expressed relate primarily to daily life, which is at the center of their concerns. A "better tomorrow" will only arrive if the solutions best suited to future needs can be found.

Transportation, a core need. Transportation is the top criterion for improving urban life. The first thing city residents ask for is more efficient transit systems: more mass transit (54%) to relieve congestion and shorter work commutes (42%). In fact, almost half of urbanites report that they spend more than an hour in transit each day. Traffic jams (70%), noise (55%) and pollution (51%) are other reasons for discontent shared by urbanites. This pivotal message makes improved transportation the key to addressing all of the types of dissatisfaction reported – because it combats pollution and reduces noise to improve quality of life, for one thing. But it also works to lower the cost of living by offering an alternative to cars and enabling people to live in more spacious housing farther from the city center.

Better housing. Some 62% of urbanites think housing prices are too high. And 45% of residents who have lived in their city for less than 10 years experience that as their main problem. Only Sao Paulo residents do not rank housing prices among their priorities. Moreover, city dwellers would like larger homes (50%) that are better insulated from cold, heat and noise (38%). Housing size is a major concern in the lowest-income households, yet 43% of the most affluent urbanites still rank it as their top priority.

Health and pollution do not go together. Some 32% of city dwellers believe their city is dangerous to their health. It is one of the three priorities for action in Beijing and Sao Paulo. Only Mumbai residents think that their city is good for their health. In fact, half of urbanites say that they live in a polluted city. Parisians (64%) and Sao Paulo residents (83%) suffer from it the most. Only the cities of London and Chicago are relatively spared.

Figure 2-3. Top criteria for living well in the city

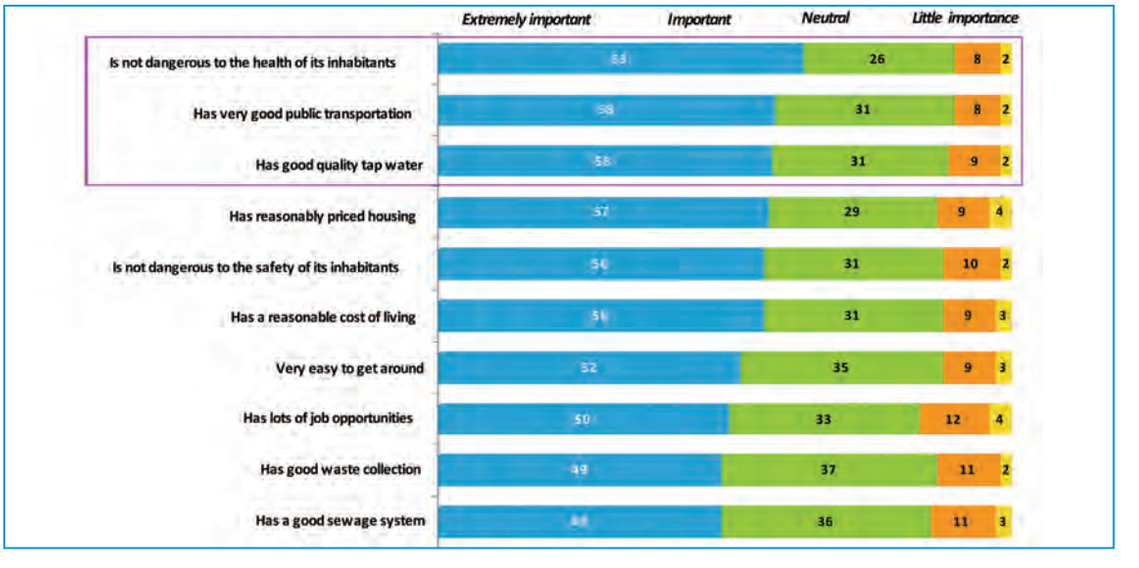
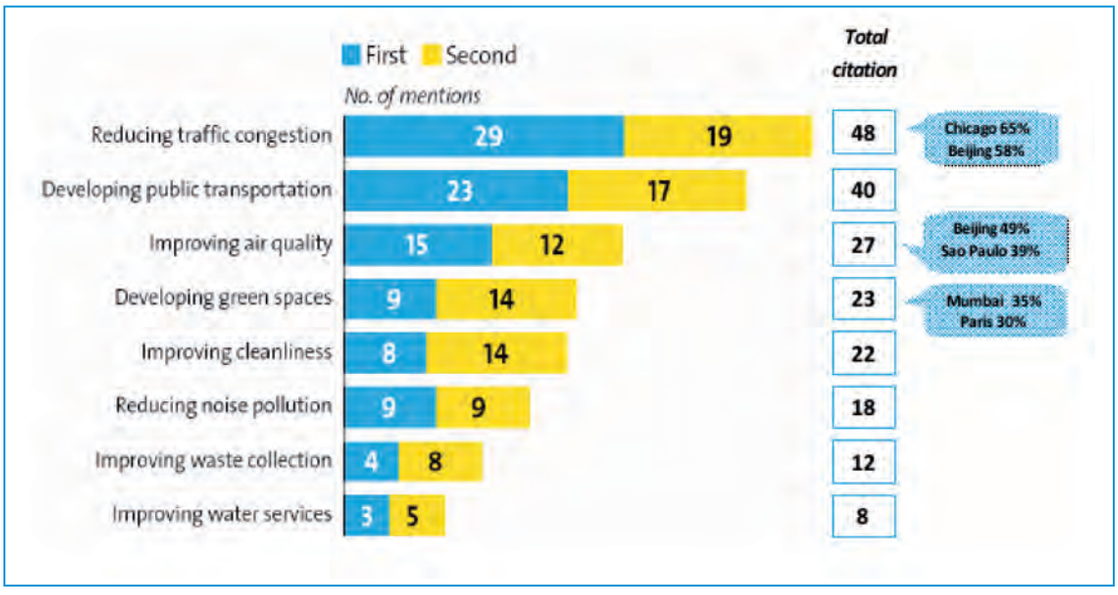


Figure 2-4. Areas of priority for city authorities

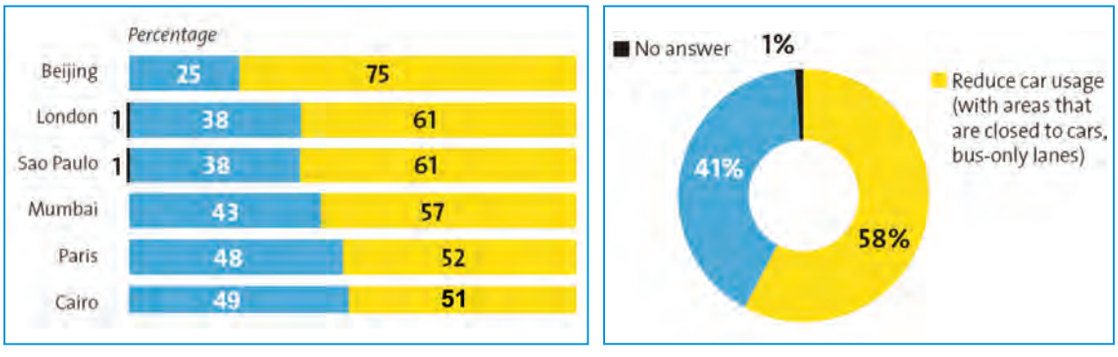


Conflicting aspirations, changing mentalities?

Urbanites express expectations and judgments that at first seem contradictory, but in fact say a lot about their nebulous but real emerging awareness of the collective issues involved in "city life."

Where do cars fit in? The symbol of a polluted, bloated, even individualistic city, the car and its place in urban environments reveal much about what urbanites are willing to do. Self-interest still trumps the collective welfare. Some 65% are attached to their cars and 79% of those who own one want to keep it. In addition, half of the respondents who do not have a car want one. This attachment is explained by the fact that public transit trips take longer: 28% spend more than two hours a day, versus 15% for drivers. Beijing (53%) and Mumbai (63%) residents are less enamored of cars. Yet these high figures conflict with the desire of 58% of city residents to see the place of automobiles in cities downplayed via car-free zones or bus lanes. In Beijing, 75% would like to see that happen. And when asked which type of transportation should be given development priority in the next few years, urban residents answer buses (67%) and metro (61%), which far outstrip cars (19%). Cars could occupy a less dominant position in the city.

Figure 2-5. Question: In your city, do you think the priority is to reduce car usage or facilitate car usage?



Insecurity vs. mutual support. One in four city dwellers cites lack of safety as their city's main problem. And 60% of Sao Paulo, Chicago and London residents do not feel safe in their city. Yet 76% respond that their city is safe and 72% believe they can trust one another. Cities for the most part remain safe, neighborly places.

Is city life really difficult? Urban residents manage to separate their demanding daily routine from the feeling of belonging to their city and from their sense that only cities can provide them with employment, collective services and cultural and sports activities all in one place. Attachment to cities is strong and as a result, 70% would like to see their children grow up in the city they live in. Apparently, then, the difficulties urbanites encounter in their city do not cause them to reject it.

How will cities develop in the future? Do urban residents want their city to grow horizontally or vertically, to prioritize quality of life or easy-to-reach services? Most of them believe that expanding detached homes is better for quality of life (64%), public health (61%) and pollution reduction (50%). Conversely, vertical growth is seen as an asset for mobility: to promote travel (53%) and expand public transit (49%). When asked about their personal preferences, the answers to these questions which are critical to the future of cities show no clear-cut tendencies. Some 52% would like to promote horizontal growth: to build detached homes by expanding the city. The other 48% choose verticality: putting up high buildings within the current city limits. Past urban planning policies seem to shape their opposite positions. As a general rule, urbanites who already live in a house would like to continue doing so (76% in Sao Paulo, 75% in London, 70% in Chicago). They are convinced building single-family homes in outlying areas is the best way to develop their conurbation. Likewise, city dwellers living in buildings prefer the multi-family solution to building homes far from the city (55% in Paris, 57% in Cairo and even 70% in Beijing). Only Mumbai residents would like to see their city grow vertically (56%) despite the fact that 59% of them live in a house.

Figure 2-6. Confidence in respect to the evolution of the quality of life in their city

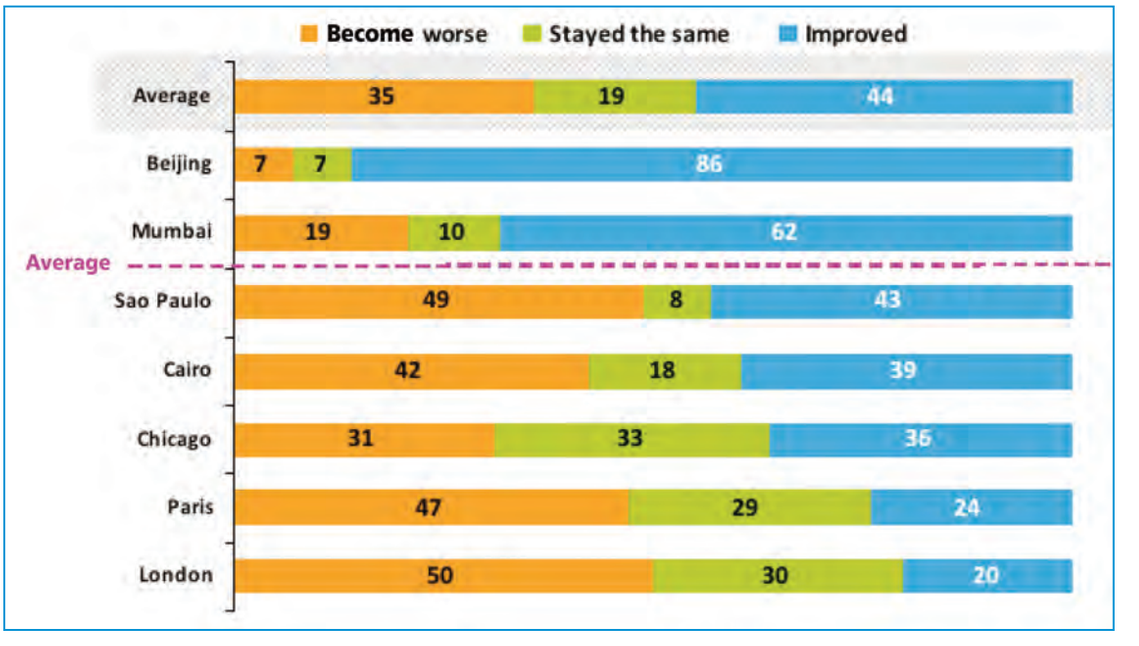
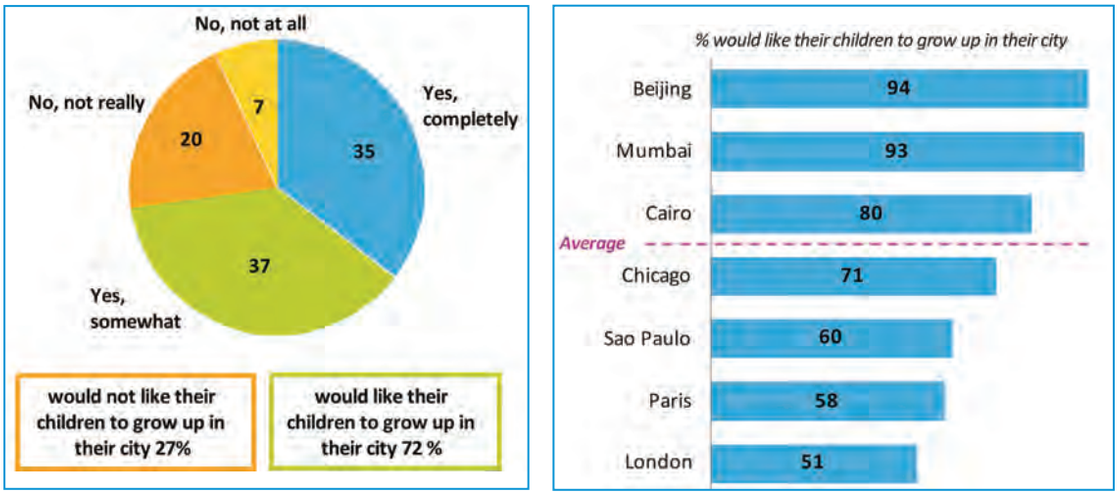


Figure 2-7. Question : Should your children grow up in the city?



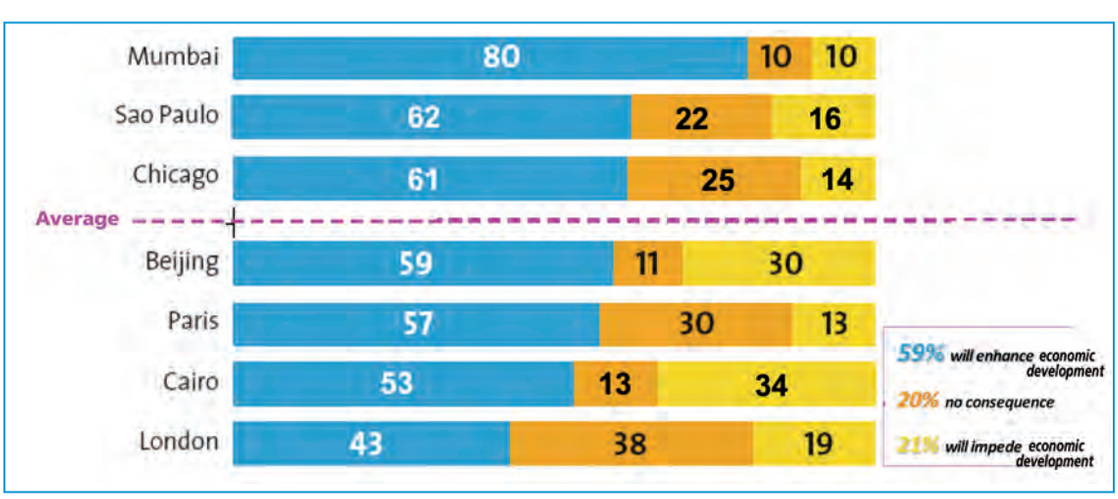
Environmental requirements

Shared awareness

Nearly 80% of urbanites say that environmental issues are a major problem. And, although they worry more about the fate of the planet than their city – except for Mumbai and Cairo – they still believe initiatives on behalf of the latter should not be neglected. Their city is paramount.

A struggle on several fronts… When residents check off what they would most like for their city, six of the top 10 most common answers involve environmental issues. In terms of transportation, 89% think very good public transit is needed and 87% believe it must be easy to get around in the city; 89% rate the quality of tap water and 85% consider wastewater disposal as very important. Finally, 86% of city residents want a good waste-collection system and 84% believe that their city should generally be very clean.

Figure 2-8. Question : How will the actions taken to protect the environment impact economic development?

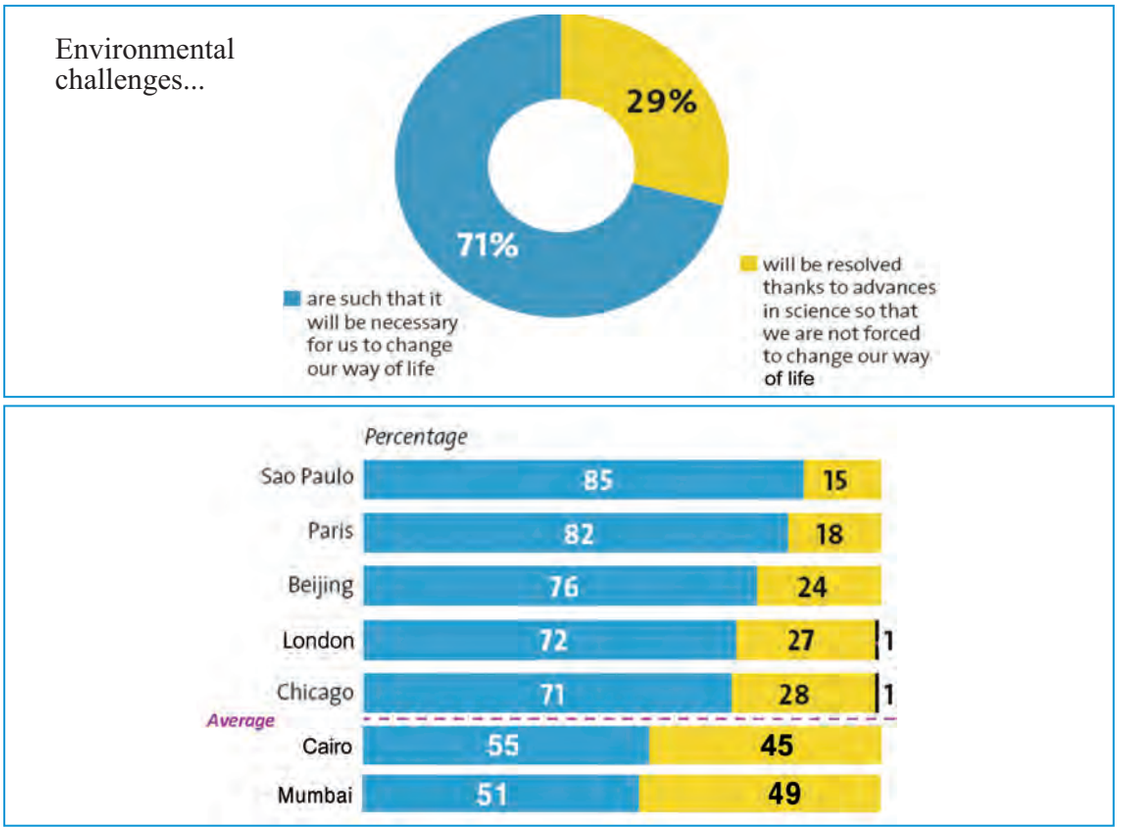


…to be fought primarily by the individual. Some 70% of urbanites think that environmental problems are so serious that whatever else happens, they will need to change the way in which they live. Mumbai (49%) and Cairo (45%) residents are more divided and believe scientific progress will be at least as important in solving environmental problems. People who have lived in their city for less than 10 years would like to help. They are more optimistic about the future quality of life in their city (49% vs. 44%) and more aware of the need to change the way they live in light of environmental threats (74% vs. 70%).

We are ready to make an effort! But not just any effort

Echoing the 71% of city residents who think they must change the way they live to meet environmental challenges, 92% look to themselves first to improve the environment. Far from being a disavowal of government authorities or businesses that provide public services, this probably shows that city dwellers are ready to shoulder their share of collective responsibility for protecting their environment.

Figure 2-9. Environmental issues to be fought primarily by the individual

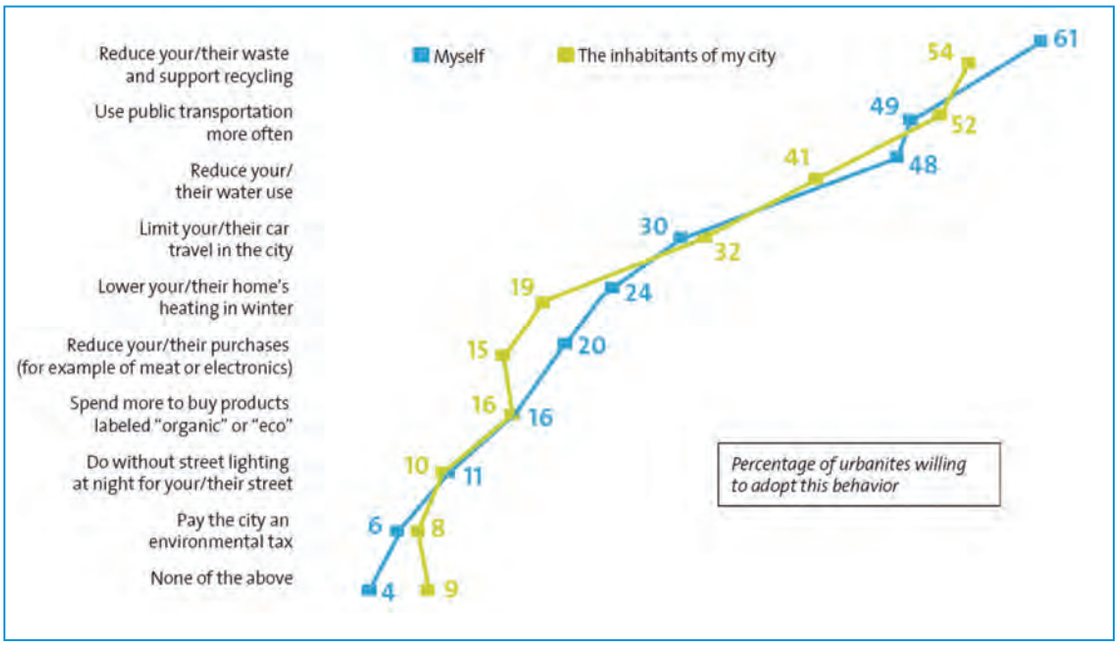


Making an effort right now. Civic awareness comes down to daily actions. Urbanites are ready to take them. Better yet, they think their neighbors are just as ready! What are they willing to do? For the most part, they see themselves trying to reduce and recycle their waste (61%), though Mumbai is less convinced at 49%; use public transit more frequently (49%) and therefore cars less often (30%). Note that Chicago (25%), Mumbai (24%) and especially Cairo (20%) residents are less interested in doing that; 48% want to cut their water consumption (65% and 63% in Mumbai and Beijing) and 24% to reduce winter heating.

Future efforts. City dwellers favor developments in their lives – and their city – that support the daily efforts they plan to make. These mainly concern transportation. Some 87% of city residents would like to see more people work from home to reduce commuting and 64% think that cities should build more bicycle trails and reduce the number of car lanes. This measure is especially popular in Sao Paulo (77%), Beijing (82%) and Mumbai (77%).

Efforts they do not think they should have to make. In keeping with the amount of dissatisfaction expressed, city dwellers do not think they need to make an effort on topics of concern to them such as their money and safety. Some 52% of urban residents oppose instituting a toll at the entrance to cities. A toll measure is popular only with Mumbai (84%) and Beijing (74%) residents. Moreover, just 6% of urbanites are willing to pay a city environment tax and 16% to spend more money to buy products labeled "organic." In addition, urbanites are not enthusiastic about cutting back on public lighting at night to curb energy use. Some 51% are opposed. Residents of London (63%), Chicago (62%) and Sao Paulo (84%)—the three cities that list safety as their top priority—strongly disapprove the idea. Residents are ready to do their part, on their level. However, they clearly state they are not willing to do just anything. To be genuinely effective, the example must also and most importantly come from the "people at the top."

Figure 2-10. Question: Out of the following behaviors, which ones would you be prepared to adopt? And in your opinion, which ones would the inhabitants of your city be prepared to adopt?



The role of public and private-sector stakeholders for improving the environment

Urbanites are aware that their scope of action is limited. They clearly favour a commitment by public authorities and private operators. Even better, they are confident that they have the skills and expertise to preserve the environment.

Reply to the expectations that urbanites can do little or nothing about. City dwellers fear the harmful impact of cities on the environment (37%) and the health of residents (32%). Many of their expectations for improving daily life lie at the intersection of those two impacts: improving transportation flows (42%), increasing public transit use (54%), better housing insulation (38%), improving air quality (27%), creating green spaces (23%), managing waste (22%), reducing noise (18%) and improving waste collection (12%) and water quality (8%).

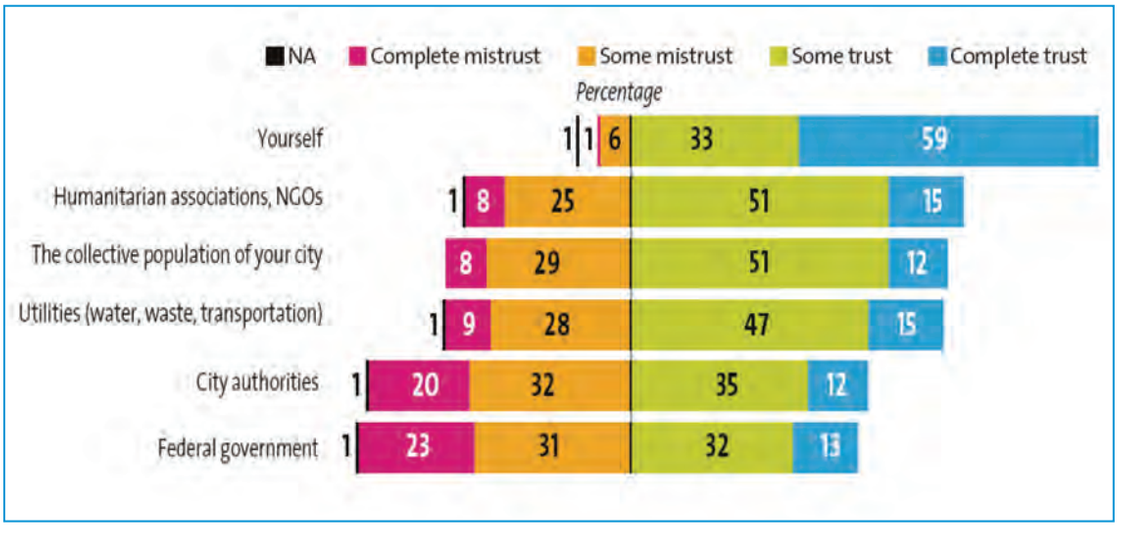
Involving residents in the city's decisions. Consulting urbanites is a prerequisite for gaining their support for the shared goal of preserving the urban environment. 44% of urban residents currently feel they participate in the decisions of their city. However, differences among cities are stark: only 20% of Parisians feel they are involved, versus 84% of Mumbai residents. And the more involved people are in authorities' decisions, the more confidence they have in them: 63% in their mayors and 70% in their governments.

The necessary, expected involvement of the city's operators. Urban residents want to see city stakeholders do even more for their city. It is a prerequisite for improving the environment.

Public authorities and associations. Political forces determine the effectiveness of environmental protection efforts. In that regard, mayors (47%) and governments (46%) have a major role to play. In addition, 66% of residents believe that associations and NGOs can extend the reach of and even effectively supplement public action in the field.

Companies that provide public services. Some 62% of urbanites have confidence in the companies that provide environmental public services in their city. They are considered necessary operators for the effective implementation of the decisions made by public authorities. More affluent households (65%) have more confidence in them to improve the environment than lower-income households (56%).

Figure 2-11. Question: For improving the environment here in your city, to what extent do you trust the following players?



Chapter 3. Which Criteria for the Cities of Tomorrow

Tan Khee Giap
Co-Director, Asia Competitiveness Institute
Lee Kuan Yew School of Public Policy
National University of Singapore

Jody Hung-Yi Tu
Research Associate, Asia Competitiveness Institute
Lee Kuan Yew School of Public Policy
National University of Singapore

Increased focus in the concept of 'livability'

As economics and societies integrate, globalization has become an inevitable path to a smaller world and closer relationship between cities through the exchange of goods and services, information, ideas and culture. Over the past decades, the pace of globalization has speeded up, contributed by the unprecedented advancements in technology, media, communication, transport and industry. Globalization, as a catalyst, increases the concept of 'livability'. As a means to attract global mobiles sources (such as talents, high net worth individuals, investors and capital), 'livability' is employed by cities to create positive impact on the growth and resilience of their economies.

Oftentimes, the concept of livability ties to economic and social factors such as employment opportunities, housing affordability, public services, and safety. In fact, with scarce resources and continuing environmental issues, another focus in 'livability' is the growing global importance and awareness of the sustainable development. A sustainable city feeds itself with consideration of environmental impact and minimizes the required inputs of energy, water and food, and waste output of pollution. Being environmentally sound helps to reduce the environmental costs on business.

Thus, it is the general consensus that for a city to 'livable', it must also be sustainable, especially when the number of megacities has increased worldwide and urbanization is taking place. It is estimated by the United Nations that the world population will increase by 1.5 billion with 60% residing in urban areas in 2030. This stresses the necessity of understanding challenges posed on implementing urban planning policies and practicing sustainability.

Factors influencing the livability of cities

The idea of 'livability' generally links with the quality of life experienced by city dwellers and their accessibility to infrastructure like clean water and air, affordable housing, meaningful employment, and a green environment. Although economic factor such as GDP is indeed an important component to make up an ideal livable city, the growth of the city also relies on its sustainability to promote high quality of life. Meanwhile, maintaining harmony in the society, low threats to safety, cultural diversity and good top management from its government as well contribute to an ideal livable city. To be fair, it is possible for potential candidates to become an ideal livable city despite the fact that there is no such city at the moment.

Available frameworks

To give an overall livability of cities, there are several existing frameworks, each with different focus on certain factors that had already carried out rankings through collection of internal organization, public, and survey data. For example, the Quality of Living Index by Mercer and the Livability Ranking by EU concentrate on mainly living conditions of the assessed cities. While Global Competitiveness Report by WEF is primarily economic orientated, the Environment Sustainability by Yale and Columbia University measures the green aspects of the city.

There are at least 21 major studies that produce rankings of the cities in fields related to economic competitiveness, urbanization, quality of life, gross national happiness, crisis management, environmental friendliness and sustained development. However, there has not been a comprehensive theoretical framework that comprises most areas of indicators to assess global cities. With such weakness, the proposed Global Livable Cities Index (GLCI) framework has a goal to improve the current deficiency of existing frameworks and to achieve it by amalgamating the merits of various studies. A global livable city, with the aim to be an ideal place for individuals to reside in, is characterized by a facilitative government, stable economic growth, and a specific level of integration to the world economy. It also should balance with exhibiting environmental friendliness, sustainability, cultural diversity, security, socio-political harmony.

Global Livable Cities Index framework

Therefore, keeping all these factors in mind, the GLCI is constructed according to five categories: (1) economic vibrancy & competitiveness, (2) environmental friendliness & sustainability, (3) domestic security & stability, (4) quality of life & diversity and (5) good governance & effective leadership.

Economic vibrancy & competitiveness

First of all, economic vibrancy & competitiveness covers sub-categories of economic performance, economic openness and infrastructure. From perspective of its economic performance and resilience to global events, it highlights a city's credit worthiness and potential growth. A city's policy towards capital and trade can be seen from its economic openness. An economic open city with high degree of free trade and access to international financial market attracts global mobile resources. The city's infrastructure as facilitators and enablers of economic activities is thereby also a key tool to gain trust and secure the investors.

Environmental friendliness & sustainability

Within environmental friendliness & sustainability, three sub-categories, pollution, depletion of natural resources and environmental initiatives are included. When the rate of resource exhaustion and waste accumulation is quickened, a city's economic performance is going to be affected in the long run. If a city can show its effort in using sustainable resource to minimize the impacts that expanding industrialization and population growth have brought, it has the advantage of attracting prospective investments. As the need of conserving the natural resources drives up, it is imperative to have environmental initiatives in the cities to create a more competitive city.

Domestic security & stability

Crime rate, threats to national security and civil unrest are under domestic security & stability, to measure the peace of the city, followed by the green factors. The presence of national security and stability plays a big role in satisfying the basic needs of the people and allowing other development

goal to be pursued. Low crime rate, low threats to national stability and low civil unrest strength confidence in leadership of government and reduce fear among the city's inhabitants.

Quality of life & diversity

Quality of life & diversity is determined by evaluating a myriad of areas from medical & health care, education, housing and sanitation & transport to income quality & demographic burden, and diversity & community cohesion. These social indicators are basic necessities to inhabitants' everyday life.

Good governance & effective leadership

Lastly and equally important, good governance & effective leadership are a must towards a more livable city. Four sub-categories: policy making & implementation, government system, transparency & accountability, and corruption, make effective indicators to examine the efficiency of a city's political group. The city's success and sustainability depend largely on the execution abilities and the judicial function of the government. For a government to maintain its justice, the liberalization and anti-corruption have to be taken care of. All in all, the five comprehensive categories are heavily interdependent.

Indicators and selection of cities

Before processing the rankings of global cities, GLCI framework proposes a set of ideal indicators under each category that could potentially be used in identifying and reflecting the 'livability' of a city. Nevertheless, since some ideal indicators are not available in several cities, comparison cannot be made for those ideal indicators. This list of ideal indicators is then reduced to a set of practical indicators to give a more meaningful result. A total of 64 cities including megacities (such as Mumbai and New York) and emerging cities (such as Shanghai) were selected in GLCI. In all, there are 18 sub-categories comprising 129 ideal indicators but only 85 practical indicators were chosen and used due to data non-availability and cost constraints.

Methodology

The methodology in GLCI framework follows a similar approach to World Competitiveness Yearbook but with different criteria and indicators. The first approach to process the rankings of global cities is to compute the mean value of practical indicator, followed by calculating its standard deviation. Using the standard deviation value, the standardized value and the 'ranked' standardized value (RSVI) of the indicator can be computed. Cities with a lower value of RSVI for that practical indicator are ranked higher than those with a higher value. For each city, the RSVI is calculated for each subcategory and category. The overall rank score of city is then formed: cities with a lower value are ranked ahead of those with higher. Thus, the city with the lowest value is the most livable city.

The above method provides the ranking of each city for each individual practical indicator. Nonetheless, depending on the nature of the indicator, a higher value or lower value may reflect a more 'livable' city. To keep the ranking purpose consistent, the values are standardized. When it comes to cases where data is unavailable for a particular city, the data is replaced by the average of existing data within the sub-category. Each sub-category has an equal impact on the overall ranking. Every RSVI of the sub-category is aggregated. In the end, the RSVI value of each category is totaled to determine the overall ranking of the city. Although the number of sub-categories and indicators varies for each main category, the aggregated score for each main category gives the same weight – 20% to the GLCI. The same method is repeated and applied consistently across all the cities to prevent biasness and to ensure the precision of the results.

Data source, constraints and proxies

Both hard data, quantitative indicators, and soft data, qualitative attributes, are used in developing GLCI. Data is only collected from credible survey agencies, reputable organizations, statistical boards and international research companies to ensure accurate ranking results. With standardized measure derived from the hard and soft data of each city, its shortcomings relative to its counterpart are clearly identified and improvements can be made. Additionally, three proxy techniques are applied in certain situations. For missing data, it is replaced with the mean value of the city figures available for that particular indicator. For lack of city level data, data at the national level is used to proxy. For absent theoretical indicator, an alternate indicator close to the ideal one with considerable data is taken.

Empirical findings

The overall results of GLCI ranking have placed two cities of Switzerland, Geneva and Zurich in the top and second position respectively and Singapore in the third, while Moscow, Manila and Jakarta take the last three positions. Both Geneva and Zurich have similar rankings in terms of government, social and environment aspects. In the aspects of 'domestic security & stability,' cities like Singapore and Hong Kong were observed to perform better than Geneva and Zurich. This is due to the number of new drug cases and fatalities from terrorist attacks pulling down both Geneva and Zurich's security ranking. Singapore performed strongly in areas of government, social and security. It performed especially well in both subcategories 'policy making & implementation' and 'corruption', compared to other cities. However, Singapore, being one of the smallest cities in terms of land area, did not perform as well as other cities that have abundant land in the fields of 'terrestrial protected area ', 'protected marine area' and 'electricity generated from renewable sources.' (Refer to Appendix for table 1-6)

For only Asian cities are selected, Singapore is ranked the top, Hong Kong the second and Auckland the third. Phnom Penh, Manila and Jakarta are placed the last three respectively. Hong Kong, Singapore and Auckland also clinch the top three positions respectively for the category 'good governance & effective leadership'. Ahead of Sydney and Singapore, Hong Kong ranks first in the aspects of 'economic vibrancy & competitiveness', but it does not perform as well as cities like Auckland and Singapore, which take the top two positions respectively, in category of 'environmental friendliness & sustainability'. In terms of 'quality of life & diversity', Singapore takes the top place while three Japanese cities Tokyo, Osaka-Kobe, and Yokohama share the second position. (Refer to Appendix for table 7)

Concluding remarks and limitations

As a comprehensive and balanced study, GLCI's performance is comparatively pioneering and timely. It also suggests possible rankings of cities as they improve on the weakest performance in the future. Moreover, it provides insightful and advantageous information such as emphasis on good governance and effective leadership for emerging cities during their stage of development and helps them in policies and decision making. These are indeed useful in the aim of achieving higher ranking.

Although GLCI is constructed as accurately as possible, there are still limitations to the findings because of the challenging nature of ranking at city level. Firstly, ideal set of data is not captured because of the unavailability in complete city level data. Previous years' information was used if there is a lack of updated information by agencies. Two implications occur when it comes to inexhaustibility of indicators list. One is the inability to reflect all the aspects of livability while another is the possibility of using less pertinent factors to produce the true ranking of a city's livability.

All in all, GLCI is a well-rounded framework that comprises many indicators from different important areas. It is developed to fully capture the concept of livability of cities. Not only does GLCI give an important result of global cities rankings, it also serves as a guide for policy makers, businesses and investors in both decision making and allocation of resources.

Table 1. Overall Ranking for 64 Global Cities

City	Region	Overall Livability		City	Régions	Overall Livability	
		Score	Rank			Score	Rank
Geneva	Europe	3.40	1	Kuala Lumpur	Asean	32.00	32
Zurich	Europe	4.60	2	Rome	Europe	34.00	34
Singapore	Asean	5.60	3	Amman	Mid East	36.60	35
Copenhagen	Europe	7.00	4	Jerusalem	Asia	37.00	36
Helsinki	Europe	7.00	4	Sao Paulo	South America	43.40	37
Luxembourg	Europe	7.80	6	Riyadh	Mid East	44.00	38
Stockholm	Europe	8.20	7	Shanghai	Asia	45.00	39
Berlin	Europe	11.20	8	Nanjing	Asia	45.20	40
Hong Kong	Asia	11.20	8	Bangkok	Asean	45.80	41
Auckland	Oceania	11.60	10	Shenzhen	Asia	45.80	41
Melbourne	Oceania	11.60	10	Ahmedabad	Asia	46.00	43
Sydney	Oceania	12.00	12	Cairo	Mid East	46.00	43
Paris	Europe	12.40	13	Tianjin	Asia	47.40	45
Vancouver	North America	16.20	14	Beijing	Asia	47.80	46
Amsterdam	Europe	16.80	15	Chennai	Asia	48.20	47
Osaka-Kobe	Asia	17.80	16	Guangzhou	Asia	48.20	47
New York	North America	18.20	17	Pune	Asia	48.20	47
Tokyo	Asia	18.60	18	Mexico City	North America	48.40	50
Los Angeles	North America	18.80	19	Damascus	Mid East	48.60	51
Philadelphia	North America	21.40	20	Chongqing	Asia	48.80	52
Yokohama	Asia	21.40	20	Hanoi	Asean	48.80	52
Boston	North America	21.60	22	Ho Chi Minh City	Asean	48.80	52
London	Europe	21.60	22	Bangalore	Asia	49.00	55
Chicago	North America	22.40	24	Mumbai	Asia	49.00	55
Washington DC	North America	22.80	25	Delhi	Asia	50.20	57
Barcelona	Europe	23.20	26	Buenos Aires	South America	50.60	58
Taipei	Asia	24.00	27	Istanbul	Mid East	52.20	59
Prague	Europe	25.80	28	Karachi	Mid East	53.00	60
Seoul	Asia	26.20	29	Phnom Penh	Asean	53.80	61
Madrid	Europe	27.00	30	Moscow	Europe	55.20	62
Incheon	Asia	27.40	31	Manila	Asean	56.60	63
Abu Dhabi	Mid East	32.00	32	Jakarta	Asean	57.40	64

Table 2. Economic Vibrancy & Competitiveness Ranking for 64 Global Cities

City	Region	Overall Livability		City	Régions	Overall Livabil-	
		Score	Rank			Score	Rank
Luxembourg	Europe	16.13	1	Rome	Europe	30.91	30.91
Copenhagen	Europe	17.78	2	Chicago	North America	31.22	31.22
Geneva	Europe	18.43	3	Riyadh	Mid East	31.26	31.26
Hong Kong	Asia	18.87	4	Nanjing	Asia	31.43	31.43
Singapore	Asean	19.78	5	Madrid	Europe	31.70	31.70
Melbourne	Oceania	20.57	6	Cairo	Mid East	32.48	32.48
Helsinki	Europe	20.96	7	Shenzhen	Asia	32.65	32.65
Sydney	Oceania	20.96	7	Tianjin	Asia	32.87	32.87
Zurich	Europe	21.35	9	Guangzhou	Asia	33.65	33.65
Amsterdam	Europe	22.65	10	Bangkok	Asean	33.91	33.91
Stockholm	Europe	23.22	11	Chongqing	Asia	34.39	34.39
London	Europe	23.30	12	Phnom Penh	Asean	34.65	34.65
Auckland	Oceania	23.91	13	Shanghai	Asia	34.83	34.83
Paris	Europe	24.87	14	Karachi	Mid East	34.83	34.83
Berlin	Europe	25.17	15	Beijing	Asia	35.04	35.04
New York	North America	26.43	16	Amman	Mid East	36.04	36.04
Barcelona	Europe	26.48	17	Damascus	Mid East	36.09	36.09
Los Angeles	North America	26.87	18	Istanbul	Mid East	36.09	36.09
Prague	Europe	26.91	19	Hanoi	Asean	36.17	36.17
Philadelphia	North America	27.39	20	Ho Chi Minh City	Asean	36.17	36.17
Boston	North America	27.48	21	Mexico City	North America	37.87	37.87
Vancouver	North America	27.91	22	Jakarta	Asean	39.09	39.09
Kuala Lumpur	Asean	28.74	23	Ahmedabad	Asia	39.96	39.96
Osaka-Kobe	Asia	29.09	24	Pune	Asia	40.09	40.09
Taipei	Asia	29.09	24	Bangalore	Asia	40.57	40.57
Jerusalem	Asia	29.30	26	Chennai	Asia	41.48	41.48
Washington DC	North America	29.43	27	Delhi	Asia	41.57	41.57
Abu Dhabi	Mid East	29.61	28	Mumbai	Asia	41.78	41.78
Incheon	Asia	29.65	29	Manila	Asean	42.22	42.22
Seoul	Asia	30.00	30	Moscow	Europe	42.78	42.78
Tokyo	Asia	30.35	31	Sao Paulo	South America	43.13	43.13
Yokohama	Asia	30.48	32	Buenos Aires	South America	44.09	44.09

Table 3. Environmental Friendliness & Sustainability Ranking for 64 Global Cities

City	Region	Overall Livability		City	Régions	Overall Livability	
		Score	Rank			Score	Rank
Stockholm	Europe	8.47	1	Boston	North America	30.93	32
Geneva	Europe	11.73	2	Washington DC	North America	30.93	32
Zurich	Europe	11.73	2	Bangkok	Asean	30.93	32
Luxembourg	Europe	13.47	4	Hong Kong	Asia	31.93	36
Berlin	Europe	14.60	5	Incheon	Asia	31.93	36
Auckland	Oceania	16.93	6	Buenos Aires	South America	32.67	38
Paris	Europe	17.00	7	Mexico City	North America	32.93	39
Helsinki	Europe	18.27	8	Hanoi	Asean	33.93	40
London	Europe	19.67	9	Ho Chi Minh City	Asean	33.93	40
Barcelona	Europe	20.60	10	Karachi	Mid East	34.40	42
Madrid	Europe	20.93	11	Mumbai	Asia	34.47	43
Sao Paulo	South America	21.47	12	Manila	Asean	34.93	44
Tokyo	Asia	22.47	13	Riyadh	Mid East	35.60	45
Singapore	Asean	22.53	14	Abu Dhabi	Mid East	35.73	46
Copenhagen	Europe	23.00	15	Ahmedabad	Asia	36.20	47
Osaka-Kobe	Asia	23.73	16	Bangalore	Asia	36.20	47
Melbourne	Oceania	24.07	17	Shanghai	Asia	36.27	49
Sydney	Oceania	24.27	18	Nanjing	Asia	36.87	50
Prague	Europe	25.40	19	Shenzhen	Asia	36.87	50
New York	North America	25.93	20	Delhi	Asia	36.93	52
Los Angeles	North America	26.20	21	Phnom Penh	Asean	37.00	53
Vancouver	North America	26.33	22	Moscow	Europe	37.00	53
Chicago	North America	26.40	23	Chennai	Asia	37.27	55
Amsterdam	Europe	26.87	24	Istanbul	Mid East	37.73	56
Rome	Europe	27.00	25	Cairo	Mid East	38.40	57
Yokohama	Asia	27.47	26	Pune	Asia	38.40	57
Kuala Lumpur	Asean	27.60	27	Damascus	Mid East	42.27	59
Amman	Mid East	29.13	28	Guangzhou	Asia	43.07	60
Seoul	Asia	29.67	29	Beijing	Asia	43.27	61
Taipei	Asia	29.73	30	Tianjin	Asia	43.80	62
Jerusalem	Asia	29.93	31	Chongqing	Asia	44.20	63
Philadelphia	North America	30.93	32	Jakarta	Asean	44.93	64

Table 4. Domestic Security & Stability Ranking for 64 Global Cities

City	Region	Overall Livability		City	Régions	Overall Livability	
		Score	Rank			Score	Rank
Singapore	Asean	4.90	1	Barcelona	Europe	30.00	33
Hong Kong	Asia	10.70	2	Madrid	Europe	30.00	33
Copenhagen	Europe	12.90	3	London	Europe	30.30	35
Auckland	Oceania	13.00	4	Rome	Europe	30.60	36
Helsinki	Europe	15.10	5	Hanoi	Asean	31.50	37
Paris	Europe	16.40	6	Ho Chi Minh City	Asean	31.50	37
Berlin	Europe	17.60	7	Kuala Lumpur	Asean	32.60	39
Taipei	Asia	17.70	8	Sao Paulo	South America	33.20	40
Luxembourg	Europe	18.10	9	Shanghai	Asia	33.40	41
Geneva	Europe	19.10	10	Nanjing	Asia	33.40	41
Zurich	Europe	19.10	10	Shenzhen	Asia	33.40	41
Vancouver	North America	20.40	12	Guangzhou	Asia	33.40	41
Melbourne	Oceania	20.70	13	Beijing	Asia	33.40	41
Sydney	Oceania	20.70	13	Tianjin	Asia	33.40	41
Tokyo	Asia	22.50	15	Chongqing	Asia	33.40	41
Osaka-Kobe	Asia	22.50	15	Buenos Aires	South America	33.90	48
Yokohama	Asia	22.50	15	Jakarta	Asean	34.80	49
Stockholm	Europe	23.20	18	Riyadh	Mid East	37.70	50
Prague	Europe	23.20	18	Phnom Penh	Asean	39.20	51
Seoul	Asia	23.40	20	Mumbai	Asia	40.30	52
Incheon	Asia	23.40	20	Ahmedabad	Asia	40.30	52
Amsterdam	Europe	25.30	22	Bangalore	Asia	40.30	52
Cairo	Mid East	25.50	23	Delhi	Asia	40.30	52
Abu Dhabi	Mid East	27.10	24	Chennai	Asia	40.30	52
Amman	Mid East	27.80	25	Pune	Asia	40.30	52
New York	North America	28.00	26	Istanbul	Mid East	42.30	58
Los Angeles	North America	28.00	26	Karachi	Mid East	42.70	59
Chicago	North America	28.00	26	Moscow	Europe	42.70	59
Philadelphia	North America	28.00	26	Bangkok	Asean	43.00	61
Boston	North America	28.00	26	Jerusalem	Asia	43.80	62
Washington DC	North America	28.00	26	Mexico City	North America	47.40	63
Damascus	Mid East	29.90	32	Manila	Asean	49.90	64

Table 5. Quality of Life & Diversity Ranking for 64 Global Cities

City	Region	Overall Livability		City	Régions	Overall Livability	
		Score	Rank			Score	Rank
Geneva	Europe	14.21	1	Taipei	Asia	26.08	33
Zurich	Europe	14.21	1	Kuala Lumpur	Asean	27.13	34
Stockholm	Europe	15.67	3	Amman	Mid East	29.21	35
Copenhagen	Europe	16.54	4	Rome	Europe	32.17	36
Singapore	Asean	16.83	5	Riyadh	Mid East	33.00	37
Helsinki	Europe	17.17	6	Moscow	Europe	35.63	38
Vancouver	North America	18.50	7	Bangkok	Asean	37.04	39
Amsterdam	Europe	18.83	8	Damascus	Mid East	37.08	40
Paris	Europe	18.96	9	Beijing	Asia	37.42	41
Hong Kong	Asia	19.63	10	Shanghai	Asia	38.29	42
Berlin	Europe	20.54	11	Buenos Aires	South America	39.25	43
Tokyo	Asia	21.79	12	Mexico City	North America	39.29	44
Osaka-Kobe	Asia	21.79	12	Ahmedabad	Asia	39.71	45
Yokohama	Asia	21.79	12	Chennai	Asia	39.71	45
Luxembourg	Europe	22.21	15	Pune	Asia	39.71	45
Melbourne	Oceania	22.46	16	Tianjin	Asia	39.75	48
Sydney	Oceania	22.46	16	Nanjing	Asia	39.79	49
New York	North America	22.83	18	Shenzhen	Asia	39.79	49
Los Angeles	North America	22.83	18	Guangzhou	Asia	39.79	49
Chicago	North America	22.83	18	Chongqing	Asia	40.08	52
Philadelphia	North America	22.83	18	Cairo	Mid East	40.21	53
Boston	North America	22.83	18	Istanbul	Mid East	40.29	54
Washington DC	North America	22.83	18	Hanoi	Asean	42.96	55
Abu Dhabi	Mid East	23.54	24	Ho Chi Minh City	Asean	42.96	55
Seoul	Asia	23.67	25	Delhi	Asia	43.58	57
Incheon	Asia	23.67	25	Bangalore	Asia	43.75	58
Madrid	Europe	24.29	27	Mumbai	Asia	43.96	59
Jerusalem	Asia	24.29	27	Manila	Asean	44.54	60
Barcelona	Europe	24.46	29	Sao Paulo	South America	44.92	61
Auckland	Oceania	24.54	30	Karachi	Mid East	46.54	62
Prague	Europe	25.92	31	Phnom Penh	Asean	47.13	63
London	Europe	26.04	32	Jakarta	Asean	48.75	64

Table 6. Good Governance & Effective Leadership Ranking for 64 Global Cities

City	Region	Overall Livability		City	Régions	Overall Livability	
		Score	Rank			Score	Rank
Geneva	Europe	12.38	1	Pune	Asia	31.15	31
Zurich	Europe	12.38	1	Delhi	Asia	31.15	31
Singapore	Asean	13.69	3	Bangalore	Asia	31.15	31
Hong Kong	Asia	14.77	4	Mumbai	Asia	31.15	31
Auckland	Oceania	15.15	5	Kuala Lumpur	Asean	31.23	37
Melbourne	Oceania	16.15	6	Abu Dhabi	Mid East	33.62	38
Sydney	Oceania	16.15	6	Jerusalem	Asia	34.62	39
Stockholm	Europe	16.62	8	Rome	Europe	35.62	40
Helsinki	Europe	16.77	9	Sao Paulo	South America	36.08	41
Luxembourg	Europe	17.00	10	Prague	Europe	36.38	42
Copenhagen	Europe	18.08	11	Mexico City	North America	38.31	43
New York	North America	18.08	11	Istanbul	Mid East	39.15	44
Los Angeles	North America	18.08	11	Chongqing	Asia	39.23	45
Chicago	North America	18.08	11	Tianjin	Asia	39.31	46
Philadelphia	North America	18.08	11	Amman	Mid East	39.46	47
Boston	North America	18.08	11	Shanghai	Asia	39.85	48
Washington DC	North America	18.08	11	Beijing	Asia	39.92	49
Vancouver	North America	18.15	18	Nanjing	Asia	40.15	50
Berlin	Europe	18.15	18	Shenzhen	Asia	40.15	50
Amsterdam	Europe	19.77	20	Guangzhou	Asia	40.15	50
London	Europe	19.77	20	Riyadh	Mid East	41.92	53
Tokyo	Asia	23.15	22	Manila	Asean	42.23	54
Osaka-Kobe	Asia	23.15	22	Bangkok	Asean	43.92	55
Yokohama	Asia	23.15	22	Jakarta	Asean	45.77	56
Taipei	Asia	26.54	25	Karachi	Mid East	46.92	57
Paris	Europe	27.00	26	Phnom Penh	Asean	48.54	58
Seoul	Asia	29.69	27	Cairo	Mid East	49.15	59
Incheon	Asia	29.69	27	Buenos Aires	South America	49.31	60
Madrid	Europe	29.69	27	Hanoi	Asean	49.69	61
Barcelona	Europe	29.69	27	Ho Chi Minh City	Asean	49.69	61
Ahmedabad	Asia	31.15	31	Damascus	Mid East	52.62	63
Chennai	Asia	31.15	31	Moscow	Europe	57.54	64

Table 7. Overall Ranking for 36 Asian Cities

City	Region	Overall Livability		City	Régions	Overall Livability	
		Score	Rank			Score	Rank
Singapore	Asean	1.80	1	Beijing	Asia	21.60	19
Hong Kong	Asia	4.80	2	Chongqing	Asia	21.80	20
Auckland	Oceania	5.00	3	Guangzhou	Asia	22.00	21
Sydney	Oceania	5.20	4	Ahmedabad	Asia	22.20	22
Melbourne	Oceania	5.40	5	Riyadh	Mid East	22.40	23
Osaka-Kobe	Asia	6.20	6	Chennai	Asia	23.00	24
Tokyo	Asia	7.00	7	Bangkok	Asean	23.20	25
Yokohama	Asia	7.80	8	Bangalore	Asia	23.60	26
Seoul	Asia	8.20	9	Mumbai	Asia	23.60	26
Taipei	Asia	8.60	10	Pune	Asia	23.80	28
Incheon	Asia	8.80	11	Delhi	Asia	24.60	29
Kuala Lumpur	Asean	12.00	12	Ho Chi Minh City	Asean	25.80	30
Abu Dhabi	Mid East	15.60	13	Damascus	Mid East	26.00	31
Amman	Mid East	16.60	14	Istanbul	Mid East	28.00	32
Nanjing	Asia	19.60	15	Karachi	Mid East	28.80	33
Shanghai	Asia	20.20	16	Phnom Penh	Asean	29.80	34
Shenzhen	Asia	20.60	17	Manila	Asean	31.40	35
Tianjin	Asia	21.20	18	Jakarta	Asean	32.00	36

Chapter 4. Environmentally Sustainable Cities in Asia : Diversity in approaches and challenges

Ryokichi Hirono
Professor Emeritus
Seikei University, Tokyo

Contents

1. Rapid Economic Growth, Widening Income Gaps and Increasing Social Inequities in Asia under Globalization

In terms of GDP growth since 1965, as shown in Table 1 below, the developing economies as a whole have grown faster than the developed region and in the developing region, Asia (East and South Asia) has grown fastest, with East Asian growth exceeding South Asia.

Table 1. Economic Growth, by Region, 1965-2008

	1965-70	70-80	80-90	90-2000	2000-08
East Asia	7.2	6.6	8.0	7.2	9.1
South Asia	3.7	3.5	5.7	5.6	7.4
LAC	6.0	5.5	1.7	3.3	3.9
MENA	6.1	5.2	3.0	3.0	4.7
ECA	n.a.	n.a.	1.8	-1.9	6.3
SSA	4.8	4.0	1.7	2.4	5.2
Developing	5.8	5.3	3.4	3.6	6.4
Developed	3.6	3.1	2.9	2.3	2.4

Sources: World Bank, *World Development Reports, 1982, 1992, 2002 & 2010,* Table 4, pp. 384-385.

There has also been a wide disparity in economic growth rates among Asian economies, as shown in Table 2 . As a result of a sustained economic growth during the last half a century, the developing region which occupied only 24.6% of the world's GDP in 1970, today constitutes 27.2%.

Table 2. Economic Growth of Selected Asian Economies and Groups

	70-80	80-90	90-00	2000-08	2011	2008 PPP GNI per capita (US $)	2008 FEMR* per capita
			(%)				
Developing	5.3	3.4	3.6	6.4	n.a.	5,330	2,789
EAP	6.6	8.0	7.2	9.1	7.7+	5,398	2,631
China	5.5	9.5	10.3	10.4	9.1	6,020	2,940
Indonesia	7.2	5.6	4.2	5.2	6.0	3,830	2.010
Malaysia	7.9	5.7	7.0	5.5	5.0	13,740	6,970
PNG	2.2	2.0	4.0	2.3	7.7	2,000	1,010
Philippines	6.1	0.9	8.5	5.1	4.6	3,900	1,890
Korea	9.6	9.6	5.7	4.5	4.6	28,120	21,530
Singapore	8.3	6.6	7.8	5.8	5.0	47,940	34,760
Thailand	7.1	7.9	4.2	5.2	4.5	5,990	2,840
Vietnam	n.a.	6.8	8.7	7.7	6.8	2,700	890
South Asia	3.5	5.7	5.6	7.4	8.0	2,754	986
Bangladesh	4.3	3.7	3.6	5.9	6.3	1,440	520
India	3.2	5.8	6.0	7.9	8.0	2,960	1,070
Pakistan	6.7	6.3	11.2	5.8	4.0	2,700	980
Sri Lanka	5.6	3.9	9.8	5.5	7.1	4,480	1,790
OECD	3.1	2.9	2.3	2.3	n.a.	37,141	39,345
Australia	3.0	3.1	4.1	3.3	n.a.	34,040	40,350
Japan	6.8	4.1	1.3	1.6	-2.1	35,220	38,210
New Zealand	1.9	1.5	3.0	3.0	n.a.	25,090	27,940
World	3.5	3.2	2.6	2.8	2.8	10,357	8,613

Sources: World Bank, WDR 1992, 2002 & 2010; ADB, Asian Development Outlook (ADO) 2010; and IMF

*Notes: * Foreign Exchange Market Rates*

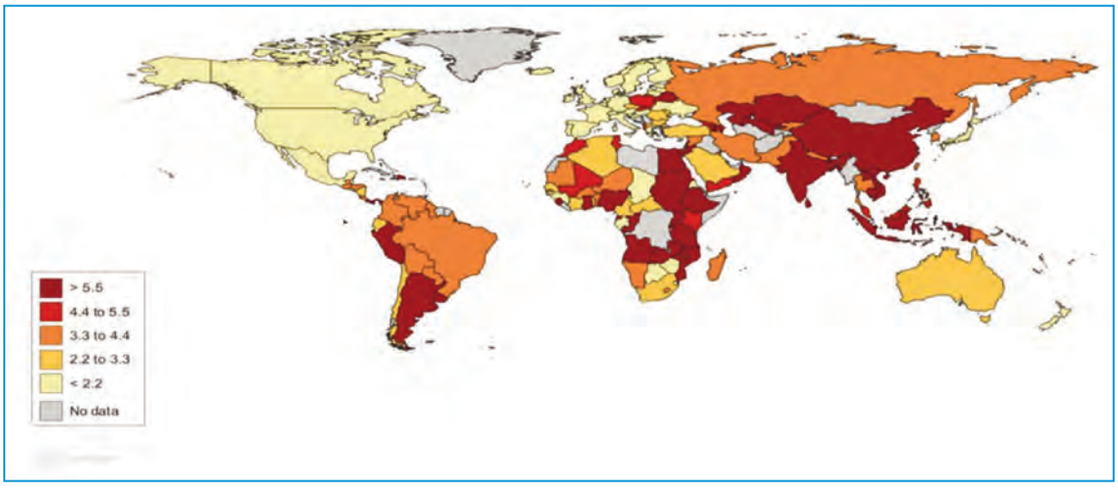
+ for East Asia, with 5.3 for Southeast Asia and 5.0 for the Pacific Island economies

Figures for 2011 are estimates predicted by ADB in ADO, 2010.

When calculated on the purchasing power parity basis, the developing region now comprises as high as 43.2 % of the world's GNI with 15.0 % for East Asia and 6.1% for South Asia.

It is no exaggeration to say that the rapid economic and per capita income growth of the developing Asian economies during the last half a century has reflected the strong will and aspirations of the governments and people of the developing Asian economies to catch up with developed economies, but also has resulted from the equally rapid pace of economic globalization through trade, investment and financial liberalization undertaken by most developed economies on the basis of the Washington Consensus spearheaded by the Bretton Woods Institutions.(See Chart 1) At the national level, however, economic globalization has widened income gaps, gave rise to environmental degradation and weakened social cohesion and stability not only in developing but also in developed economies, and in some developing economies resulting even in social unrest.

Chart 1. Annual average growth rates of GDP, by economy, 1990-2008



Source: Computed from World Bank, World Development Report, 1990-2008.

Also, at the global level, economic globalization, while contributing to higher global economic growth through international trade and investment expansion on the basis of comparative advantages, have intensified an unbridled exploitation of natural resources in poor economies, widened absolute income gaps between rich and poor economies, lessened cultural diversities and threatened health and other dimensions of human security and precipitated the globalization of economic fluctuations which is in turn enhancing the threat of protectionism and even terrorism and breeding xenophobia and international tensions in some cases.

2. Rapid Pace of Urbanization and Enhanced Environmental Degradation

With rapid economic growth has come a rapid pace of urbanization and a steady expansion of mega-citiy population in both developing and developed economies of Asia and the Pacific region, as shown in Table 3 and 4 below. Like economic globalization, urbanization has brought with it both bright and dark dimensions to the quality of human lives. Often observed among the brighter aspects of urbanization is an increased accessibility to better-paying job opportunities, higher-quality educational, health and cultural programmes and faster and more frequent transportation facilities essential to a higher level of the quality of life.

Table 3. Growth of Population and Urbanization, 1970-2025

	Population		Population Growth Rates		Urbanization	
	2010	2030	1975-1995	1995-2015	1990	2010
Developing	5,843.4	7,169.0	1.9	1.3	n.a.	n.a.
East Asia	1,974.3	2,204.3	1.3	0.7	28.1	45.3
China	1,354.1	1,462.5	1.2	0.6	26.4	47.0
Indonesia	232.5	271.5	1.7	1.1	30.6	44.3
Malaysia	27.9	35.3	2.5	1.6	49.8	72.2
PNG	6.9	10.1	2.5	1.9	15.0	12.5

	Population		Population Growth Rates		Urbanization	
	2010	2030	1975-1995	1995-2015	1990	2010
Philippines	91.6	124.4	2.3	1.8	48.6	48.9
Singapore	4.8	5.5	2.2	1.1	100.0	100.0
Thailand	68.1	73.5	1.3	0.6	29.4	34.6
Vietnam	89.0	105.4	1.9	1.3	20.3	30.4
South Asia	1,719.1	2,158.2	2.3	1.5	26.5	31.7
Bangladesh	154.4	203.2	2.2	1.6	19.8	28.1
India	1,214.5	1,484.6	1.9	1.3	25.6	30.0
Pakistan	184.8	265.7	2.8	1.9	30.6	35.9
Sri Lanka	20.4	22.2	1.1	0.4	18.6	14.3
Developed*	1,056.0	1,129.6	0.6	0.5	72.0	77.1
Australia	21.5	25.7	1.3	1.0	85.4	89.1
Japan	127.0	117.4	0.5	- 0.1	63.1	66.8
New Zealand	4.3	5.0	0.9	0.8	84.7	86.2
World	6,908.7	8,308.9	1.6	1.1	42.6	50.5

Sources: UNDP, *HDR 2007/8,* Appendix Table 5, pp.243-246 and *HDR 2010,* Table 184-187

*Note: * Figures for urban population as % of the total are for OECD members only.*

Table 4. Steady Expansion of Megacity Population in Asia, 1975-2025

Cities	1975	2007	2025	Cities	1975	2007	2025
Tokyo-Yokohama	26.6	35.7	36.4	Shanghai	7.3	15.0	19.4
Mumbai	7.1	19.0	26.4	Karachi	4.0	12.1	19.1
New Delhi	4.4	15.9	22.5	Osaka-Kobe	9.8	11.3	11.4
Dhaka		13.5	22.0	Beijing	6.0	11.1	14.5
Kolkata	7.9	14.8	20.6	Manila	5.0	11.1	14.8

Source: UNESCAP, Statistical Yearbook for Asia and the Pacific 2010; UNDP, Human Development Report 2007/08

Note: In millions.

Here again, however, people in those developing Asian economies without adequate administrative, technological and financial capacity have been affected with a varying degree of adverse impact of urbanization such as urban sprawling, suburban deforestation, traffic congestion in city centers, noise, air and water pollution, slums and squatters, poor sanitation and higher health risks.(See Table 5 and Chart 2)

Table 5. Air Pollution in Major Cities in Asia, 1990s

	Seoul	Busan	Guangzhou	Dalian	Shanghai	Bankok	Manila	Jakarta
A	84	94	295	185	246	223	200	271
B	44	60	57	61	53	11	33	n.a.
C	1.5	1.6	2.5	1.9	n.a.	>30	>30	23
D	60	51	136	100	73	23	n.a.	71

Source: World Bank WDR, *2002.*
Notes: A-Particulate matter (μg/m³), B-SO2 (μg/m³), C- CO (ppm), D-NO2 (μg/m³)

Chart 2. Air pollution in Ahmedabad, November 2010 and in Hanoi, February 2011

By courtesy of R&K Associates *By courtesy of R&K Associates*

These health hazards and deteriorating amenities associated with a rapid pace and a higher level of urbanization are being compounded with an equally rapid, if not faster, increase of household and industrial wastes far beyond municipal treatment capacity, as shown in Table 6 below.

Table 6. Solid Wastes in Asian Economies, 1993-2010

	1993	2000	2010
China	50,000	130,000	250,000
India	39,000	82,000	156,000
Indonesia	5,000	12,000	23,000
Malaysia	377	400	1,750
Pakistan	786	1,735	3,100
Korea, South	269	670	1,265
Thailand	882	2,215	4,120
Vietnam	460	910	1,560
Japan**	39,700	40,600	41,700

Sources: UNESCAP, *State of the Environment in Asia and the Pacific, 2000;* Secretariat of the Basel Convention; Ministry of Environment, Japan, White Paper on Recycling Society 2005
Notes:1,000 tons; ** Industrial Wastes.

Also, a high concentration in both developing and developed economies of office and commercial buildings in city centers meant increased micro-level business efficiency associated with the economy of scale and aggregation is often resulting in a higher macro-level inefficiency through traffic congestion, higher environmental and disaster risks and at times even social risks arising from sharper confrontation among conflicting parties.(See Chart 3) Rising heat waves in city centers resulting from inefficient

Chart 3. High-rise buildings in Bangkok, 2010 and traffic congestion in Seoul, 2004

By courtesy of R&K Associates *By courtesy of Prof. Hayashi, Nagoya U.*

and highly subsidized use of hydrocarbon energy sources under an increasing motorization associated with urban lifestyles are intensifying the pressures of global warming. Furthermore, the urban, time- and space-wise high-pressured patterns of life are increasing the incidence of ulcer, cancer and other stress-related health risks.

3. Local and Central Government Responses to Arrest Further Environmental Degradation in Asian Cities

Table 7. Years of Life Lost due to Environmental Risks in Asian Economies

	China	India	Asia/Pacific
Water supply and sanitation	4.5	11	10
Malaria	0	0.5	1.5
Indoor air pollution	9.5	6	4
Urban air pollution	5	2	2
Agro-industrial wastes	1.5	1	1.5
Under 5 mortality rates(%)	4.1	9.8	4.4/9.7*

Sources: Douglas V. Smith & Kazi F. Jalal, ADB, *Sustainable Development in Asia,* Table 4-5,
*Note: * Data for East Asia and the Pacific/South Asia, Relevant Years in 1990s*

Asian cities have been warned since decades ago to deal with natural disasters that deprived their inhabitants of lives and assets every year. Governments of developing Asian economies, however, had not been seriously concerned with environmental health risks until the findings of an Asian Development Bank's study presented in 1998, as shown in Table 7 above. Today, as shown in Table 8 below, nearly all stakeholders in different occupations not only recognize the seriousness of environmental risks, but consider that they will grow in Asia from year to year in the near future. Most prominent among them are water pollution and shortages, followed by global warming, natural disaster and avian flu and other pandemics.

Table 8. Threats to Human Security in Asia

	Very Low to Low	Moderate	Serious	Very Serious
High energy prices	12 (12)	28 (24)	42 (38)	18 (22)
Water pollution & shortage	28 (17)	35 (27)	30 (37)	6 (15)
Global warming	35 (22)	29 (25)	26 (28)	10 (22)
Failure of the Doha Round	28 (22)	33 (35)	24 (25)	12 (13)
Protectionism	26 (24)	38 (31)	29 (34)	6 (8)
Terrorists	31 (27)	33 (31)	26 (26)	8 (11)
Sharp decline in asset markets	31 (22)	37 (39)	23 (24)	6 (8)
Natural disaster	34 (30)	34 (32)	24 (24)	5 (9)
Current account imbalance	30 (22)	38 (40)	21 (22)	6 (7)
Avian flu and other pandemics	43 (40)	32 (27)	17 (20)	6 (7)
Proliferation of preferential trade agreements	40 (32)	36 (39)	18 (20)	4 (5)

Source: PECC, State of the Region 2007-08, pp.45-46.
Notes: Respondents to the above survey taken in 2007 were: 107 businessmen, 68 government officials, 166 academics and researchers, 14 media persons, 5 civil society representatives and 22 others. Of these 382 respondents, 228 are from Northeast and Southeast Asia. Figures are for the next 1-2 years, whereas those in brackets are for the next 3-5 years.

It is natural that in response to these perceived environmental threats, governments in Asia have been taking measures at both central and local levels including legislative and administrative and technological research and development (R&D) actions.

1) Legislative and Administrative Measures by Central Government

Central governments in Asia have passed a series of laws and regulations on preventive and remedial measures, installed regulatory mechanisms, scientific research and juridical institutions, and enhanced fiscal, financial and administrative support to local governments to minimize environmental degradation and improve the living environment of their people. National legislation for reducing air, water, soil and noise pollution has installed Polluter Pay Principle (PPP), arrested deforestation by imposing penalties and criminal charges against violation, promoted 3Rs (reduce, reuse and recycle) for paper, electrical and electronic home appliances, automobiles, etc. by way of internalizing environmental costs and encouraged a shift of energy sources from hydrocarbon to natural and renewables through fiscal and financial incentives in the main, but in a few cases through carbon taxes and emission trading. Also, national legislation has encouraged local governments to build environmentally sustainable cities and communities (ESCs) appropriate and conducive to each in terms of topographic, ecological, economic, financial and social characteristics and cultural heritages.

A series of administrative guidelines and safeguards including distribution of national hazard maps have been issued by central governments to protect human lives against natural disasters, take all necessary relief measures affecting people's daily living, install green government procurement programme, promote education for sustainable development (ESD), and encourage environmentally sustainable patterns of production and consumption. Also, calls for all stakeholders such as local governments, private sector and NGOs have been made to join their heads, hands and hearts together to cope with environmental degradation including nuclear hazards in some relevant economies and promote environmental sustainability in their respective activities. Depending upon the socio-political environments specific to economies and sub-national regions, either top-down or bottom-up, or both approaches have been taken, all with a view to effectively implementing the legislative measures, although their effectiveness has varied among different economies and sub-national regions, depending on their own administrative, financial and technological capacity. Common across many economies of Asia and the Pacific region are: inadequate financial, human and institutional capacity, insufficient awareness not only among policy makers (politicians) but also among the people on the street of the current and future threat to environmental sustainability, and furthermore an inadequate support of the international community including, as being observed, repeated failures at COP meetings of reaching a consensus on the post-Kyoto international arrangements on climate change after 2012, in spite of urgency demonstrated by small island economies.

In many economies of the region, national governments have developed Environmental Model City Programmes whereby cities and provinces interested in transforming themselves into environmentally sustainable districts have been selected by national government authorities as such. In applying for such award by national government, cities and provinces have submitted their own programmes detailing short, medium and long-term plans and quantitative targets for achieving or exceeding national targets, for example, for carbon dioxide emission and solid waste reduction, or for replacement by recycled paper and renewable energy. National government award have included among others tax exemptions, grant-in aid and/or low-interest loans, as practiced in China, Japan, South Korea and Thailand. These national EMCs/EMCs have been replicated by a few other economies of the region, with support given by bilateral and multilateral donors. The two High-Level Seminars for ESCs under the East Asia Summit/Environmental Ministers' Meeting (EAS/EMM) have been instrumental to such replication in Asia and the Pacific region.

2) Legislative and Administrative Measures by Local Governments

Closest to community residents, local governments have in general been ready and quick in responding through ordinances and guidelines to various issues raised in their communities, whether in reducing and eliminating air, water, soil and noise pollution and household and industrial wastes or in expanding greenery, ensuring food and traffic safety and disaster relief and prevention, improving public access to sanitation, health and other social services and promoting education for environment and sustainable development.

Provincial governors, city mayors and councilmen, when elected directly by community voters, have usually been better performers than their counterparts appointed by central governments, to make their communities safe, clean and amenable. Governance effectiveness, however, has varied, depending on the leadership of these policy makers and the degree of mutual confidence and trust between them and community residents which often rises in accordance with the latter's participation in local government decision-making processes and formal and informal process of consultation among the parties concerned Provincial and municipal legislative ordinances and guidelines for environmental protection, to be effective, are worked out usually through cooperation between local assemblies and executives, with participation by representatives of different stakeholder groups in local communities in the decision-making processes. They have to be consistent with national legislative and regulatory framework to qualify for central government decentralization measures and fiscal and financial assistance. Most often provincial and municipal executives are formulating provisions of proposed environmental

legislation for submission to local assemblies for decision. When opposed by government executives either in substance or for financial implications, it is not so rare that some groups of community residents/voters have opted to submit their own legislative proposals to local assemblies where councilmen sympathetic to such community proposals would join their forces together to eventually enact them into local ordinances and guidelines.

City managers have now found that the first step required for building ESCs/EMCs is the collection, analysis and publication of accurate data on various dimensions of the urban environment at a regular interval, which today is far from adequate in many cities of Asia and the Pacific not only due to lack of financial, human and institutional capacities but also insufficient recognition among city officials and community residents of the urgency and range of environmental protection. Recruitment of scientific and technical staff who have received professional education in the field of the environmental science and technology is found as totally inadequate in many cities, and so with opportunities for training of the people engaged in environmentally related jobs. This is particularly significant in case of Japan which is now undergoing, immediately following the East Japan Great Earthquake and Tsunami (EJGET), an unprecedented experience of nuclear power plant explosions one after another, resulting in the steady emission of all sorts of radiation materials exceeding the internationally approved safety standards. Among those radiation materials requiring immediate response measures are iodine (I) 131 and 132, cesium (Cs) 134, cobalt(Co) 56 and 60, Zirconium (Zr) 95, Lantan (La) 140 and plutonium 238, 239 and 240.

Confronted with large fiscal deficits every year and heavy fiscal deficits outstanding, city managers have found it extremely difficult to give priority to environmental protection and ESC/EMC development, however desirable in the longer term perspectives, which requires reallocation of the limited current and future city budgets. In spite of such bottlenecks, some municipal majors and provincial governors have taken bold actions to initiate green town concept and found it essential to link with local economic development and employment expansion, to be accepted widely by community residents. City managers have also found that the closest possible cooperation is required from the board of education at municipal and provincial levels to strengthen environmental education at all levels of educational institutions and at the informal level to mobilize the support of community residents to ESC/EMC development.

Diversity and Challenges in Building Environmentally Sustainable Cities (ESCs) and Environmentally Model Cities (EMCs) in the Asia-Pacific Region

Background

In Asia a series of intergovernmental meetings have been organized to promote ESCs/EMCs under the sponsorship of various international organizations covering either the entire Asia-Pacific region or part of the region Most prominent among them have been the meetings organized by the East Asian Summit (EAS), the ASEAN Plus Three (APT consisting of ASEAN ten member economies, China, Japan and South Korea) and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) headquartered in Bangkok, Thailand.

EAS organized its Third Summit Meeting in Singapore in November, 2007, issuing Singapore Declaration on Climate Change, Energy and Environment which referred to the need for building eco-friendly cities in its member economies composed of ASEAN 10 members, Australia, China, India, Japan, New Zealand and South Korea. The Meeting of the G8 Environmental Ministers' Meeting in Kobe in May 2008 installed the Low Carbon Society Research Network (LCS-RNet) among

the G8 member economies. The Meeting of the Network of East Asian Think Tanks (NEAT), established under the aegis of APT, installed its own Working Group on the Environment and began to do a collaborative study on Climate Change, issuing in Singapore in June, 2008 a joint policy recommendation on actions to be taken by its 13 member states to reduce emission of greenhouse gases (GHG). EAS Environmental Minister's Meeting in Hanoi in October, 2008 recommended ESCs to be its priority area for intra-EAS/EMM environmental cooperation. The Meeting of NEAT, WG/Environment made policy recommendations on Eco-Cities in Singapore in June 2009. Also, a High-Level Panel of the ESCAP Committee on Environment and Development met in Bangkok in December, 2009 on Key Challenges, Opportunities and the Way Forward in the Area of Environment and Development especially focused on Enhanced Access to Services Towards Socially Inclusive and Sustainable Development on Water, Sanitation, Energy, Transport and Housing.

To promote ESCs/EMCs in Asian economies and to identify specific areas of international cooperation for the purpose, the First Meeting of the High Level Seminar (HLS) on Environmentally Sustainable Cities (ESCs) was organized in Jakarta in March, 2010 by ASEAN Secretariat and the Governments of Indonesia and Japan. This inter-governmental and inter-city seminar was followed simultaneously by the Asian productivity Organization (APO) headquartered in Tokyo which organized in Jakarta an international private sector symposium on ECO-friendly infrastructure development, commercial and industrial building and home construction, participated by a large number of private sector corporations of Japan and other Asian economies. There was also a Meeting of APT/NEAT, WG/Environment on Water Resources Management in Singapore in June, 2010 in connection with Singapore International Water Week (SIWW) which issued policy recommendations specifically aimed at improving water supply and quality as well as more effective water demand management in the 13 APT member economies.

In order to deepen the understanding on the policy requirements for expanding ESCs/EMCs throughout Asia and mobilizing the efforts of central and local governments and other stakeholders in the region as well as international organizations, a Meeting of the International Forum for Sustainable Asia and the Pacific (ISAP) 2010 on Sustainable and Low Carbon Development was organized in Yokohama in July, 2010 by the Institute for Global Environmental Strategy (IGES) in collaboration with the Asian Development Bank and World Bank to identify Innovative Pathways for Asia-Pacific region and on possible IGES/World Bank Collaboration for Supporting Model Cities Programme in Asia. The PECC General Meeting in Tokyo organized in October, 2010 on New Vision for APEC and Toward Further Regional Economic Cooperation had a working group session on ESCs/EMCs. In 2011, the National Institute for Environmental Studies (NIES) headquartered in Tsukuba Research Metropolis, Japan organized Tokyo Symposium on Low Carbon Asia under LCS-RNet in Tokyo in February, 2011, followed by the Second Meeting of the HLS on ESCs in Kitakyushu City in March, 2011. In April this year there will be a PECC Meeting in Perth on Environmental Sustainability in Urban Centers : Efficiency and New Technologies, Best Practices for the Provision of Public Services for a Better Protection of the Environment, to be followed in September, 2011 by a Meeting of APT/NEAT, WG/Environment on Natural Disaster Relief and Preventive Measures in Asia and a Third Meeting of the HLS on ESCs to be held in Phnom Penh in March, 2012.

Requirements for Building ESCs/EMCs

As a result of all these efforts by governments, private sector and NGOs, while paying due attention to differences in socio-economic, ecological and cultural traditions among different economies and communities, ESCs/EMCs in Asia and Pacific region are addressing common agenda on applying their respective expertise and technologies in such areas as: i) urban planning including environmentally sustainable transportation, ii) green building, iii) urban water supply and sewage treatment, iv) urban greenery, urban biodiversity conservation and urban landscape, v) sanitation and waste management,

vi) 3Rs and resource efficiency improvement, vii) air, noise, water and soil pollution control, viii) co-benefit approaches to climate change and pollution control, ix) adaptation to climate change in cities, x) urban infrastructure building and xi) reduction of natural disaster risks. It is important to note in this connection that all those seminars and symposia on ESCs/EMCs and liveable cities have been found as a useful tool for sharing experiences and best practices among all economies and communities interested in building and reinforcing ESCs. Also, all the national governments in the region have now launched some ESCs/EMCs programme and projects in collaboration with various stakeholders within national borders and in the international community where political leadership at the top is the key to their initiation and success.

Barriers to Building ESCs/EMCs

In spite of such progress for initiating ESCs/EMCs, there are still a number of barriers in many Asian economies to the task at hand. First of all, there is a lack of consensus among community residents not only of the need for building ESCs/EMCs, but also on what kind of ESCs/EMCs are to be built. Many residents are opposed to any change of their residential districts and/or quarters. Also, most major cities and metropolis in Asia, having large population, covering large space and with emotional attachment to their own residential communities, have found it extremely difficult to reach consensus among community residents on building ESCs/EMCs. Even when eventually agreed upon the need for them and what types they ought to be, specific issues such as when, where and how to start have brought the consensus into sharp dissension, delaying the whole process of building ESCs/EMCs. Secondly, there is an important question of the high cost of building ESCs/EMCs. Built up over centuries, remodeling of any major cities into ESCs/EMCs has been found extremely costly to local governments which are already heavy in fiscal deficits outstanding. Financing by public-private partnership, the only way out for realizing ESCs/EMCs cost-effectively, has often been marred in Asia by corruption and/or extraordinarily excessive charges on account of the lack of good governance, transparency and accountability of both public authorities and private entrepreneurs. Thirdly, a serious question remains in many Asian economies of an inadequate human and institutional capacity for planning and implementing local development programmes for building ESCs/EMCs. With the exception of a few metropolis in Asia and the Pacific, region most are inadequately equipped with appropriate institutional mechanisms and under-manned by appropriate expertise to undertake the remodeling of their ancient cities into ESCs/EMCs. Assistance of foreign expertise, private and public, is urgently required to install proper human and institutional capacity.

Diverse Approaches to ESCs/EMCs

As large as 60 cities in Asian economies participated during the years 2000-2010 in a series of international conferences organized by Kitakyushu City for ESCs under the Kitakyushu Initiative for a Clean Environment in association with ESCAP Ministerial Conference on Environment and Development (MCED). Under this long-term ESC development programme, different cities. confronted with differing environmental issues, have taken different approaches to building ESCs/EMCs in the first instance.

Weihai City, China have focused on reduction targets for sulfur dioxide (SO_2) emission and chemical oxygen demand (COD), respectively, of 5 % and 15 % as compared with 2005 levels. Surabaya City, Indonesia, Sibu Municipal Council, Malaysia and Bago City, Puerto Princesa and San Fernando City, Philippines, all have focused on waste reduction targets respectively of 40%, 10-15%, 60 %, 68% and 28% and promotion of waste segregation at source and household composting. Ulsan Metropolitan City, ROK has given top priority to reducing municipal waste down to 0.9 kg per day and achieving a recycling rate of 65 %, while Kathmandu Metropolitan City, Nepal to improving overall urban environmental conditions. Environmental policy priority of Cebu City, Philippines has remained on municipal waste and plastic use reduction respectively by 50 % and 75 %, whereas that

of both Bangkok Metropolitan Administration and Nonthaburi Municipality, Thailand has been on municipal waste reduction by 30%. The main concern of Muntilupa, Philippines has been with installing cost-wise affordable, less energy intensive, less polluting, and less spacious wastewater treatment, with replication in Demaguete and San Fernando Cities in the economy, while that of Municipality of Korat, Thailand with the use of filter system and grease traps and of Pang-Kone Municipality with a clustered approach of constructed wetlands. Cities of San Fernando, San Carlos, Metro Clark, Sagay, Calbayog and Davao, all in the Philippines, as well as Sibu City, Malaysia and Kathmandu Metropolitan City, Nepal have focused on sanitary landfill, with gas for electricity generation and a flare system to burn excess and unutilized gas. Cities of San Fernando and Puerto Princesa, Philippines have given top priority to promoting marine sanctuary and reforestation through bio-engineering and zoning of environmentally critical areas. While setting and achieving all these specific targets do not by themselves solve wide ranging issues of urban environmental protection, there is no doubt that they do contribute to enhancing environmental awareness among community residents and eventually to the urgent need for building ESCs/EMCs.

As compared with the above specific target approaches by central and local governments in Asia, the low carbon city development programme under LCS-RNet, 2009-2011 aims at contributing to building ESCs/EMCs through a variety of sector initiatives for low-carbon society at the national and local levels. These drafts are comprehensive in terms of setting multiple targets, implementation and monitoring programmes including procedures for achieving the targets. The joint study among research institutions in Asian economies under this program has now produced drafts of *Japan Scenarios and Actions Towards Low-Carbon Societies, Shiga's Scenario Towards the Realization of a Sustainable Society, A Roadmap Towards Low Carbon Kyoto, Sustainable Low Carbon Development Towards 2030 in Vietnam, Low Carbon Society Scenario Towards 2050: Indonesia, Scenario Analysis on Low Carbon Economy Development in Jilin City, China, Low Carbon Society Vision 2030: Thailand, Low Carbon Society Vision 2050: India, Low Carbon Society Vision 2035: Ahmedabad, Low Carbon City 2025: Sustainable Iskandar, Malaysia,* and finally*, Towards Putrajaya Green City 2025, Malaysia.* It is hoped that through closest possible cooperation and consultation among these research institutions and central and local governments in Asia, a wide range of policy recommendations based on their study will be translated into actual government policies in Asian economies.

ESC development programme under East Asian Summit Environmental Ministers' Meetings (EAS/EMM) and ASEAN Working Group on ESCs (AWGESC) initiated since 2010 has focused its sustainable development activities on such issues as urban air quality management (Bangkok Metropolitan Area, Thailand; Iloilo City, Philippines; and Singapore), a whole range of environmental issues (Cagayan de Oro City, Philippines; North Kuching City, Malaysia; and Yichang City, Hubei Province, China), planning for a liveable city (Gwanggyo New Town, Gyeonggi Province, Korea), Eco-town development; (Kitakyushu City, Japan), waste collection and minimization (Luang Prabang, Lao PDR), urban solid waste management (Phnom Penh City, Cambodia; Surabaya City, Indonesia and Tirupati, India), and adaptation to climate change (Puerto Princesa City, Philippines and Yokohama City, Japan). Here again it is hoped that through joint participation of all stakeholders including public and private sectors and NGOs and enhancing their closest possible cooperation and coordination, there will be accelerated replication of ESCs in the near future from one city to another within and across economies of the Asia and the Pacific region, with initial funding by international development and finance institutions interested in the development of sustainable Asia and Asian cities.

PART TWO : FROM DESIGN TO OPERATION - INTEGRATING URBAN SERVICES AND DEVELOPING GOVERNANCE TO CONTRIBUTE TO A BETTER CITY

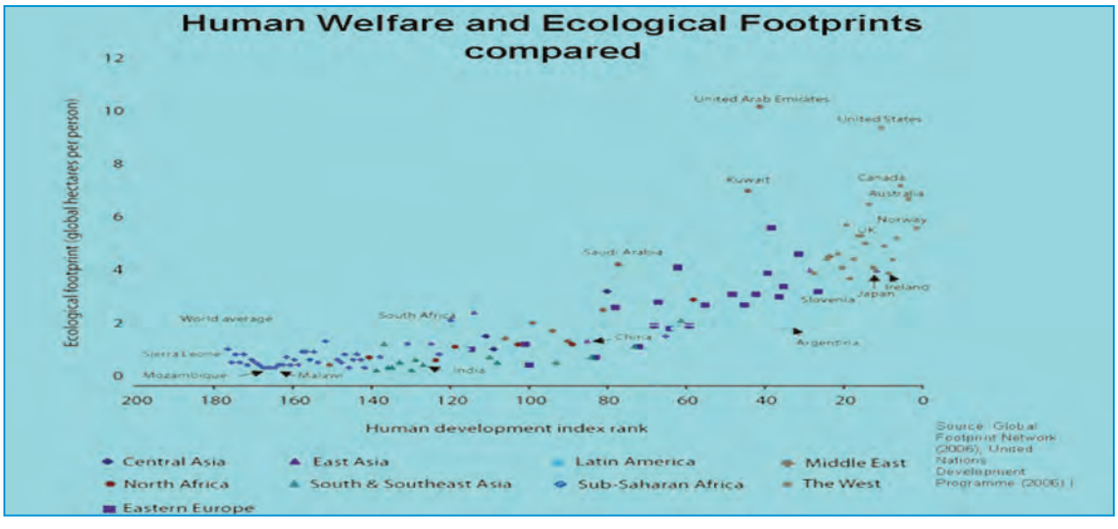
Chapter 1. Better Governance for Large Cities

Coral Ingley
Associate Professor
AUT University
Auckland, New Zealand

During 2007 the human species became predominantly urban. The proportion of the human population living in cities is forecast to continue to increase until the global population peaks at about 9 billion in the middle of this century. By that time, almost two-thirds of the population is likely to live in cities (UN-HABITAT: State of the world's cities 2006/7, The Millennium Development). Most of this population growth will occur in small cities (less than 500 000 inhabitants) and medium-sized cities (between 1 and 5 million inhabitants) in less developed regions.

The fast growth of urbanisation has brought with it enormous environmental and social problems. Cities occupy just 2 percent of the earth's land surface but consume three quarters of the world's resources. A sustainable ecological footprint that shares all of the world's resources equally among its inhabitants would be 1.8 hectares per person (see Figure 1).

Figure 1



What is governance?

The word 'governance' means to steer and to pilot or to be at the helm of things. It indicates a political unit for the function of policy making and denotes an overall responsibility for both political and administrative functions. Governance involves participation; the rule of law; transparency; responsiveness; consensus orientation; equity; effectiveness and efficiency; accountability; and strategic vision (UNDP, 1999: 4). Governance is a system; it is not synonymous with government. Partly, governance is about how government and other social organisations interact, how they relate to citizens and how decisions are taken in a complex world. Governance is also about the more strategic aspects of steering the larger decisions concerning direction and roles: where to go, who should be involved in deciding and in what capacity.

The United Nations Development Programme (UNDP) defines urban governance as the exercise of political, economic and administrative authority in the management an urban entity's affairs at all levels. It comprises the mechanisms, processes and institutions through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations and mediate their differences (UNDP 2006). According to UN-HABITAT, urban governance is the sum of the many ways individuals and institutions, public and private, plan and manage the common affairs of the city. It is a continuing process through which conflicting or diverse interests may be accommodated and cooperative action can be taken. It includes formal institutions as well as informal arrangements and the social capital of citizens (UN-HABITAT 2009).

Within these definitions there are common themes : Institutions and groups ; Individuals and citizens ; political, economic, and social contexts ; formal and informal mechanisms and processes ; public and private dimensions ; interests, rights and obligations ; cooperation and mediation. Governance as a concept recognizes that power exists both inside and outside the formal authority and institutions of government. Many definitions of urban governance include three principle groups of actors : government, the private sector, and civil society (see Figure 3). The concept recognizes that decisions are made based on complex relationships between many actors with different priorities. The reconciliation of these competing priorities is at the heart of the concept of urban governance. The concept is complex and controversial and implies a re-organisation of the social relations between actors.

There are four aspects relating to the urban governance concept that are relevant to this discussion. First, it is broader than government. Second, it is broader than management, also. Third, the concept emphasises process. It focuses on progress in decision making and implementation as well as where actors can assume ownership of the process of city development and management of their own communities. Fourth, urban governance is a neutral concept. Actors, mechanisms, processes, and institutions can produce positive or negative outcomes ; hence the notion of "good" urban governance which, as stated in UNDP policy, is a necessary ingredient to achieve equitable and sustainable growth and development.

Central to the concept are notions of participation, engagement and inclusion. In the past few years, issues of national governance such as participatory and representative democracy, rule of law and judicial responsibility have received considerable attention.

There are also at least four layers of governance : local, national, 'basin' or regional, and global levels. A key idea is the principle of subsidiarity and decentralisation. Governance at the global level can involve trans-boundary institutions, as well as regional cooperation and requires political sensitivity with regard to problems and benefits of co-operation cross regional boundaries. There can also be a facilitating role for key players in the international financial architecture e.g. multi-lateral development banks (ADB, World Bank, GWP). This leads to the idea of multi-level governance.

In a highly urbanised world, cities are sites of high energy consumption and waste production. The influence of local governments over these processes varies but can include energy supply and management, transport, land use planning, building regulations and waste management.

Why governance ?

Good governance is vital to attracting finance for infrastructure and services. The UN Commission on Human Security (2003) has argued that : "Without effective governance, people are not empowered. And unless people are empowered to let their voices be heard or to participate in decision-making, governance is not feasible". Similarly, the United Nations and its Secretary-General has argued that : "Good governance is perhaps the single most important factor in eradicating poverty and promoting development".

According to UN-HABITAT in its Global Campaign on Good Governance, research at the national level has demonstrated that good governance correlates with positive development outcomes. A survey on governance in 165 economies reported that a one standard deviation increase in any one of 6 governance indicators causes a two-and-a-half-fold increase in income, a four-fold decrease in infant mortality and a 15 to 25 percent increase in literacy, thus establishing a clear relationship between governance and human development. As the survey concluded, "The result of good governance is development that "gives priority to the poor, advances the cause of women, sustains the environment and creates needed opportunities for employment and other livelihood". The concept of social inclusion is a key to UN-HABITAT's Global Campaign on Good Governance initiative and their approach to poverty reduction.

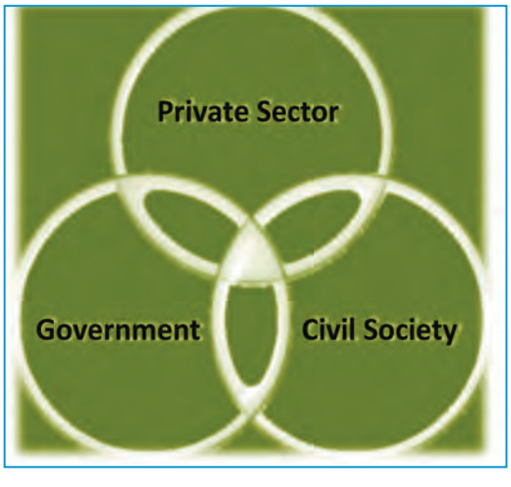
Good governance

Some fundamental questions can be asked about good governance, such as: What are the characteristics of good governance? Are there universal principles of good governance? If so, what are they? Where do these principles come from? In applying such principles what quality of detail do we need? What particular criteria are necessary to build governance? How might we apply these principles to assess current governance regimes (Institute of Governance, 2003)?

Good governance, according to the Institute of Governance (2003) can be understood as: "…the institutions and processes, both formal and informal, which provide for the interaction of the state with a range of other agents or stakeholders affected by the activities of government". It can only be called 'participatory governance' if it meets the following criteria: government engages with groups that share a certain interest that goes beyond the individual interest; a sense of group identity and interest is important and forms a starting point for negotiation and collaboration; and the arena of action with regard to policy or practice has to go beyond a specific neighbourhood or single development, and not be too limited in scope, scale and place.

Good urban governance is defined by UN-HABITAT (2009) as "inextricably linked to the welfare of the citizenry. Good urban governance must enable women and men to access the benefits of urban citizenship. Good urban governance, based on the principle of urban citizenship, affirms that no man, woman or child can be denied access to the necessities of urban life, including adequate shelter, security of tenure, safe water, sanitation, a clean environment, health, education and nutrition, employment and public safety and mobility. Through good urban governance, citizens are provided with the platform which will allow them to use their talents to the full to improve their social and economic conditions". Figure 2 shows how this is represented by the overlapping domains of the main players: government, the private sector and civil society.

Figure 2.



Focusing on the intersection between the three players in Figure 2 implies the need for fundamental rethinking of the ways citizens' voices are represented in the political process. There is now space for civic participation. Good urban governance is about re-thinking the meaning of citizenship and creating new deliberative spaces and also a continuous and dynamic process of learning about bridging the knowledge and authenticity gaps with regard to needs and issues as well as the responses to these, between technocratic expertise and local involvement. It involves learning about the outcomes as these emerge.

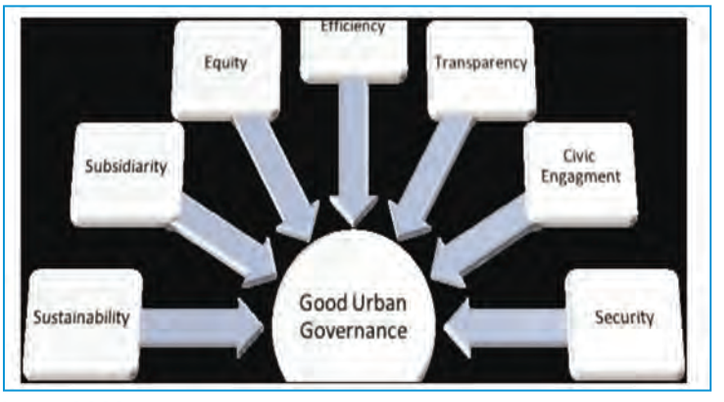
The role of the public sector in urban governance is to create business friendly policies, to share power, delegation of authority (e.g. according to ISO standards), and setting the rules of engagement. The private sector's role is to maximise the benefits of resources, to include principles of urban governance in its activities, and to lobby with stakeholders to ensure economic stability for the city. Civil society acts as "watchdogs" over the other two sectors on behalf of the citizens; it will also create norms, develop a good governance culture and voice public opinions.

In many Asian economies, rapid urbanisation is associated with unacceptable pollution (fouling air, water and land) and ecosystem disruption. It is essential that governance is improved. Good governance requires strong public health and environmental regulation and policy. It also requires industry and government to take a longer-term view, beyond annual financial reports and individual parliamentary terms (Capon, 2007).

Principles of good urban governance

UN-HABITAT (2009) argues that good urban governance is characterised by the principles of sustainability, subsidiarity, equity, efficiency, transparency, civic engagement and security, and that these principles are interdependent and mutually reinforcing (see Figure 3).

Figure 3. Principles of good urban governance



Source: UN-Habitat (2009)

The Institute of Governance, similarly, has developed a set of principles which are based on the UNDP principles. These include: legitimacy and voice (involving participation and requiring a consensus orientation); direction (the need for strategic vision); performance (based on responsiveness); accountability (and transparency); fairness (which is about equity and the rule of law).

Principle of subsidiarity

Responsibility for service provision, according to UN-HABITAT (2009), should be delivered on the basis of the principle of subsidiarity. This involves the devolution of authority and the allocation of resources at the closest appropriate level that is consistent with efficient and cost-effective delivery of

the service, to maximise the potential for inclusion of the citizenry in the process of urban governance. Decentralisation and local democracy should improve the responsiveness of policies and initiatives to the priorities and needs of citizens. Cities should be empowered with sufficient resources and autonomy to meet their responsibilities. UN-Habitat details various practical means of realising the principle.

Principle of Equity

This principle requires equity of access to decision-making processes and the basic necessities of urban life. The sharing of power leads to equity in the access to and use of resources. Women and men must participate as equals in all urban decision-making, priority-setting and resource allocation processes. Inclusive cities provide everyone – be it the poor, the young or older persons, religious or ethnic minorities or the handicapped — with equitable access to nutrition, education, employment and livelihood, health care, shelter, safe drinking water, sanitation and other basic services.

Principle of Efficiency

The principle of efficiency is in the delivery of public services and in promoting local economic development. Cities must be financially sound and cost-effective in their management of revenue sources and expenditures, the administration and delivery of services, and in the enablement, based on comparative advantage, of government, the private sector and communities to contribute formally or informally to the urban economy. A key element in achieving efficiency is to recognize and enable the specific contribution of women to the urban economy.

Principle of Transparency and Accountability

This principle requires transparency in decision making and the accountability of decision-makers and all stakeholders. The accountability of local authorities to their citizens is a fundamental tenet of good governance. Similarly, there should be no place for corruption in cities. Corruption can undermine local government credibility and can deepen urban poverty. Transparency and accountability are essential to stakeholder understanding of local government and to who is benefiting from decisions and actions. Access to information is fundamental to this understanding and to good governance. Laws and public policies should be applied in a transparent and predictable manner. Elected and appointed officials and other civil servant leaders need to set an example of high standards of professional and personal integrity. Citizen participation is a key element in promoting transparency and accountability.

Principle of Sustainability

Sustainability is required in all dimensions of urban development. Cities must balance the social, economic and environmental needs of present and future generations. This should include a clear commitment to urban poverty reduction. Leaders of all sections of urban society must have a long-term, strategic vision of sustainable human development and the ability to reconcile divergent interests for the common good.

Other Principles, frameworks and models

The best known models and frameworks for urban governance are those developed by UN-HABITAT for the Governance Campaign, and the UNDP. These frameworks include the UN-HABITAT Urban Governance Index (UGI), Agenda 21, and the UNDP's ESCAP, TUGI, UNCHS, GUG, the DA Project and CDM projects. Various other models have also been developed by e.g. the Global Footprint Network (GFN), Eco^{2}Cities, the EU's CCG projects, the participatory budgeting model and the Millenium Development Goals – notably Target 12, which aims to develop further a rules-

based, non-discriminatory trading and financial system – and includes a commitment to good governance, development, and poverty reduction.

In evolving its models of governance UN-HABITAT synthesises lessons learned from promoting inclusive urban planning and management processes through such programmes as the Sustainable Cities Programme, the Urban Management Programme, the Community Development Programme, etc. Urbanisation cannot be sustained without good governance and governance cannot be considered effective if it does not sustain urbanisation (UN-HABITAT, 2009).

A central conclusion by the Institute of Governance is that a universal set of principles for defining good governance can be developed and that the strength of their universality rests to a large extent on the body of international human rights and laws. In addition, these principles can be usefully applied to help address current governance challenges. When the principles are applied it becomes apparent that there are no absolutes: that the principles often conflict, that the devil is in the detail and that context matters. The nature of governance – both means and ends – needs to be understood and only then does it make sense to elaborate the principles in order to create a meaningful analytical tool.

Criteria for effectiveness

Various organisations have outlined criteria for urban governance effectiveness. The following is a synthesis of the criteria developed by the Asian Development Bank (ADB), the World Bank, and the UNDP: participation, involving consensus and top-down-bottom up decision making processes; transparency, including transparency of information, and accountability; equity; efficiency and effectiveness; predictability; the rule of law; policy coherence; responsiveness; integration; leadership and strategic vision; ethical considerations; and indicators to assess governance.

Good urban governance is characterised by transparent decision making and financial management, public accountability and probity. While there is no blueprint for success, measures of effectiveness will help ascertain the quality of governance performance. In developing measures of the quality of urban governance it is important to be clear about the purpose at various levels. At the global level, measures demonstrate the importance of good urban governance in achieving broad development goals. The Millenium Development Goals and the Habitat Agenda are good examples. At the local level the purpose is to catalyse local action. Local indicators will be developed at this level by cities and partners to respond directly to their unique contexts and needs, supported by tools, training guides, etc.

Figure 4. Urban Governance Index

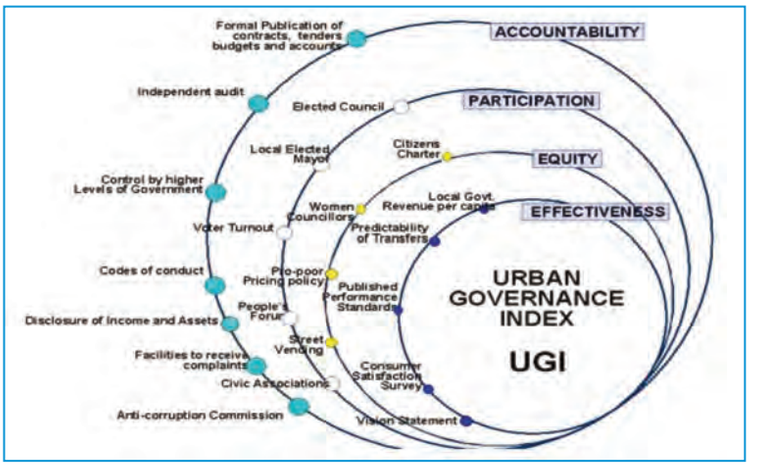


Figure 4 presents an example of an index developed by UN-HABITAT to align broad overarching goals for effectiveness, equity, participation and accountability, with various measures specified for each goal. The index can be used to test the correlation between the quality of urban governance and issues such as urban poverty reduction, quality of life, city competitiveness, and inclusiveness.

The aim of measuring urban governance is to synthesize complex concepts of urban governance by a simplified summary measure. The Urban Governance Index (UGI) will measure the quality of governance mechanisms, institutions and processes. It will include the process indicators and will be compared with other result-oriented indices (such as the Commitment to Development Index (CDI), identify gaps, priority and future local level research.

What is an eco-city?

There are various concepts and terms that relate to eco-cities including: sustainable city, ecological city, eco-urbanisation, and ecopolis. The concept of the eco-city presents the perfect or ideal image of an eco-city. Cities adopt different sets of methods, according to size, capacities and financial resources in developing an eco-city. However, only a few of the so-called eco-cities can be considered "eco" in all aspects of the concept.

The label "eco-city" creates a distinguishing image that mobilizes resources, increased accumulation of capital and investment. This represents twofold changes for the city: in its urban planning to create a healthy city, and in its economic development, which creates a new image that is successfully merchandised. The problem is that there is no standard label for eco-cities. Cities adopt a certain set of eco-city principles that allow them to be labelled eco-cities and to profit from this new image.

The dimensions of an eco-city include appropriate technology, community economic development, and social ecology. They also include green principles which relate to community self-reliance, improving quality of life, harmony with nature, decentralisation, and diversity, bio-regionalism, and sustainable development (Roseland 1997). UN-HABITAT (2009) identifies and distinguishes between a Green Agenda (relating to the natural environment) and a Brown Agenda (which concerns the built environment).

Eco-cities are self-sufficient in energy, water and most food products, with the aim of zero-emissions of greenhouse gases in transport systems; they are environmentally and socially friendly. Eco-cities are created through changes in the production mode, consumption behaviour and decision instruments, based on ecological economics, systems engineering and overseen by good governance. They combine ideas about urban planning, transportation, public health, housing, energy, water, economic development, natural habitats, public participation and social justice.

Eco2Cities – Ecological cities as economic cities

Eco^{2}Cities is a new initiative launched by the World Bank as an integral part of the World Bank Urban and Local Government Strategy to help cities in developing economies achieve greater ecological and economic sustainability. Ecological cities are designed to enhance the wellbeing of citizens and society through integrated urban planning and management that fully harnesses the benefits of ecological systems. An ecological city protects and nurtures these assets for future generations. Economic cities create value and opportunities for citizens, businesses and society. The emphasis is on sustainable, innovative, inclusive, and resilient economic activity, within the context of a larger cultural and value system. An Eco^{2}city builds on the synergy and interdependence of ecological and economic sustainability and their fundamental ability to reinforce and strengthen each other in the urban context.

The first phase of the Eco²Cities Programme was the development of the analytical and operational framework, which is based on four key principles:

1 - A City Based Approach, which enables local governments to lead a development process that takes into account their specific circumstances, including their local ecology;

2 - An Expanded Platform for Collaborative Design and Decision Making, that accomplishes sustained synergy by coordinating and aligning the actions of key stakeholders;

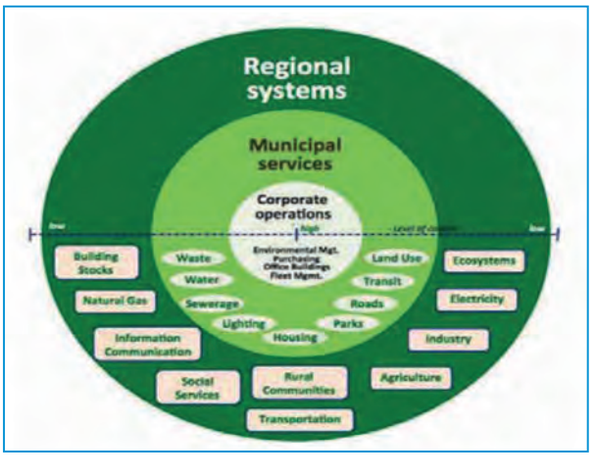
3 - A One System Approach, that enables cities to realize the benefits of integration by planning, designing, and managing the whole urban system; and

4 - An Investment Framework that Values Sustainability and Resiliency, by incorporating and accounting for life cycle analysis, the value of all capital assets (manufactured, natural, human, and social), and a broader scope of risk assessments in decision making.

Eco²Cities provides a framework and example of an eco-city development. The model is based on a set of principles which include a city-based approach, an expanded platform for collaborative design and decision-making, a one-system approach and an investment framework that values sustainability and resiliency. According to the Eco²Cities concept, by extending the platform for decision-making to include planning institutes, and by encouraging alignment among all stakeholders, the governance of a city becomes less vulnerable to the inevitable disruptions created by elections, political incidents, and the manipulation of policy by special interest groups at election time. An expanded platform for collaboration compensates for the inherent short-termism of the democratic process.

Three mutually-reinforcing goals involve eco-industry, an eco-culture and an eco-scape. The city's working group is coordinated at three levels: corporate, municipal and regional (see Figure 5). Moving from the inner tier to the outer tier increases the number of stakeholders and the complexity, as well as the scope of the potential benefits.

Figure 5. The collaborative working group



Source: Eco²Cities – World Bank

The city-based approach is bottom-up. The bottom-up actions at the local level generate creative self-reliant solutions, while the top-down actions support at the senior government level enables cities to implement local solutions (see Figure 6).

The approach recognizes that cities are now at the front line for managing change and leading an integrated approach. Only at the city level is it possible to integrate the many layers of site-specific information and work closely and rapidly with the many stakeholders who can contribute to an integrated solution. In addition, fiscal and administrative decentralization has brought important decision-making and management responsibility to local governments. The approach emphasizes the importance of incorporating within any development programme the unique aspects of place, especially the ecological assets. Increasingly, cities depend on their natural landscapes to provide food and recreation, capture and store water and energy, absorb wastes, and satisfy many other needs. Protecting and enhancing ecological assets — the natural capital — is a priority when directing (and constraining) urban growth. A city-based approach is thus very place-specific, with a focus on enabling local leadership and local ecologies.

When a city takes leadership in setting priorities and implementing solutions, two factors appear to be critical : its level of commitment and its capacity to act. To act effectively, a city may need technical, administrative, and financial support, including knowledge, skills, and tools. It will also depend on levers beyond its realm of control. Often a city's legislative, administrative, and fiscal powers are circumscribed by national or state level governments whose cooperation is crucial. Given the growing predominance of metropolitan areas which span the jurisdiction of more than a single city, it is often the case that coordination is required at the metropolitan level for optimal interventions within and across all sectors. Thus leadership by cities needs to occur at many levels, including the regional level.

Figure 6. The city-based approach

Source : Eco[2] Cities – World Bank

Conclusion

In their book "Worlds in Transition – Evolving Governance Across a Stressed Planet" (Camillieri & Falk, 2009), the authors promote the idea of mutually reinforcing processes of increasing organisational complexity and personal and institutional reflexivity. This involves a holistic and comprehensive analysis of the mechanisms, structures and processes of the whole. According to Camillieri

and Falk, this analysis is global in that it encompasses all social groupings, communities, cultures and civilisations, and planetary in that it comprises the totality of relationships between the human species and the rest of the biosphere.

The direction in human evolution, they argue, has been towards greater social, economic and political complexity and greater reflexivity. Camillieri and Falk explain that in the challenges we face and in our responses there is a consistent arrow of complexification: ⟶ more complexity ⟶ more efficiency ⟶ a larger population but new problems ⟶ learning and more reflexivity ⟶ more complexity. Prior concepts of boundaries – for example, between government, market, civil society – are less useful as the interconnections proliferate across them.

Governance can thus be seen as an organic formation, breaking through previous structures, developing with an architecture but without any institutional architect. One key characteristic of successful adaptation, they believe, will be the development of greatly enhanced capacity by human communities and institutions at all levels (from local to global) to see and comprehend impacts, changes and initiatives elsewhere. It can be seen also as a race against time, driven by sophisticated systems of knowledge, organisation, and networks of ethical awareness. Increasingly powerful voices are calling for democratic global decision-making – which is easy to say but very hard to do. Human governance is developing at a phenomenal rate but so are the challenges before us (Camillieri & Falk 2009).

According to Camillieri and Falk (2009), "Our laws and institutions are struggling to find a formula which recognises the social reality which is global and planetary, yet comprised of diverse cultures, societies, religions and civilisations. Reconciling the one and the many is the supreme challenge confronting contemporary governance. Future human adaptation depends on it".

Paraphrasing T. L. Friedman (New York Times, 18 October, 2010) "In a world where so many people now have access to education and cheap tools of innovation, innovation that happens from the bottom up tends to be chaotic but smart. Innovation that happens from the top down tends to be orderly but dumb. As a result, on balance, the sweet spot for innovation is moving down, not up. As such, government's job today is to inspire, liberate, empower and enable – all that stuff coming up from below – while learning to live with the chaos".

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Chapter 2. Eco Cities : Models from practice

Coral Ingley
Associate Professor
AUT University
Auckland, New Zealand

Saurav Satyal
Faculty of Business and Law
AUT University
Auckland, New Zealand

The aim of this paper is to compare different eco-city approaches and thereby to highlight key issues and best practices associated with such developments. The comparison is made between new eco- city development and eco-initiatives in existing cities, the eco-cities in advanced economies and those in developing economies of the world. This is based on the recognition that different approaches are required in different settings – or "one-size-doesn't-fit-all". The intention is to generate some general conclusions drawn from the cases while noting that most of the eco-city developments are still at a pilot stage or are in progress. The paper does not recommend any universal models of governance that suit a particular part of the world but, instead, generalises from the nature of the initiatives and describes the characteristics of the models implemented in new and existing developments in the advanced and the developing economies.

1. What is an Eco-city ?

There are various definitions of an "eco-city" but all the definitions have similar characteristics. The OECD (1996, cited in Surjan & Shaw, 2008, p 250) defines an eco-city thus : "in an ecological city, people would be conscious of their local and global responsibilities for the environment, environmental problems would be addressed continually and proactively, environmental considerations would be integral to a wide range of policies and sectoral activities, and greater attention would be given to providing a better quality of life for all urban citizens. Roseland (1999) has focused on the idea that an ecological city should have an interactive framework where decision making and solutions take a bottom-up approach. Most eco city definitions emphasise the importance of co- creation and collaboration between the public and private sectors and civil society. The partnership between the three parties is a core concept in eco city governance. The public sector acts as monitor, the private sector often brings expertise, while civil society is the whistle-blower and voice of the people. Besides the ecological concerns, the eco city seeks to encourage participation at all levels in order to be considered fully sustainable. Pieter Van Dijk (2010) offers the following criteria to assess and define an eco-city :

- How does the city deal with **energy** issues ?
- How does the city deal with **solid waste** issues ?
- How does the city deal with **transport** issues ?
- How does the city deal with **pollution** issues ?
- How does the city deal with **water** related issues ?
- How does the city deal with **sanitation** issues ?
- How does the city deal with **climate change** issues ?
- How does the city deal with **housing** issues ?
- How does the city deal with **sustainable urban development** issues ?
- Does the city follow an **integrated approach** ?

The following are some of the principles and frameworks for the eco-city concept :

Table 1. Eco-city Principles and Frameworks

Models and Frameworks	Principles
Millennium Development Goals	Commitment of member States to improve the lives of at least 100 million slum dwellers by the year 2020. Has drawn upon the agency and its partners in government, regional and local authorities, civil society, and the private sector increasingly closer to the lives of the urban poor. Key audience remains the policy-maker at every level with the power and authority to tackle urban poverty. Priority is given to policy, legislative and institutional changes at national and city level that can lead to effective local governance.
Agenda 21	Recognises the inter-relationships between people, the environment, and the economy. Encourages a cautious and long-term view on future development and present activity and encourages community-led initiatives in the areas of economic and social development, environmental protection, and community involvement in decision making. Partnerships between and within different sectors of society and nations, are felt to be essential.
Eco2Cities	A city-based approach: Local governments lead the development process and take into account their specific circumstances including local ecology. An expanded platform for collaborative design and decision making: Sustained synergy through collaboration of all the actions of the key stakeholders. A one-system approach: Integration of the whole urban system An investment framework that values sustainability and resiliency: Incorporates and accounts for lifecycle analysis, the value of all capital assets (manufactured, natural, human, and social), and a broader scope of risk assessments in decision-making.

Models and Frameworks	Principles
Bio Regional and WWF: One Planet Living	The 10 One Planet Living principles: Zero carbon: Making buildings more energy efficient and delivering all energy with renewable technologies. Zero waste: Reducing waste, reusing where possible, and ultimately sending zero waste to landfill. Sustainable transport: Encouraging low carbon modes of transport to reduce emissions, reducing the need to travel. Sustainable materials: Using sustainable healthy products, with low embodied energy, sourced locally, made from renewable or waste resources. Local and sustainable food: Choosing low impact, local, seasonal and organic diets and reducing food waste. Sustainable water: Using water more efficiently in buildings and in the products we buy; tackling local flooding and water course pollution. Land use and wildlife: Protecting and restoring biodiversity and natural habitats through appropriate land use and integration into the built environment. Culture and heritage: Reviving local identity and wisdom; supporting and participating in the arts. Equity and local economy: Creating bioregional economies that support fair employment, inclusive communities and international fair trade. Health and happiness: Encouraging active, sociable, meaningful lives to promote good health and wellbeing.

On analysis of these frameworks or models of the eco-city it is apparent that the core principle is similar. All of the models are focused on having a balance between the economic, social and ecological needs of the world. To create the balance these frameworks or models are concerned with bridging the economic, social, cultural, environmental, knowledge and technology gaps between societies. To achieve this, participatory governance at the local and national levels as well as the international level is necessary. Partnership between the public and private sectors and civil society is central to the governance concept.

The following section presents a selection of examples of various eco-cities from around the globe. The macro principles of these eco-cities are similar to the frameworks and models presented in Table 1. Variations lie in the implementation stage where the models and frameworks have been modified and adapted to suit the local needs.

2. Case Examples of Eco-cities

2.1 BedZEd – UK

Beddington Zero Energy Development, or BedZed, is the first UK's best known ecological village. Residents have been living in BedZed since March 2002 (BioRegional, 2009). The ecological village is based on a technological innovation and urban expansion initiative (Joss, 2010). BedZed follows the voluntary code of sustainable houses initiated by the UK government. The BedZed project is based on using the latest technology to solve issues relating to the environment as well as encouraging sustainable lifestyle through behaviour changes. The approach adopted by BedZEdto change behaviour is to ensure that the residents find it easy to follow sustainable lifestyle patterns and harder to follow the unsustainable ones (BioRegional, 2009).

A car club (car pool) has been established in BedZed for residents who may use this local fleet on a pay-as-you-drive basis. Forty-nine per cent of the residents at BedZed own bicycles (BioRegional, 2009); they are also encouraged to use efficient appliances so that waste is reduced; most tend to buy organic food, while some households grow their own food (BioRegional, 2009). In becoming more ecological, BedZed is now looking at encouraging its residents in the direction of household composting.

BedZed uses a private company, ESCO, to operate the local water and energy plants. In addition, BedZed uses photovoltaic panels to generate some of its renewable energy. Private businesses such as ESCO are seen to have a different model from other utilities companies and their main focus is job creation. Regular monitoring of BedZed's ecological footprint is also undertaken by ESCO.

Studies have found that residents need to be more involved in communication/consultation regarding the services BedZed provides to reduce ecological impact. The studies show that an appealing aspect of BedZed is that it has lowered its environmental impact, while the most disliked fact is that it is isolated as an eco-development within the wider environment (BioRegional, 2009). Most of the residents living in BedZed are passionate about environmental ecology and, in a spirit of communal living, were ready to accept the additional responsibility associated with eco-practices for the sake of a better environment.

2.2 European Eco-towns: Amersfoort – The Netherlands; Freiburg – Germany; Hammarby Sjöstad – Sweden; Zaragoza – Spain

Amersfoort is a ten-year housing programme for developing 90 new settlements and millions of new homes (Homes and Communities Academy, 2009). Freiburg is looking towards renewable sources of energy based on technological innovation. Hammarby Sjöstad is an expansion of the urban area which is also based on technological innovation. Zaragoza has focused on sustainable energy management and social housing.

Most of the European nations have strong local authorities and a history of commitment to sustainable development. "In Sweden, Germany and the Netherlands, there is over twenty five years of experience in developing eco-living strategies, and stronger evidence of achievement in environmental goals and objectives" (Homes and Communities Academy, 2009, p 3).

These three case examples (Amersfoort, Hammarby Sjöstad, and Zaragoza) emphasise a governance model that is reliant on building urban extensions rather than free standing eco-villages in isolation, the application of proven technology rather than short term new solutions, building neighbourhoods that offer a better quality of life compared to existing lifestyles, and improving existing standards in transportation and energy consumption (Homes and Communities Academy, 2009). These European eco-cities share eight common features that explain their success:

- They are located in growing and prosperous parts of the economies where there is an assured demand for new homes and a choice of good jobs

- They are close to existing settlements and hence offer easy access to jobs and services from the outset
- They are built on land owned by a public agency, which also commissions the project and develops the master plan as well as installing the basic infrastructure to enable plots to be sold to small builders and cooperative groups
- They include a significant proportion of social housing (25-30%) but this does not dominate the development (except in the Spanish case)
- They fund the infrastructure from the increase in land value (which in some cases, such as Freiburg and Hammarby Sjöstad, required decontamination first)
- They secure a higher level of investment in infrastructure through long-term contracts with utilities, such as energy and water companies
- They involve a major commitment from entrepreneurial local authorities to eco-town principles
- Local universities and companies work alongside the authority to assist the process (Homes and Communities Academy, 2009)

Based on these eco-cities, seven principles for successful eco-developments have been generated:

- locating growth in the right places
- agreeing development frameworks
- drawing up master plans
- orchestrating infrastructure
- selling plots to small builders
- building to higher standards
- fostering communities

(Homes and Communities Academy, 2009)

The most important ambition is to make the place attractive. To make it attractive it should be located in an area that has reliable services in close proximity. Availability of jobs and transport facilities are other important criteria. The urban planning policies and the government at different levels have to work together to make an eco-city compelling. The local council has to work with its external stakeholders, whose views need to be taken into account in drawing up the framework. Similarly, collaboration and dialogue with the private and public sectors and civil society is necessary to draw up master plans and to orchestrate the infrastructure. In Spain, the regional council, local authority and two savings banks collaborated in raising the finance, with central government support (Homes and Communities Academy, 2009).

The new eco-city must also be built to higher standards to attract people. To successfully run an eco-city the spirit of community needs to be fostered. In the Netherlands there are systems for agreeing the rules or 'social etiquette' in neighbourhoods and residents are provided with information

packs that explain responsibilities (Homes and Communities Academy, 2009).

To achieve this, there are new skills that need to be developed. In creating eco-towns local councillors and officers, as well as private developers and companies, need the skills to:

- understand and listen to people's concerns
- communicate and 'sell' new ideas
- identify relevant benefits (rather than simply features)
- organise effective forms of 'action planning'
- create realistic but inspirational images or brands
- bring the new technologies to life in easily-understood ways.

(Homes and Communities Academy, 2009)

2.3 The Dublin City Development Plan – Ireland

The largest local authority in Ireland, Dublin City Council, began its preparation in January 2009 (Nolan, Ostafi and Planchenault, 2009) for managing the city's infrastructure in a sustainable manner. It had developed various action plans for the city, such as the Climate Change strategy for Dublin City, the Dublin City Biodiversity Action Plan, and the Action Plan on Energy for Dublin.

In this case, it was found that the head of the City's planning department was a champion of the Framework for Strategic Sustainable Development (FSSD). The needs in moving Dublin towards a sustainable city required a long term vision, a visionary plan and greater alignment with stakeholders as well as fuller community engagement (Nolan, Ostafi and Planchenault, 2009). Selling the vision to the community was also another important aspect. Transparency in the planning and implementation of the plan and regular assessment were other concerns. The Dublin City case study (Nolan, Ostafi and Planchenault, 2009) demonstrated strong internal engagement by the City Council in steering the city towards adopting an ecological path.

The main issue with the Dublin City's development plan, however, was that it followed a model of command and control instead of focusing on the interdependencies and adopting a systems approach. Sharing a common vision and the concept of co-creation was also lacking, as well as measures to ensure transparency and strategic guidelines.

2.4 The Dongtan Project and Changxing Eco-City in Beijing – China

Dongtan is China's first initiative to build an eco-city from scratch. The backbone of this initiative lies in the socioeconomic study of the location. For this purpose the Dongtan Institute for Sustainability has been developed. The intention is for the city to be fossil fuel free. Working with the Institute, ARUP, an architectural company responsible for the design of the city, has studied the Chinese culture and other behavioural aspects such as how the people use roads. Even though the city is a completely new project the existing cultural factors were considered to be an important influencing factor in the approach taken in Dongtan. To create an eco-friendly culture, the Dongtan Institute for Sustainability is also responsible for teaching people in the area the importance of environment, since the project'sdepends on its acceptance by the people. To devise the master plan for the eco-city, the project has initiated partnerships locally as well as internationally. The project has faced many hurdles due to various local issues, with corruption being one of the biggest problems (The Economist, 2009).

The Changxing project in Beijing has based planning and implementing a sustainable ecological city based on an integrated urbanism development concept. The concept looks at balancing the environmental, social and economic needs of the city to achieve "energy efficiency, environmental friendliness, economic growth, and social harmony" (Yip, 2008). The project is driven through a range of key performance indicators (KPIs) to achieve the level of desired ecological balance.

As with the Dongtan project, the problems mostly faced in China are at the implementation stage of its eco-city model (Yip, 2008). The macro policies suit the needs of ecological cities but micro policies are still not effective, especially at the local level where planning is inadequate for the needs of these cities. The problems lie in China's historical practices : the macro policies follow new practices but the policies are compromised once a project reaches the implementation stage. Regulatory requirements at the local level are also narrow in scope. Conventional Chinese planning focuses more on tangibles, whereas in eco-cities it is important that intangibles are also taken into account. Transparency is another issue in initiating a sustainable model in China. Planning of eco-cities requires transparency in a trade-off between economic, social and environmental factors and such decision models have not yet been defined within planning practices in China (Yip, 2008).

2.5 Puri – India

The municipality of Puri and an agency of the Indian Government decided to make Puri an eco-city and shared the cost. To initiate the project, The School of Planning and Architecture in New Delhi prepared the plan. The parties in the project brain stormed and devised unconventional plans early as the natural environment was already deteriorating compounded by a lack of awareness, finances and basic infrastructure (Surjan and Shaw, 2008). Various other problems needed to be addressed as well. There was a clash between religious and commercial activity. In addition Puri's historical planning also posed problems in transforming the city into an eco-city. Enforcement of rules and regulations was a further problem. The strategy undertaken to overcome these constraints was to include public participation as early as possible.

However, deeply-rooted religious values among the people of Puri presented problems for the city to make radical changes. Having a low budget the project was also severely constrained in its implementation and at times there was no money to pay salaries to the staff. The project later went ahead after receiving 80 per cent of the project costs in financial support from the government of India.

3. Eco-cities Around the World : Types of Eco-city Development and Implementation Mode

Based on Joss (2010), Table 2 presents examples of new eco-city developments, Table 3 shows eco-city developments involving urban expansion and Table 4 identifies retro-fit developments. Cities are grouped by type of eco-city development and implementation mode, according to the following key :

Type of eco-city development

I — new development
II — expansion of urban area
III— retro-fit development

Key implementation mode

a — technological innovation
b — integrated sustainability vision/planning
c — civic empowerment

Table 2. New Development and Implementation Mode

City	Type of Eco City Development	Implementation Mode	City	Type of Eco-City Development	Implementation Mode
Arcosanti, USA	I	a	Masdar, UAE	I	a
Bahia de Caraquez, Ecuador	I	a	Songdo, South Korea	I	a
Bicester +3, UK	I	a	SseesamirembeUganda/ Tanzania	I	a
Destiny, Florida, USA	I	a	Auroville, India	I	c
Dogtan, China	I	a	Bicycle City, USA	I	b
Gwang Gyo, South Korea	I	a	Black Sea Gardens, Bulgaria	I	b
Incheon Eco City, South Korea	I	a	Sanoma Mountain Village, USA	I	b

Table 3. Expansion of Urban Area and Implementation Mode

City	Type of Eco City Development	Implementation Mode	City	Type of Eco-City Development	Implementation Mode
Aerial Treasure Island, USA	II	b	Hanham Hall, UK	II	a
Amman, Jordan	II	a	Helsingor/ Helsingborg, Denmark/ Sweden	II	b
BedZED, UK	II	a	Johannesburg Eco City, South Africa	II	a
Chalon-sur-Saone, France	II	a	Kalundborg, Denmark	II	a
Changxing, China	II	a	Logrono Montecorvo, Spain	II	a
Clonburris, Rep of Ireland	II	a	MenTouGou, China	I	a
Ecociudad Valdespartera, Spain	II	a	Nieuw Terbregge, Netherlands	II	a
EcoVillage, Ithaca, USA	II	a	Rizhao, China	II	a
Greenwich Millennium Village, UK	II	a	Segrate, Italy	II	b
Hacienda Ecocities, Kenya	II	a	Thames Gateway, UK	II	a
Hammarby Sjostad, Sweden	II	a			
Tianjin, China	II	a	Trondheim, Norway	II	a
Tudela, Spain	II	a	Zilina, Slovakia	II	a

Table 4. Retro-fit Development and Implementation Mode

City	Type of Eco City Development	Implementation Mode	City	Type of Eco-City Development	Implementation Mode
Erlangen, Germany	III	a	Oslo, Norway	III	a
Ferrara, Italy	III	a	Portland, USA	III	a
Freiburg, Germany	III	a	Puerto, Princesa, Philippines	III	b
Glumslov, Sweden	III	a	Reykjavik, Iceland	III	a
Gothenburg, Sweden	III	a	Sydney, Australia	III	b
Hamburg-Harburg, Germany	III	a	St. Davids, UK	III	b
Hamm, Germany	III	a	Tajimi, Japan	III	b
Heidelberg, Germany	III	a	Tangshan, China	III	c
Kampala, Uganda	III	a	Toronto, Canada	III	a
Kottayam+5, India	III	a	Vancouver, Canada	III	a
Loja, Ecuador	III	a	Vaxjo, Sweden	III	a
Malmo, Sweden	III	a	Waitakere, New Zealand	III	c
Yokohama+5, Japan	III	a			

4. Discussion

The eco-city models have been applied either to completely new developments or as an eco-initiative extension of existing cities. Most cities are compelled to incorporate the eco-city philosophies within existing infrastructures and cultures, which limits their ability to fully apply eco-city principles. Conversely, new eco-city developments such as Dongtan and BedZEd are better able to follow the eco-city model without the compromises. These new developments are small and can be self-sustainable. BedZed works within the boundaries of the government and has collaborated with local businesses. The decision-making approach is bottom up which can be understood by the communal nature of the eco-village. Being small, the residents attracted by BedZed are also people who have similar levels of awareness and passion for the environment. This makes it relatively easy to manage the interests of all the residents. BedZed is also technologically driven. All the processes and utilities are made eco-friendly through "green" innovation. However, without the level of access to finance and technology, keeping BedZed "green" would not have been possible. Moreover, there is general criticism of private sector involvement in delivering and managing a resource or utility as crucial as water, on the basis that this resource is a public good and should only be governed/managed/controlled by the public sector (e.g. Bretton Woods Project, 2010).

The main disadvantage of a small scale eco-city is that once the residents leave the confines of BedZEd they are forced to confront the "real world" of the surrounding environment. These small scale eco-cities are inspirational but they need to be integrated to the greater whole. BedZed has rules that

force residents to be more eco-friendly but in the world outside the village rules and decisions are more often based on economics. While small scale eco-cities are idealistic, whether the same model can be applied to the greater whole is doubtful. The residents who live in BedZed might be attracted to the village because of their own values and are ready to compromise over a certain level of comfort to attain this ideal. However, this set of values is not generally applicable to the wider population.

For new eco-developments in existing cities the main issue is integration of the eco-model with the existing urban model. The choice of location is based on its attractiveness. To attract people, integrated eco-cities must be more attractive to both "green" and "non-green" residents than is the existing urban environment. This means that the new eco-developments must retain the same level of convenience, comfort and efficiency as the existing environment. The aim is to integrate government, civil society and the private sector in creating an eco-city vision that is appealing and can be promoted to the people.

The Dublin case study highlights the possibility of centralisation when a government initiates an eco-model. Conceptually, the eco-model in the Dublin case appeared workable at the macro-level but the government controlled all aspects of the project; thus it lacked stakeholder engagement and participation at the micro level of implementation. The factors that lead to centralisation warrant further study but one of the main eco-city governance principles is "participation at each level", which was lacking in the Dublin case.

Table 5 compares the characteristics of new eco-city developments with those of developments in existing cities. The table also highlights relative disadvantages experienced with the eco-model in each type of development.

Table 5. Eco-city Models in New and Existing Developments

New Eco-city Developments	Eco-expansion of Existing Cities
Characteristics	***Characteristics***
Developed in isolated location	**Technology driven**
Partners with local businesses with similar business models	**Location is of prime importance to attract majority of people**
Residents have similar values	**Intensive planning to foster communities and sell the idea**
Technology driven	**Integration of eco-values with present infrastructure**
Governed by "green" rules and regulations	**Importance of partnerships between public, private and the civil society**
Aims at being a small scale self-sustaining city	**Aims at integrating existing cities with a new eco-model for cities**
Disadvantages	***Disadvantages***
Difficult to integrate with existing cities	**Slow change**
Values might be compromised with growth	**Often not "green" enough for the radicals**
Some disconnection for residents due to isolation	**Centralisation of power may mean that government fails to delegate sufficiently during implementation**
Eco-values are compromised after leaving the city premises	

In terms of eco-city models in advanced and developing economies, both follow the same governance principles at a macro level. They both seek participation at all levels, aiming at cohesion between government, civil society and the private sector, as well as transparency in decision-making.

While the philosophy and the models are similar, the differences can be found at the implementation stage. Aspects such as culture, the level of eco-awareness among the people and, most importantly, the level of finance and technology a city has at its disposal will significantly affect the successful implementation of the eco-city model.

While the advanced economies already have a long history of moving their cities toward sustainability, no such history applies to the developing economies. As noted in the preceding section, the European cities discussed above have 25-years of eco-development strategies to draw upon and, being able to take advantage of new eco-technological advances along with access to additional finance, are generally able to move faster and better implement the strategies.

Some of the cities in developing economies such as Dongtan in China do not have finance problems but this is not the norm and initiatives such as Puri, which stopped due to lack of finances, are more usual. On the other hand, Dongtan has experienced problems related to corruption, which has created hurdles for the project (The Economist, 2009).

A pattern common to both advanced and developing economies is that of easing a city toward sustainability. However, Tables 2 to 5 show that most eco-models, whether in advanced or developing economies, are based on technological innovation as the main stimulus which also requires heavy financing.

Advanced economies also have a greater awareness of and cultural disposition towards eco-friendly values, while developing economies are driven mainly by necessity i.e. to counter pollution, over -population and over-migration to the cities. The way cities in developing economies have largely been unplanned historically has also posed problems, as in Puri. The strong local culture typical in developing economies, such as India and China with their many religious and indigenous values, must also be taken into account while attempting to integrate and implementing eco-models. The local culture in these economies has a strong influence and change is often not welcomed. This emphasises the necessity of conducting a detailed study of the local culture and behaviour, as was initiated by ARUP for Dongtan, to increase acceptance of the eco city model.

Most of the cities in Tables 2 to 4 that have a technological orientation towards sustainability are the large, financially secure cities, in both advanced and developing economies. For cities that are small and financially under-resourced, civic empowerment and integrated sustainability vision/planning is an alternative strategy that has been employed. Through adopting a "bottom-up" approach, civic empowerment tends to ensure consumer acceptance. Integrated sustainability vision and planning are seen either at the pilot project/planning stages, where this approach represents more detailed planning, or on a larger scale. Table 6 highlights characteristics of eco-city models typically applied in developing economies compared with those in advanced economies.

Table 6. Eco City Models in Developing and Advanced Economies

Eco-cities in Developing Economies	Eco-cities in Advanced Economies
Driven by :	**Driven by :**
Technological Innovation Civic Empowerment Integrated Sustainability Vision/Planning	Technological Innovation Integrated sustainability vision/planning
Models need to integrate local culture	Greater level of awareness thus easy to initiate eco-strategies
Lack a "green" culture in comparison advanced economies	Technologically advanced models
Unplanned historical decisions create problems in implementation	Advantage in having a history in developing and implementing eco-strategies
Transparency problems	Financially secured eco-projects

Conclusion

Eco-city models have been applied to either existing cities or in the development of completely new cities. In developing a new city ecological values may be less compromised but the development tends to function in isolation. Integrating the eco-city model into an existing city takes time but is beneficial in long term. Not all residents or consumers are prepared to sacrifice their living comfort and convenience to "green" values. To be appealing to potential communities the integrated eco-city model has to deliver more intrinsic and extrinsic benefits than the existing city. This means selecting a prime location within the existing city and not compromising current standards of living and convenience.

Both advanced and developing economies may follow the same eco-city principles but the key difference lies in the implementation of the model. The need for eco-cities in developing economies is not always driven by ecological awareness but more often by necessity. With eco-models in this context, local and indigenous cultures must be integrated for the model to be acceptable to the people.

Most eco-models around the world are driven by technology; thus, it is very important that a city has the resources to sustain the technology. Cases in the developing world that have lacked significant finance have opted for other strategies such as civil empowerment. Both advanced and developing economies need to understand the importance of co-creation through public, private and civil society partnerships, which were lacking in the Dublin and Changxing examples.

In terms of the implementation and governance of any eco-city model, practical considerations are paramount and the economy must have a system to reinforce the model since most initiatives are compromised during the implementation stage. A proper monitoring system as well as a fully participatory system is needed. While governance can be influenced by the political ideologies of an economy, both advanced and developing economies may adopt a centralised model rather than a democratic approach. However, experience has shown that implementing eco-city principles at a macro level without changing the policies at a local level to stimulate participation is not effective. A detailed framework that creates a synergistic effect is needed to successfully implement the eco-city model. Within an existing city, unique ways of integrating the eco-model are also required. Thus, a universal blueprint for an eco-city model is difficult to devise.

Any eco-model must take into account the historical choices, while adopting strategic and technological innovation. Education policies must also be developed and implemented to create ecological and sustainability awareness and to reinforce eco-values. Only when people naturally align and think of the trade-offs between people, planet and profit can a true eco-city be developed.

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Chapter 3. How to Develop Good Governance at the City Level

Peter McKinlay, Director
Local Government Centre, AUT University
Auckland, New Zealand

Introduction

The obvious starting point for a paper on this theme is to look at what could be meant by good governance. International interest in governance as opposed to government per se took off at the beginning of this century with work being undertaken by agencies such as the World Bank and the OECD as part of a focus on how to improve economic performance in developing economies. The OECD identifies the following characteristics of good governance:

> It is participatory, consensus oriented, accountable, transparent, responsive, effective and efficient, equitable and inclusive and follows the rule of law. It assures that corruption is minimized, the views of minorities are taken into account and that the voices of the most vulnerable in society are heard in decision-making (OECD, 2001).

Robin Hambleton, Professor of City Government at the University of the West of England draws what is now an often used distinction between government and governance:

> Government refers to the formal institutions of the state. Government makes decisions within specific administrative and legal frameworks and uses public resources in a financially accountable way. Most important, government decisions are backed up by the legitimate hierarchical power of the state. Governance, on the other hand, involves government plus the looser processes of influencing and negotiating with a range of public and private sector agencies to achieve desired outcomes. A governance perspective encourages collaboration between the public, private and non-profit sectors to achieve mutual goals (Hambleton 2004:50).

The emphasis in both of these quotations is on inclusiveness; on reaching out well beyond the formal structures of government. An additional and different emphasis comes through from recent reports on local government restructuring, with an emphasis on the need to create capable organisations able to take and implement decisions in a timely way.

The Royal Commission on Auckland Governance found that «regional governance is weak and fragmented» and «community engagement is poor». It went on to state:

> Auckland's regional council and seven territorial authorities lack the collective sense of purpose, constitutional ability, and momentum to address issues effectively for the overall good of Auckland. Disputes are regular among councils over urban growth and the development and sharing of key infrastructure, including roads, water and waste facilities, and cultural and sporting amenities. Councils cannot agree on, or apply, consistent standards and plans. Sharing of services among councils is limited, yet there is scope for so much more activity in this area.
>
> The end result is delayed and sometimes suboptimal decisions for the region. In its funding decisions, central government has to deal with multiple parties, with Auckland councils and agencies

> failing to articulate clear regional priorities. Citizens and businesses get poorer services than they hope for, at a higher cost than necessary. There is waste. (RoyaCommission 2009 p 4).

Queensland's Local Government Reform Commission, which reported in 2007, identified broadly similar issues in its discussion of structural inefficiencies in Queensland's local government which it saw as including:

- Where multiple local governments' planning arrangements increase the complexity of managing economic development and growth for the region;
- Where current local government boundaries artificially create barriers between similar communities, create duplication of administration and mitigate against consistency in planning and service delivery;
- Where a large number of small administrations in a compact geographical area do not facilitate the ability of local government to actively capture and manage regional economic opportunities; and
- Where local government boundaries impede optimal service delivery, for example, donut councils.

Similar concerns have also driven local government restructuring in Canada. Stoney, Hilton and Krawchenko (2009) in a critical review of Canada's City-regions (drawn on below) observe that in their comprehensive text on local government in Canada, Tindal and Tindal comment that the philosophies underlying the various models for local government in Canada have tended to reflect "…a concern for efficiency and coordination in the delivery of services to the relative neglect of the representative and political aspects that are (or should be) equally a concern of municipal government" (Tindal & Tindal, 2004, p. 297).

Summary

From this brief overview it is clear that among the different understandings of good governance are:

The ability to take and implement decisions which promote efficient resource use, and collaboration in planning and delivery; and

Inclusiveness - reaching well out beyond the local authority to bring a range of interests into decision-making - and including due regard for the representative and political aspects of local government.

Good Governance

How do we recognise good governance when we have it? For the purpose of this paper good governance will be treated as the ability to take and implement decisions about the community's desired future. It is a combination of capability and legitimacy - the technical and administrative capabilities needed to ensure that decisions are well-informed, and pay due regard to matters such as area of impact, and integration with other activities (integration of transport and land use planning is a classic example) - and the legitimacy or community acceptance required so that a broad spectrum of the community is satisfied that the decisions are 'right' in a sense meaningful to them, even though they may not support the actual decision itself.

To put it another way, good governance can be seen as requiring a combination of technical and organisational capability with community engagement and legitimacy.

In a world in which local government restructuring is often driven by strongly held but not always evidence-based beliefs that bigger is better[1], and efficient service delivery is the principal business of local government, it is important to remember the community/legitimacy dimension. As the Greater Toronto Area Task Force (1996) advised the Ontario provincial government:

> The right kind of citistate governance must be developed in a consultative «bottom-up» process involving a wide range of civic players, neighbourhood leaders up to the level of corporate leadership. Mutual trust needs to be built amongst the parties. It would be an error for a state government to impose a regional government without broad consultation with the local community.

That advice was not followed. Both in Toronto, and in Ottawa, the provincial government imposed its own view of what was required to create a strong regional government. A number of researchers, and reports such as the Blueprint for Fiscal Stability and Economic Prosperity, the final report of the Toronto Mayor's Fiscal Review Panel (2008), have found significant fault with the resultant governance structures, especially in terms of their ability to deliver on effective decision-making.

Stoney, Hilton and Krawchenko (op. cit.) are among a number of researchers who have found the new structures wanting. They comment that «continued dominance of ward centric decision-making, a weak mayoral system, the absence of policy platforms and party political cohesion, dependence on developer funding, poorly contested elections, severe restrictions on debt financing, weak autonomy and a growing dependence on the still largely incidental funding from higher level governments are some of the key factors often credited with undermining effective municipal governance of Canada's cities.»

Context

The governance of cities used to be concerned with relatively simple and straightforward matters such as the provision of major infrastructure in an age when environmental impacts and climate change were not a critical part of decision-making, and providing or facilitating access to a range of recreational, artistic and cultural facilities, as well as local regulation.

It was an age when representative democracy provided a sufficient mandate for the decisions of local government, and local government generally had the combination of powers and capability required to implement those decisions effectively.

The great issues confronting local government, especially the world's mega -cities, are now both more complex and require quite different approaches for implementation. Cities are expected to play a leading role in areas such as response to climate change, and minimising the impact of service delivery on the environment. This means, for example, working to reduce energy consumption, minimise the use of motorised transport, manage water both as a scarce commodity, and in terms of the impact of the capture and disposal of water on the environment and much more besides.

Unlike the relatively simple tasks confronting local government in years gone by, these are not areas where duly elected local governments can simply direct their citizens in terms of what is required, or make unilateral decisions as to what should be provided, and expect compliance. We are now in the very different world of seeking to lead behavioural change, something which to be effective

1 See Bish (2001) for a compelling argument against this position

requires both genuine understanding by and acceptance on the part of those whose behaviour is to change. How many times have the people in this audience heard experts in areas such as energy efficiency, or water management, state that we already know what needs to be done to reduce our impact on the environment very substantially? The point is that people don't want to do it.

Predicting Community Behaviour in Relation to Wastewater Reuse: What drives decisions to accept or reject (Po et al 2005) reports the findings of a research project undertaken by the CSIRO (the Australian government's principal research institution) into the behavioural factors influencing people's willingness to use recycled wastewater. A key conclusion is that governments need to engage rather than persuade the community. A genuine partnership with the community needs to be developed over time if changes in expectations and behaviour are to be brought about consensually.

The significance of this finding for designing good governance at the level of the city cannot be overstated. It is not sufficient (although it is necessary) that governments, city or otherwise, have the formal legal powers, and the scientific and technical information, required to enable and justify initiatives which they may want to take in areas such as infrastructure and environmental management; increasingly they also require legitimacy in terms of community acceptance that what they propose is 'right' in terms relevant for the community.

In some respects, this should not really come as a surprise. There is an increasing volume of research which emphasises that citizens wish to engage with local governments not simply through the conventional representative process (which in many jurisdictions appears to be in decline) but through active participation, sharing in shaping issues and in taking decisions (see, for example, Haus & Sweeting 2006; Schaap et al 2009).

There is evidence of the same trend in Australia. In 2010 Pittwater Council in NSW conducted a customer satisfaction survey involving 400 local residents of varying ages. The General Manager provided the following view of the results:

What has surprised the council about the survey results is the fact that residents appear to be less concerned about what I would call the 'traditional' activities of local government – and much more interested in what could loosely be termed participatory democracy. The survey findings go on to say that out of ten drivers of satisfaction – what residents really want – the top two were access to Council information and support and community involvement in decision-making. Managing development came third, domestic waste fourth and perhaps most surprising of all, maintaining local roads came seventh[2].

Developing good governance

If the evidence of recent experience is anything to go by, developing good governance for megacities is an extremely challenging and not always successful endeavour. Part of the challenge is that good governance needs to be effective at two different levels; regional as a means of taking and implementing decisions on major regionwide issues such as infrastructure and regional economic development; local or neighbourhood as a means of building the connections and legitimacy essential for local government's 'licence to operate'.

It requires, as the Greater Toronto Area Task force emphasised, a bottom-up process to establish legitimacy, as well as a very good understanding of what works and what doesn't at the regional level.

Recent experience allows us to draw some very useful lessons. One concerns what is often referred to as the 'parochial' nature of ward-based local government - or more generally what is perceived as

2 Excerpt from the blog of the Council General Manager, accessed at www.pittwater.nsw.gov.au/blogspot

the problem of placing decision-making power with a body made up of people who individually represent only part of the area its decisions affect.

The Royal Commission on Auckland Governance in its discussion of leadership stated that «Fresh blood and fresh ideas will be required to move on from the region's **history of parochialism**» (emphasis added). In this quote, the term parochialism is clearly used pejoratively; parochialism is something to be avoided.

The reality, as anyone familiar with local government will be very aware, is that people who put themselves forward for election typically do so because they have a strong commitment to the area or district which they represent. For them this attitude is not parochialism, rather it's what local government is about - representing your particular area and protecting its interests. In this respect, it's important to recollect the difference between local government and central government. Generally the impact of central government activities is not felt directly within the personal space of individual citizens. In contrast, most of what local government does impacts directly within the local community, whether it's consent and regulatory powers in respect of land use and building development, dog control, local infrastructure development, management of local streets parks and reserves and much more – local government is literally about shaping the local environment in ways which arouse local passions in a way which central government activities seldom do. Recognising this, I have occasionally argued that 'local parochialism' should be regarded as 'local patriotism' if we want to have a serious policy debate about how this characteristic of elected members should be managed.

In many jurisdictions parochialism is exacerbated by the electoral process. Unsurprisingly, the electors will tend to favour candidates who promise to protect their interests, and reject those who do not. How and the extent to which this is a problem depends on whether or not there is a tradition of political party participation. Where there is, party discipline can normally be relied on to override parochialism on the part of individual candidates but, at the same time, can intensify the impact of policy shifts.

Designing regional (mega-city) level governance

The overarching requirement which comes out of the discussion in this paper is the need for a structure which can take and implement decisions notwithstanding the inherent parochialism of elected members. A realistic approach to this will recognise that there is the potential for a conflict with higher tiers of government who may for their own reasons prefer relatively weak regional decision-making bodies (OECD 2004).

Recent experience shows a number of different approaches to dealing with this need.

London

- The governing body for Greater London is the Greater London Authority (GLA) which is headed by an elected executive mayor with decision-making authority but within constraints designed to ensure a measure of accountability. These include:

- Requirements for public consultation on the development of the various plans for which the mayor is responsible.

- The power of the GLA to overturn the Mayor's budget on a two thirds majority (considered in practice to be a relatively weak power as normally the Mayor's own party will have at least one third of the seats on the Authority and can be presumed to be supportive).

- A requirement that the statutory officers of the GLA are appointed jointly by the Mayor and the assembly.

- The assembly (elected members other than the Mayor) has power to hold non-binding confirmation hearings for key appointments which the Mayor proposes to make - essentially the chair and deputy chair of four key functional bodies.

The assembly has a scrutiny role in respect of the decisions and activities of the Mayor which enables it to summons officials and information from across the GLA and to investigate and prepare reports.

A further constraint arises from the fact that the government still exercises significant control over the funding of the GLA.

Notwithstanding the various constraints, it is clear that the Mayor does have very significant authority, including the power inherent in the leadership role, as well as specific statutory powers - as an example the power to determine London's spatial plan must be regarded as extremely important given its role in regulating activity across the entire city region.

The creation of the Greater London Authority, and the role of elected executive mayor, were expressions of the vision which the leader of the Labour Party in government, Tony Blair, had for local government. He expressed much of this in a 1998 pamphlet published by the Institute of Public Policy Research (Blair 1998) in terms such as:

> *New ways of working:* most people do not know the name of the leader of their council. The committee system takes up an enormous amount of time and discourages rather than encourages leadership. A radical overhaul is needed. Councils should separate the executive from the non-executive role of councillors. Directly elected mayors and cabinet style appointments should be used to develop clear and strong local leadership. Other councillors should have more support in scrutinising decisions, monitoring performance and representing constituents and community groups in their ward.

Tony Blair's vision strongly influenced the provisions of the Local Government Act 2000 which amongst other things introduced the concept of Cabinet government, with up to 10 executive councillors holding decision-making authority within their portfolios, and the remaining non-executive councillors primarily responsible for oversight and scrutiny.

In a sense, these reforms contributed to the objective of clarifying decision-making power, but they did relatively little to increase the power of local government itself as central government continued to exercise very considerable influence and authority, both through the fact that on average 75%-80% of local government revenue comes in various forms of central government grant (approximately 20% is the redistributed business rate), and through a comprehensive system of KPIs and directions. Much of this is now being swept aside by the new coalition government whose initiatives include a Localism Bill which will grant local government a power of general competence but it remains to be seen whether local government will gain any more power over funding (and central government has been making very substantial cutbacks to the funding for local government services).

For London specifically, as the Mayor's powers increase (they were significantly extended in 2008), will this place additional stress on the GLA/Central government relationship? How tolerant will central government and its bureaucracy be of a single individual holding enormous decision-making power - what if the Mayor were to be given significant financial powers? Would this tip the balance towards England adopting a federal system? What does this say about the limits on the potential for the executive mayor model, at least in economies which follow the Westminster tradition?

Toronto and Ottawa

These are both examples of a relatively weak mayoral model in the sense that formal decision-making power for the most part is vested in the elected council. In turn, the councils themselves are elected on a ward basis. Because there is no tradition of political party control, the councils can resemble a collection of independents making it difficult to establish consistency in council policy, a fact highlighted in the final report of the Mayor of Toronto's Fiscal Review Panel, which in the section dealing with political culture had this to say:

> Criticisms go to the incivility of the political culture, its inefficiency, the lack of a will to change, and the ineffectiveness of Council. The daily press is full of examples of petty bickering, grandstanding to score points, mistrust, bad blood, and the remembrance of past grievances among members of Council. There are many occasions when Councillors intervene with the administrative staff to promote some local cause or to subvert normal procedures. All of this is layered on top of the threats and challenges posed by amalgamation and the seeming ignorance of the City's fiscal problems. (op. cit. P 44)

The inherent problem is one of organisational design. Both the Toronto and Ottawa restructurings appear to have proceeded on the assumption that differences amongst the pre-existing local authorities would be resolved by combining them within a single organisation and overlooked the impact of placing that single organisation under the control of ward-based councillors who would still carry with them a sense of commitment to the place they represented.

The risk, if the situation is not addressed, is that one or both of two possible outcomes will result. The first is gridlock; the inability to take decisions on critical citywide matters because of parochial opposition. The second is that the provincial government will intervene in order to fill the vacuum (and almost certainly without recognising the irony that the vacuum results from the actions of a previous provincial government).

Vancouver

As discussed in the companion paper presented to this conference on the integration of urban services and good governance, metropolitan governance for the Greater Vancouver region is exercised through the Greater Vancouver Regional District. Essentially, the regional district is an umbrella for inter-municipal co-operation which is now sponsored with the delivery of a wide range of services including infrastructure for water and waste water.

The British Columbia regional district system, and in particular its application in Greater Vancouver, has received high praise as evidenced by the following quotation from one of Canada's leading authorities on local government:

> The genius of the Regional-District system in British Columbia is that the Vancouver city-region obtains most of the benefits of having a metropolitan authority without the addition of another competing tier of directly-elected local government. For many of the world's city-regions, the Greater Vancouver Regional District merits at least further study, if not emulation (Sancton 2005).

However, the regional district system has not been without its difficulties. First, and again as discussed in the companion paper, it has not been immune to intervention by a pair of government as evidenced by the enforced restructuring of TransLink.

Next, there is evidence that the regional district system is much better at dealing with «win-win»

situations than it is with situations in which one or more municipalities will be winners and one or more will be losers. In 2008 the writer had the opportunity of interviewing one of the leading chief administrative officers within the regional district system. He was quite clear that the system worked extremely well when all participants believed that they were benefiting from the initiatives to which they were party, in other words, when the people sitting around the regional district board table all believed that their own local interests and the regional interest coincided. This was not the case when board members believed that their local interests and the regional interest were potentially in conflict. The example he gave was regional economic development (perceived as primarily focused on attracting new businesses) which his own board had refused to become involved with because a number of the board members each wanted their own local district to have first opportunity.

This experience is supported by the findings of the Regional District Task Force, an initiative of the Union of British Columbia Municipalities (UBCM) and the Ministry of Community and Rural Development, which reported in January 2010. It noted that «frictions among governments – whether rural, municipal, regional or provincial – can turn healthy debate over different perspectives into a barrier to effective performance at some board tables.»

Brisbane

The present structure of the City of Brisbane dates back to 1924 when the original City of Brisbane Act was passed (the present legislation is the City of Brisbane Act 2010).

The legislation adopted what could be described as a strongish mayor model. The mayor (titled the Lord Mayor) does not have the type of decision-making power which the Mayor of London has, but does have very significant powers to set the direction for the council itself, and oversee administration. These are set out in section 14 (4) of the present act as responsibilities which the mayor has over and above those of ordinary elected members:

> The mayor has the following extra responsibilities—
>
> (a) implementing the policies adopted by the council;
>
> (b) developing and implementing policies, other than policies that conflict with policies adopted by the council;
>
> (c) leading and controlling the business of the council;
>
> (d) preparing a budget to present to the council;
>
> (e) leading, managing, and providing strategic direction to the chief executive officer in order to achieve high quality administration of the council;
>
> (f) ensuring that the council promptly provides the Minister with the information about Brisbane, or the council, that is requested by the Minister;
>
> (g) arranging representation of the council at ceremonial or civic functions;
>
> (h) directing the chief executive officer and senior contract employees of the council.

The governance of the council is undertaken primarily through seven standing committees whose chairs, plus the Lord Mayor, make up what is known as the Civic Cabinet and in practice forms the Council's primary decision-making body.

As well as the statutory provisions, which support a strong decision-making structure, the city's political culture is also significant. Party politics have been a feature of council administration since

the city was established. For most of its history, one or other of the main political parties (Liberal and labour) has held a majority (there have been occasions when there has been no majority party and thus a form of coalition government).

With the combination of mayoral powers, the Civic Cabinet, and party political control, Brisbane provides an example of a ward-based Council which does provide an effective basis for taking and implementing decisions on regionwide issues, in part because party political control has generally been an effective means of countering the risk of parochialism.

Despite its powers, the City of Brisbane is subservient to the State government in a number of significant areas including regional planning, which is led by the state government, and water and wastewater where the State government sets the basic policy framework, and owns all of the infrastructure associated with the supply of bulk water.

It should also be noted that the City of Brisbane covers only some 50% of the Brisbane Metropolitan area by population, and only one third of the population of South East QLD which is treated as a single region for planning and infrastructure purposes. It does, though, play a lead role in the South East Queensland Council of Mayors which is emerging as a potentially important countervailing force to the role of the state government as a de facto regional authority.

Auckland

Auckland represents a somewhat different approach to the challenge of establishing a means of taking and implementing decisions on significant regionwide matters. We have already seen (page 2 above) that the Royal Commission took the view the pre-existing authorities generally lacked what was required to address issues effectively for the overall good of Auckland.

When it came to considering what structure it should recommend for that purpose, the Royal Commission was prepared to give the mayor greater authority than is the case for New Zealand mayors generally, but was not prepared to recommend an elected executive mayor taking the view that the mayor should be required to persuade councillors, rather than being able to impose a decision. Accordingly the principal additional powers and prerogatives which the Royal commission recommended were the power to appoint the deputy mayor and committee chairs (positions normally filled by election by the council as a whole), the power to propose the Auckland council budget and initiate policy, and the support of an appropriately staffed mayoral office.

- Without specifically making it clear that it was substantially enhancing the powers proposed by the Royal Commission, the government gave the mayor a number of additional powers. The statutory provision is set out in appendix I. The powers include:

- In addition to the appointment of committee chairs, the power to establish committees which clearly includes determining how many committees, what subject areas, their terms of reference, and their membership.

- The power to lead the development of council plans, policies and budgets for consideration by the governing body. This is a significantly strengthened power in comparison with that to propose the budget and initiate policy.

- to establish processes and mechanisms for the Auckland Council to engage with the people of Auckland.

The Auckland Council itself is what is known as a unitary council; it has within its region all of

the powers of the two different forms of local authority in New Zealand, regional councils and territorial authorities.

Both the Royal Commission, and the government, rejected the idea of establishing a second tier of local government to be responsible for sub-regional matters. Instead both accepted that the Auckland Council should be the sole employer, asset owner, fundraiser (both revenue and capital) and should also have the sole responsibility for service delivery either itself or through council controlled organisations.

For the Royal Commission, local democracy was to be provided by six local councils in geographic terms broadly replacing the predecessor city and district councils. Their primary function was to be a combination of advocacy on behalf of their communities, and oversight and monitoring of services delivered locally by the Auckland Council as well as negotiating the budget to meet the cost of those services together with any targeted rate required to fund services over and above the budgetary provision made by the Auckland Council.

The Government rejected the proposal for six local councils and replaced it with a proposal for local boards with the final number, now set at 21, to be determined by the Local Government Commission. The principal reason given by government for this change was that six local boards were too few for effective local democracy. The functions of local boards are not significantly different from those proposed by the Commission for local councils again being primarily a mixture of advocacy and the oversight and monitoring of local services (there is a statutory difference. The actual legislation rather than giving local boards specific authority in respect of defined services, it provides that generally decision-making on the non-regulatory activities of the Auckland Councils should be by local boards unless the impact of the decision is likely to extend beyond the area of a single local board, the decision requires integration or coordination with decisions of the Auckland Council itself, or the benefits of a co-ordinated approach will outweigh the benefits of local decision-making.

It is yet unclear whether local boards will evolve as a strong expression of community governance, or whether the Auckland Council's management of its relationship with local boards effectively suppresses their community governance potential.

Finally, the government determined that virtually all of the Auckland Council non-regulatory service delivery activity should be vested in a series of council controlled organisations.

The Auckland case is of particular interest because of the way the mayoral powers are defined. They could have provided the basis for strong mayoral lead Cabinet government if the mayor had decided to use his powers to establish committees, and appoint committee chairs, as the basis for building the equivalent of Brisbane's Civic Cabinet. It would have been relatively straightforward to create an effective majority of elected members loyal to the Mayor and other things by virtue of patronage. Instead the Mayor opted for what he described as an inclusive approach, ensuring that every elected member had some position of significance with the objective of building a consensual approach to council decision-making. Whether that approach will withstand pressures of parochialism and political difference remains to be seen (although the Auckland Council is not party political controlled, there are a number of elected members that stood on tickets known to have party political affiliations, and by the very nature of the areas they represent, councillors do have different political perspectives).

Is also too early to make a considered judgement about how the establishment of the Auckland Supercity will affect the balance of political power as between the Auckland region on the one hand and central government on the other. There are clear signs that the Auckland Council intends to be

assertive in terms of what it sees as Auckland's needs. On the other hand, Central government has made it very clear that it sees establishment of the Auckland Council has amongst other things a means of ensuring better integration between decision-making for Auckland, and central government policy which a number of people have interpreted as code for a declared intention to intervene actively in decision-making on the future of Auckland.

Have we solved the regional level design problem?

The answer, reviewing the experience described above, is almost certainly not. Each brief case study illustrates one or more of the major issues which confront the task of establishing effective metropolitan level governance:

- The vulnerability to parochialism, unless structures are specifically designed to ensure that this cannot influence decision-making, or unless there are other mechanisms in place (for example party political control of Brisbane) which mitigate against parochialism as such.

- The ongoing tendency of higher tiers of government to intervene whenever they consider that the interests they represent demand it.

It is difficult to see easy answers to dealing with either of these problems. Party political control may provide an effective means of mitigating against parochialism, but there's no way of simply requiring that there should be party politics in local government. That is very much a function of local choice, culture and practice.

The executive mayor model, at first blush, appears to provide a solution but that carries its own challenges with it. In particular, is it viable as a long-term solution, especially if the mayoral reach is across the full range of services which could best be managed and/or co-ordinated at a regional level? Concentrating power to that extent in the hands of a single individual is a challenging choice in a democratic society.

Nor is easy to see how higher tiers of government could be expected to stand back when a major metropolitan centre within their jurisdiction is either pursuing a course of action which the higher tier considers to be against the state, provincial or national interest, or failing to act in a way which the higher tier regards as appropriate. Higher tiers of government will respond to what they see as the interests of their electorate. In this respect, it is instructive to consider the reasons which the Queensland State Government put forward for putting in place a Local Government Reform Commission, with a mandate to report swiftly on restructuring local government, rather than awaiting the outcome of the Size, Shape and Sustainability initiative being undertaken by local government:

- With the next council elections scheduled for 2008, this reform needs to be implemented now.

- Local government's Size, Shape and Sustainability initiative will not achieve reform before the next elections.

- Queenslanders need improved services now and cannot wait another four years for local government reform. (Queensland Government 2007).

The changing emphasis on the role of major urban centres within the world economy is raising the stakes, both in terms of the need for effective governance at the metropolitan level, and in terms of the incentives facing higher tiers of government. The more you believe that the success of your

major metropolitan centre or centres is the single critical factor in the success of the national economy, the greater your incentive to intervene to 'steer' the metropolis in the direction you believe it should travel. At the same time, we also know that strong metropolitan governance requires a measure of local autonomy - which suggests that higher tiers of government should be focused more on collaboration and partnership than on intervention.

There is a further factor which also needs to be considered, when thinking about the design of metropolitan governance. Inevitably and always formal jurisdictional boundaries, and the functional boundaries especially for economic activity will differ. The final report of the Lyons Inquiry into Local Government observed:

> There are important questions about what is the best level of governance to drive economic prosperity, but the fact that functional economic boundaries are not precisely defined, are different for different kinds of activity, and change over time, means that we should avoid simplistic solutions to what are complex problems (p6).

Andrew Sancton took this point further in a thoughtful reflection in The Limits of Boundaries (Sancton 2008), recognising that this was an issue not just for economic activity, but for other uses. He began with the following observation:

> Because cities are becoming increasingly important as sources of innovation and wealth in our society, does it follow that their own institutions of government will become increasingly autonomous such that they will become self-governing? I argue in this book that, contrary to some recent claims, cities in Western liberal democracies will not and cannot be self-governing. Self-government requires that there be a territory delimited by official boundaries. For cities, the boundaries will never be static, will never be acceptable to all, and will always be contested. Boundaries fatally limit the capacity of cities to be self-governing. (P3).

Local or Neighbourhood Governance

This is the second necessary dimension of effective metropolitan governance. We have already observed in the discussion on the context above (P4) that the great issues confronting local government are now more complex than in former years.

The complexities take two different forms. One concerns how best to deliver the wide range of social services which are now seen as the core responsibility of the state in most Western liberal societies. The other concerns the issue of educing behavioural change; how to garner support for the practical steps required to implement policies in areas such as climate change, water management, energy efficiency, transport…?

The Big Society initiative of the present Conservative-Liberal Democrat coalition government in the United Kingdom can be interpreted in a number of different ways. One, which has some credence, is that it proceeds from an evidence-based belief that the 'top-down' design and delivery of social services is relatively ineffective to achieve the desired outcomes; the missing element is the intimate knowledge and networks at a local level required to really understand where, when and how best to deliver interventions. The Manifesto for Londoners, prepared by London Councils in the dying days of the previous Labour government argued cogently that devolution of service delivery from central government was desirable both in terms of effectiveness and in terms of efficiency - in other words, that the conventional 'top-down' approach was not just relatively ineffectual, but overly costly.

The initiative is also resulting in a number of councils reviewing the way in which they connect with their own communities. One example which is attracting attention is Lambeth Borough Council's

rebranding itself as the cooperative Council, shifting from doing things **to** its communities to doing things **with** its communities. At the heart of this is an objective that, as far as possible, services should be delivered through employee or community owned and/or controlled entities, rather than by the council itself (see The Co-operative Council Sharing power: A new settlement between citizens and the state, the report of the Cooperative Council Citizens Commission).

This is just one of a number of examples of initiatives which are looking to reinvent the way in which communities are governed ranging from participatory budgeting, to the exercise of community governance through a network of community owned branches of an Australian commercial bank.

Perhaps more critical from the perspective of the urban sustainability is how we hold the necessary discussions required to achieve community buy-in to the behavioural changes needed in order to deliver the environmental outcomes we now seek. To do so is crucial for the future of our cities, but we lack the means.

Most recent metropolitan restructurings assume that the critical issue to resolve is how to take decisions at the regional level. Little thought has been given to the separate question of how to secure the necessary buy-in at the community, neighbourhood and individual level required if we are to achieve the significant changes in behaviour needed to implement the policies we now regard as essential. The Toronto and Ottawa restructurings rely on ward based councillors as the main contact between the council and the citizen - with Representation ratios (number of citizens per councillor) in the order of 40,000, 50,000:1. The Auckland restructuring has a representation ratio at the level of the Council itself of approximately 70,000:1. Local boards have been advanced as the local democratic element in the mix, but they have very limited resources, and a representation ratio of 10,000:1. To put this in context, it is common in continental Europe for the representation ratio to be less than 1000:1.

The discussion mentioned earlier about research into public attitudes to the use of recycled wastewater is simply one example of a significant pro-environment initiative which will not proceed without widespread public understanding and acceptance. It is a typical if somewhat extreme illustration of the kind of policy which can only be implemented through engagement rather than persuasion, and which requires a genuine partnership with the community.

The challenges facing Auckland provide further illustrations of the same issue. The CCO responsible for all bulk water and wastewater across the region (other than one minor exception) is statutorily required to set its pricing at the lowest level consistent with being able to maintain renew and extend its network. This provision is a clear response to public concern that water should be as cheap as possible. There is little understanding of the environmental or economic implications. Ironically, the CCO is also statutorily required to implement demand management policies - and by far the most effective policy for this purpose is pricing.

Possibly the single largest issue facing the Auckland Council, certainly in expenditure terms, is the continuing development of transport infrastructure including roading and public transport. The number and scale of projects which the Council is currently contemplating appears well beyond the ability of the council and central government combined to fund given current approaches to the pricing of transport services. There is a real possibility of continuing gridlock, and an ongoing preference for the use of private vehicles rather than public transport.

Theoretically the obvious answer is to use a range of pricing tools including 24/7 road pricing and possibly a New Zealand version of the French Versement Transport, a regional payroll tax used as one of the principal funding mechanisms for public passenger transport.

Auckland, in common with many metropolitan centres, lacks the ‘soft infrastructure’ required to have the ongoing community conversation. To do so needs strong local or neighbourhood government

- structures within which people meet and interact informally, and which can provide the framework for the oldest discussions we need to have, rather than the silo-based discussions around particular taxes in isolation from the overall community impact.

This is about more than simply putting in place structures at a local level. It is about passing over responsibility so that the ordinary citizen genuinely understands that she or he has a central role to play in helping take the decisions which will shape the future both of the local neighbourhood, and of the metropolis itself. It requires a significant change in the behaviour of politicians at the Metropolitan level (and in higher tiers of government) including a shift in understanding of the timeliness of decision-making. There is a need to realise the real nature of the trade off between taking decisions quickly, and taking decisions through a process which builds a constituency for implementation.

Establishing effective local or neighbourhood governance, which can be the locus for the conversations we need to have, is almost certainly the elephant in the room of metropolitan governance. No one wishes to recognise it, but unless we do, the ability of metropolitan governments to make and implement the decisions we need will be severely compromised. This is truly the major challenge ahead of us in developing good governance at the city level.

Conclusion

To develop good governance at the city level necessarily requires an understanding of what is meant by good governance. This paper argues that the critical test of good governance is the ability to take and implement decisions about the community's desired future.

It is a combination of capacity and capability on the one hand and legitimacy on the other.

Much recent activity in restructuring metropolitan governance has focused too much on capacity and capability, and not enough on legitimacy. Possessing the technical and organisational skills required to develop complex solutions modern cities need in order to be sustainable is only half the task. The other half is possessing the skills and culture of collaboration and engagement required to ensure the communities which finally grant the 'licence to operate' which all democratically-based institutions ultimately require are prepared to accept solutions which will deliver the desired outcomes.

The need is for a major shift in understanding, and in empowerment. The requirement is strong community governance to serve as a basis for collaboration and partnership in the development and implementation of those solutions. This is a different approach to policy making. It starts by recognising that local government's communities must be part of the process of defining the problem, not just responding to local government's definition and crucially the community must take ownership both of the problem and of the preferred solution.

There is a useful analogy with the great circle route which airlines fly between Europe and North America. The straight line is not the shortest distance. In the same way, the administratively neat decision-making process, is not the quickest way to a shared and legitimate agreement on the measures we must take to ensure urban sustainability.

Appendix

Local Government (Auckland Council) Act 2009
Section 9 Mayor of Auckland

(1) The role of the mayor is to—

(a) articulate and promote a vision for Auckland; and

(b) provide leadership for the purpose of achieving objectives that will contribute to that vision.

(2) Without limiting subsection (1), it is the role of the mayor to—

(a) lead the development of Council plans (including the LTP and the annual plan), policies, and budgets for consideration by the governing body; and

(b) ensure there is effective engagement between the Auckland Council and the people of Auckland, including those too young to vote.

(3) For the purposes of subsections (1) and (2), the mayor has the following powers:

(a) to establish processes and mechanisms for the Auckland Council to engage with the people of Auckland, whether generally or particularly (for example, the people of a cultural, ethnic, geographic, or other community of interest):

(b) to appoint the deputy mayor:

(c) to establish committees of the governing body:

(d) to appoint the chairperson of each committee of the governing body and, for that purpose, the mayor

- *may make the appointment before the other members of the committee are determined; and*
- *may appoint himself or herself:*

(e) to establish and maintain an appropriately staffed office of the mayor.

(4) The mayor must exercise the power in subsection (3)(e)

(a) in consultation with, and acting through, the Council's chief executive; and

(b) within the budget in the annual plan adopted for that particular expenditure (being an amount not less than 0.2% of the Council's total budgeted operating expenditure for that year).

(5) The mayor must not delegate any of his or her powers under subsection (3).

(6) The mayor is a member of each committee of the governing body.

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Chapter 4. Suez Environnement's Vision and Solutions for Sustainable Cities : The triple challenge of development, quality of life and environment

Thomas Perianu
Vice President, Sustainable Development
Suez Environnement
Paris, France

Our planet will soon have 4 billion urban dwellers who expect to have access in their city to essential services in a harmonious living environment, source of well-being and fulfilment. Historically, cities developed along coasts and rivers, which fostered trade and represented sources of water, energy and life. Over time, cities had to learn to manage their resources but also their effluents and waste, to ensure sanitation and to offer their residents a comfortable living environment. Cities have hence shaped their services in the areas of water and waste, which tomorrow will still be key factors of smart growth and a sustainable city.

Reconciled with its natural environment, the city will be a place of solidarity between generations and between neighbourhoods, proud of its past, its cultural heritage and its singularities, but also open to the future and modernity.

These challenges are also those of Suez Environnement : reconciling growth (economic and urban), attractiveness (economic and human) and environment (quality of life and sustainable respect for the environment).

For over a century, Suez Environnement has been involved in the heart of cities and territories, and supports all stakeholders, policy makers and experts of urban developments. Suez Environnement operates on a daily basis complex infrastructure and networks, that deliver essential services such as production and distribution of drinking water, collection and treatment of wastewater, collection, treatment and recovery of waste, allowing everyone to live in harmony with his/her city.

With its research centers and its network of partners, Suez Environnement looks toward the future. Its proximity to the territories lead Suez Environnement to continuously develop innovative solutions to the changing needs of cities.

The city is a place that we all contribute to build. With 80,000employees worldwide, Suez Environnement is an economic actor located in the heart of the territories that it contributes to develop through a close and long term relationship, allowing it to propose tailor-made solutions.

Like living organisms or ecosystems, cities are operating systems, the operation of which is becoming ever more complex, in an increasingly demanding environment. As an historic and innovative actor in management of water and waste urban infrastructure in France, Europe and worldwide, Suez Environnement is willing to share its experience, expertise and innovation with all stakeholders involved in city planning and management, to provide local solutions for a successful, responsible and environmentally friendly city : a sustainable city.

I. Manage resources

A. Water : a historical factor of cities'development

Water is an essential flow that feeds the city and offers a potential for human and economic development. Suez Environnement works every day over the entire water cycle to provide cities with a sustainable and efficient hydrological mix (diversity of water resources), and a high quality, healthy drinking water resource. Suez Environnement also addresses water scarcity situations by offering solutions, and contributes to a wider access to water in developing economies.

1. Smart-metering, to contribute to sustainable resources management in Malta

In 2010, through its subsidiary Ondeo Systems, Suez Environnement has won the largest European contract for remote reading of meters : 250,000 water meters for 400,000 inhabitants of the island of Malta. The island of Malta is facing a serious shortage of natural water resources, reinforced by the consequences of climate change and the influx of tourists up to one million people in thesummer. New information technologies allow today to inform users about their daily water consumption and to optimize it. The remote reading technology is already installed in some French cities and tends to spread. Lyonnaise des Eaux in particular has equipped the Left Bank of Paris with remote reading.

2. Water footprinting

Suez Environnement, through its subsidiary SAFEGE, participates in the international effort underway to develop the ISO 14046 standard on the water footprint. Using the same approach as the calculation of the environmental impact and according to the Water Footprint Network, the water footprint of a product is defined as the total volume of water used directly or indirectly to produce a product or service. This quantity is estimated by considering the consumption and pollution of water throughout the production chain. Measure this volume is a step in the development of a comprehensive resource management.

B. New energy sources for cities

Faced with the scarcity and rising prices for fossil fuels, the energy performance of the city should be improved in all its activities. Suez Environnement is developing new solutions to provide integrated energy to cities and improve the energy efficiency of urban services.

1. Energy in wastewater

Lyonnaise des Eaux proposes an ecological solution coupling heating and cooling for local governments and building managers, which uses the heat contained in wastewater networks : "Degrés Blue". This system was implemented for the heating system of the Wattiginies school in Paris. It can cover up to 73 % of the needs, or about 370 MWh per year. It will result in a reduction of emissions of greenhouse gases by about 76 tonnes of CO2eq. per year. The Levallois-Perret aquatic center, hosting 80,000 visitors per year, also benefits from this technology : thanks to the calories of the wastewater discharged by 10,000 people, it provides a continuous thermal comfort (production of 900 MWh/year, 90 % of energy needs for three pools to heat the water up to 28 °C). The system can help reduce energy costs (€ 48,000 saving from the first year) and helps to fight against global warming : 24 % saving of primary energy per year, reducing emissions of greenhouse gas emissions by 66 % (150 tCO2eq.).

2. Energy recovery of sewage waste

CETaqua – the laboratory of Agbar subsidiary of Suez Environnement - is the leader on a project called BIOCELL (supported by the EU's LIFE + Environment and Nature), which aims to demonstrate the technical feasibility, the economic and environmental relevance of the production of energy from fuel cells powered by biogas from sewage waste.

II. Manage the waste and effluents life cycle

A. An intelligent and responsible management

All activities conducted in the city produce waste and effluents the management of which is becoming ever more complex for local governments.

Suez Environnement assists communities in the management of all types of waste and effluents in order to help them meet their health objectives, and also by fostering material recovery thus promoting a circular economy with demanding environmental accounting standards.

1. Ambitious partnerships for waste management

SITA helps its clients to meet the municipal recycling targets imposed on them by national regulations. For example, in Britain, SITA UK helps Northumberland County to exceed the target which is set by the Government to recycle and compost 40 % of its municipal waste, through a twenty-eight years contract. Northumberland County and SITA UK have a common goal to reduce the fraction of waste to be landfilled to 8 % by 2012, a goal that should be achieved with the high recycling rates coupled with energy recovery.

2. Leading-edge technologies for quality water

The Water Framework Directive sets for 2015 the restoration of good ecological and chemical status of water bodies. To meet this challenge, Suez Environnement and CEMAGREF have built a research partnership within which AMPERES is a program (funded by the National Research Agency - total budget : 2.4 million €) that has, among other objectives, to identify priority substances and micro-pollutants present in urban wastewater, and to identify the most effective treatments for their elimination. Thus, while most stations already eliminate up to 85 % of these molecules, the elimination of the residual fraction now requires the use of advanced treatment solutions such as membrane bioreactors developed by Degremont, a Suez Environnement subsidiary.

B. Preserved living environment

The activities of the city are likely to produce harmful effects (noise, smells) for which satisfactory solutions need to be found. Suez Environnement considers urban services as a whole and considers cross-cutting and innovative solutions to achieve a healthy, pleasant living environment, whilst minimizing nuisance.

1. Pneumatic waste collection for a renovated city

As part of the urban renewal undertaken in the Balzac district, the city of Vitry-sur-Seine decided to implement a pneumatic collection system for its waste. Thus, by 2018, 10,000 households in four major areas of collective housing will be served by a 10.5 km of underground network,

making it the largest project developed at European level. This is not only an effective response to the increase in waste genartion and congestion of waste collection services, but this is mostly a revolution in the quality of life of city dwellers. The availability of receptacles and the removal of containers on the sidewalks, bad smells and daily rounds of collection trucks will make public spaces cleaner and healthier and improve sorting, particularly in vertical habitat. The pneumatic collection also removes some of the logistics of waste management that appear to be increasingly complex for communities and provides agents of the municipality with an opportunity to work in less painful and less dangerous conditions.

2. Restore marine bodies facing pollution

GIREL is a project of infrastructure management for the ecological rehabilitation of the coastal areas, on the sites of the "Grand Port" of Marseilles. The project was selected in response to a call for tenders launched in May 2010 by the Rhone-Mediterranean-Corsica Water Agency and the "Pôle Mer PACA" on ecological restoration of the marine environment. SAFEGE, with its Cystore project (transplantation of structuring algae, trophic resources, and indicator of water quality) and Lyonnaise des Eaux associated with Ecoceane with the Biorestore project (capture, magnification and release of juvenile indigenous fish) help to restore the integrity of the marine ecosystem and its resilience.

III. Operate and help cities develop

A. Sustainable infrastructure management

Infrastructures of cities deliver daily essential services to citizens. They must always have the highest availability rates. Cities are increasingly complex systems to manage, so Suez Environnement aims to provide its expertise in the sustainable management of the interlocking systems of cities, in direct interaction with users.

1. Optimise the water network technical yield

Suez Environnement has implemented innovative methodologies to fight against leakages in water networks in various cities on all continents : in the urban community of Bordeaux by Lyonnaise des Eaux (gain of 1.6 million m3 of water and an increase by 2.7 % of network yield in 6 months), in Algiers with the local operator SEAAL (transition from discontinuous to 24/7 supply, in Casablanca through the Suez Environnement subsidiary LYDEC (gain of 10 % network yield in 10 years). This leads to lower operating expenses, conservation of water resources and improved service.

2. Performing and sustainable laying of water mains

The research project ECORE is a partnership between several research centers of Suez Environnement and GDF Suez. This project aims to experiment with various innovative techniques for laying gas and water pipes in order to analyze their technical, environmental, and economic performance. New construction works technologies will not only perform better but also limit nuisances to local residents (traffic, noise,...) and to the environment.

B. Contribute to a better city planning

To be sustainable, city planners have to anticipate multiple variables in integrate services as upstream as possible. Suez Environnement helps them to assess the environmental performance of projects to optimise the renovation and the construction of new neighborhoods. To be successful at the scale of the city, solutions must integrate multiple parameters. Integrating services in the upstream planning process allows city planners to provide the best technical solutions while integrating in the existing urban context (Heritage, mobility, networks).

1. Upstream consulting in city planning

To support local decision-makers in their planning choices, Suez Environnement and its subsidiary SAFEGE have developed a range of consulting services around the issues of territorial development and environmental performance of eco-districts : sustainable development consulting as for the proposed development of the "Triangle of Gonesse", Environmental Analysis of Urban Planning, "High Environmental Quality" ® developments, studies and project management of urban transport projects… And to enable city stakeholders to measure and monitor the appropriateness of the scenarios and recommended solutions, Suez Environnement has developed a multi-criteria evaluation tool of the performance of projects and services : CityBiose ®.

2. Systemic and « contextualised » city planning

Presented by a multidisciplinary team (LATTS, ENPC, Suez Environnement, EPA Plaine de France), the Syracuse project was selected as part of the "Building and Sustainable City" of the National Research Agency. Sobriety in energy use and waste generation, autonomy of different urban scales, organization of urban services, all issues that lead to a multidisciplinary analysis leading to an approach integrating urban development including socio-economic alternatives and techniques. The project thus analyses three flows (energy, water and waste) at different scales of urban development in order to demonstratewhich are the most appropriate technologies for a given context.

IV. Make cities resilient

A. Manage and mitigate risks

The environment in which cities evolve has always been changing and risky. In the face of climate change, threats to biodiversity, natural hazards and complexity of rules governing the liability of elected officials (safety and quality of life), Suez Environnement develops systems adapted to urban services to help the prevention of risks, and to allow cities to cope with extreme weather events.

1. Flood and pollution prevention

Prevention of flood risk, environmental quality and health of natural environments and bathing waters is a major concern of local governments. Suez Environnement, through its subsidiaries, has developed a range of complementary and innovative solutions that meet these goals through modeling real-time behavior of sewer systems during rainy events and their impact on the environment : Lyonnaise des Eaux with the solution iNFLUX, notably deployed for SIAAP (covering 8.6 million

inhabitants, 400 km of network) and the Bordeaux Urban Community, AGBAR with the COWAM solution (Coastal Water Management) deployed in Barcelona and in three other Spanish cities and SAFEGE's Qualicôte a tool developed in partnership with Actimar, deployed in the Cannes region.

2. Solutions to respond to coastal cities'hydric stress

In the face of climate change, some areas are more water-stressed than others and need to find solutions for sustainable and efficient supply of drinking water. Degremont, a subsidiary of Suez Environnement has been recognized repeatedly for its position as industry leader in the field of desalination. Degremont has indeed installed more than 250 desalination plants worldwide, producing over 2.7 million m3 of water each day, including through the reverse osmosis technology. The plant in Perth (Australia), built in record time after the severe drought of 2003, is capable of producing 144 million liters of drinking water per day with an optimal energy and environmental performance, including through a wind farm, and using innovative technologies for the dispersion of brine. The Barcelona plant, providing drinking water to about 20 % of the population of the region (up to 200,000 m3/day) is the largest desalination plant in Europe.

Chapter 5. New Policies, Public Incentives, New Technologies to Promote the Development of 'Eco-Cities'

Simon Gardner Lee
General Manager, Marketing & Strategy,
SITA Environmental Solutions
Sydney, Australia

This presentation outlines some of the innovative market offerings that SITA Environmental Solutions (SITA) has developed in Australia to improve sustainability in urban centres and broader regional areas. SITA achieves this through applying resource recovery best practices to solid waste management, with a particular focus on the role of recycled organics in a circular economy.

The role of Government in waste sustainability

Local Government in Australia is responsible for the planning and provision of services to meet the needs of individuals and businesses within local communities. However, Local Government must co-operate at a regional scale to address issues affecting adjoining communities, and to provide a basis for effective inter-government relations. This approach should include appropriate resource sharing and joint activities amongst councils or Local Government Authorities (LGAs). The consequences of Local Government's decision-making in relation to environmental sustainability have ramifications beyond the boundary of their constituents, therefore revealing a need for a framework at a regional, national or even international level, dependent upon the scale of the issue being considered.

Australia's six state governments have different drivers and priorities on waste issues but all states are using a landfill levy (tax) as their primary policy lever to influence decision making on the diversion of waste from landfill, and increasing recycling and resource recovery rates.

At the federal level, there is a largely ineffectual but strategically important National Waste Policy, developed to support a national approach on the recovery of resources from waste material streams.

To improve sustainability practices within urban areas and across regional centres, there is a clear need for more sophisticated policy settings by state and federal agencies that allow LGA's to increase their resource recovery activities.

Advanced Resource Recovery methods and technologies available to urban centres

Australia's major players within the waste industry have driven innovative, practical solutions for recycling and resource recovery over the past 10+ years that now provide LGA's with a sustainable platform for future development. SITA is the leader in resource recovery from solid waste material streams in Australia.

■ Advanced Resource Recovery Technologies (ARRTs)

ARRTs (sometimes referred to as AWT – Advanced Waste Treatment - for MSW processing) enable LGA's - and businesses - to process their mixed and/ or co-mingled organic (or 'wet') and combustible (or 'dry') waste streams into quality composts and mulches or process engineered fuels (PEF) respectively. This allows LGAs and businesses to reduce their greenhouse gas (GHG) emissions and deliver on their sustainability goals. SITA is the main provider of ARRTs and operates 7 of the 12 operating facilities across Australia.

■ Composting ARRTs

Composting ARRT facilities that process MSW can divert up to 60% of this waste stream previously landfilled by separating valuable commodities and the organic fraction from the residuals, then transforming the raw organic material into beneficial, fit-for-purpose compost products for land application.

Currently only 5% of MSW generated by councils in Australia is recovered though such dedicated composting advanced resource recovery facilities; the remaining being sent directly to landfill. Approximately half of MSW in Australia is made up of organic matter (kitchen food scraps and gardening materials) - a raw feedstock that when processed correctly can be used to replenish the soil fertility of Australia's degraded agricultural land. If all LGAs in Australia adopted best practices for organics resource recovery, approximately 7 million tonnes of organics currently being landfill could be recovered, improving soil structure and fertility, and significantly reducing GHG emissions from both landfills and agricultural activities.

In 2011, SITA will produce over 500,000 tonnes of recycled organics (compost) through its composting ARRT and organic resource recovery facilities (the latter processing source separated organics). The following sections will highlight the critical role of organics in environmental sustainability and introducing a circular economy for urban and broader regional centres.

■ Processed Engineered Fuel (PEF) from alternative fuel ARRTs

PEF is an alternative fuel which can be produced from the residual high calorific fraction resulting -mixed plastics, wood, textiles - from the ARRT separation process. Dedicated alternative fuel ARRT facilities - such as the SITA-ResourceCo facility in Adelaide - produce specified PEF for use in furnace and power stations as a substitute to fossil fuels.

Thus SITA, by combining organics recovery (through composting ARRTs) with PEF production (through alternative fuel ARRTs), can recover 85+% of MSW.

The critical role of recycled organics in environmental and social sustainability

■ Reduction in agricultural environmental degradation and improved food security

By recovering the food and garden organic residues from waste streams, urban centres can significantly improve on both their own environmental sustainability as well as that of agriculture generally. This creates circular economies both within the local area and in the broader macro regional and national economy.

It is well documented and accepted that preventing organics from going to landfill helps reduce GHG emissions by avoiding landfill methane emissions. Preserving organic carbon and nutrients in the form of compost for beneficial reuse in land management and food production also reduces fertiliser and pesticide usage, further improving environmental outcomes through reduced nutrient and fertiliser run-off.

Australia's arable land is severely degraded from chemical fertiliser and pesticide use as well as significant falls in soil organic matter. Recent research suggests that we may hit 'peak' phosphorous in the 2030's, after which supplies will become increasingly scarce and expensive. This issue is a serious threat to global food security and highlights the urgent need for farming to become less reliant on phosphate rock-based fertiliser by returning lost nutrients to the soils. Compost is the best option available for achieving a 'circular economy' for phosphorous, and to returning soil organic matter that was originally removed through harvesting the food.

■ Carbon trading

The use of recycled organics is also a powerful instrument in relation to carbon trading and potential offsets. In Australia, the primary mechanism to generate offset credits for subsequent trading will be the Carbon Farming Initiative, with legislation introduced to Parliament in July 2011. The use of compost, being one of the most sustainable ways to increase soil carbon levels, may be able to create carbon credits.

Because of its national coverage with its processing facilities, SITA is able to apply composts to all major soil types and plant production systems. This will allow SITA to establish trials nationally (which has already commenced) and provide the data for the creation of soil carbon sequestration methodologies in Australian agriculture.

- **Improved social amenity**

  Reduced fertiliser and pesticide use also occurs when these fit-for-purpose composts are used in urban park and garden rejuvenation and maintenance, as well as for improving the playability of sports ovals. Recent droughts in eastern and western Australia closed many local community sports fields and ovals. Those playing fields that had compost applied remained open all year round.

  Best practice resource recovery enables LGAs to close the loop through the buy-back of recycled organics products derived from their communities' recycling activities.

- **Storm water recycling**

  Recycled organic products can also be used to recycle storm water in-situ through innovative roadway construction and pavement landscaping. This is being enacted around Australia and is a new market for recycled organic products that filter the storm water before it is reused on local parks and gardens. This provides further social amenity thorium increased urban 'green' areas that could not otherwise be constructed due to water constraints.

The role of community engagement and education programs

Engagement of local and regional communities in the circular economy is crucial to its successful implementation. It is critical to involve the community by associating actions to relevant outcomes, otherwise education programs are ineffectual. Communities have to be exposed to the importance of waste avoidance and resource recovery.

This can be achieved through integrated education, marketing programs and incentives. Examples of such actions include the promotion of social benefits (i.e. better public amenities), incentive-based programs (i.e. rewarding residents for separating their waste or participating in a facility tour), and targeted marketing activities (e.g. market savvy brand development for fit-for-purpose recycled organic products).

SITA has developed such a savvy marketing platform within it's 'ARRT' range of product brands, and is working closely with LGAs and State Governments to implement associated education programs.

Conclusion

Best-of-class resource recovery practices are a key aspect of driving environmental sustainability in urban centres. It entails not only the recycling of commodities such as paper, plastic and glass, but most importantly the recovery and reuse of organic materials and high calorific feedstocks. Recovering and reusing organics is one of the easiest options available to society to mitigate climate change. It is a key component to drive urban centres towards a circular economy.

The proven technologies now available to LGAs guarantee maximum rates of resource recovery. SITA has a wide range of advanced resource recovery technologies which assist Councils, and State Governments, to minimise environmental impact, reduce costs and improve social amenity.

State Governments can support these initiatives through continual increases in waste levies and market development activities in urban and rural target markets. The Federal Government can introduce a carbon trading mechanism that allows offsets to be derived from the addition of recycled organics to land.

Chapter 6. EU-China, Energy for a Changing World

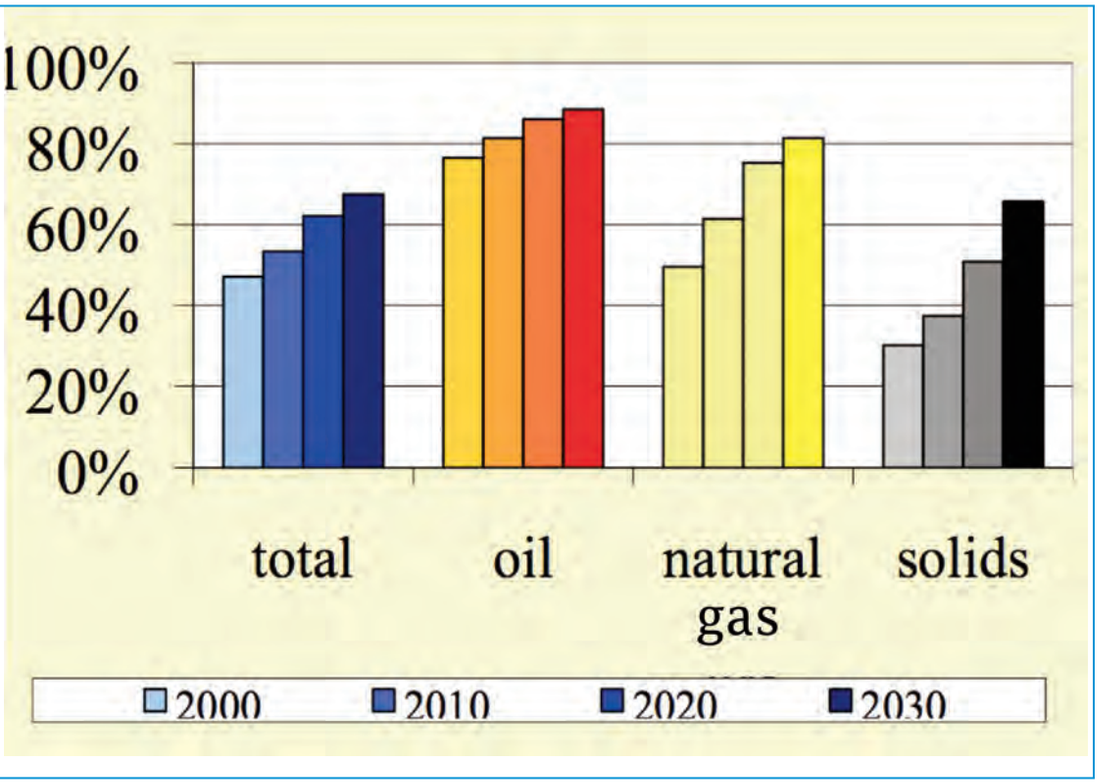
The EU Climate Action Plan and the EU/China Cooperation

Denis Fourmeau
Counsellor, EU Delegation
Beijing, China

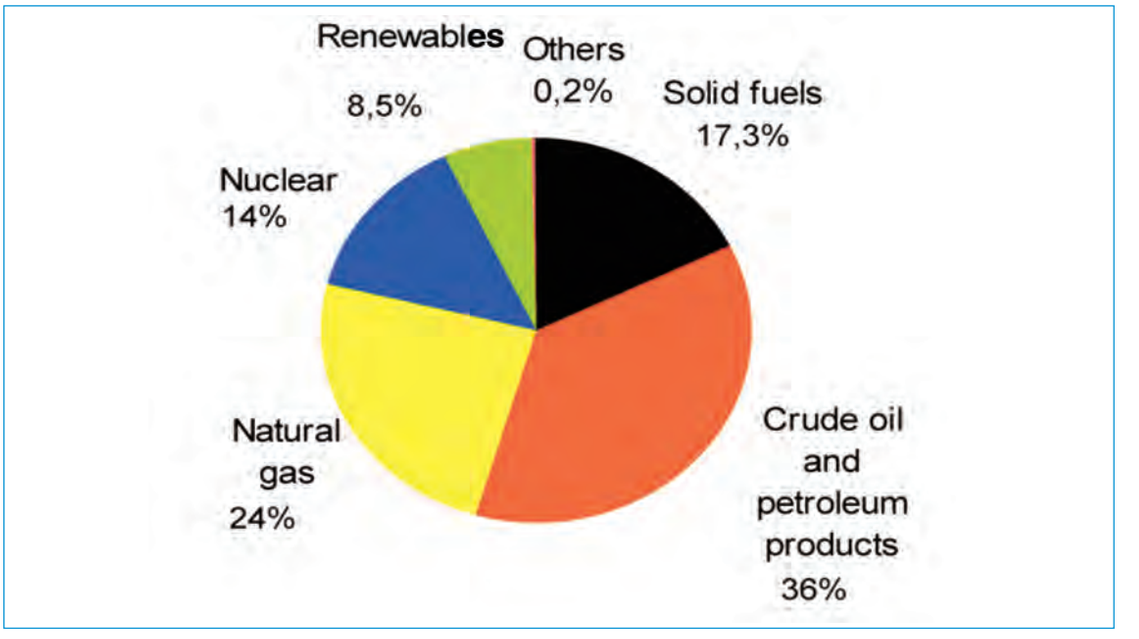
There is a growing concern about security and continuity of oil and gas supplies in Europe due to rising energy prices, despite the increased efficiency resulting from the EU market liberalization. Due also to climate change. Consequently, the EU competitiveness policy needs for innovative industrial development. The EU Energy Policy relies on 3 pillars: sustainability, security of supply and competitiveness. A policy in favor of renewable energy has been an important element of the European Energy Policy since the 1997 white paper.

In January of 2008 the EU commission has proposed an "Energy Package" for 2020 conducting to 20 % GHC reduction compared to 1990 and an estimated 20 % renewable energy from 8.5 % presently. In addition 20 % increase in energy efficiency and 10 % of biofuels component in vehicle fuel are expected by 2020.

EU energy mix and import dependency: "business as usual" is not sustainable



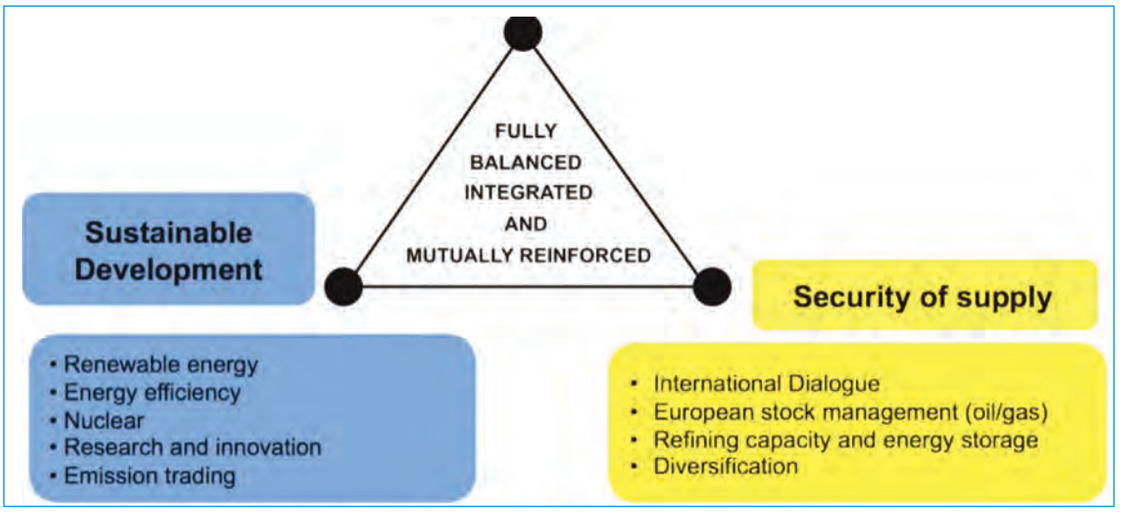
2005 ~ 80 % fossil fuel



The EU Commission Energy Policy package launched on 23 January 2008 introduced a plan of action integrating:

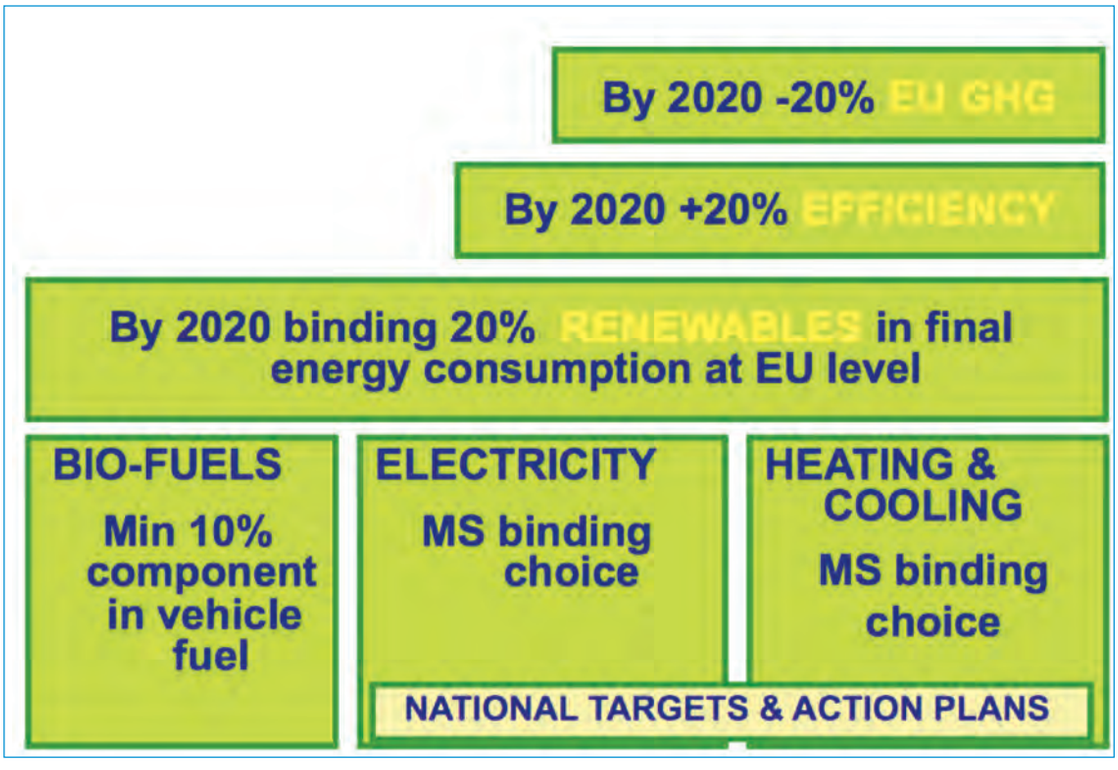
- A new EU emissions trading scheme with a European (not national) gap and auctioning of allowances with a view to generate reductions in GHG by 20 %.
- New national targets to achieving a 10 % GHG reduction in non ETS Sectors.
- A framework to promote the development of CO2 capture and storage, with the aim that all new plants would reach near – zero emission by 2020. And finally a New Directive to reach the 20 % renewable energy target and 10 % biofuels target.

To strengthen this policy, a new Directive adopted in April 2009 sets mandatory national targets for renewable energy shares, including 10 % biofuel share in 2020; requires mandatory action plans; standardizes "guarantees of origin" (certifying the renewable origin of electricity or heat) and enables the transfer of these to provide flexibility to Members States; requires reduction of administrative and regulatory barriers, improvements in provision of information and training, and improves renewables' access to electricity grid; and finally, creates a sustainability regime for biofuels.



Certifying the renewable origin of electricity or heat allows to standardize information requirements, issuing transfer and cancellation procedure. The transfer of guarantees of origin gives the flexibility to meet national targets by developing cheaper renewable energy in other Member States. MS meeting their trajectory may transfer extra GOs to other MS.

In the third part of the renewable energy sector, "heating", which includes solar thermal, geothermal and biomass, we have developed standards and R&D, but not much else. As a result, the sector is lagging behind, although it has reached 9 % of heating needs.



Improved renewables' access to the electricity grid requires Member States to provide priority access to the grid system for electricity RES; to develop Grid Infrastructure i.e. Smart Grids and to review cost sharing rules.

In the transportation sector the EU looks for sustainability criteria for biofuels: GHS savings rising from 35 % up to 50 % by 2017; no exploitation of raw materials from sensitive areas such as old forests, grasslands and protected areas; no conversion of wetlands and continuously forested areas. In addition, biofuels must meet "cross compliance" environmental rules.

Bonuses will be given for second generation biofuels and for electric vehicles. Criteria on sustainability and proposals on biomass sustainability criteria were published in 2009.

Investment of 13 to 18 billion Euros a year will drive down the price of the renewable energy technologies. Renewable energies today cost more than energies from conventional sources, but for how long? Many Members States already provide tax incentives to help consumers with the extra cost of renewables.

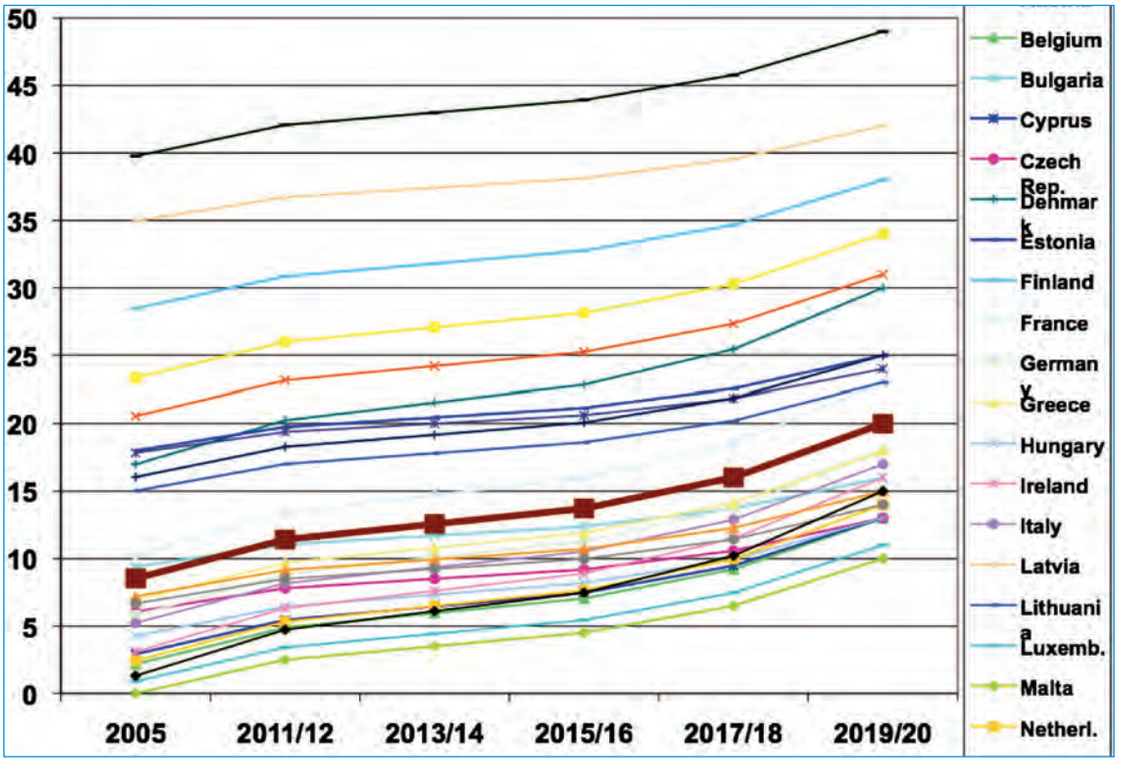
The EU needs to cut its GHG emissions; this is not happening fast enough. The increased dependence on imports of oil and gas leads the EU to look for new energy alternatives.

What are the EU proposals:

- To set a target of 20 % of renewable energy by 2020 (compared with the 8.5 % in 2005) To allocate the efforts fairly between Members States
- To remove barriers to the growth of renewable energy through the easing of authorization procedures
- And, to encourage better types of renewable energy, by I.E. setting sustainability standards for biofuels. Biofuels, where we also set targets and create a favourable regime for trade.

Serious benefits will be derived in the short and medium terms from these policies: the savings of 600 to 900 million tons CO2 per year; a reduction of fossil fuel consumption of 200 to 300 million tons per year; benefit for all citizens from lower GHG emissions and more secure energy provision; a boost from high-tech industries, new economic opportunities and job creation, mainly in rural areas.

EU trajectory to 20 %



The EU-China Cooperation in Energy and Water

Building upon the policy background initiated for the European economies, the EU Commission has launched in cooperation with China an ambitious programme on energy conservation : "The 5Cs programme": Climate Change, from Competition to Convergence through Cooperation.

Demand from China is changing global production patterns in food and other key commodities. For example, if China's grain use continues to rise, by 2030 it will need to import some 370 million tons of grain, an amount roughly twice 2007 world grain exports.

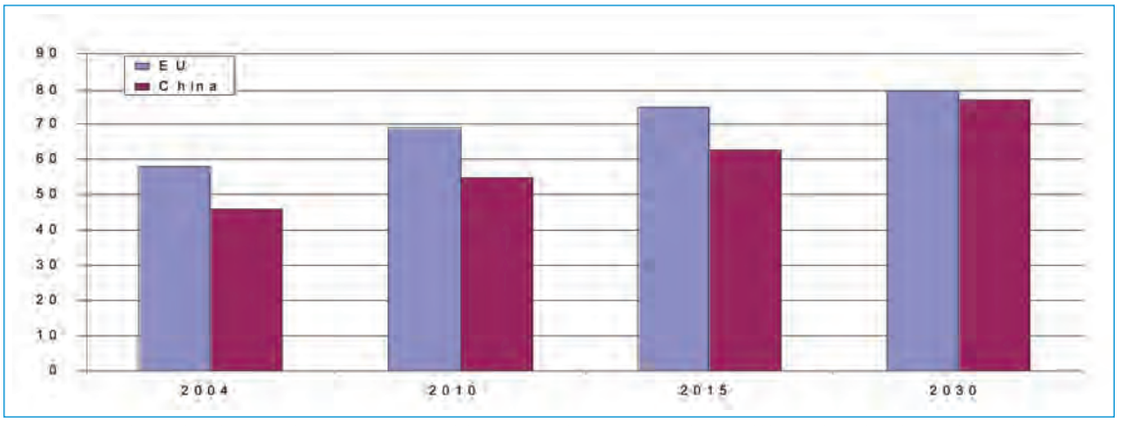
Rapid economic growth at the expense of the environment – water, air, food, and biodiversity. Initial evaluation by SEPA – around 10 million hectares of farmland (10 %) is polluted. Farms are losing over US2.5Bn a year to pollution. (SEPA, 2007) Sixteen out of the world's twenty most polluted cities are in China (World Bank, 2007).

China's growth is energy intensive. Energy consumption per unit of GDP is about 6.2 times than the EU average (Eurostat, 2006), about 70 % of its GDP are for exports. In 2007 China topped the list of CO2 emitting economies, surpassing now the US.

Domestic energy shortages in China results in sharp increase in demand for imported oil, contributing to driving international energy prices to 20-year highs. Price rises and energy security have in turn driven investment into all energy options including carbon-intensive technologies and infrastructure – but also renewable.

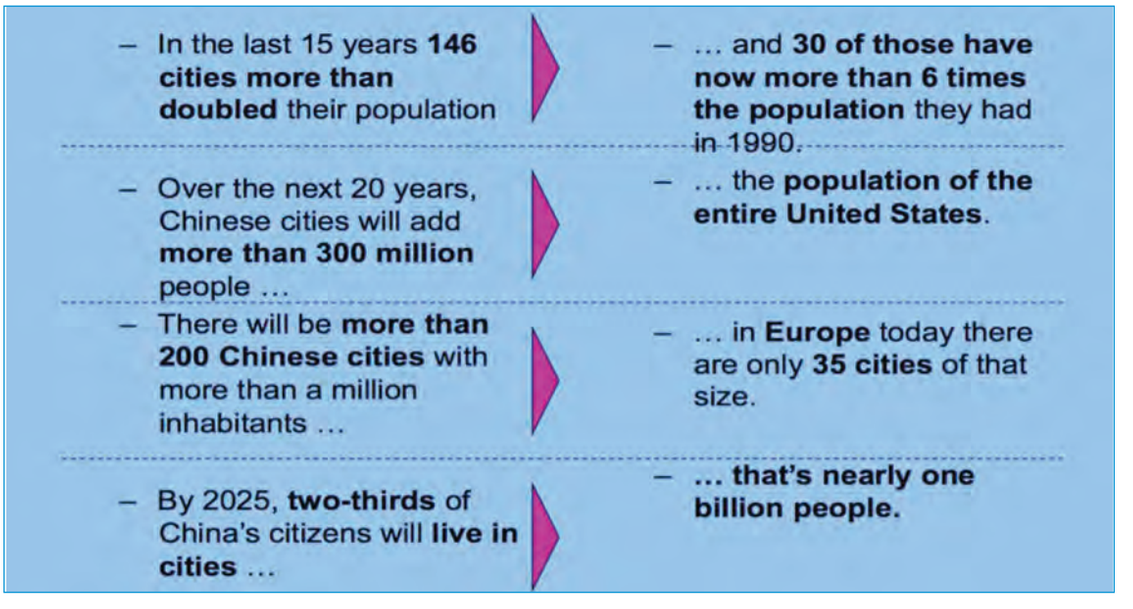
China's resource needs are driving investments in many politically unstable regions. This is changing the geopolitical landscapes in fragile regions such as Central Asia, the Middle East and Africa.

EU and China depend equally on oil imports



Reductions in domestic reserves and increased consumption will lead to both regions importing nearly 80 % by 2030 (another kind of "peak oil"…)

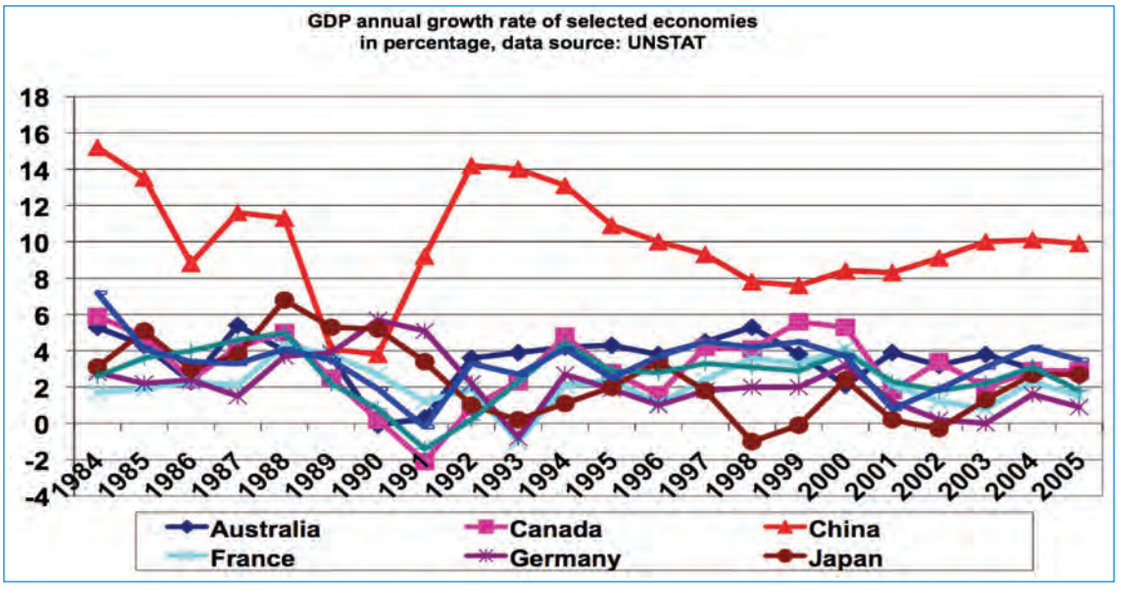
The scale of urbanization is unprecendented



In a rapidly changing world it is no longer sustainable to assume 3 % global economic growth, even less 10 % when taking into account the following issues:

- **The costs of climate change are still unclear**. The Stern Review estimates a range of 5 – 20 % of future GDP;
- **Climate change will slow the pace of progress towards sustainable development** and undermine the achievement of the Millennium Development Goals;
- **Climate change will add to existing pressures** on natural resources, including population growth, water stress and biodiversity decline, and lessen the ability of nations to respond to pre-existing environmental challenges;
- **Higher temperatures (above 5 degrees) will bring growing risks** of abrupt and large-scale changes, such as the collapse of the Greenland Ice Sheet, risking large-scale movements of populations and global insecurity;
- **Under a high emissions scenario** it is no longer possible to assume 3 % year on year global economic growth.

Consequently "business as usual" is no longer an option!



Climate change may have direct impact on China if we are to consider the IPCC WG Report April 2007 on climate change impact. The rate of development of China will be undermined as climate change compounds the pressures on natural resources and environment associated with urbanisation and industrialisation. Social stability in turn is threatened:

- **Glacier melt** – in the Himalayas will increase flooding and rock avalanches. Water flow will peak from 2030 – 50 and decline thereafter as glaciers recede;
- **Freshwater availability** – predicted to decrease along with population growth and increasing demand;
- **Coastal areas** – especially heavily populated delta regions will be at greatest risk of flooding;

- **Crop yields** – could decline by up to 30 % by the mid 20th century, increasing the risk of hunger;

- **Endemic morbidity and mortality** - disease associated with floods and droughts could rise;

- The economic development of China will be undermined as climate change compounds the pressures on natural resources and environment associated with urbanisation and industrialisation. **Social stability in turn is threatened.**

To limit the likely negative effect on its economy, China as the EU has ambitious and parallel climate and energy plans.

China has achieved a programme leading to a 20 % reduction in energy intensity energy consumption per unit of GDP, compared to 2005 in current FYP 2006-2010 and specific programmes targeted at the 1000 largest enterprises. On 26/11/2009, China has launched a programme that should allow to reach by 2020 a 40 % reduction in energy intensity compared to 2005. In 2020, 15 % of its energy should come from renewable.

The EU, under the 2008 Energy Package should reduce its energy intensity by 20 % in 2020; in addition 20 % should at that time come from Renewables, compared to 8.5 % presently and GHG emissions should drop also by 20 % (The 20-20 agreement by 2020). 10 % of transportation fuel should come from biofuels.

These policy shifts present genuine opportunities for seeking common ground between China and the EU. The EU is the world's largest single market, and China is the world's fastest growing economy. This means that there are unprecedented opportunity to generate scale effects for low carbon/energy efficient/environmental investments in goods and services.

With uncertainty around US leadership in global affairs, the EU is well placed to engage with emerging powers like China in discussions around global public goods. EU and China are major importers of energy and will face energy import dependence challenges over the next two decades.

Both EU and China will have to confront the impacts of climate change, including water stress, shifting agricultural zones, and extreme weather events. Long EU experience in internalization of externalities, and on **sustainable cost recovery**, basis of most EU regulatory framework (directives) on environment allows for a fruitful cooperation between the two economies.

Example of the EU (continued growth despite GHG stabilization then reduction) shows that fight against climate change should not be seen as a threat to economic development, but rather as a fantastic opportunity.

Concrete cooperation between the two economies is underway in several ways:

- **HYDROGEN:** HYAPPROVAL (Handbook for Approval of Hydrogen Refuelling Stations) 4 m€; NEMESIS (New Methods for Superior Integrated Hydrogen Generation System) 4 m€; HYFLEET: CUTE (Hydrogen for Clean Urban Transport in Europe) 43 m€; IPHE-GENIE (International Partnership for a Hydrogen Economy for Generation of New Ionomer membranes) 2.6 m€

- **BIOFUELS:** BEST (BioEthanol for Sustainable Transport) 17.4 m€

- **WIND :** UPWIND (Integrated Wind Turbine Design) 22.6 m€
- **CCS** : CACHET (Carbon Dioxide Capture and Hydrogen Production from Gaseous Fuels) 13.5 M€; COACH (Cooperation Action within CCS China-EU) 2.6 m€
- EU-China Partnership on Climate Change (8th EU-China summit 09/2005) : high-level political framework complementing UNFCC and Kyoto Protocol
- Actions detailed in "Rolling Work Plan" (agreed October 2006) : deployment and transfer of low carbon technology, including advanced near zero emission coal (NZEC) through Carbon Capture and Storage (CCS), CDM facilitation project launched in June 2007.
- Future EU-China Clean Energy Centre (EC^2) : focal point for collection and distribution of information on clean energy to potential stakeholders in Europe and China
- Other projects in capacity building (key issue for implementation of clean and renewable energy projects)

An EU/China Clean Energy Center has been created to promote use of clean energies through improved access to EU policy & regulatory framework, technology experiences & best practices. This platform for capacity building will provide relevant Chinese authorities with an advisory role on clean energy issues in general including : Sustainable coal (including CCS), Sustainable biofuels, Renewables, Energy efficiency and savings, Sustainable and efficient distribution systems. The Center will benefit form 10 M € EU financing for 5 years, before self-sustainability

To more completely address the issues related to climate change ; in addition to the co-operative programmes on energy efficiency, an EU-China cooperation is underway on integrated river basin management. Europe and China are facing similar challenges with regard to water management ; the EU experience can be useful for China to develop an Integrated River Basin Management inspired by the EU Water Framework Directive.

The **EU-China River Basin Management Programme (RBMP)** aims at developing integrated river basin planning and management practices, which are environmentally sustainable and addresses global environmental concerns as well as those of local population. This programme, in a first step, is covering parts of the Yangtze and Yellow River basins and can be replicated in other regions in China. It will benefit from an EC contribution of € 25 million over the 2007-2012 period. This programme aims, through the development of "soft and hard " policies at policy development, institutional set-up, monitoring, identification of priority areas for intervention, feasibility studies, etc

For general information on EU energy policy :
http://ec.europa.eu/energy/index_en.html

Third legislative package :
http://ec.europa.eu/energy/electricity/package_2007/index_en.htm

Climate and renewable package :
http://ec.europa.eu/energy/climate_actions/index_en.htm

Strategic Energy Technology Plan :
http://ec.europa.eu/energy/res/setplan/communication_2007_en.htm

Intelligent Energy Europe :
http://ec.europa.eu/energy/intelligent/index_en.html

Chapter 7. Energy Efficiency Awareness
The use of smart grids and smart meters

Henri Boyé
Council for Environment and Sustainable Development
Ministry of Ecology, Energy, Sustainable Development and the Sea
Paris, France

The importance of energy efficiency awareness to improve city governance

The world development is following non sustainable trajectories for energy and environment, world energy consumption, world population, Oil price, in CO2 concentration in the atmosphere, due to the emission of greenhouse gases.

Let us imagine a green city , energy efficient, promoting sustainable transportation and waste management. As cities are also vulnerable to the impacts of climate change, they need to take bolds actions to mitigate climate change and adapt to its impacts.

In France, buildings and transport are the two most emitting sectors, and the two most energy consuming sectors :

44 % of total energy consumption (71 Mtoe)
20% of national GHG emissions

The "Grenelle de l'environnement" objectives are: decreasing energy consumption by 40% by 2020

Grenelle measures for buildings **New buildings energy regulation 2012**	**50 kWh primary energy / m2 /year (vs 100 kWh/m2/year RT 2005)**
New buildings in 2020	**Regulation :Positive energy buildings**
Existing buildings to 2020	**Reducing by 38% existing buildings consumption (240 kWh/m2/year in 2008, 150 in 2020)**
Public buildings refurbishing (120 Mil. m2) to 2018	**Reducing by 40% energy consumption and 50% GHG emissions**
Social households (800 000)	**Reducing energy consumption from 230 kWh EP / m2 / year to 150 kwh EP/m².**

The research priorities on new energy technologies in France:

Transports : vehicles and organization
Capture and storage of CO_2
Solar energy (Photovoltaic)
Bio-resources and biofuels
Smart grids, energy storage

Ecotechnologies : energy efficient processes
Marine energy, Fuel cells

Technological research for positive energy buildings:

Buildings efficiency, sustainable cities
Development of super thin insulation materials , Electrochroms windows, intelligent windows , Phase changing materials,
Intelligent facades with double shell with dynamic solar protections,
Very low energy consuming buildings :
Superinsulation of enveloppe,
Air impermeability, high performance windows,
Ventilation systems with heat recovery
and renewable energy integration, Solar systems (water solar heaters and PV)
« Zero Energy Homes »

Definitions of smart grids

The smart grid is a reinvention of how energy is transmitted, distributed and measured. It is becoming the new standard for utilities and consumers
"What cannot be measured cannot be improved" (Lord Kelvin, physician, 1824-1903)

Although there is no standard global definition, the European Technology Platform SmartGrids defines smart grids as an"**electricity networks that can intelligently integrate the behavior and actions of all users connected to it - generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies." (**European Technology Platform)

« A smart grid uses information technology to manage electricity networks to promote energy efficiency and cost efficiency. » Financial Times Lexicon

Networks of the future: concept and vision EPRI *Electric Power Research Institute*

A smart grid employs innovative products and services together with intelligent monitoring, control, communication, and self-healing technologies in order to:

. Better facilitate the connection and operation of generators of all sizes and technologies;
. Allow consumers to play a part in optimizing the operation of the system;
. Provide consumers with greater information and options for choice of supply;
. Significantly reduce the environmental impact of the whole electricity supply system;
. Maintain or even improve the existing high levels of system reliability, quality and security of supply;
. Maintain and improve the existing services efficiently;
. Foster market integration towards European integrated market.

What is a smart grid? What does "smartness" imply?

SmartGrids do not only supply power but also information and intelligence. The "smartness" is manifested in making better use of technologies and solutions to better plan and run existing electricity grids, to intelligently control generation and to enable new energy services and energy efficiency improvements.

A short history of electric grids and smart grids

Over the past 50 years, electricity networks have not kept pace with modern challenges, such as: security threats, from either energy suppliers or cyber attack, national goals to employ alternative power generation sources whose intermittent supply makes maintaining stable power significantly more complex, conservation goals that seek to lessen peak demand surges during the day so that less energy is wasted in order to ensure adequate reserves, high demand for an electricity supply that is uninterruptible, digitally controlled devices that can alter the nature of the electrical load (giving the electric company the ability to turn off appliances in your home if they see fit) and result in electricity demand that is incompatible with a power system that was built to serve an "analog economy." For a simple example, timed Christmas lights can present significant surges in demand because they come on at near the same time (sundown or a set time). Without the kind of coordination that a smart grid can provide, the increased use of such devices lead to electric service reliability problems, power quality disturbances, blackouts, and brownouts.

The term smart grid has been in use since at least 2005, There are a great many smart grid definitions, some functional, some technological, and some benefits-oriented. A common element to most definitions is the application of digital processing and communications to the power grid, making data flow and information management central to the smart grid. Various capabilities result from the deeply integrated use of digital technology with power grids, and integration of the new grid information flows into utility processes and systems is one of the key issues in the design of smart grids. Electric utilities now find themselves making three classes of transformations: improvement of infrastructure, called the *strong grid* in China; addition of the digital layer, which is the essence of the *smart grid*; and business process transformation, necessary to capitalize on the investments in smart technology. Much of the modernization work that has been going on in electric grid modernization, especially substation and distribution automation, is now included in the general concept of the smart grid, but additional capabilities are evolving as well.

Smart grid functions

Before examining particular technologies, a proposal can be understood in terms of what it is being required to do. The governments and utilities funding development of grid modernization have defined the functions required for smart grids. According to the United States Department of Energy's Modern Grid Initiative report, a modern smart grid must:

1. Be able to heal itself Self healing
2. Motivate consumers to actively participate in operations of the grid
3. Resist attack
4. Provide higher quality power that will save money wasted from outages
5. Accommodate all generation and storage options
6. Enable electricity markets to flourish
7. Run more efficiently
8. Enable higher penetration of intermittent power generation sources

Self-healing - Using real-time information from embedded sensors and automated controls to anticipate, detect, and respond to system problems, a smart grid can automatically avoid or mitigate power outages, power quality problems, and service disruptions.

As applied to distribution networks, there is no such thing as a «self healing» network. If there is a failure of an overhead power line, given that these tend to operate on a radial basis (for the most part) there is an inevitable loss of power. In the case of urban/city networks that for the most part are

fed using underground cables, networks can be designed (through the use of interconnected topologies) such that failure of one part of the network will result in no loss of supply to end users.

It is envisioned that the smart grid will likely have a control system that analyzes its performance using distributed, autonomous reinforcement learning controllers that have learned successful strategies to govern the behavior of the grid in the face of an ever changing environment such as equipment failures. Such a system might be used to control electronic switches that are tied to multiple substations with varying costs of generation and reliability.

Consumer participation - A smart grid is, in essence, an attempt to require consumers to change their behavior around variable electric rates or to pay vastly increased rates for the privilege of reliable electrical service during high-demand conditions. Historically, the intelligence of the grid has been demonstrated by the utilities operating it in the spirit of public service and shared responsibility, ensuring constant availability of electricity at a constant price, day in and day out, in the face of any and all hazards and changing conditions. A smart grid incorporates consumer equipment and behavior in grid design, operation, and communication. This enables consumers to better control (or be controlled by) "smart appliances" and "intelligent equipment" in homes and businesses, interconnecting energy management systems in "smart buildings" and enabling consumers to better manage energy use and reduce energy costs. Advanced communications capabilities equip customers with tools to exploit real-time electricity pricing, incentive-based load reduction signals, or emergency load reduction signals.

The real-time, two-way communications available in a smart grid will enable consumers to be compensated for their efforts to save energy and to sell energy back to the grid through net-metering. By enabling distributed generation resources like residential solar panels, small wind and plug-in hybrid, smart grid will spark a revolution in the energy industry by allowing small players like individual homes and small businesses to sell power to their neighbors or back to the grid. The same will hold true for larger commercial businesses that have renewable or back-up power systems that can provide power for a price during peak demand events, typically in the summer when air condition units place a strain on the grid. This participation by smaller entities has been called the «democratization of energy».

Resist attack - Smart grid technologies better identify and respond to man-made or natural disruptions. Real-time information enables grid operators to isolate affected areas and redirect power flows around damaged facilities.

One of the most important issues of resist attack is the smart monitoring of power grids, which is the basis of control and management of smart grids to avoid or mitigate the system-wide disruptions like blackouts. The traditional monitoring is based on weighted least square (WLS) which is very weak and prone to fail when gross errors (including topology errors, measurement errors or parameter errors) are present. New technology of state monitor is needed to achieve the goals of the smart grids.

High quality power, accommodate generation options - As smart grids continue to support traditional power loads they also seamlessly interconnect fuel cells, renewable, micro turbines, and other distributed generation technologies at local and regional levels. Integration of small-scale, localized, or on-site power generation allows residential, commercial, and industrial customers to self-generate and sell excess power to the grid with minimal technical or regulatory barriers. This also improves reliability and power quality, reduces electricity costs, and offers more customer choice.

Enable electricity market - Significant increases in bulk transmission capacity will require improvements in transmission grid management. Such improvements are aimed at creating an open marketplace where alternative energy sources from geographically distant locations can easily be sold to customers wherever they are located.

Intelligence in distribution grids will enable small producers to generate and sell electricity at the

local level using alternative sources such as rooftop-mounted photo voltaic panels, small-scale wind turbines, and micro hydro generators. Without the additional intelligence provided by sensors and software designed to react instantaneously to imbalances caused by intermittent sources, such distributed generation can degrade system quality.

Optimize assets - A smart grid can optimize capital assets while minimizing operations and maintenance costs. Optimized power flows reduce waste and maximize use of lowest-cost generation resources. Harmonizing local distribution with interregional energy flows and transmission traffic improves use of existing grid assets and reduces grid congestion and bottlenecks, which can ultimately produce consumer savings.

Enable high penetration of intermittent generation sources - Climate change and environmental concerns will increase the amount of renewable energy resources. These are for the most part intermittent in nature. Smart Grid technologies will enable power systems to operate with larger amounts of such energy resources since they enable both the suppliers and consumers to compensate for such intermittency.

Benefits of smart grids

Smart grids employ innovative products and services together with intelligent monitoring, control, communication, and self-healing technologies in order to:

- Better facilitate the connection and operation of generators of all sizes and technologies (e.g. renewables);
- Optimize grid operation and usage (e.g. reducing losses) and grid infrastructure;
- Provide consumers with greater information and options for choice of supply, and allow them to play a part in optimizing the operation of the system;
- Significantly reduce the environmental impact of the whole electricity supply system;
- Maintain or even improve the existing high levels of system reliability, quality and security of supply;
- Maintain and improve the existing network services efficiently(e.g. adequate short-circuit power at point of grid connection, efficient and reliable alarm and fault management for self-healing procedures in distribution networks, adequate (bidirectional) protection concepts for distributed generation, etc);
- Foster market integration towards an integrated EU electricity market.

Although there are specific and proven smart grid technologies in use, smart grid is an aggregate term for a set of related technologies on which a specification is generally agreed, rather than a name for a specific technology.

Some of the benefits of such a modernized electricity network include the ability to reduce power consumption at the consumer side during peak hours, called Demand side management; enabling grid connection of distributed generation power (with photovoltaic arrays, small wind turbines, micro hydro, or even combined heat power generators in buildings); incorporating grid energy storage for distributed generation load balancing; and eliminating or containing failures such as widespread power grid cascading failures. The increased efficiency and reliability of the smart grid is expected to save consumers money and help reduce CO2 emissions.

Role of smart grids in climate change

Smart grids are about building, expanding, operating and maintaining the electricity networks of the future in a way which will also help meet the EU's 20/20/20 climate change objectives. These ambitious targets for the year 2020 include 20% reduction in greenhouse gas emissions, 20% EU renewable share and 20% savings in consumption by improving energy efficiency.

Smart grids are key to reducing carbon emissions and improving energy efficiency by:

- reducing network losses;
- facilitating higher penetration of renewable (e.g. wind) and distributed generation (e.g. small windmill or micro-CHP plant) in compliance with operational security, power system and electricity market efficiency;
- helping consumers better participate in the market not only by using their energy more efficiently (e.g. through smart metering) but also by allowing consumers to act also as producers selling back their excess electricity (e.g. plug-in electrical vehicles).

The projects resulting from the Smartgrids vision will stimulate innovation in new network and associated information technologies. The benefits of new technologies will have a positive effect for European citizens and for international business. Job opportunities will be broadened as the networks require workers with new skills and integration across new technology areas.

Smartgrids will help achieve sustainable development. Links will be strengthened across Europe and with other economies where different but complementary renewable resources are to be found. An increasingly liberalized market will encourage trading opportunities to be identified and developed. Smartgrids networks will, in addition to electricity flows, establish a two-way flow of information between supplier and user.

For a successful transition to a future sustainable energy system all the relevant stakeholders must become involved: governments, regulators, consumers, generators, traders, power exchanges, transmission companies, distribution companies, power equipment manufactures and ICT providers. Coordination at regional, national and European levels is essential and the Smartgrids European Technology Platform has been designed to facilitate this process.

Technology of smart grids

The bulk of smart grid technologies are already used in other applications such as manufacturing and telecommunications and are being adapted for use in grid operations.

Integrated communications

Some communications are up to date, but are not uniform because they have been developed in an incremental fashion and not fully integrated. In most cases, data is being collected via modem rather than direct network connection. Areas for improvement include: substation automation, demand response, distribution automation, supervisory control and data acquisition (SCADA), energy management systems, wireless mesh networks and other technologies, power-line carrier communications, and fiber-optics. Integrated communications will allow for real-time control, information and data exchange to optimize system reliability, asset utilization, and security.

Smart meters

A smart grid replaces analog mechanical meters with digital meters that record usage in real time. Smart meters are similar to Advanced Metering Infrastructure meters and provide a communication path extending from generation plants to electrical outlets (smart socket) and other smart grid-enabled devices. By customer option, such devices can shut down during times of peak demand.

Smart grids and digital technologies

A smart grid is a form of electricity network utilizing the new digital technology. A smart grid

delivers electricity from suppliers to consumers using two-way digital communications to control appliances at consumers' homes; this saves energy, reduces costs and increases reliability and transparency. It overlays the ordinary electrical grid with an information and net metering system, that includes **smart meters**. Smart grids are being promoted by many governments as a way of addressing energy independence, global warming and emergency resilience issues.

A smart grid is made possible by applying sensing, measurement and control devices with two-way communications to electricity production, transmission, distribution and consumption parts of the power grid that communicate information about grid condition to system users, operators and automated devices, making it possible to dynamically respond to changes in grid condition.

A smart grid includes an intelligent monitoring system that keeps track of all electricity flowing in the system. It also has the capability of integrating renewable electricity such as solar and wind. When power is least expensive the user can allow the smart grid to turn on selected home appliances such as washing machines or factory processes that can run at arbitrary hours. At peak times it could turn off selected appliances to reduce demand.

Other names for a smart grid (or for similar proposals) include smart electric or power grid, intelligent grid (or intelligrid), futuregrid, and the more modern intergrid and intragrid.

In principle, the smart grid is a simple upgrade of 20th century power grids which generally «broadcast» power from a few central power generators to a large number of users, to instead be capable of routing power in more optimal ways to respond to a very wide range of conditions, and to charge a premium to those that use energy during peak hours.

Smart energy demand, energy efficiency and demand response

"Smart energy demand" is a broad concept. It includes any energy-user actions to:
Enhancement of reliability, • reduce peak demand, shift usage to off-peak hours, lower total energy consumption, actively manage electric vehicle charging, actively manage other usage to respond to solar, wind, and other renewable resources, and buy more efficient appliances and equipment over time based on a better understanding of how energy is used by each appliance or item of equipment.

All of these actions minimize adverse impacts on electricity grids and maximize consumer savings.

Smart Energy Demand mechanisms include: smart meters, dynamic pricing, smart thermostats and smart appliances, automated control of equipment, real-time and next day energy information feedback to electricity users, usage by appliance data, a scheduling and control of loads such as electric vehicle chargers, home area networks (HANs), and others.

Peak curtailment/leveling and time of use pricing

To reduce demand during the high cost peak usage periods, communications and metering technologies inform smart devices in the home and business when energy demand is high and track how much electricity is used and when it is used. To motivate them to cut back use and perform what is called peak curtailment or peak leveling, prices of electricity are increased during high demand periods, and decreased during low demand periods. It is thought that consumers and businesses will tend to consume less during high demand periods if it is possible for consumers and consumer devices to be aware of the high price premium for using electricity at peak periods. This could mean making trade-offs such as cooking dinner at 9pm instead of 5pm. When businesses and consumers see a direct economic benefit

of using energy at off-peak times become more energy efficient, the theory is that they will include energy cost of operation into their consumer device and building construction decisions.

According to proponents of smart grid plans, this will reduce the amount of spinning reserve that electric utilities have to keep on stand-by, as the load curve will level itself through a combination of «invisible hand» free-market capitalism and central control of a large number of devices by power management services that pay consumers a portion of the peak power saved by turning their devices off, etc.

Load adjustment and Demand Response support

In electricity grids, demand response is similar to dynamic demand, mechanisms to manage customer consumption of electricity in response to supply conditions, for example, having electricity customers reduce their consumption at critical times or in response to market prices. The difference is that demand response mechanisms respond to explicit requests to shut off, whereas dynamic demand devices passively shut off when stress in the grid is sensed. Demand response can involve actually curtailing power used or by starting on site generation which may or may not be connected in parallel with the grid. This is a quite different concept from energy efficiency, which means using less power to perform the same tasks, on a continuous basis or whenever that task is performed. At the same time, demand response is a component of smart energy demand, which also includes energy efficiency, home and building energy management,distributed renexable resources, and electric vehicle charging.

Current demand response schemes are implemented with large and small commercial as well as residential customers, often through the use of dedicated control systems to shed loads in response to a request by a utility or market price conditions. Services (lights, machines, air conditioning) are reduced according to a preplanned load prioritization scheme during the critical time frames. An alternative to load shedding is on-site generation of electricity to supplement the power grid. Under conditions of tight electricity supply, demand response can significantly reduce the peak price and, in general, electricity price volatility.

Demand response is generally used to refer to mechanisms used to encourage consumers to reduce demand, thereby reducing the peak demand for electricity. Since electrical generation and transmission systems are generally sized to correspond to peak demand (plus margin for forecasting error and unforeseen events), lowering peak demand reduces overall plant and capital cost requirements. Depending on the configuration of generation capacity, however, demand response may also be used to increase demand (load) at times of high production and low demand. Some systems may thereby encourage energy storage to arbitrage between periods of low and high demand (or low and high prices).

There are two types of demand response: Emergency demand response and economic demand response. Emergency demand response is primarily needed to avoid outages. Economic demand response is used to help utilities manage daily system peaks**.**

Decentralization of power generation

Another element of fault tolerance of smart grids is decentralized power generation. Distributed generation allows individual consumers to generate power onsite, using whatever generation method they find appropriate. This allows individual loads to tailor their generation directly to their load, making them independent from grid power failures. Classic grids were designed for one-way flow of electricity, but if a local sub-network generates more power than it is consuming, the reverse flow can raise safety and reliability issues. A smart grid can manage these situations.(The impact of renewable on the electric grid is an important issue, and a big part of the future of electric industry. The variability of the resource, in the case of wind, solar or wave energy, is a difficulty for integration of renewable in the network.)

Price signaling to consumers

In many economies, the electric utilities have installed double tariff electricity meters in many homes to encourage people to use their electric power during night time or weekends, when the overall demand from industry is very low. During off-peak time the price is reduced significantly, primarily for heating storage radiators or heat pumps with a high thermal mass, but also for domestic appliances. This idea will be further explored in a smart grid, where the price could be changing in seconds and electric equipment is given methods to react on that. Also, personal preferences of customers, for example to use only green energy, can be incorporated in such a power grid.

Obstacles to the widespread adoption of smart grid technologies

In Europe and the US, significant impediments exist to the widespread adoption of smart grid technologies, including:

- The high cost of the investment
- regulatory environments that don't reward utilities for operational efficiency, not the good incentives
- consumer concerns over privacy,
- social concerns over «fair» availability of electricity,
- limited ability of utilities to rapidly transform their business and operational environment to take advantage of smart grid technologies.
- concerns over giving the government mechanisms to control the use of all power using activities.

smart meter

A "smart meter," according to regulatory authorities, is an advanced meter that records consumption in intervals of an hour or less and communicates that information at least daily via some communications network back to the utility for monitoring and billing purposes (telemetering). Smart meters enable two-way communication between the meter and the central system. Unlike home energy monitors, smart meters can gather data for remote reporting.

Purpose for smart meters

Since the inception of electricity deregulation and market-driven pricing throughout the world, government regulators have been looking for a means to match consumption with generation. Traditional electrical meters only measure total consumption and as such, provide no information of when the energy was consumed. Smart meters provide an economical way of measuring this information, allowing price setting agencies to introduce different prices for consumption based on the time of day and the season. Smart meter most often refers to an electrical meter, but it could increasingly also mean a device measuring natural gas or water consumption.

Electricity pricing usually peaks at certain predictable times of the day and the season. In particular, if generation is constrained, prices can rise from other jurisdictions or more costly generation is brought online. It is believed that billing customers by how much is consumed and at what time of day will force consumers to adjust their consumption habits to be more responsive to market prices. Regulatory and market design agencies hope these «price signals» will delay the construction of additional generation or at least the purchase of energy from higher priced sources, thereby controlling the steady and rapid increase of electricity prices.

These progress request the implementation of advanced meters which are capable of collecting interval data and remotely communicate with meter data agencies, either on a predefined schedule

or an ad hoc basis. Advanced Metering Infrastructure is currently rolling out across Australia also known as Smart Metering. The Advanced Metering Infrastructure will allow electricity to be charged according to demand based tariffs.

Examples of smart meter implementation

Italy - Over 27 million electronic maters have been installed between 2000 and 2005 by Enel. It is a remote metering system, with transmission by telephone of the collected data (under the GSM norm).

United Kingdom, Japan, Canada (The Ontario Energy Board in Ontario, BC Hydro in British Columbia), **United States** (California), **Australia** (Victoria), and **New Zealand**

France (The Linky Project) - A smart metering pilot project is being conducted in 2010-2011 by ERDF (Electricité Réseau Distribution France), involving 300,000 clients supplied by 7,000 low-voltage transformers. It is the "Linky Project." It is processing successfully and enables the technical and economic hypotheses of the general roll-out project to be validated. "Linky" is an electric meter, but it is also a system of communication, to serve customers and all the players on the market. This system is interoperable (interchangeable equipment, standard communication protocol), and works in two-ways, (communication from the central system to the electric meter and vice-versa. It will allow better energy efficiency, increased awareness of the customers, and "remote control", via the electric meter, as a result in reduction of consumption. It will allow also a faster intervention time on networks, (diagnostic, locating incidents, self healing, remote operation and intervention), adjusting the local balance production/consumption, better targeting of network investment, thanks to risk management and preventive maintenance. Linky is, above all, a strategic choice for the future: international technological leadership, an essential building block to develop both smart grids and demand side management.

Smart meters and privacy

Many questions have been raised about privacy issues that may be associated with smart meters. Smart meters can provide surprisingly detailed information about your daily life. Energy usage data, measured moment by moment, allows the reconstruction of a household's activities: when people wake up, when they come home, when they go on vacation, and maybe even when they take a hot bath. It is not hard to imagine a divorce lawyer subpoenaing this information, an insurance company interpreting the data in a way that allows it to penalize customers, or criminals intercepting the information to plan a burglary. In California, EFF and other privacy groups asked for the adoption of stringent rules to protect the privacy and security of customers' energy-usage information. In France, there are opponents to smart meters and the "Linky Project" on the basis of the privacy issue. It is also a reflection of general fears or resistance towards new technologies.

Conclusion

'Smart energy demand' is a broad concept. It includes any energy-user actions to: Enhancement of reliability, reduce peak demand, shift usage to off-peak hours, lower total energy consumption, actively manage electric vehicle charging, actively respond to solar, wind, and renewable resources, buy more efficient appliances and equipment over time based on a better understanding and awareness of how energy is used by each appliance or equipment.

The future depends on eco-efficiency and ways of cooperation. International cooperation is a necessity, to achieve merge or harmonization of tools, study compatibilities, and increase uptake of available tools. Eco-efficiency can be attained by: 1) (in construction) enhancing energy efficiency in new and existing buildings, setting new targets in all renovation works; 2) (in transport) reducing carbon-dioxide emissions of vehicles, by developing or improving the public transport, bicycle and pedestrian traffic and logistics systems, by supporting low-emission motoring, and 3) smart grids and smart meters.

PART THREE : TOWARDS A DEEPER INTEGRATION OF URBAN SERVICES

Chapter 1. Towards a Deeper Integration of Urban Services : An operator point of view

Nicolas Renard,
Adviser to the Chairman and CEO,
Veolia Environnement
Paris, France

I - Overview of urban challenges

Services operators are « flows' managers ».

Cities have to manage flows, day and night: flows of water, waste, materials, energy, air, passengers, etc. Put this way, it seems very simple; but in metropolitan areas with mushrooming populations, it isn't. There will soon be 4 billion city dwellers, all of them producing, consuming and traveling. We have to supply these people with drinking water and energy, give them means of transportation, and collect and treat their wastewater and waste. Managing those flows, which are indispensable to *Homo urbanus's* quality of life, while at the same time preserving the environment, requires know-how in many spheres, along with a very tight organization. Making cities more fluid requires expertise and technology.

In urban areas, the demand for public services is continuously increasing.

We may not know how the 21st century will unfold, but we do know that it will be the century of the city. Cities, towns and metropolitan areas are home to half the world's people and, within 30 years, will have attracted another 3 billion. Every month, the world's urban population increases by the equivalent of a city the size of Madrid. The Africa, Asia and Latin America of tomorrow are being born in rapidly expanding urban areas.

Every economic growth point means one or several growth points in water consumption, public transportation. While occupying only 1% of the planet's landmass, cities produce 3 billion kilograms of waste a day. That waste will have to be sorted better and more of it will have to be recovered. The more prosperous a city, the more waste it generates.

The climate challenge is too serious for us to be able to afford the luxury of mismanaged urban services.

Much of the battle against warming will be fought out in the towns and cities, those energy-guzzling islands of heat. Cities are responsiblefor 80 % of GHG emissions and for 75% energy consumption. Furthermore, current forecasts place Asian electricity consumption at an annual increase of 5-8 %*. Oil reserves are steadily declining, yet less than 20% of plastic is recycled worldwide.

The many « diseases » of cities

Cities suffer from a variety of disorders: urban "*obesity*"; natural resource bulimia; traffic clots in their arteries; contamination by wastewater; failures in vital systems, such as electricity; and

*Source: Asian Regional Document, March 2009, 5th World Water Forum

deformities due to excessive stretching. Manila is "collapsing" under the weight of its waste, Los Angeles is being asphyxiated by its transportation systems, Beijing is suffering from drought... Many metropolitan areas are living on ecological credit. Sooner or later, pollution of the environment, the "collateral damage of urbanization," curbs growth. In the long term, no city, no economy, no company can continue expanding in a damaged environment. But when the environment is protected, it in turn protects human health and enables the economy to run smoothly.

The environmental challenges of cities are multiplying. How can we respond to them? One part of the solution is a deeper integration of their urban services.

II - Toward low impact urban utilities through a better integration of them

The city of the future will operate with maximum integration of public services.

At Veolia Environnement, we observe that our four businesses (water, waste management, public transportation and energy services) are interacting more and more. The heat from wastewater is being injected into district heating systems. We are converting byproduct energy produced in steelworks into a source of heating for the town. We are producing biodiesel from used oil that will run a city's bus fleet. We are transforming non-recyclable waste into electricity, which we sell to urban electricity suppliers. We are recovering potential energy and producing electricity with turbine in water networks. In fact, there are many possibilities of integrating urban services: these synergies are technical, economical and environmental.

Integration is particularly appropriate for energy recovery.

The cities want to capture the many sources of energy gushing in their midst rather than ignore them as they did in the past. In Guangzhou Likeng, the waste-to-energy plant can produce 21 MW of electricity. In Ho Chi Minh City, optimizing street lighting has reduced energy consumption by 30%. In Sydney, hydroelectricity is produced thanks to 250 m difference in level between the water resource and the 2 drinking water production plant. Hydro-electricity produced amounts to 75 % of the needs of these 2 plants.

Integrating urban services helps produce energy locally, as close to the needs as possible. It is by managing and integrating together their various urban services than cities will capture their internal source of energy.

There are other advantages of urban services' integration:

- optimization of Customer Relationship Management: homogenous Quality standard for clients of electricity service, water service, (e.g. call outs, response times, warnings when work on the network may affect service…); savings generated by shared Call Centers; remote automatic reading of electricity and water meters…
- optimization of maintenance and renewal operations on networks: reduction of damages caused to nearby residents (such as noise, waste generated by works); savings made on the costs for opening and closing trenches…
- optimization of the maintenance of municipal vehicles (for passengers' transportation, waste management or parks management): time-saving and labour-saving process; reduction of components stocks for repairs…

In the future, urban services will be designed and managed two by two, three by three…

Major gains results from the integration of urban services at the very beginning of their design and construction: all networks are installed in the same Utility tunnel; networks and major installation are localized so that as to facilitate and maximize their interconnections.

Looking at water, waste, public transportation, energy… services simultaneously generate valuable insights that do not arise from separate policy. This is a prerequisite for building ecocities. On the contrary, by being limited to each service, a separate management of urban services deprives the municipality and the population of the environmental advantages and savings they could derive from their joint management. If cities want to reconnect with the environment, their services have to be better connected together.

Integration between individual and collective solutions is a key issue.

Another issue related to service integration consists in finding the optimal economic and environmental balance between:

- area-specific solutions (such as recovery of rainwater, solar panels, etc.), which are often implemented on an individual scale;
- collective systems (such as public transportation, district heating fueled by biomass, etc.).

For instance, low consumption buildings comprise high energy efficiency equipment, altogether compact and multipurpose (i.e. simultaneously producing heating, ventilation and domestic hot water), so as to reduce costs and seek synergies. Buildings will become energy local production sites, thanks to photovoltaic and micro wind power. The million urban energy consumers will change into just as many producers.

In order to optimise the way this multi-source/multi-use network will operate, a smart management system, based on telecommunications, will have to be implemented. The IT's revolution will contribute to hurry up the integration of urban services

Toward low impact urban utilities

It is urgent to mitigate and control the ecological impact of cities and to improve the quality of urban life. The ambitious objective of carbon-neutral cities won't be rich without integrating urban services. To reach this goal, decisions-makers have various levers at hand to act:

- urban design defining the functionalities of urban space.
- optimization of networked solutions: water, wastewater, solid waste collection, power grids…
- cross-energy recovery between urban services.
- energy efficiency of buildings and equipments.
- development of adequate public transit networks.
- deployment of local sustainable solutions of wastewater recycling, solid waste treatment and recycling, alternative energy generation…

However, there are various obstacles to a greater integration of urban services:

- lack of local outlets: close heating networks for heat produced by cogeneration or recovered from wastewater networks; markets for secondary raw materials,…
- high investments costs for creating new connections or local outlets (e.g. creation of underground heating networks).
- technical difficulties, large distance between networks.
- integration limited or prohibited by laws or standards. How to promote the integration of urban services when existing laws are organizing their separated management? It's not just a matter of inventing sustainable services and then making widespread use of them: they first have to be accepted by lawmakers.
- service users' reluctance to direct upstream-downstream integration (e.g. wastewater recycling in 2006 in Toowoomba, Australia).

III - Linking energy and water

The nexus between energy and water is a critical issues for ecocities, and thus the integration of these two services.

A combined approach is all the more necessary since energy security may be conflicting with water security. Water and energy are competing for the same resource. For instance, American energy production is very much at the mercy of water availability. The dilemma is that energy enables us to reduce water scarcity and that water enables us to reduce energy scarcity…

Due to the give and take relationship between the water and energy systems, it is necessary:

- to look at the same time for energy efficiency and water efficiency;
- to move towards an optimum between low energy water systems and low water energy systems.

Water efficiency should be given a priority by energy planners and energy efficiency should be given a priority by water planners. The objective is to save water in order to save energy, and to save energy in order to save water.

Here are a few examples of synergy or combined approach:

- Combining desalination plant and power production plant. As for new thermal desalination projects, desalination plants are increasingly being installed in conjunction with energy production installations. The heat produced (when hydrocarbons are burnt to produce electricity) is used to vaporise sea water. These hybrid solutions allow optimal use of thermal power stations.
- Sewage and wastewater heated apartments in the former Olympic Village of Vancouver in 2010.

- South Korea aims at improving energy independence of public sewerage facilities from 0.8 % in 2007 to 45 % in 2030 [4].
- The heating network of Jiamusi, China. This heating network is operated by Dalkia, (subsidiary of Veolia Environnement), since 2007. Following a large-scale initiative to update the network's facilities: water loss has been cut by 30%, energy consumption has fallen 13.5%, and yearly CO_2 emissions have been reduced by 65,000 tonnes; the network has been extended by 56% to total 8.6 million sq.m, and work has started to expand it still further, to 14.5 million sq.m.; a customer support centre is now available 24 hours a day, and access to information has been expanded via an Internet site and local media; by improving service quality, Dalkia has gained its customers' trust and reduced the bad debt rate from 7% to 2%. This project was honored with an award from the International Energy Agency at the international heating network summit held in Copenhagen in 2009.

IV - The future of R&D

The crucial need for innovation

We will not overcome the urban environmental challenges without investing heavily in research. It is an illusion to think we can address the climate upheavals and pollution in the absence of major innovations. How can we get out of the "business as usual" mold if we stick to our usual technology? How can the economy, high on carbon, be detoxed without new production methods? If we had to build the future with the same old technology, the war on pollution and climate change would be lost in advance. It is by innovating that we will make the economy more economical ant the city eco-friendly.

Ecocity will require better system engineering, more and seamless interconnections, less-polluting energy,... In other words, it will require innovation to create sustainable solutions that fit together perfectly.

The close association of many types of urban services and expertises is a driver for progress.

In the future, most of inventions will not come from each urban activity or service, but rather from their interfaces. For instance, tomorrow's wastewater treatment plants will emerge from 3 activities: water, solid waste management and energy. They will be "energy-positive plants" and genuine biorefineries, producing clean water, generating energy instead of consuming it, and manufacturing biofertilizers and bioplastics from the organic material in wastewater.

One of the keys to future advances is close association of expertise in a variety of fields. That is why Veolia Environnement opted for pooling knowledge.

There is a need for a professional management of new technologies.

No matter how much R&D you do, it will amount to nothing if the technologies invented are not used in a professional manner. What good would the cleanest technology do if it were not properly applied? If poorly designed or poorly managed, a building complex, a cooling network or a transit system becomes an energy guzzler. When properly operated, they save energy.

Even the most efficient technologies will disappoint if they are used unprofessionally. In that sense, combating environmental pollution and "curing the climate disease" are an industrial challenge. Especially since tomorrow's technologies will be more complex and the energy mixes more varied. Employing disparate energy sources, combining them ingeniously and operating them efficiently will demand organizational refinement and greater expertise.

4. Chong Chun KIM, Korean Ministry of Environment – Incheon Water Forum, August 21rst, 2009

Conclusion: The sustainability of the globe will be decided by how our cities perform

« Trans-sector » services are the services of the future

Therefore we need to move towards an urban planning of services' linkage. This implies modifying the organization of cities, urban planning, services operation and industrial engineering. This means that the architecture of all urban services' networks must be studied at the design stage of block plans by the town planner, the landscape designer and the various urban services' managers. This imposes innovations in terms of processes as well as in the overall way the urban territory is structured (construction law, connection obligations to networks, energy performance building standards, architectural regulation, choice of materials,…)

Strengthening connectivity is a key element to reinvent cities

The 20th century saw the triumph of large infrastructure. The 21st century will in addition see a proliferation of decentralized, local solutions: solar panels, geothermal installations, biomass power plants, waste recycling centers, wastewater reclaiming plants and more. It is the "local energies," "local materials" and "local water" that will enable cities to establish an urban model that preserves nature while making use of it.

The ideal of an environmentally neutral, zero footprint city is not unachievable. Many projects are springing up: Phoenix, Singapore or Rizhao in China aim at getting closer to carbon-neutrality or achieving it. In China, 200 new cities are expected by 2020: many will incorporate the principles of sustainable development in their design. For *homo urbanus*, it is not just a necessity, but also a dream, since a city with no dream is a city without a future.

Chapter 2. Integration of Urban Services and Good Governance: the Auckland Supercity Project

Peter McKinlay
Director, Local Government Centre
AUT University
Auckland New Zealand

Introduction

The restructuring of metropolitan Auckland is one of the most substantial and far-reaching local government restructurings in recent years. This paper examines the restructuring from the perspective of the integration of urban services by looking first at the problem definition, and then at the proposed solution. It will include a detailed consideration of New Zealand's unique governance framework for local authority control armslength entities - what we term council controlled organisations, or CCOs. It will then compare the Auckland approach with experience in three other mega-cities; Brisbane/South-East Queensland, Greater Vancouver and London. It will conclude by drawing some tentative conclusions - tentative as the restructured Auckland Council only came into being on 1 November 2010.

A preliminary comment: the proposed single authority for the entire Auckland region quickly became referred to as the 'Auckland supercity'. The term 'supercity' needs some context; it simply reflected the scale of the new city (1.4 million people) compared with the scale of New Zealand's other large local authorities - the biggest of which by population is Christchurch city with a population of approximately 350,000, or one quarter that of the new Auckland. The term should not be confused with the usage which 'supercity' has gained internationally, for example, in discussion of emerging megalopolises such as the Boswash corridor, or Portland to Vancouver (see Ecolopolis: Making the case for a Cascadian Supercity accessed on 6 April 2011 at http://www.america2050.org/pdf/ecolopoliscascadia.pdf).

Background

It will help to start with a brief overview of the structure of New Zealand's local government sector. It comprises two principal forms of local authority; regional councils and territorial authorities (which may be either city or district councils). A further form of local authority is known as a unitary council; a council that exercises the powers of both regional councils and territorial authorities. New Zealand has four relatively small unitary authorities and, post the restructuring of Auckland, one very large unitary authority, the Auckland Council.

Regional councils, as the name implies, have a significantly larger geographic coverage than territorial authorities, but a more limited range of functions[5]. Their functions are primarily environmental management and planning (including responsibility for air and water quality), regional land transport planning, public transport, the coastal zone out to the 12 mile limit and pest and noxious weed control. Territorial authorities are responsible for the bulk of local authority service delivery, including water and sewerage services, local roads, arts culture and recreation, local regulation (including district planning and building consents) minor health regulation and a wide range of other essentially local services.

5. Strictly, this describes the formal legal situation prior to the enactment of the Local Government Act 2002 which conferred identical powers on regional councils and territorial authorities but with a set of provisions designed to require consultation if a regional council proposed adopting a new function already undertaken by a territorial authority within its region. In practice the actual functions of regional councils have changed little despite the expansion in their formal powers.

Local government in the Auckland region included one regional council, four city councils which were amongst the economy's largest territorial authorities by population, and all of two and part of a third district council, each of which had a substantial rural component. In addition it had a number of special purpose entities including Watercare services Ltd which was responsible for wholesale water and wastewater services for most of the region, and the Auckland Regional Transport Authority. A feature of these arrangements was divided responsibility, and an inability to take and implement major regionwide decisions as can be seen from the following 'wiring diagram' prepared by one of the submitters to the Royal Commission outlining who had what responsibilities in respect of transport within the region (Royal Commission 2009 p 543):

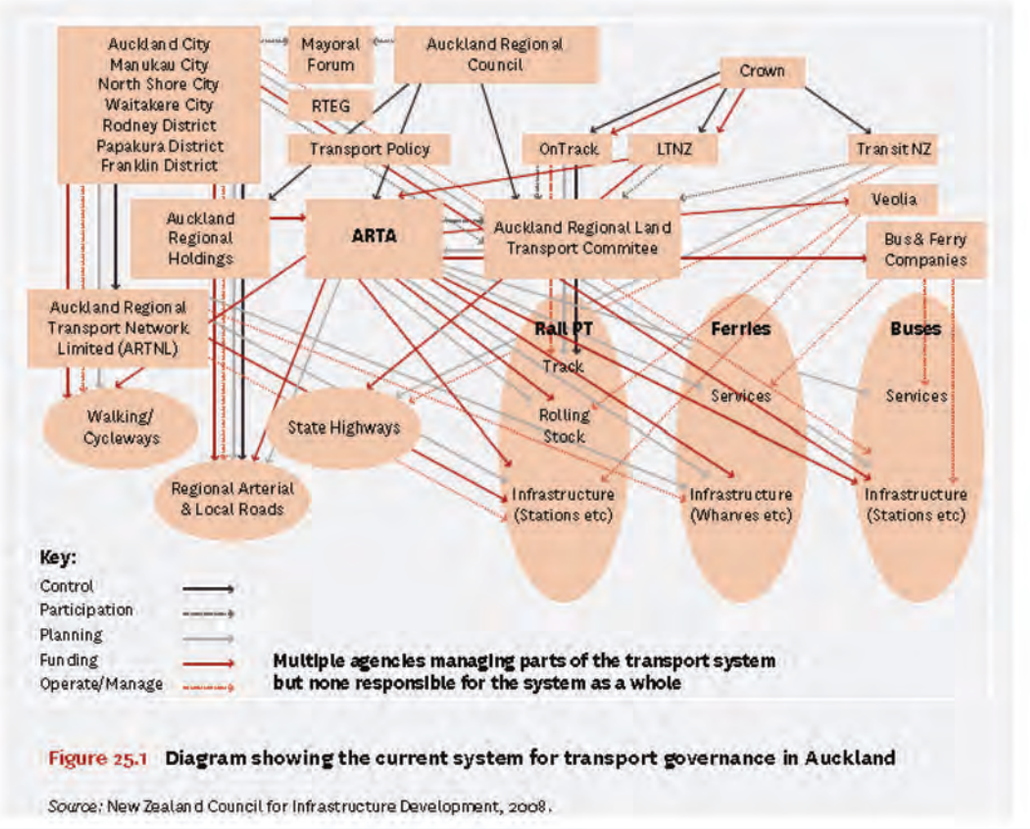


Figure 25.1 **Diagram showing the current system for transport governance in Auckland**

Source: New Zealand Council for Infrastructure Development, 2008.

Land use planning was similarly complex. The Auckland Regional Council was responsible for producing the Regional Policy Statement, a document which territorial authorities were required to 'have regard to' until a recent change in legislation which now requires them to 'give effect to' it. Territorial authorities were responsible for preparing district land use plans. Tensions between the two were often considerable especially over the application of what is known as the Metropolitan Urban Limit, a tool used by the regional council in an endeavour to constrain urban sprawl. Of relevance for the present paper, regional land transport planning and regional land use planning were not well integrated.

These complexities of decision-making and implementation were the subject of considerable public debate, including endeavours within the Auckland region itself by local government to agree a better way of managing their respective responsibilities. The lack of any worthwhile progress lead to the then Labour led government, in late 2007, establishing the Royal Commission on Auckland Governance. Among the matters which the terms of reference required the Royal Commission to consider was:

> What ownership, governance, and institutional arrangements and funding responsibilities are required to ensure the effective, efficient, and sustainable provision of public infrastructure, services, and facilities…

The Royal Commission delivered its report in March 2009. Since its establishment, there had been a change of government and the report was received by the now National led government whose Minister of Local Government was the leader of a small right-wing political party, a position which had been secured as part of coalition negotiations.

The Royal Commission's Recommendations

The Royal Commission proposed a single Auckland Council as a unitary authority for the whole of the Auckland region but including within it six local councils based largely on the previous territorial authorities which would have responsibility for local service delivery and community engagement. However, these were not to be separate legal entities, and it would be the Auckland Council itself which would be the actual service deliverer, with the six local councils specifying service level standards, monitoring performance, and negotiating with the Auckland Council budgets required to fund service delivery (with the actual funding itself being raised by the Auckland Council).

The Royal Commission rejected the idea that those local councils should be an independent tier of local government (as for example London boroughs are within the area covered by the Greater London Authority). It did so in very large part because it had considered the history of the experience of Auckland's territorial authorities in recent years in exploring the potential for shared services. Briefly, significant potential had been identified but not acted on largely because of a combination of management and political resistance. The Commission was clearly concerned that an important part of its role was to establish a structure which would be an efficient deliverer of services able to take account of economies of both scale and scope. The Commission explained its decision in the following terms: «the Commission considered the possibility of retaining the existing territorial authorities and limiting their powers, by removing from them responsibilities relating to regional infrastructure and assets and development, and requiring councils to share services. The Commission concluded that this approach would be difficult to implement and would not necessarily achieve the organisational and culture change required.» (P 317)

The Auckland Council itself would be elected on a ward basis and led by a Mayor elected at large. In respect of mayoral powers, the Commission explicitly rejected the «strong mayor» model stating that «it considers that it is desirable for the Mayor of Auckland to muster majority council support for his or her policies before being able to implement them» (P 427). The commission did recommend, however, that the Mayor should have the power to appoint the deputy mayor and committee chairs.

The Auckland Council as an organisation would among other things provide integrated back-office services to support all local authority activities across Auckland, focus on regional level policies and projects, and undertake much of its activity through CCOs (other than regulatory and licensing activity). This was an important shift, placing activity which was conventionally undertaken within councils themselves in separate stand-alone but council controlled organisations. As an example the Royal Commission recommended the establishment of a new CCO, the Regional Transport Authority (RTA) with «responsibility for the planning, development, and management of arterial roads and all public transport infrastructure service planning and procurement.» Local roads would remain the responsibility of local councils but with the RTA exercising a funding approval and ensuring consistency with the regional spatial plan.

The Commission's most controversial recommendation was for what would amount to a co-decision-making structure, drawn from the Auckland Council and from central government, to be responsible for decision-making in respect of the Government's spending on social services within Auckland.

The Government's Response

The Government which received the report of the Royal Commission was not the Government had commissioned it. Some eight days after the Royal Commission had delivered its report, the Government issued its response. The immediate public reaction was that the Government had rejected the report of the Royal Commission and imposed its own hastily cobbled together alternative.

It was perhaps a natural reaction especially given the known views of the Minister. However, a close look at the Government's principal decisions suggests that rather than rejecting the report of the Royal Commission, the government had instead taken the basic proposals, and extended them further to reflect the government's preferences . The key elements in the Government's proposal for Auckland were:

- A Mayor elected at large but as well as the additional powers recommended by the Royal Commission of appointing a deputy mayor and committee chairs, the mayor was also given the power to establish committees, lead the development of the Council's policies and plans, and provided with a substantial budget to establish a separate mayoral office.

- The Royal Commission support for the delivery of services through CCOs was taken further. In particular, Auckland Transport as well as being given the powers the Royal Commission had proposed for a Regional Transport Authority was also given full powers over local roads which is a very sensitive issue.

- The Royal Commission's proposed six local councils were scrapped in favour of 21 local boards, with the Minister arguing that a larger number was required in the interests of local democracy. Like the proposed six local councils, they were to have decision-making power over local services, but within a somewhat less clear framework than proposed by the Royal Commission. The Commission had proposed setting out the powers of local councils in legislation. The Government chose instead to state in legislation the principle that local boards should have decision-making power over local non-regulatory matters but to leave it to the Auckland Council to delegate, with the ability to determine that powers should remain with the Auckland Council if their exercise had regional implications.

- The proposed co-decision-making structure for social spending has been replaced by a Social Policy Forum with no explicit decision-making powers - it appears intended as purely a means for bringing parties together to discuss what they are doing and look at the potential for collaboration.

The new approach to service delivery

As a result of the restructuring, the greater part of the Auckland Council's service delivery activity is now undertaken through a series of seven CCOs:

- Auckland Council Investments Ltd which manages the council's investments, principally

its 22% shareholding in Auckland International Airport Ltd and its 100% shareholding in Ports of Auckland Ltd.

- Auckland Council Property Ltd which manages approximately $700 million of commercial and non-core property (property not required for core council services or infrastructure).

- Auckland Tourism Events and Economic development whose stated purpose is to «rationalise and consolidate events and economic development activities across the region to achieve a consistent approach.»

- Auckland Transport which has responsibility for all of Auckland's transport other than state highways.

- Auckland Waterfront Development Agency which is charged with leading the development of Auckland's waterfront including the completion of a master plan for the area.

- Regional Facilities Auckland which is responsible for the management and oversight of major regional arts, cultural and recreational facilities.

- Watercare Services Ltd which is responsible for wholesale and retail water and wastewater across the whole of the Auckland region with the exception of the former Papakura district where these services are managed under a long-term franchise agreement entered into some 20 years ago.

This structure is a first for New Zealand although the basic legislative powers for local authorities to undertake activity through arms length entities including council owned companies and council controlled trusts have been in place for more than 20 years. They originate in the major restructuring of New Zealand's local government sector which took place in 1989 as part of a much more comprehensive set of reforms which embraced not just the public sector but the entire New Zealand economy (Boston et al 1991).

The underlying approach of New Zealand's reforms was based very firmly on new public management, and drew heavily on insights from public choice theory. Particular emphasis was placed on separating out potentially conflicting interests or activities, and identifying the appropriate structures required to achieve the desired outcomes from different activities. This meant, for example, separating responsibility for policy advice from responsibility for delivery, and placing commercial or quasi-commercial activities in structures designed for that purpose. Within central government this resulted in a number of trading activities which had previously taken departmental form being restructured as state-owned companies, known as state-owned enterprises or SOEs.

It was consistent with the nature of the reform process, and the analysis driving it, that considerable care was taken in designing the new structures. Thus with state-owned companies or as they became known, state-owned enterprises, it was not seen as sufficient merely to place them in a company form; the company form itself needed to be nested in a framework which, while encouraging a commercial approach to management, remained appropriately accountable to ministers.

This was achieved through a combination of a legislated accountability framework, and the development of practice associated with that to underpin the desired relationship between the government, through shareholding ministers (the Minister of Finance, and the Minister for the portfolio which has responsibility for the area in which the company is engaged) and SOEs. Directors are

required to prepare an annual statement of intent which spells out the nature of the business or businesses in which the SOE will be involved, its key financial and non-financial performance indicators, its accounting principles, how it will handle major divestments or acquisitions and much more.

That legislative requirement is complemented by an annual cycle managed by the (now) Crown Ownership Monitoring Unit which has responsibility for monitoring the performance of SOEs and advising ministers on director appointments. The annual cycle commences with what is known as the letter of expectations in which the shareholding ministers spell out their expectations of the SOE in terms of the forthcoming year's performance, activities, required rate of return, dividend policy and any other matters of concern to the government as owner. The statement of intent is then prepared by the directors taking account of the letter of expectations, and finally agreed between shareholding ministers and directors.

The framework is a delicate balance between the rights of the Crown as owner, and the legal responsibilities of directors to act in good faith and in what the director believes to be the best interests of the company.

The 1989 restructuring of local government was simply one part of the then government's reform programme to increase the efficiency of the public sector and the wider economy. It was entirely consistent with this that, when it came to considering the powers which local authorities should have, the government included the power to establish local authority owned companies, initially known as local authority trading enterprises, to carry out commercial or semi-commercial activities, and gave them essentially the same statutory framework as had recently been put in place for its own state-owned enterprises.

There was, however, a significant difference. Government itself was an enthusiastic corporatiser and ultimately privatiser of many of its own trading activities. Local government and its residents and ratepayers did not share the enthusiasm for the use of companies. Indeed, corporatising a publicly owned activity rapidly became seen as a first step in privatisation as a consequence of the extent to which central government itself privatised many of the entities which it had turned into companies.

As a consequence, although New Zealand local authorities have long had the power to establish council owned companies (and council controlled trusts) the use of council owned companies has been relatively uncommon and typically confined to cases where government policy has strongly encouraged or required this approach. By value, the great majority of council owned companies result either from situations where receipt of government subsidy was dependent upon corporatisation (public passenger transport) or companies had resulted from the corporatisation by government of activities in specific sectors - harbour boards' port operations were corporatised in the mid-1980s and the resultant companies vested in local authorities during the 1989 restructuring; retail electricity distribution, much of which had been owned by council electricity departments, was corporatised in the early 1990s so that a number of councils found themselves owning electricity companies.

This background set a context for public opposition to the establishment of the Auckland Council's 7 CCOs which was amplified by the process which the government itself followed. Because the intention was that the CCOs should be in place on day one of the existence of the new council, in order that there should be a seamless transfer of service delivery responsibilities from the former councils, the corporate structure and governance of each of the CCOs had to be in place before the newly elected members of the Auckland Council took office. This left a vacuum which needed to be filled - the responsibility for appointment of the initial directors.

The approach which the government took was that the Minister of Local Government (in conjunction with the Minister of Transport in respect of the Transport CCO) should be responsible for

the appointment of initial directors. The immediate reaction especially given the Minister's known preference for small government and privatisation was that the Minister was taking the opportunity to appoint his «mates» in order to forward his agenda for privatisation.

Public comment, and many of the submissions to the select committee considering the legislation, was dominated by the view that placing important service delivery activities under the control of non-elected directors was undemocratic, and would undermine public accountability[6]. Few of the commentators appeared to consider the counterfactual; that the alternative of placing these major activities in CCOs was that they would be large business units within the Auckland Council itself.

New Zealand's local government legislation, harking back to the reform ideology of the late 1980s, is based on a separation of responsibility for policy and implementation between elected members and management. New Zealand councils have a single employee, the chief executive, who is responsible for employment of all other staff, for implementation of Council policy, and for providing the council with advice (there is no provision for elected members to obtain advice from alternative sources unless councils themselves specifically decide to make provision for this as a matter of policy, a practice which has seldom been adopted).

In practice, the use of CCOs can be argued as enhancing both the power of elected members, and democratic accountability. Although officials are involved in supporting elected members both in setting the terms of the letter of expectations and negotiating the statement of intent, it is the elected members who have the power to make decisions on these matters. It is also the elected members who are responsible for appointing directors and monitoring the performance of CCOs. Transparency is greatly enhanced by the fact that CCOs prepare their own individual financial statements and have their own individual reporting requirements - business units within a council may not necessarily, and financial information could be aggregated across more than one making it very difficult for elected members and others to monitor performance.

The nature of the relationship between elected members and CCOs puts a much stronger emphasis on specifying outcomes and reporting against them than would be the case with council business units. This is especially important when it comes to issues such as ensuring the integration of the different aspects of urban services including environmental management, and other activities which impact on this. The fact that the CCOs are as a matter of law independent legal entities focuses attention and practice on areas where they need to collaborate in a very different way from placing a whole series of different activities within a single entity - the 'silo' effect which can so easily make it difficult to integrate activities across a single large public sector entity effectively disappears and is replaced by an overt need to put in place mechanisms to ensure collaboration.

Appendix 1 sets out the key expectations outlined in the Auckland Council's letters of expectation to the directors of its CCOs. Among other things these include a strong emphasis on public engagement and accountability, including developing a local board engagement plan to ensure that local boards have adequate opportunity for input, achieving the Council's strategic objectives, and having a high level of coordination.

The model needs to be seen very much as a work in progress in the process of ensuring effective coordination and collaboration, especially in areas such as the integration of transport and land use planning. This will be a very real test of its effectiveness as responsibility for planning, including the spatial plan and land use planning remains a core council responsibility whilst transport planning,

6. Amongst the changes made following the select committee report on legislation were provisions emphasising what was in fact already legal situation, that the Council has the power to appoint and dismiss directors at any time (a power which the Auckland legislation constrained by providing that elected m and embers themselves may not be appointed to boards with the single exception that two may be appointed to the board of Auckland Transport).

including the development of the regional land transport plan, is now a function of the Auckland Transport CCO. The statutory framework regulating the relationship between the Council and CCOs gives the Council or formal powers it requires to ensure a collaborative approach, but achieving this in practice will require embedding a culture of collaboration within both organisations, and ensuring that planners and organisations work together not just in a formal sense, but in a range of informal ways to build a sense of common purpose despite the fact that they are working within what are, in legal (and almost certainly organisational) terms separate entities.

This will place a premium on the quality of governance within both the Council and CCOs. Interviews which the author has conducted with selected directors of CCOs in some other councils, and with elected members, suggests that there is still much to learn in terms of the good governance of arms-length entities. Private-sector directors who may have the necessary commercial skills often lack a good understanding of what is needed to be fully effective in a public ownership environment. Elected members may lack a full understanding of the separate roles of elected members, shareholders and directors. It seems clear that the success of the Auckland model, and its extension to other local authorities, will be at least partly dependent on the development of a culture of governance in the local public sphere.

Its success will also be dependent on how the relationship between the Auckland Council and central government evolves. Government has made it clear that it expects to play an active role in the future development of Auckland. In part this is because government is the principal funder of major roading and other transport infrastructure. In part it is clearly because government will be reluctant to cede significant authority to a lower tier because of the size and scale of the area for which new council is responsible- 33% of the economies's population and 35% of its GDP.

This has been made clear through the way in which legislation frameworks what will be the key planning document for Auckland, the spatial plan (Appendix II sets out the legislative framework for the spatial plan). The process includes ongoing iteration between the Council and Cabinet which made its position clear in a series of papers released late in March. The following paragraphs from the overview paper for the series signal the government's approach:

> Central government spends the majority of public money in Auckland, more than eight times the amount that local government spends. The imperative to spend this money effectively is one driver for taking a coordinated, cross-portfolio approach to providing input into the development of the spatial plan.
>
> One of the primary opportunities for Government provided by the Auckland spatial plan is to better align the location and sequencing of different infrastructure and services with each other, and with land use and demand. The size and nature of Government investment in Auckland emphasises the importance of this opportunity.

How does the Auckland approach compare with other megacities?

This section briefly considers the approaches to coordination of urban services taken in three other megacities; Brisbane, Vancouver and London, and comments briefly on the merits of the different models.

A common theme can be seen running through each of these (and through Auckland); the reluctance of higher tiers of government to concede significant authority to local tiers of government over areas where traditionally the higher tier has expected to exercise the primary decision-making role.

The following comment from a paper considering the role of central governments in metropolitan regions within the OECD is instructive:

> Even in countries which have carried out significant institutional reforms leading to the creation of a new metropolitan structure, the central government remains hostile to a strong metropolitan level. This is particularly apparent in countries with a limited number of large metropolitan areas that concentrate a high share of the national wealth and population. The presence of one or more metropolitan areas is a political threat to the central state impeding its ability to guarantee balanced territorial development. But even in the case of the most advanced metropolitan governance models, such as supra-municipal multi-sectoral or metropolitan governments, the institutional, political and fiscal weight tends to be limited when compared with other levels of government. This trend can be seen in the most advanced metropolitan governance models such as Stuttgart, London or Montréal. (OECD 2004 p7).

Brisbane

The Brisbane metropolitan area has a population of approximately 2.1 million with the population of Brisbane City itself approaching 1.1 million. In turn, the metropolitan area is part of south-east Queensland which for infrastructure development and regional planning purposes is treated as a single region (with a total population of approximately 3,000,000).

Brisbane City Council, until the formation of the Auckland Council, was by far the largest local authority by population in Australasia, and is still the largest in terms of GDP and turnover. It operates under its own legislation, originally the City of Brisbane Act 1924, passed to facilitate the amalgamation of a number of smaller local authorities into a single city, and now the City of Brisbane Act 2010. The legislation gives the city a power of general competence. However, despite its scale and legal powers, in many respects the critical decisions affecting the city are taken at a state level.

Regional planning in South-East Queensland began in 1990 as a collaborative function linking the local authorities in the area and the State government, based around a series of sub-regional organisations of councils linked through a South-East Queensland Regional Organisation of Councils. In 1994 the state government passed legislation giving regional planning a statutory basis and placing it under the oversight of a newly established Office of urban Management, and a new Regional Coordination with Committee involving six State ministers and four Mayors under the umbrella of the Department of Infrastructure and Planning (now the Department of Local Government and Planning). Regional planning continues to be led by the state with regional plans being «developed in partnership with local councils, the community and stakeholders.»

Queensland was, until recently, the one Australian state in which water and wastewater services were a local authority responsibility. Lack of coordination, and multiple responsibilities, were a feature of water services in South-East Queensland. One speaker at a Brisbane Institute seminar in 2005 characterised service delivery these terms:

> Service delivery is also too complex, involving a mix of local governments, and local and state owned corporations. There is primarily vertical separation between bulk and retail services with some exceptions. The total water cycle is disaggregated at the retail end, with environmental water being separate from water supply and wastewater. Urban water and wastewater retail services are geographically disaggregated across 18 local authorities, serving a total of 2.5 million people (Cox 2005).

The clear expectation on the part of local government was that rationalisation was necessary and would take place through a rationalisation of local authority ownership and delivery interests coupled with a reform of the state regulatory environment for water. Instead, the state opted to take over ownership of bulk water supply, creating an integrated water grid for the whole of south-east Queensland,

and driving the restructuring of local authority retail and wastewater services into three local authority owned companies.

The Queensland experience is clearly one of state intervention to ensure what it regards as effective collaboration and delivery of key services (reflected not just in the examples cited in this paper, but also in the major restructuring of local government in Queensland driven by the state when it lost patience with a local government lead review, *Size, Shape and Sustainability*).

Vancouver

The City of Vancouver, with a population of 600,000, is the principal local authority within the Greater Vancouver Regional District, a metropolitan area with a total population of approximately 2.2 million, the principal population centre of the Canadian province of British Colombia.

The province has a somewhat unique approach to its oversight of local government, taking a relatively non-interventionist approach and preferring to encourage collaboration amongst local authorities rather than amalgamation as a means for improving efficiency.

In a presentation to the World Urban Forum III (Paget and Walisser 2006), 2 senior officials of the province's Ministry of Community Services described the four key factors of the province's local government architecture as:

- municipal governments are strong – they are equipped to meet real local needs;
- regional governments serve the local government system without dominating it. Political boundaries are fixed, yet functional or service boundaries are soft. There are literally thousands of different boundaries for providing and financing individual services (with new service units forming each year);
- municipal and regional governments provide local services – they regulate people and property, and guide physical and social development of communities – but are not responsible for equity services such as health or education; and
- collaborative institutions provide support in areas where local governments can achieve more by acting collectively rather than individually.

Central to this approach are what are known as regional districts which link together groups of municipalities in what is intended to be essentially a collaborative approach to managing inter-municipal issues. The boards of regional districts are made up of elected members appointed from constituent municipalities, together with members elected from unincorporated areas (only a relatively small part of British Columbia's land area has formal local government).

The Greater Vancouver Regional District is by far the largest of the regional districts, and provides a comprehensive range of regional level services to its 21 municipalities.

Sancton (2005), a very well respected writer on metropolitan governance considers that the Regional District approach is the best option yet developed for effective metropolitan governance. In respect specifically of the Greater Vancouver Regional District he comments:

> Although it is impossible to determine objectively an ideal institutional model for Metropolitan governance, it is hard to imagine a mechanism that could better combine local self-government through established municipalities with the existence of an institution at the Metropolitan level that can both provide a degree of consensual Metropolitan leadership (the strategic plan) and a framework within which municipalities can voluntarily co-operate with each other.

He goes on to conclude that:

> The genius of the Regional-District system in British Columbia is that the Vancouver city-region obtains most of the benefits of having a metropolitan authority without the addition of another competing tier of directly-elected local government. For many of the world's city-regions, the Greater Vancouver Regional District merits at least further study, if not emulation.

Despite the relatively hands off approach which has been traditional in British Columbia, the provincial government has recently intervened in a major reform of transportation governance and management for Vancouver and surrounding areas.

Since 1999, municipal transit, including the building of associated infrastructure, had been the responsibility of the Greater Vancouver Transportation Authority known as TransLink. The authority was the vehicle through which the Greater Vancouver Regional District exercised its public transit function. TransLink's governance was through a board made up of elected members from within Greater Vancouver who were directly responsible for major decision-making.

In 2006 the provincial government established a panel to review TransLink. The background to the decision to establish the review was provincial government dissatisfaction with the decision-making process of the TransLink board over a major public private partnership proposal known as the Canada Line. At heart of the disagreement between the TransLink board and the provincial government was a difference in priorities; the provincial government wanted a link from the airport to the centre of Vancouver constructed in time for the 2010 Winter Olympics. The TransLink board was committed to completing a different line first because this formed part of an agreement amongst the Regional District's municipalities on integrated transport planning.

Another factor leading up to the review was that the TransLink governance structure was coming under pressure from several sources including the rising cost of infrastructure, and the difference between the administrative and functional boundaries of the transport function. A board made up of elected members was finding it more difficult to make decisions that could be seen as being in the «wider regional interest» when this might result in significant tax increases for their own residents and ratepayers. This was compounded by the need to improve transit arrangements for communities outside the regional district itself.

The review report recommended a different approach to governance, distancing the political level from the planning and implementation level.

Under the new structure, the ultimate responsibility still formally rests with local government but they exercise real power only to the extent that local government itself is required to contribute funds to TransLink. At the peak of the governance arrangements is a Mayors' Council made up of Mayors of councils within the metropolitan area and with provision for Mayors of additional municipalities to join the Council to facilitate extension of Translink's coverage. The Mayors' Council is responsible for appointing Translink's Board of Directors who may not themselves be elected members or employees of public bodies.

The board is responsible for preparing and implementing Translink's strategic and operational plans. The Mayors' Council receives these but has limited powers to amend. The arrangements were predicated on the assumption that TransLink would be self funding through a combination of fare income, and profits from property development around transport nodes. These have not eventuated with result that TransLink may now require funding from local government, thus placing the Mayors' Council in a much stronger position to influence its decision-making.

The arrangements can be seen as a compromise between the public interest in democratic control of major decision-making, and the imperative, especially strong in major infrastructure issues, to be able to get on and make timely and efficient decisions. It addresses what is now a common dilemma in this area that, typically, any major infrastructure issue can be dealt with by more than one possible solution, each of which will impact differently on different interests within the affected community or region. The provincial Minister of Transport clearly believed that, if these kinds of matters were left to be resolved by decision-making groups with individual members whose primary loyalties are to only part of the affected region, there could be a very real risk of parochial interests overwhelming any rational decision-making process. In the light of the issues currently facing many metropolitan centres, this is an extremely interesting experiment in balancing competing interests, especially as it has been developed within a jurisdiction that historically has eschewed intervention within local government.

London

The Greater London Council was abolished by the Thatcher government in 1986 (that government actually abolished all seven metropolitan counties). The London boroughs remained in existence, managing service delivery at the local level, but London wide services became the responsibility of a mixture of London wide appointed boards, other institutions and various departments. Travers and Jones (1997) concluded that «London is a city with much government but little political power. While this contrast has been true in the past, the demands of a modern, advanced democracy make the failures of weak and fragmented government more important than before.»

The then Labour opposition made a commitment in its 1997 election manifesto to put in place a new deal for London with a strategic authority and Mayor each directly elected. Once in office, it published proposals for the establishment of a Greater London Authority and submitted these to a referendum. A turnout of 34.6% provided a majority of 72% in favour.

The Mayor of London has become a well established and internationally prominent figure. The mayoral power to be the final decision maker, exemplified in Ken Livingston's decision to introduce a congestion charge against virtually total opposition both from the elected members of the Authority, and from the general public presents a picture of a very powerful position. In practice the mayoral power is significantly less than this suggests. Most major service delivery is still the responsibility of London boroughs. The Greater London Authority has responsibility only for transport (admittedly a very important function), Metropolitan police, economic development (the London Development Agency) and Fire and emergency services. Funding is constrained. The mayor effectively sets the budget and the Greater London Authority then pre-empts on the boroughs, but the amount by which it can increase the amount it pre-empts is capped at the same percentage as the council tax levied by the boroughs themselves.

What the Mayor does have is significant influence over service coordination. The Mayor is responsible for the preparation of the London Plan which «sets out an integrated economic, environmental, transport and social framework for the development of the capital over the next 20-25 years.» (accessed at http://www.london.gov.uk/shaping-london/london-plan/). The plan is currently undergoing public examination and is expected to be formally adopted by the Mayor late in 2011.

The Mayor has a range of other planning responsibilities including a duty to set out plans and policies for London covering transport, planning and development, housing, economic development and regeneration, culture, health inequalities, and a range of environmental issues including climate change, biodiversity, ambient noise, waste disposal and air quality.

Crucially, what the Mayor does not have (and nor does the Greater London Authority itself) is funding autonomy. The great majority of operational funding (other than revenue such as public

passenger transport fares) is provided either by government grant (for example for the Metropolitan police) or by pre-empting on the London boroughs but within strict constraints. The current public sector spending cuts will provide a crucial test of the extent to which the Mayor has the power to govern with a high degree of autonomy, or whether the continuing government control over funding will prove to be the real determinant of who exercises power in London.

Merits of the different models

Each of the four models is structurally quite different. Vancouver (1886) and Brisbane (1924) are both relatively old established sizeable cities within a much larger metropolitan area, but with quite different provisions for metropolitan governance; Vancouver has a relatively non-interventionist provincial government (with the restructuring of Translink being the principal exception) and, at the Metropolitan level, a voluntarist approach to collaboration through the Greater Vancouver Regional District. Brisbane has a strongly interventionist state government which acts both as the regional planning body, and as a principal player in the provision of regional infrastructure. In practice, if there is a metropolitan governance body for the Brisbane metropolitan area, or for south-east Queensland, it is the State government although the emerging role of the South-East Queensland Council of Mayors could also be seen as a nascent form of metropolitan governance.

London, in the form of the Greater London Authority and the elected executive mayor, is a genuine metropolitan government, but with a relatively limited role in service delivery other than transport, and limited autonomy in respect of funding. Its principal distinguishing characteristic is the decision-making role of the Mayor. This is both a strength but potentially a weakness as it may act as a considerable disincentive to extending the powers of the GLA and thus the Mayor.

Auckland is still very much 'work in progress'. Its outstanding characteristic is a combination of the use of a series of council controlled organisations, and the governance and accountability framework in which those are nested (the use of the company form for the delivery of services, especially services which have a commercial or semi-commercial nature is not uncommon elsewhere, for example Italy and Germany (see Grossi and Reichard 2008) but there is no equivalent of the Auckland (New Zealand) emphasis on governance and accountability, and the role of the elected member.

A word of caution is appropriate. The critical difference between different metropolitan governance structures may be the least as much a matter of how elected members discharge their governance responsibility as it is a matter of the structure itself. In October 2010 the Melbourne-based Grattan Institute released Cities: Who Decides? (Kelly 2010), a report described as « This report is about city governance. Its focus is on *who* makes decisions about our cities and *how* they are made». The following excerpt from the overview is especially pertinent:

"…the research suggested that success did not depend on any particular type of government structure. Nor was there an ideal 'model of development'.

What does this mean for Australian cities? Our findings have a series of implications, from the significant role that genuinely cross-sectoral organisations can play, to the importance of collaboration between different levels of government. However, two implications in particular leap out:

- Residents must be involved in decisions. Those cities that made tough choices and saw them through had early, genuine, sophisticated, and deep public engagement. This level of engagement is an order of magnitude different from

what happens in Australia today.

- Changing structures does not in itself result in success. No one particular type of governance structure was associated with broad-based improvement. Changing structures has the danger of being a distraction.

Conclusion

There are two messages which people concerned with the quality of metropolitan governance may wish to take from this state. They are:

- There is almost certainly no 'one right way' for structuring effective metropolitan governance. Metropolitan areas are complex geographically, politically, economically, socially, and environmentally. Existing structures are commonly a product of their own particular history and circumstances, and strongly influenced by local political cultures and practices.

- Although structure matters, quality of and commitment to engagement matters more.

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Appendix I

Auckland Council's Letters of Expectations for CCOs

The key expectations outlined in the proposed Letters of Expectation include:

- Having an ethos fitting of a publicly accountable organisation;
- Contributing to achieving the Mayor's vision for Auckland;
- Achieving the strategic priorities identified by the Council;
- Holding open board meetings;
- Taking account of the key objectives and activities from 2011/12 outlined in each draft Local Board Agreement, to the extent substantive CCOs/Watercare are accountable for their delivery;
- Consulting with local boards on activities and projects and preparing a Local Board Engagement Plan;
- • Providing opportunities to the Local Boards and the Independent Maori Statutory Board to contribute to the development of the SOIs;
- Adhering to the Council's Board Appointment and Remuneration Policy when CCOs appoint directors to their current and future subsidiaries;
- Reinforcing the ownership link back to Auckland Council through all branding and external communication devices (where practical);
- Having a high level of coordination between the substantive CCOs/Watercare;
- Effective working relationships between each substantive CCO/Watercare and the Council;
- Working with the Council to realise savings;
- Using a new Statement of Intent (SOI) template;
- Identifying the decisions for which CCOs/Watercare are required to seek prior Council approval;
- Adhering to the SOI principles (agreed by Council on 6th December 2010);
- Including informative and accurate financial and non-financial performance information in SOIs; and
- Nominating the dates for the two public meetings required to fulfil the requirements of section 96 of the Local Government (Auckland Council) Act 2009.

Appendix II

Local Government (Auckland Council) Act 2009
Section 79 Spatial Plan for Auckland

(1) The Auckland Council must prepare and adopt a spatial plan for Auckland.
(2) The purpose of the spatial plan is to contribute to Auckland's social, economic, environmental, and cultural well-being through a comprehensive and effective long-term (20- to 30-year) strategy for Auckland's growth and development.
(3) For the purposes of subsection (2), the spatial plan will—
    (a) set a strategic direction for Auckland and its communities that integrates social, economic, environmental, and cultural objectives; and
    (b) outline a high-level development strategy that will achieve that direction and those objectives; and
    (c) enable coherent and co-ordinated decision making by the Auckland Council (as the spatial planning agency) and other parties to determine the future location and timing of critical infrastructure, services, and investment within Auckland in accordance with the strategy; and

(d) provide a basis for aligning the implementation plans, regulatory plans, and funding programmes of the Auckland Council.

(4) The spatial plan must :

(a) recognise and describe Auckland's role in New Zealand; and

(b) visually illustrate how Auckland may develop in the future, including how growth may be sequenced and how infrastructure may be provided; and

(c) provide an evidential base to support decision making for Auckland, including evidence of trends, opportunities, and constraints within Auckland; and

(d) identify the existing and future location and mix of—

(1) residential, business, rural production, and industrial activities within specific geographic areas within Auckland; and

(2) critical infrastructure, services, and investment within Auckland (including, for example, services relating to cultural and social infrastructure, transport, open space, water supply, wastewater, and stormwater, and services managed by network utility operators); and

(e) identify nationally and regionally significant—

(1) recreational areas and open-space areas within Auckland; and

(2) ecological areas within Auckland that should be protected from development; and

(3) environmental constraints on development within Auckland (for example, flood-prone or unstable land); and

(4) landscapes, areas of historic heritage value, and natural features within Auckland; and

(f) identify policies, priorities, land allocations, and programmes and investments to implement the strategic direction and specify how resources will be provided to implement the strategic direction.

Chapter 3. Drinking Water Production from Freshwater Resources: The energy footprint in the Pacific Islands

Marc Overmars
SOPAC
Suva, Fiji Islands

Overall sanitation and drinking water status

According to statistics provided by WHO, UNICEF (2008) under the Joint Monitoring Programme (JMP), which assesses the progress on the water and sanitation related Millennium Development Goals (MDGs), the number of people in the Pacific island economies[7] served with some form of improved sanitation rose from 2.9 million in 1990 to 4.0 million in 2006. Despite this impressive achievement, the proportion of people served in 2006 was still barely 48% of the overall population.

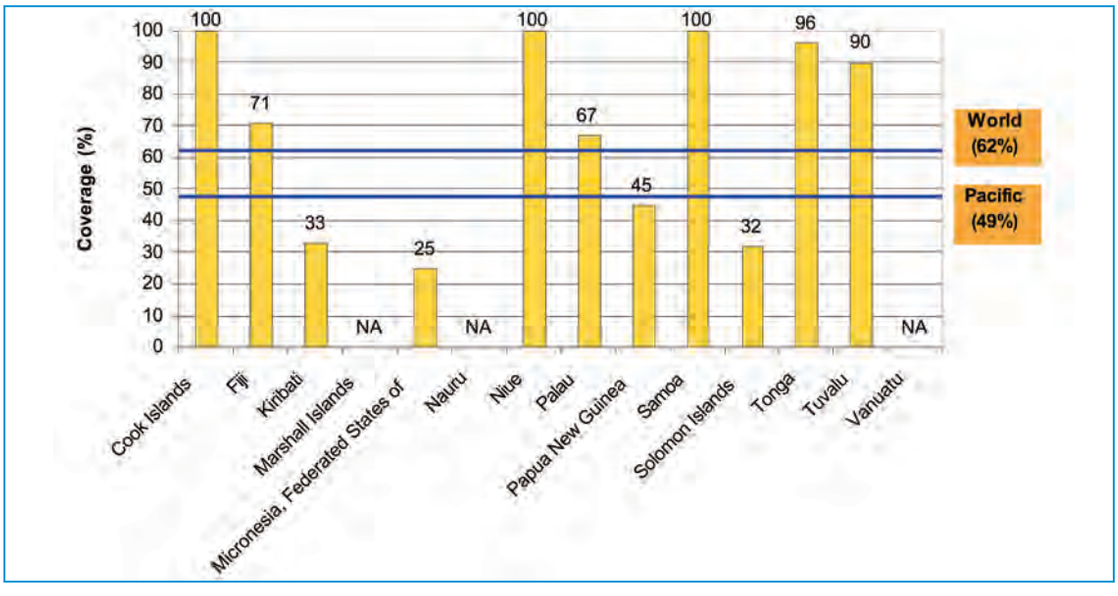
The status of drinking-water is not much different, with the current proportion of people served with any type of improved drinking-water reaching 46%, leaving alone the fact that only 13% of the overall population has access to drinking-water piped to the household through a piped distribution system.

These statistics, associated with a less than optimum management of water resources may aggravate the gloomy perspectives brought about by climate change, which causes increasing concerns in Pacific island economies. Drinking-water and sanitation relies on water governance and water resources management and this is closely linked with climate change in the Pacific islands.

What is the sanitation coverage in the Pacific island economies?

The sanitation coverage in the Pacific island economies (48%) in 2006 was far below the world average of 62% (Figure 1). There is a huge disparity in access to improved sanitation services among the Pacific island economies. While less than a half of the population of economies such as Kiribati, Micronesia, Papua New Guinea and Solomon Islands have access to improved sanitation, Cook Islands, Niue and Samoa have achieved full coverage.

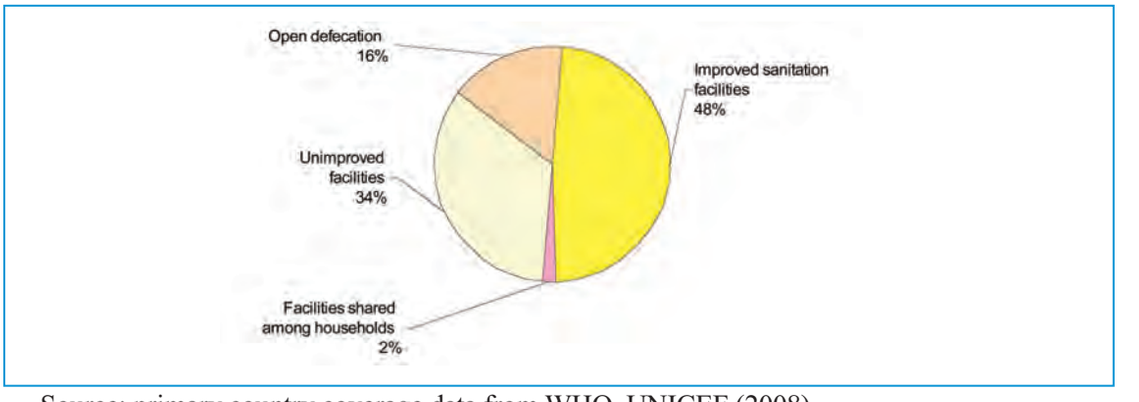
Figure 1 Coverage with improved sanitation by Pacific island economy, 2006



Source: data from WHO, UNICEF (2008)

Figure 2 indicates the status of the Pacific island economies concerning types of sanitation practices. There is evidence that the proportion of people with access to flushing toilets connected to sewerage systems with adequate sewage treatment and sound disposal might be used by just a fraction of the Pacific islands population.

Figure 2 Proportion of people using different types of sanitation practices in the Pacific islands, 2006

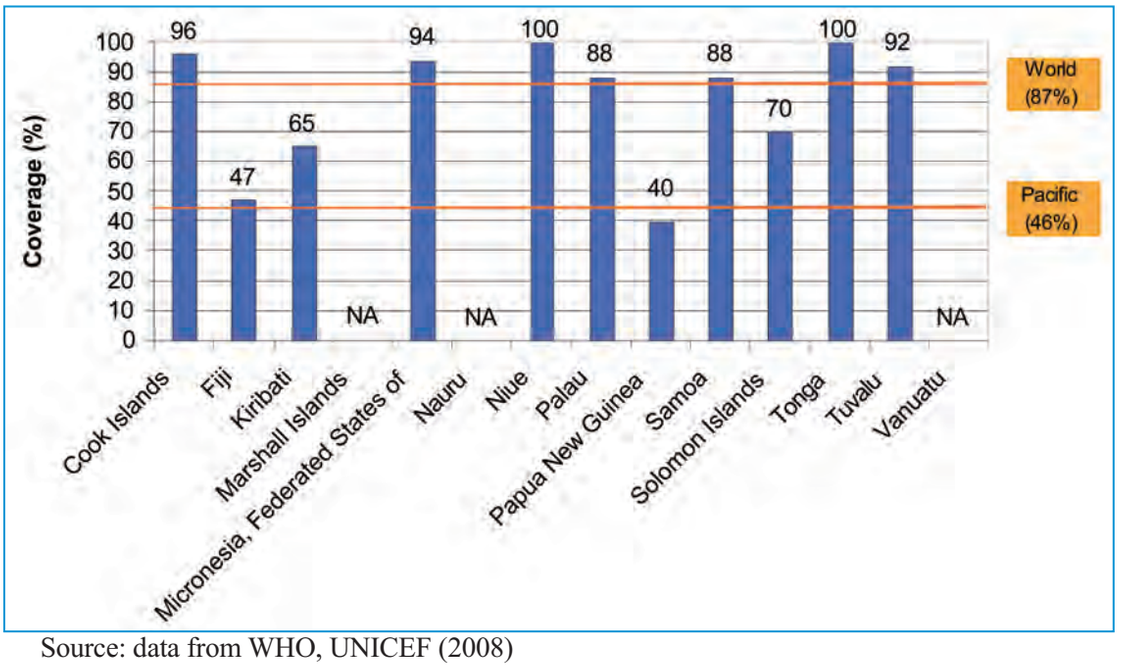


Source: primary country coverage data from WHO, UNICEF (2008)

What is the status of access to improved drinking-water in the Pacific island economies ?

In 2006, only 46% of the population in the Pacific Islands had access to improved drinking-water sources (Figure 3). This represents almost a half of the 2006 coverage attributed to the world population by the JMP. Although less populated economies present high coverage, the low coverage of Papua New Guinea, which alone represents three quarters of the region's population, steers the average coverage to levels comparable to those of least-developed regions.

Figure 3 Coverage with improved drinking-water sources by Pacific island economy, 2006

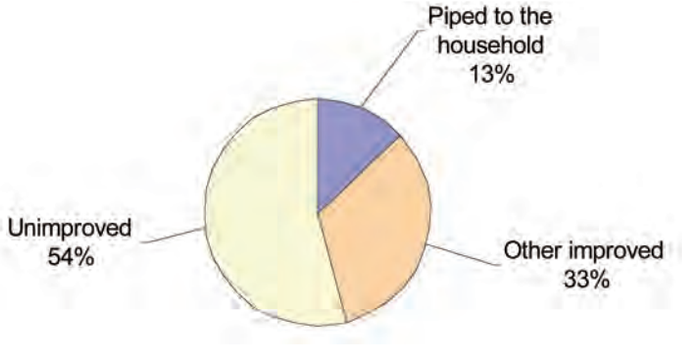


Source: data from WHO, UNICEF (2008)

7. The Pacific island economies addressed in this abstract include 14 independent and self-governing economies in the Pacific Region (Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Nauru, Niue, Palau, Papua New Guinea, Republic of Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu).

Although three in five of the Pacific island economies present coverage beyond 80%, it is important to highlight the fact that only 13% of the population count on drinking-water piped to internal household systems or household yards (Figure 4). The absence of piped water to the household hampers the ability of the users to utilize drinking-water in sufficient quantities as to meet the basic demand not only for drinking, cooking and hand washing, but also for bathing and laundry. In addition, piped drinking-water to the household is likely to be of better quality than that from point source systems, as there is the possibility of carrying out effective centralized treatment by the service provider including drinking-water quality control. Piped water to the household will also avoid the problem of recontamination of water carried manually from point sources to the household.

Figure 4 Proportion of people using different types of drinking-water sources in the Pacific island economies, 2006



Source: primary coverage data from WHO, UNICEF (2008)

Progress in providing access to improved drinking-water sources to the inhabitants of the Pacific island economies over the last 16 years is modest as compared with the huge population growth experienced over the same period of time. About 4.5 million people remained un-served in 2006, an astounding 54% of the whole population. The numbers of un-served have grown by almost 50% over the same period, which means that people are increasingly relying on unprotected wells, rivers, etc., to satisfy their basic needs of drinking-water for domestic use.

On-site versus reticulated systems

As can be seen from the above JMP figures, the total water and sanitation services (where they exist) are being largely provided through on-site methods requiring little or no energy sources. It is estimated that less than 10 % of the Pacific population has access to a centralized wastewater system. Regarding drinking water supply, JMP figures indicate that for every eight people in the Pacific, only one had access to piped water into their dwelling, plot or yard i.e. only 13%.

However, if progress is to be made on achieving the MDG targets, specifically those for water and sanitation, a general increase in access to reticulated services is necessary. This is partly due to economies of scale, as reticulated distribution, treatment and access is generally cheaper, but also due to the need to maintain human health, as reticulated water supply and wastewater systems are generally safer than on-site systems.

Domestic water use

Figures from Pacific water utilities participating in a regional benchmarking exercise, indicate that in some economies domestic water consumption rates from the reticulated system are amongst the highest in the world with six out of 14 participating economies reporting values above 308 litres

per capita per day. This can partly be due to inaccuracies in monitoring but more likely due to inefficiencies of the systems, general leakage rates and subsequent high rates of unaccounted for water. As annual rainfall figures in Pacific island economies range from 1500 to over 3500 mm, there is generally an abundance of water available, although over-abstraction and recurring droughts caused by inter-annual rainfall pattern changes (such as El Niño and La Niña) cause water shortages and disruptions in delivery on a regular basis.

Other Pacific island economies with more constrained access to water resources such as the low lying atoll islands of Kiribati, Tuvalu and Marshall Islands or the raised limestone islands of Nauru and Banaba, have generally very low domestic water consumption rates, from as low as 35 to 58 litres per capita per day.

Energy Consumption

From case studies in the region (ADB, 2008), the costs associated with the provision of water services is strongly correlated to the energy costs required for abstracting water and pumping to water treatment plants and high level service reservoirs before being distributed to households. This is often not allowing for cost-recovery of the operation.

In Fiji for example, the operation of the Waila and Tamavua water treatment plants are costing approximately 2.1 M and 1.5 M USD/year. The average electricity costs for the production of safe drinking water amounted to 0.066 USD/kL as compared to the base rate tariff of 0.067 USD/kL. As systems losses have been estimated to be above 55 % of the total production, cost recovery and subsequent fair pricing to customers will only be possible if the high leakage rates are being addressed and adequate metering and billing is being implemented.

With the establishment of the Water Authority of Fiji (WAF) there has been major progress reported on reducing unaccounted for water and improved delivery of services at lower costs. In addition a comprehensive water demand management program which looks at reducing unaccounted for water, system loss management plans and the awareness on reducing water consumption, may further reduce overall energy use.

As part of a water demand management program in Niue (SOPAC, 2007), it was estimated that electricity for pumping groundwater accounts for 35 % of the operating costs of Niue's Water Division under the Public Works Department. Pumping groundwater constitutes herewith the largest share of national electricity consumption. The introduction of system loss management plans and general awareness campaigns have assisted Niue to bring down the high level of domestic consumption (350 l/c/d) and subsequent use of electricity, despite the fact that the public is not being charged for water. As Niue relies largely on the large and deep (50-60 m below MSL) freshwater aquifer, groundater will have to be pumped for future use. However, reducing transmission losses as well as reducing groundwater extraction rates by promoting the use of alternative, less energy-consuming, water sources such as rainwater harvesting, overall costs of water services in Niue can significantly be further reduced.

In general, the reduction of overall water consumption through increased awareness, setting appropriate tariffs and establishment of water demand management plans are important elements in the reduction of energy use for water and wastewater services.

Desalination as alternative option

Given the periodic shortages of water availability in some Pacific island economies related to the general vulnerability of water resources, on mainly the smaller and low-lying islands in the region,

the use of desalination as viable alternative to conventional water sources is being promoted, often following emergency drought situations on islands. As desalination has several advantages including an unlimited supply of feed water through the large Pacific Ocean, safety of the end-product, and independence on water and climate, there are many disadvantages associated with the sustained use of desalination.

The general disadvantage of desalination is the high cost of available technologies especially for small and isolated island economies, including the high capital cost and the high to very high energy cost (which is often not passed onto the consumer) as well as the environmental cost of discharging highly concentrated brine into oceanic water which may cause harm to aquatic life.

Numerous examples exist in the Pacific region of failed introductions of desalination plants and despite the little data being available there is sufficient general and anecdotal information available warranting a closer look at the constraints. Problems have regularly been reported on the high capital and maintenance costs, the difficulties in maintaining the high technology and providing adequate staff resources to undertake this.

A study by SOPAC (2010) identified various non-commercial applications of desalination which augmented the conventional water supply in various Pacific island economies including (Tuvalu, Marshall Islands, Kiribati, Nauru and Tonga). It showed the general short duration of their successful operation and the extremely high cost of producing drinking water. Tuvalu's reverse osmosis desalination unit for instance, produces desalination water to augment the general use of rainwater harvested through roof catchments at reportedly a cost of over 10 AUD/m3. The electricity costs alone was estimated at about 5.7 AUD/m3 with the remainder of the costs including salaries, delivery to houses, plant depreciation and general maintenance. As these costs are not transferred to the consumer the sustainability of such an operation is to be questioned. With rainwater harvesting as the preferred option in Tuvalu for the lack of potable groundwater, desalination water is regarded as option of last resort and is being specifically used in times of drought to address acute shortages.

In Nauru an even higher rate has been estimated for the operation of a reverse osmosis plant with a rather high energy use of 42 kWh/m3. The costs of producing and delivering potable water was estimated at around 17 AUD/m3 and with payment upon tanker truck delivery at a fraction of this cost, the sustainability of these services is in doubt.

In Kiribati several studies have evaluated the costs of producing water from desalination versus the conventional groundwater source. As the desalination water can be added to the existing reticulated water supply the unit cost of 5.40 AUD/m3 is significantly lower than in Nauru and Tuvalu. However, compared with a cost of 2.40 AUD/m3 for using groundwater sources, it can hardly be considered a feasible option. In terms of electricity costs alone desalinated water was estimated to be 16 times more expensive than groundwater (2.81 AUD/m3 for desalination compared with 0.17 AUD/m3 for groundwater). Despite this high energy and price difference, Kiribati may have to resort to desalination in the future as climate change and sea level rise combined with the high urban and population growth rates may simply make it impossible to rely on Tarawa's groundwater resources only.

To give an idea of the comparative cost of desalinating water in the Pacific, the following table shows the costs of desalination relative to traditional water sources, including rain water harvesting. It is clear that costs associated with desalination are significantly higher compared to more traditional water supply methods such as groundwater extraction and rainwater harvesting.

Table 1 Cost comparison of various desalination methods (from SOPAC, 2010)

Method	Location	Cost/m3	Currency
Groundwater extraction	Niue (Ambroz, 2010)	0.35	AUD
Rainwater Harvesting (upgrade)	Tuvalu	0.40	AUD
Water treatment and distribution	Auckland (Metrowater, 2010)	1.20	AUD
Solar (without rain catchment)	Kiribati, Tuvalu	1.33 - 1.44	AUD
Solar (with rain catchment)	Kiribati, Tuvalu	0.53 - 0.73	AUD
Reverse Osmosis Desalination	Kiribati, Tuvalu, Nauru	3.15 - 6.08	AUD

Conclusion

The high domestic drinking water consumption rates and levels of unaccounted-for-water in all Pacific island economies are reasons for concern as the subsequent high energy and financial costs hamper the sustainability of water and wastewater services in the region. Adequate water demand management planning inclusive of increased awareness, leak detection and implementation of system loss management plans can improve water use efficiency and reduce the energy footprint in the water sector.

For small and low-lying islands the use of alternative options such as desalination should be explored only as an option of last resort given the high failure rate of past introductions, and especially the high energy costs associated with this technology. Water protection and conservation and exploring conventional methods such as groundwater abstraction and rainwater harvesting should be maximized before resorting to high-energy demanding technologies such as desalination.

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Chapter 4. Water in Sustainable Cities and Wards

Nicolas Renard
Veolia Environnement
Paris, France

I - Water and ecocities, a challenging context

Before dreaming of ecocities, let's have a look at the starting point…

Water scarcity is increasing in Asian and American cities.

Many cities are living beyond their hydrologic means. In few decades, many Asian coastal cities have consumed a large part of their groundwater resources, which sometimes took centuries to fill. Some conurbations like Los Angeles are on the verge of "aquatic bankruptcy".The south-western United States, south-eastern Australia, and north-eastern China are already extracting more than 75 % of the flows of their rivers.

Many cities are wasting their scarce water resources. In the networks of Colombo, Delhi, New Orleans, losses can be as much as 50%. Out of 2 m^3 of water treated, 1 m^3 is lost during its transport to the consumer! The carefree era of profusion has to end.

In terms of water services, the challenges from urban growth are enormous. The urban population increases by the size of a city like Madrid each month. Rising urban demand in finite resources means that there will no longer be sufficient water to afford ourselves the luxury of misusing it.

Sanitation is still the poor cousin of the water sector.

Many cities have achieved a minimal level of sanitation service at household. But in most cases, these investments have not been followed by the development of public infrastructure, such as trunk sewerage systems. Other cities have wastewater pipes, but no or very limited sewage treatment capacity. According to the United Nations Environment Programme, in Latin America and the Caribbean, 80 % of waste water returned to rivers or the sea does not undergo any treatment whatsoever. In eastern Asia the figure is 90 %.

In the huge urban areas with their teeming population, urban inflation generates pollution at unbearable levels. It concentrates large quantities of liquid waste in confined areas. The destructive potential of wastewater that is neither collected nor treated is truly explosive. For obvious reasons of hygiene, the bigger cities become, the more urgent will be the challenge of sanitation.

There is a long road to a sustainable management of water and to ecocities.

The first challenge is to respond to current water challenges. This means halting domestic and industrial pollution of water, the "collateral damage of urbanization", and coping with current and emerging water resources scarcities. In other words, a prerequisite before dreaming of ecocities is to properly manage existing water resources and urban water services.

Then to become sustainable, cities have to establish an urban development model that consumes less of water, energy, materials and space, and, in the long run, to achieve a zero-carbon urban footprint. How can water and wastewater services contribute to this objective? On the one hand, by reducing the water footprint of cities, and on the other hand, by reducing the carbon footprint of water services.

II - Towards a coherent management of all the urban water cyles

It is necessary to manage all the water cycles with a focus on saving water and protecting resources. The key points to reduce the water footprint and preserve the environment are:

- *stopping policy-induced scarcity.* The underpricing of water creates disincentives for conservation. In ecocities, a key target of pricing policies should be to give a price to nature and a cost to pollution. Since 2009, various Chinese cities applied water-price increases by 20 to 50%.

- *saving water resources.* Water savings in urban network are often the resource that is immediately available in the largest quantity. A good operator of urban water services is both a "water saver" and a new resources creator (in particular thanks to the mobilization of alternative water resources).

- *increasing water productivity in cities and industrial areas.* For instance, China is 5 times less water-efficient than Japan[8]. This figure signals an immense margin for improvement.

- *moving from a culture of supply management to demand management.* It is crucial to involve consumers more so that they can take actively control of their consumption and safeguard their environment. But the adoption of behaviour which saves water will not increase unless inhabitants are given the means by which to control their consumption. This can be done by the widespread installation of household water meters and remote meter-reading or text-message information systems such as in Shenzhen.

- *planning sanitation coherently with urban development and economic activities.* It is vital to work simultaneously on all the sources of pollution of aquatic environments. None of them can be left out. It is possible to escape from the spiral of "more and more treatment for water that is more and more polluted" : in 10 years, Chile increased its wastewater treatment rate from 16% to 84%.

III - Reducing the energy and carbon footprints in drinking water production

The nexus between energy and water is a critical issue for ecocities, and thus the integration of the two related services.

A lot of energy may be expended or saved in urban water services. In USA, 4% of total power generation is used to supply, purify, distribute and treat fresh water and wastewater [9]. In Sweden, only 1 % is used for the same purpose [10]. In California, 19 % of the state's electricity are used for water: thus *"rationalising water use saves more energy than introducing other measures of energy efficiency*" [11]. Saving water means saving energy.

How to move towards low energy water service? In particular since water production requires more advanced technologies, which require more energy, except if innovative processes invert this trend.

8. Source: Mc Kinsey Global Institute, 2009
9. Source: Managing our future water needs, World Economic Forum, January 2009
10. Source: IWA 21, June 2009
11. Source: California Energy Commission, 2005

The situation is quite different for sanitation and drinking water services:

- achieving energy and carbon neutral wastewater treatments plants is feasible. The issue is disseminating recent innovation on the field.
- drinking water production plant cannot be energy neutral but they can be carbon neutral.

For power production, "*the best alternatives from a water perspectives are wind and photovoltaics, that require effectively no water*"[12]. For thermoelectric plant, the cooling technology used is the biggest factor in its water needs.

How much energy is needed to produce drinking water? (Source: TSM n° 9 – 2007)

With freshwater. Electricity consumption amounts to 50 – 150 Wh / m^3 with conventional treatment; to 100 – 200 Wh / m^3 with membrane treatment such as microfiltration and ultrafiltration; to 250 – 700 Wh / m^3 with advanced membrane treatment (eg: nanofiltration).

With seawater. Electricity consumption amounts to 3,000 – 5,000 Wh / m^3 with membrane desalination (reverse osmosis) with energy recovery system, and to 5,500 – 8,000 Wh / m^3 without energy recovery system. Electricity consumption overpasses 6,000 Wh / m^3 with thermal desalination.

With wastewater. Electricity consumption usually ranges from 25 to 1,500 Wh / m^3, according to the quality required.

Carbon footprint of desalination, according to technologies selected

According to a survey made on Veolia Water operated plants, reverse osmosis rejects 1.8 kg CO_2 per m^3, thermal desalination (Multi Effect Distillation) 10 times more, either 18 kg CO_2 per m^3, and thermal desalination (Multi Stage Flash Distillation) 23.4 kg CO_2 per m^3. These are indicative figures, since CO_2 emitted is function of the local energy mix.

For instance, in the case of a reverse osmosis plant consuming 3,000 to 4,000 Wh per m^3, GHG emissions amount to 2.1 kg CO_2 for each m^3 produced with the European energy mix and to 0.6 kg CO_2 with the French energy mix.

IV - Wastewater recycling and rainwater collection, two key issues for the water management of ecocities

Recycled wastewater, a resource that reduces the water footprint of cities, since it prevents water being returned to nature after only 1 use

	% of energy consumption by country	
	Primary energy	*Electricity*
United States	1.6 %	4.3 %
China	1.7 %	5.5 %
India	8.9 %	30.5 %
Saudi Arabia	3.7 %	-
France	1.6 %	3.4 %

12. Peter Gleick, Pacific Institute, International Herald Tibune, May 18th, 2010

In cities without enough water, the solution is not to divide it up as sparingly as possible but to call on alternative resources. Recycling wastewater is a tried-and-tested solution for producing water suitable for industrial, agricultural and even domestic use.

The many advantages of wastewater recycling in order to build ecocities

First, with regards to water withdrawals. Wastewater recycling is a fast track for increasing the productivity of water and therefore reducing the water footprint of cities. Separating water use from water abstraction means that maximum use can be made of the same quantity. Reusing water before it is finally discharged back into the environment increases the productivity of each m^3 borrowed from nature (by 2, 3, 10,…, as much as wastewater is reused without new withdrawals from nature). It is also the only resource that increases with economic development, in parallel with the growth in need for water.

Secondly, with regards to pollution released into the environment. Recycling reduces the amount of purified waste water returned to the environment and, in so doing, helps to break the all too common link between urban growth and pollution of aquatic environments.

Thirdly, with regards to energy consumption. Wastewater recycling is a less-energy consuming solution compared with seawater desalination and brackish water desalination.

Developing rainwater collection, a useful resource, but not without its risks

Making use of rainwater clearly shortens the water cycle and creates a direct supply exactly where it is needed. For private users, the simplest, the least dangerous and the most ecological method of collecting rainwater to water the garden is to use a water butt. Rainwater can also be used by industry for part of a production process. Designing systems to collect rainwater is a key responsibility for urban planners and architects.

Conversely, experience has shown that directing rainwater inside homes has not been a good idea. Bringing it inside the home introduces germs, close to vulnerable people such as children and the elderly. Faulty plumbing could inadvertently connect the rainwater system to the drinking water system, making the risk of polluting the drinking water system difficult to control.

V - The future wastewater treatment plants of ecocities

Over the coming 10 years, wastewater treatment plants will undergo profound changes.

The main function of a wastewater treatment plant today is to remove the pollution from wastewater to make it clean enough to be discharged into a river without harming the natural environment or causing a public health risk. Tomorrow these plants will convert what we are finished with into something useable, they will recycle wastewater as completely as possible. This objective will entail a shift in attitudes: rather than viewing wastewater as water laden with pollutants, we need to see it as a resource. Instead of removing the pollutants in successive stages to obtain clean water, we have to extract the resources one after the other.

Turning wastewater into a raw material

The materials would have to be sorted so that they could be directed towards the most appropriate recovery system (energy, green chemistry and mineral chemistry) depending on their characteristics:

- Part of the material with a high energy content (sugars, oils and proteins) would be directed towards a reactor to produce biogas.
- The remainder of the organic matter would be directed towards green chemistry, providing there were direct or indirect outlets.
- Lastly, the components, such as nitrogen, phosphorus and sulfur would be extracted and delivered to fertilizer manufacturers or compounders.

Tomorrow's wastewater treatment plants will do more than just remove pollution. They will become real biorefineries.

Today, we are already capable to design wastewater treatment plants that produce as much energy as they burn.

By around 2020, treatment plants will not only produce clean water, but also various resources: green energies (CH4, H2 and ethanol biofuels), mineral materials ingredients (fertilizers), biomaterials such as PHA biopolymer, which can be used to manufacture bioplastics.

The treatment plant's functions will change, as will its physiognomy and its place in the economy. The current treatment plant is a cost center as it consumes energy and produces sludge that is costly to treat. Tomorrow, self-sufficient in terms of energy, it will be a producer of recoverable and marketable substances, and generating less waste. Tomorrow, it may present a completely different economic balance. Wastewater will be recovered as a "raw material" for the production of added-value products.

VI - The future wastewater treatment plants of ecocities

The evolution of the place of water in cities

The vast majority of the world's greatest cities are built near water – either close to the sea or on the banks of large rivers or lakes. Water plays a significant role in urban life – traditionally for commerce (river ports) or for manufacturing and trade (water-powered industry). In some instances, water has proved a vital factor in the manifestation of political power. This is the case of the Aztec city of Tenochtitlán (Mexico), built on Lake Texcoco.

During last century, in many cities, water has been expelled, hidden or channeled away. "Great conurbations no longer live on the river which often generated them"[13]. Most of the surface water has been harnessed and buried. For instance, in Bangkok, many old "Khlongs" have disappeared. "Even where the river flows, it is regimented, boxed in between embankments"[14].

Today, water is back in the city:

- *With the development of "water landscape".* Stormwater is currently considered a major element of urban planning, in particular with the reintegration of a "water landscape" in the city.
- *With the rediscovery of urban water, as a key component of a pleasant living environment.* Hence the opening of canals and rivers to the public and the creation of open-air basins, thereby combining storage, leisure, landscape and risk control.
- *With a softer wetland management, for the sake of urban biodiversity*

13. Source: Water seen from the sky, Guido Alerbto Rossi, Gabriele Zaneto
14. Source: Water seen from the sky, Guido Alerbto Rossi, Gabriele Zaneto

Various avenues are used in order to animate the city life with water activities: restoring city river, such as the Chonggye river in Seoul; creating new landscapes; developing new water-based recreational activities; creating beaches inside city, etc.

Conclusion

Water management is a key component for establishing an urban development model that consumes less of nature.

To become ecocities, conventional cities must in particular reduce their water footprint; their carbon footprint at all the stage of the drinking water and wastewater service; the carbon footprint of all their other public services and activities; their energy footprint. Therefore they need reliable tools for assessing urban water footprint; radical new solutions (such as biorefinery to subsitute wastewater treatment plant); appropriate and continuous public policies to save natural resources (eg. raw water).

Chapter 5. Economies of Energy and Cost Optimization: An operator point of view

Nicolas Renard
Veolia Environnement
Paris, France

I – Short overview of the water and energy nexus

Energy for water represents a large item in economies' budgets.

At the scale of economies, a lot of energy is expended on producing and distributing water, and treating wastewater, as expressed in the table below:

Assessment of energy used for water production [15]

	% of energy consumption by country	
	Primary energy	*Electricity*
United States	1.6 %	4.3 %
China	1.7 %	5.5 %
India	8.9 %	30.5 %
Saudi Arabia	3.7 %	-
France	1.6 %	3.4 %

In the procurement budgets of water and sanitation services, energy is a major item. Typically, electricity accounts for approximately 80 % of municipal water processing and distribution costs in the US[16]. The 16,583 wastewater treatment plants in the US spend about $4 billion a year on electricity and add more than 45 million tons of GHG to the atmosphere[17].

There is, at the same time, a competition and a cooperation between water and electricity.

There is no drinking water without energy, and no energy without water. The nexus between energy and water is a critical issues for many economies, in particular for PECC economies. Current forecasts place Asian electricity consumption at an annual increase of 5-8 %. This trend will have significant implications for water resources, since energy generation requires water [17]

Water and energy are competing for the same resource. Water withdrawal for energy is much larger than water consumption (as much as 25 times in the US). American energy production is very much at the mercy of water availability (as reported to the Congress by the US Department of Energy). Uruguay recently offered an example of conflict between water management and energy production: cities of this economy had to choose whether they want the water in their reservoirs to be used for drinking water or electricity.

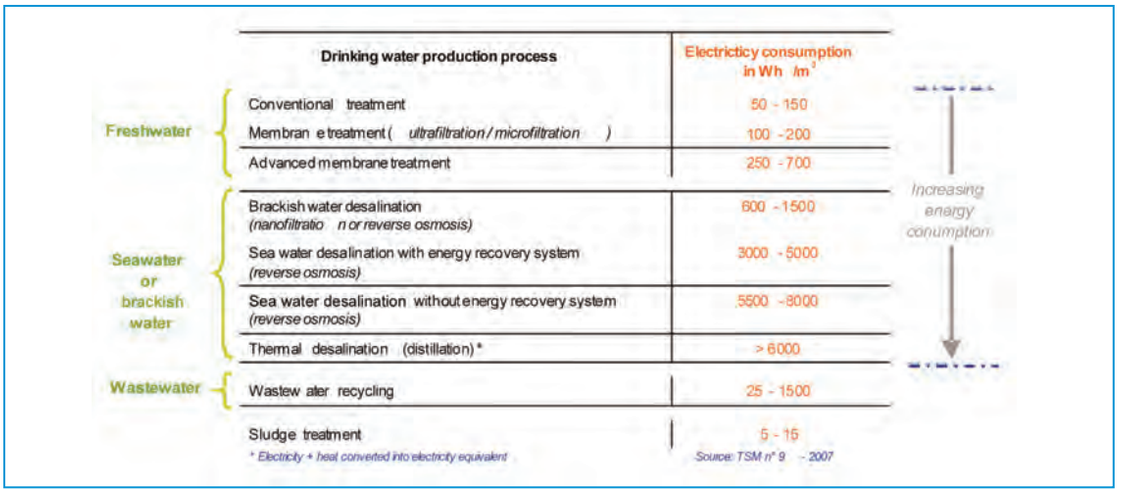
The "*green revolution*" allowed India to become self-sufficient in food. It was based on more productive crop varieties and cheap, plentiful water, thanks to subsidized electricity price for pumping water. But these hidden electricity subsidies lead to overexploitation of groundwater.

15. Source: Water-energy-interactions: a look at the challenges at different levels, Jean-François Bonnet, Zaragoza 2008
16. Source: Managing our future water needs, World Economic Forum, January 2009
17. Source: Water 21, June 2009

II - Comparison of water treatment process, according to energy required

How much energy is needed to produce drinking water

Table of average electricity consumption of drinking water production, according to treatment process (Source: TSM n° 9 – 2007)



	Drinking water production process	Electricticy consumption in Wh /m³
Freshwater	Conventional treatment	50 - 150
	Membran e treatment (*ultrafiltration / microfiltration*)	100 - 200
	Advanced membrane treatment	250 - 700
Seawater or brackish water	Brackish water desalination *(nanofiltratio n or reverse osmosis)*	600 - 1500
	Sea water desalination with energy recovery system *(reverse osmosis)*	3000 - 5000
	Sea water desalination without energy recovery system *(reverse osmosis)*	5500 - 8000
	Thermal desalination (distillation) *	> 6000
Wastewater	Wastew ater recycling	25 - 1500
	Sludge treatment	5 - 15

Increasing energy conumption

* Electricity + heat converted into electricity equivalent

Source: TSM n° 9 - 2007

Wastewater versus freshwater. In average, wastewater recycling consumes 1,000 Wh per m³. This is at least 2 times more than producing drinking water from freshwater resources.

Seawater versus freshwater. Seawater desalination consumes at least 20 times more electricity than conventional treatment of freshwater. And thermal desalination consumes in average 3 times more energy than membrane desalination.

Wastewater versus seawater. Wastewater recycling is a less-energy consuming solution compared with seawater desalination and brackish water desalination.

Alternative resources versus long distance transportation. Wastewater reuse needs less energy than water imports over more than 60 km. In Southern California, pumping water long distances (500 km from Colorado to Los Angeles) requires 2,300 Wh per m³ compared with 4,000 Wh per m³ for desalination[18].

III - Reducing energy consumption in drinking water production

Changing pumps can save energy and money.

Pumping frequently uses more than 80 % of sites electricity consumptions. This is clearly where efforts should focus on. The experience shows that it is often worthwhile to anticipate pumps renewal to reduce energy consumption.

In 2004, Veolia Water was awarded the 30 year contract for managing the wells' field and drinking water production plant of Hohhot, a Chinese city of 2.5 million inhabitants. Capacity production amounts to 515,000 m³ / day. In 2008, Veolia Water made a study to renew 14 boosting pumps and 15 deep-well pumps. By carefully selecting energy efficient pumps and properly adapting pumps to

18. Gustaf Olsson, Professor emeritus at Lund University, Sweden – Water 21, June 2009

specific needs and conditions, the project could save 7.2 million kWh / year. This is equivalent to 3,700 tons of coal and to US $400,000 savings on the annual electricity bill (2.9 million Yuan). The total investment amounted to US $250,000 (1.8 million Yuan). The payback was shorter than 1 year.

Impressive progress were made since 1970's in terms of energy consumption and costs for desalination.

Energy consumption was 20 kWh per m^3 of desalinated sea water in 1970; it has now fallen to less than 3 kWh for the most energy-efficient processes.

At the same time, the cost of membrane desalination has dropped considerably, so that this technology is no longer the privilege of rich economies[19]:

- in 1965, the cost of desalination was $ 6.80 per m^3 with distillation and $2.20 per m^3 with membrane technologies;
- in 2000, the cost of desalination was $1 per m^3 with thermal desalination and $0.60 per m^3 with reverse osmosis.

Even if great progress has been made, the cost of desalination remains heavily dependent on energy consumption.

On-going research programs on energy for water

R&D programs are of the utmost importance to reduce energy consumption and price in desalination. Developing low energy desalination plant is a key driver for research. Thermal desalination is a more mature technology and less progress is hoped with regards to energy consumption: further gains in energy efficiency, and hence in cost reduction, will be increasingly difficult.

But whatever future progress, seawater desalination will never compete with freshwater treatment:

- in the world, for private operators, the average electricity consumption for water production is assessed at 500 Wh per m^3;
- the theoretical energy requirement for desalinating 1 m^3 of seawater is 900 Wh.

Nevertheless, a "*green desalination plant*" is feasible subjected that large renewable energy source is available.

Veolia R&D aims at lowering the energy consumption of membrane systems by 30% to 50%, whatever the type of raw water used.

IV - Towards energy self-sufficient wastewater treatment plants

Optimizing energy consumption at a wastewater treatment plant

Energy is usually the third budget line of wastewater treatment plant. Aeration is generally the first electricity consumer, followed by the air treatment (if there is one) and the sludge treatment (when there are centrifuges).

Sludge can have and should have a second life. Sludge should always be seen as a source of energy. Once dried, the Calorific Value of sludge reaches 4 to 5 kWh / metric ton. This is equivalent to wood.

19. Source: L'eau, géopolitique, enjeux, stratégies. Franck Galland, CNRS Editions, 2008

Wastewater treatment plants are really energy production plants. Usually, energetical valorization of sludge (sludge digestion + biogas production) offers to cover 60 % of energy needs of wastewater treatment plants.

The move towards energy self-sufficient wastewater treatment plant

Recently, a strategic frontier was crossed. Thanks to recent progress achieved in reducing energy needs and boosting the amount of biogas available for use, Veolia is now able to design energy-neutral wastewater treatment plants, producing as much energy as they consume. With this innovation, the water industry has moved closer to one of its great "*dreams*", which is to build wastewater treatment plants that generate energy rather than consume it.

The contribution of solar energy in water and wastewater services

In only 40 minutes, the sun sends to the Earth all the energy needed by humankind during one year! But mobilizing solar energy requires large areas.

There is an undervalorized potential on water treatment and wastewater treatment plants, since these plants are usually « *space consumers* ». Roof solar power station can equip drinking water plant or wastewater treatment plant to provide one part of electricity. At the Hague wastewater treatment plant (1.7 million population-equivalent), basins are covered by 450 m^2 of solar panels. Thanks to biogas production by sludge digesters and additional solar energy, energy independence ratio amounts to 50 %.

Conclusion

Looking at water use and energy use simultaneously generates valuable insights that do not arise from separate policy. This combined approach is all the more necessary since:

- energy is a potential limiting factor in water scenarios, and water is a potential limiting factor in energy scenarios.
- many recent technologies are water intensive. In the water sector, technologies required to mobilize alternative water resources are energy intensive. In the energy sector, hydrogen economy would require much more water.

There is a need for a new and linked water and energy culture. At the world scale, it needs half a century to deeply change the breakdown of energy consumption according to primary sources of energy. Therefore, implementing energy savings measure are much more quick-acting.

On the other side, saving water means saving energy. In California, "*rationalising water use saves more energy than introducing other measures of energy efficiency*" [20]. Preserving freshwater resources for drinking water production is often the best way to save energy, compared to alternative water resource mobilization. However, in many dry areas, it is impossible.

It is necessary to save all kind of energy and water, not only some of them. It would be a non-sense to save one type of energy and to waste another type, or to save one type of water and to waste another one.

20. California Energy Commission, 2005

Chapter 6. Opportunities for Renewable and Carbon-Free Energy

Henri Boyé
Ministry of Sustainable Development
Paris, France

Our planet is hungry of energy, as population growth and economic development are calling for more and more energy, with the acknowledged problems of the emission of greenhouses gases and global warming and climate change concerns, coupled with high oil prices, peak oil, and increasing government support, are driving increasing renewable energy legislation, incentives and commercialization.

Renewable and Carbon free energy are particularly interesting, and offer great hopes for the future.

But many questions must be addressed, and the answer is not always easy. What are the best technologies available? In which place, and which condition? What is their cost and competitiveness, now? What will be their cost and competitiveness tomorrow and in the future? What are the obstacles to overcome for a sustainable development?

In the first place, we must remember the importance of sobriety and energy efficiency, and the demand site management. Producing energy, even renewable, is not the first objective; the best energy is the one that is not used, or well conserved. We present the negawatt scheme. Negawatt power is a theoretical unit of power representing an amount of energy (measured in Watts) saved. Energy is saved by either increased efficiency or reduced energy consumption. The concept of a negawatt is simply a measure of power that is not used, and a form of encouragement to motivate consumers to conserve energy.

Renewable energy comes from natural resources such as sunlight, wind, rain, tides, and geothermal heat, which are renewable (naturally replenished). In 2008, about 19 % of global final energy consumption came from renewables, with 13 % coming from traditional biomass, which is mainly used for heating, and 3.2 % from hydroelectricity. New renewables (small hydro, modern biomass, wind, solar, geothermal, and biofuels) accounted for another 2.7 % and are growing very rapidly. The share of renewables in electricity generation is around 18 %, with 15 % of global electricity coming from hydroelectricity and 3 % from new renewables.

The Primary *Renewable* Sources are: Fusion reaction *burning* the Sun, Tidal friction *slowing* planetary motion, Radioactive *decay heating* the earth's core. There are several secondary, derivative renewable sources: Sun, PV, thermal, CSP Concentrated solar Power, Solar radiation driven wind, Hydro (rivers), Wind-driven ocean waves, Solar-driven biomass photosynthesis, Geothermal. **Sun Energy** is the Source of Hydropower, source of biomass growth, source of wind energy.

Renewable energy is derived from natural processes that are replenished constantly. In its various forms, it derives directly from the sun, or from heat generated deep within the earth. It is interesting to remark that these two big sources of renewable energy are two nuclear reactors. Sun = fusion, Earth Core = fission.

Included in the definition is electricity and heat generated from solar, wind, ocean, hydropower, biomass, geothermal resources, and biofuels and hydrogen derived from renewable resources. Renewable energy flows involve natural phenomena such as sunlight, wind, tides, plant growth, and geothermal heat. Renewable energy replaces conventional fuels in four distinct areas: power generation, hot water/space heating, transport fuels, and rural (off-grid) energy services.

Mainstream forms of renewable energy

Wind power. For Wind energy resource : Velocity and density (1.2 kG m^{-3}) determine kinetic energy, Power is proportional to the cube of the wind speed and the density of the air, Velocity increases with height above ground owing to ground or water shear stress.

Modern wind turbines range from around 600 kW to 5 MW of rated power, although turbines with rated output of 1.5 – 3 MW have become the most common for commercial use ; the power output of a turbine is a function of the cube of the wind speed, so as wind speed increases, power output increases dramatically. Areas where winds are stronger and more constant, such as offshore and high altitude sites, are preferred locations for wind farms. Typical capacity factors are 20-40 %, with values at the upper end of the range in particularly favourable sites.

In Morocco the wind farm of Koudia al Baida. Located in the northern part of Morocco, near the Straits of Gibraltar, the Al Koudia Al Baïda wind farm is made up of 84 identical wind-powered generators, aligned over a distance of approximately 10 kilometers and grouped at the top of hills lying in a north-southerly direction. Each wind generator has capacity of 600 kW bringing the installed capacity to 50,4 MW. Located in Northern Morocco, overlooking the Straits of Gibraltar, the region enjoys highly favorable wind conditions. The thermal contrasts are high, due to the proximity of « cold » maritime areas (Atlantic Ocean and Mediterranean Sea) and « warm » lands (Spain, Morocco, Sahara). The bottleneck formed by the Straits of Gibraltar also heightens the winds coming from the south-west to north-west sector and from the south-east to north-east sectors. The Al Koudia Al Baïda site itself is a line of crests, at elevations ranging from 400 to 600 meters over a distance of a dozen kilometers, perpendicular to the prevailing winds. All of these characteristics result in a high and steady wind potential. Owing to the quality of the site and the techniques selected, the project is profitable, both for the investors and ONE. What's more, it relies on no subsidy or preferential loan.

Wind power market. Wind power : worldwide installed capacity. Global wind power installations increased by 35,800 MW in 2010, bringing total installed capacity up to 194,400 MW, a 22.5 % increase on the 158,700 MW installed at the end of 2009. For the first time more than half of all new wind power was added outside of the traditional markets of Europe and North America, mainly driven, by the continuing boom in China which accounted for nearly half of all of the installations at 16,500 MW. China now has 42,300 MW of wind power installed. Wind power accounts for approximately 19 % of electricity generated in Denmark, 9 % in Spain and Portugal, and 6 % in Germany and the Republic of Ireland.

The Top 10 wind power economies in installed capacity are United States, China, Germany, Spain, India, Italy, France, United Kingdom, Portugal, Denmark. The United Kingdom is the world's leading generator of offshore wind power, followed by Denmark.

Solar energy. Solar energy is the energy derived from the sun through the form of solar radiation. Solar powered electrical generation relies on photovoltaics and heat engines. A partial list of other solar applications includes space heating and cooling through solar architecture, daylighting, solar hot water, solar cooking, and high temperature process heat for industrial purposes. Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute solar energy. Active solar techniques include the use of photovoltaic panels and solar thermal collectors to harness the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air.

Photovoltaic market. Photovoltaic production has been increasing by an average of some 20 percent each year since 2002, making it a fast-growing energy technology. At the end of 2009, the cumulative global PV installations surpassed 21,000 MW.

New generation of solar thermal plants. The solar thermal power industry is growing rapidly with 1.2 GW under construction as of April 2009 and another 13.9 GW announced globally through 2014. Spain is the epicenter of solar thermal power development with 22 projects for 1,037 MW under construction, all of which are projected to come online by the end of 2010. In the United States, 5,600 MW of solar thermal power projects have been announced. In developing countries, three World Bank projects for integrated solar thermal/combined-cycle gas-turbine power plants in Egypt, Mexico, and Morocco have been approved.

Heating. Solar hot water makes an important contribution in many economies, most notably in China, which now has 70 percent of the global total (180 GWth). Most of these systems are installed on multi-family apartment buildings and meet a portion of the hot water needs of an estimated 50 – 60 million households in China. Worldwide, total installed solar water heating systems meet a portion of the water heating needs of over 70 million households. The use of biomass for heating continues to grow as well.

While many renewable energy projects are large-scale, renewable technologies are also suited **to rural and remote areas**, where energy is often crucial in human development. Globally, an estimated 3 million households get power from small solar PV systems. ***Example Rural electrification by PV in Morroco, the Temasol project.***

Hydropower. Energy in water can be harnessed and used. Since water is about 800 times denser than air, even a slow flowing stream of water, or moderate sea swell, can yield considerable amounts of energy. There are many forms of water energy. Hydroelectric energy is a term usually reserved for large-scale hydroelectric dams. Micro hydro systems are hydroelectric power installations that typically produce up to 100 kW of power. Run-of-the-river hydroelectricity systems derive kinetic energy from rivers and oceans without using a dam.

Hydrogeneration is a resource very connected to geography. The resource is the product of rainfall, catchments area, and vertical head, a power resource that has evolved with technology for centuries, simple, well understood conversion of potential energy into mechanical and then electrical power. ***The World Hydro Potential is presented on a global map, the big possibilities are now mainly in Asia, and Africa***.

New and emerging renewable energy technologies. New and emerging renewable energy technologies are still under development and include cellulosic ethanol, hot-dry-rock geothermal power, and ocean energy. These technologies are not yet widely demonstrated or have limited commercialization. Many are on the horizon and may have potential comparable to other renewable energy technologies, but still depend on attracting sufficient attention and research, development and demonstration (RD & D) funding.

Ocean energy. Ocean energy describes all the technologies to harness energy from the ocean and the sea. This includes marine current power, floating windmills, ocean thermal energy conversion, and tidal and wave power. Systems to harvest utility-scale electrical power from **ocean waves** have recently been gaining momentum as a viable technology. The potential for this technology is considered promising. Portugal now has the world's first commercial wave farm, the Agucadoura Wave Park, officially opened in September 2008. In Australia Wave energy Resource, we mention the CETO Wave technology (Carnegie technology, Australia, in partnership with EDF EN).

Ocean thermal energy conversion (OTEC) uses the temperature difference that exists between deep and shallow waters to run a heat engine. Let us mention several projects in the Pacific Area, in Hawaii, Tahiti, and in the Indian Ocean, at the Reunion Island.

Biomass and Biofuel. Biomass (plant material) is a renewable energy source because the energy it contains comes from the sun. Through the process of photosynthesis, plants capture the sun's energy. When the plants are burnt, they release the sun's energy they contain. In this way, biomass functions as a sort of natural battery for storing solar energy. In general there are two main approaches to using plants for energy production: growing plants specifically for energy use, and using the residues from plants that are used for other things. The best approaches vary from region to region according to climate, soils and geography.

Biofuel. Liquid biofuel is usually either bioalcohol such as bioethanol or an oil such as biodiesel. Bioethanol is an alcohol made by fermenting the sugar components of plant materials and it is made mostly from sugar and starch crops. With advanced technology being developed, cellulosic biomass, such as trees and grasses, are also used as feedstocks for ethanol production. Ethanol can be used as a fuel for vehicles in its pure form, but it is usually used as a gasoline additive to increase octane and improve vehicle emissions. Bioethanol is widely used in the USA and in Brazil. Biodiesel is made from vegetable oils, animal fats or recycled greases. Biodiesel can be used as a fuel for vehicles in its pure form, but it is usually used as a diesel additive to reduce levels of particulates, carbon monoxide, and hydrocarbons from diesel-powered vehicles. Biodiesel is produced from oils or fats using transesterification and is the most common biofuel in Europe.

Geothermal energy. Geothermal energy is the energy obtained by tapping the heat of the earth itself, both from kilometers deep into the Earth's crust in volcanically active locations of the globe or from shallow depths, as in geothermal heat pumps in most locations of the planet. It is expensive to build a power station but operating costs are low resulting in low energy costs for suitable sites. Ultimately, this energy derives from heat in the Earth's core.

Three types of power plants are used to generate power from geothermal energy: dry steam, flash, and binary. Dry steam plants take steam out of fractures in the ground and use it to directly drive a turbine that spins a generator. Flash plants take hot water, usually at temperatures over 200 °C, out of the ground, and allows it to boil as it rises to the surface then separates the steam phase in steam/water separators and then runs the steam through a turbine. In binary plants, the hot water flows through heat exchangers, boiling an organic fluid that spins the turbine. The condensed steam and remaining geothermal fluid from all three types of plants are injected back into the hot rock to pick up more heat.

The geothermal energy from the core of the Earth is closer to the surface in some areas than in others. Where hot underground steam or water can be tapped and brought to the surface it may be used to generate electricity. Such geothermal power sources exist in certain geologically unstable parts of the world such as Chile, Iceland, New Zealand, United States, the Philippines and Italy (since 1904). The United States led the world in geothermal electricity production with 3,086 MW of installed capacity from 77 power plants; the largest group of geothermal power plants in the world is located at The Geysers, a geothermal field in northern California. The Philippines follows the US as the second highest producer of geothermal power in the world, with 1,904 MW of capacity online; geothermal power makes up approximately 18 % of the economy's electricity generation. Iceland produced 170 MW geothermal power and heated 86 % of all houses in the year 2000 through geothermal energy. France has developed a geothermal plant in Guadeloupe island, at Bouillante. Geothermal energy represents more than 10,715 MW of geothermal power in 24 economies, a 20 % increase in geothermal power online capacity since 2005. This will grow to 18,500 MW by 2015, due to the large number of projects presently under consideration, often in areas previously assumed to have little exploitable resource.

There is also the potential to generate geothermal energy from hot dry rocks. Holes at least 3 km deep are drilled into the earth. Some of these holes pump water into the earth, while other holes pump hot water out. The heat resource consists of hot underground radiogenic granite rocks, which heat

up when there is enough sediment between the rock and the earths surface. Several companies in Australia are exploring this technology.

Enhanced Geothermal Systems are a new type of geothermal power technologies that do not require natural convective hydrothermal resources. The vast majority of geothermal energy within drilling reach is in dry and non-porous rock. EGS technologies « enhance » and/or create geothermal resources in this « hot dry rock (HDR) » through hydraulic stimulation.

Geothermal (ground source) heat pumps represented an estimated 30 GWth of installed capacity at the end of 2008, with other direct uses of geothermal heat (i.e., for space heating, agricultural drying and other uses) reaching an estimated 15 GWth.

Growth of renewable. During the five-years from the end of 2004 through 2009, worldwide renewable energy capacity grew at rates of 10 – 60 percent annually for many technologies. For wind power and many other renewable technologies, growth accelerated in 2009 relative to the previous four years. More wind power capacity was added during 2009 than any other renewable technology. However, grid-connected PV increased the fastest of all renewables technologies, with a 60-percent annual average growth rate for the five-year period.

Economic trends for renewable. All forms of energy are expensive, but as time progresses, renewable energy generally gets cheaper, while fossil fuels generally get more expensive. Renewable energy technologies are expected to decline in price for several reasons : First, once the renewable infrastructure is built, the fuel is free forever. Unlike carbon-based fuels, the wind and the sun and the earth itself provide fuel that is free, in amounts that are effectively limitless. Second, while fossil fuel technologies are more mature, renewable energy technologies are being rapidly improved. So innovation and ingenuity give us the ability to constantly increase the efficiency of renewable energy and continually reduce its cost. Third, once the world makes a clear commitment to shifting toward renewable energy, the volume of production will itself sharply reduce the cost of each windmill and each solar panel, while adding yet more incentives for additional research and development to further speed up the innovation process.

Developing economy markets. Renewable energy can be particularly suitable for developing economies. In rural and remote areas, transmission and distribution of energy generated from fossil fuels can be difficult and expensive. Producing renewable energy locally can offer a viable alternative. Micro-hydro systems configured into village-scale or county-scale mini-grids serve many areas. More than 30 million rural households get lighting and cooking from biogas made in household-scale digesters. Biomass cookstoves are used by 160 million households, and 40 percent of the world's population. These stoves are being manufactured in factories and workshops worldwide, and more than 160 million households now use them. More than 30 million rural households get lighting and cooking from biogas made in household-scale digesters. An estimated 3 million households get power from small solar PV systems. Micro-hydro systems configured into village-scale or county-scale mini-grids serve many areas.

Renewable energy projects in many developing economies have demonstrated that renewable energy can directly contribute to poverty alleviation by providing the energy needed for creating businesses and employment. Renewable energy technologies can also make indirect contributions to alleviating poverty by providing energy for cooking, space heating, and lighting. Renewable energy can also contribute to education, by providing electricity to schools.

Renewable energy policy targets exist in some 73 economies around the world, and public policies to promote renewable energy use and renewable power generation have become more common in recent years.

The Mediterranean Solar Plan, developed under the umbrella of the Union for the Mediterranean, with an objective of 20 GW of RE by 2020, in the economies of South and Eastern Mediterranean. There are more than 200 Projects in Perspective

Renewable energy debate and obstacles to overcome. There are many obstacles to overcome, technical and industrial, before RE secure economic competitiveness. We mention the technology and cost of RE, offshore wind energy, PV, issues of social acceptability, impacts on electrical networks and management of intermittent resources, Environment : CO_2, polluting emissions, fauna, flora, water, mobilization of the biomass resource, compatibility with reduction of consumption.

Renewable electricity production, from sources such as wind power and solar power, is sometimes criticized for being variable or intermittent.

There have been « not in my back yard » (NIMBY) concerns relating to the visual and other impacts of some wind farms, with local residents sometimes fighting or blocking construction.

Conclusion

In conclusion, there is a a huge potential in renewable, with always local adaptation and adaptation to the geography. The market for renewable energy technologies continues to grow. Climate change concerns, coupled with high oil prices, peak oil, and increasing government support, are driving increasing renewable energy legislation, incentives and commercialization.

Financing and incentive should be focused on Research & development : technology for generation and management of intermittent energies. In the short term : biofuels derived from food agriculture in transports, biomass, solar and geothermal for thermal uses, wind and hydro for electric power. In Medium/long term : lignocellulosic biofuels, offshore wind, deep geothermal, solar PV and CSP. Time is necessary for progress, with commitment and will.

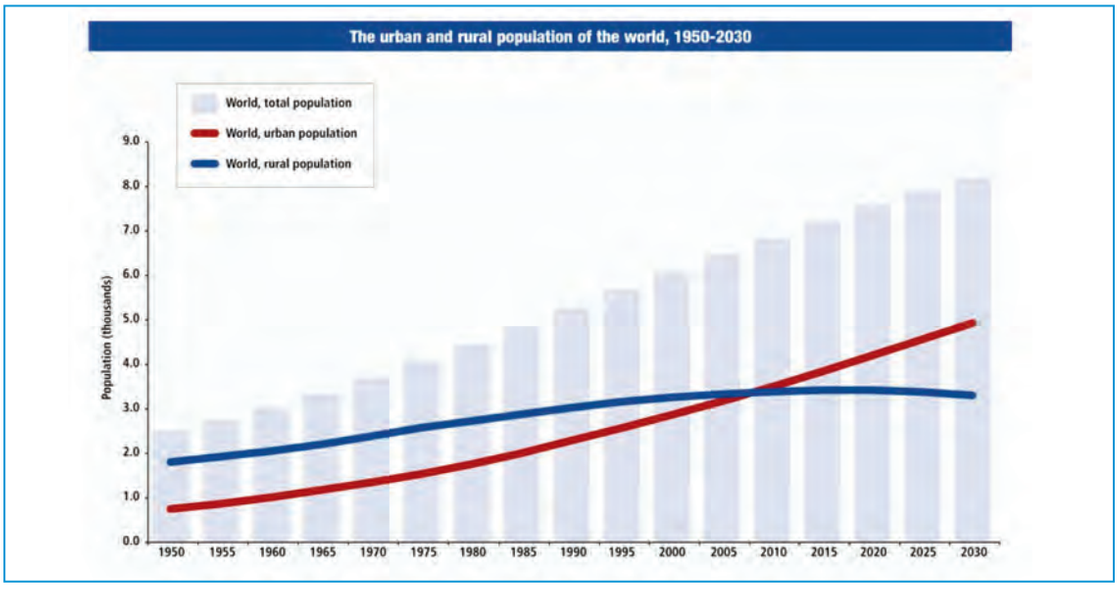
Chapter 7. New Economic Models for Urban Transportation : Green infrastructure and transportation system

Jin Young Park
Urban Development Specialist (Transport)
Regional and Sustainable Infrastructure Division
Asian Development Bank

1. Changes in Urban Transportation

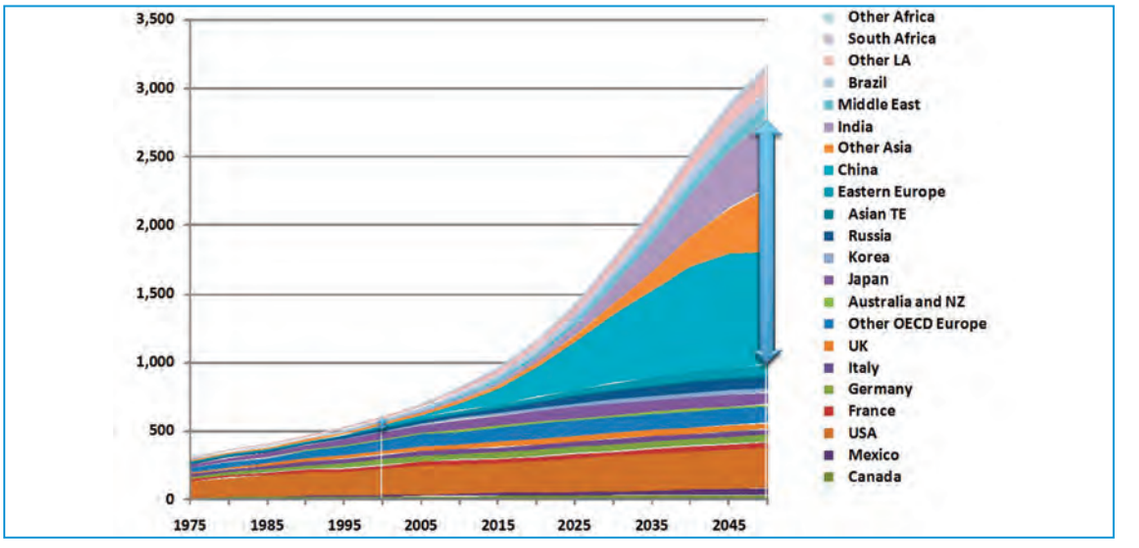
City has been a center for economic activity. People come to city to buy and sell goods, and sharing information. The importance of city has increased, and number of people living in city also has increased. By 2030, 4.9 billion people are expected to be urban dwellers. From 2010 number of people living in urban area already exceeded that in rural area. Particularly, Asia is a key of this global trend. Urban population in Asia will be tripled from 1950 to 2030 by UN (United Nations).

Figure 1 Urban and rural population of the world



With rapid urbanization in Asia, motorization in Asia is more severe than urbanization. Figure 2 shows vehicle ownership projections around the world. China, India and other Asian economies show significant increase of vehicle ownership. With these rapid increase of vehicle, energy consumption and Green House Gas emissions from transportation sector also has been critical issue for global energy security and climate change. Asia contributed 19 % of global GHG emission from transportation sector in 2006. The portion of Asia is expected to be increased as 31 %, in 2030. At the local and human level, these emissions translate into heath problems and significant costs to society.

Figure 2 IEA vehicle ownership projections



As a result, the cost of congestion continues to rise and is a sizeable share of GDP in Asian economies. Congestion costs also contribute to higher prices of goods and services, and negatively impacts the competitiveness of cities as well as economies. Road accidents are also on the rise and have tremendous social costs.

2. ADB Strategy

These inconvenient truths have served as a wake-up call for the Asian Development Bank. Transportation accounts for a large share of ADB's operations, averaging about 30 % of our annual lending. In recent years, ADB lending in the transportation sector has been about $3 billion per annum. While transportation has been the backbone of ADB's lending since the Bank's founding in 1966, changing times require new strategies in transportation operations. the new direction is captured in ADB's New Sustainable Transportation Initiative.

The Sustainable Transportation Initiative is aligned with the three core pillars of ADB's Strategy 2020 :

- Inclusive economic growth
- Environmentally sustainable growth, and
- Regional integration

The Sustainable Transportation Initiative is actually an operational plan that seeks to align ADB's transportation operations with the changing needs and demands of the Asia and Pacific region. ADB's Sustainable Transportation Initiative builds upon extensive consultations and analytical work covering :

- The environmental impacts of the transportation sector
- Road safety
- Energy efficiency and climate change, and
- Sustainable urban transportation

ADB is already starting to change the composition of its transportation operations, and much of this change is in response to changing demands in our borrowing member economies in Asia and the Pacific. In recent years, one of the biggest changes has been the increase in lending for urban transportation projects. While ADB is changing directions, this is not to say that ADB is exiting from support to the road sector. Because roads have yielded tremendous economic and social benefits to ADB's developing member economies across the region. From sustainable transportation perspective, our road sector operations are incorporating components that help:

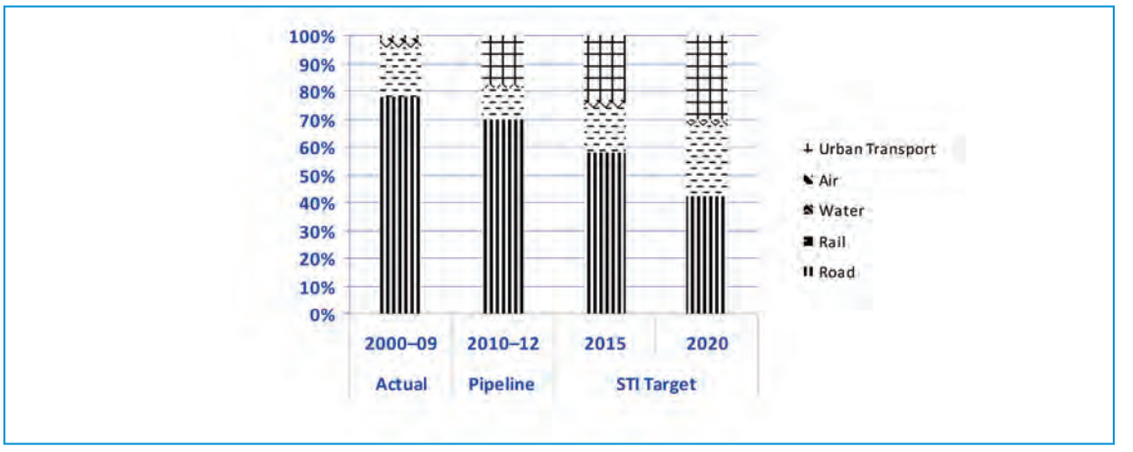
- Strengthen the capacity of road institutions.
- Increase private sector participation,
- Support poverty reduction efforts, and
- Improve road maintenance

In addition to the traditional support of ADB for roads, the new and enhanced operations under ADB's Sustainable Transportation Initiative fall into four focal areas:

ADB will focus on scaling-up urban transportation and promote model projects involving bus rapid transit and rail mass rapid transit systems. ADB also seek to mainstream climate change into our operations. ADB will continue to focus on improving cross-border transportation and logistics which involves reducing the non-physical barriers to the flow of goods and people across borders. And road safety is an area where we will increasingly partner with other organizations and institutions to address.

In terms of the four areas of focus under the Sustainable Transportation Initiative, ADB is already scaling up its support for urban transportation. In Lanzhou, China, for example the ongoing sustainable urban transportation project centers on the promotion of non-motorized transportation and a bus rapid transit system. In the city of Pimpri in India's Maharashtra State, ADB is also supporting a bus rapid transit system. The urban transportation development project in Ulanbaatar involves the development of an integrated public transportation system. ADB will support for two metro rail projects in Vientam, one in Hanoi and the other in Ho Chi Minh City. ADB also approved a sustainable urban transportation investment program for Georgia that includes support to extend the metro line in Tiblisi. ADB is also supporting a number of projects that promote integrated urban transportation.

Figure 3 Actual and targets of annual transportation lending



The annual transportation lending on urban transportation will be continuously increased. The portion of urban transportation budget will reach about 30 % of total transportation sector lending.

3. Implementation : New Economic Models

While ADB sets up sustainable transportation initiative, and spends more budget and effort for sustainable urban transportation, conventional economic model for transportation project is still used. Conventional economic evaluation model has based on road project and can not consider various issues of sustainable growth. To achieve sustainability of transportation project, economic, social, and environmental issues should be reviewed and included in the evaluation model. Figure 4 describes issues related to sustainability. And figure 5 lists issues which generally considered in conventional economic evaluation model and overlooked.

Figure 4 Issues related to sustainability of transportation project

Economic	Social	Environmental
— Mobility — Congestion reduction — Road and parking facility costs — Consumer costs — Employment and business activity	— Equity — Affordability — Human health — Cultural preservation — Community livability — Public participation	— air pollution — noise — water pollution — climate protection — Habitat preservation

Figure 5 Evaluation of transportation project by conventional model : considered and overlooked

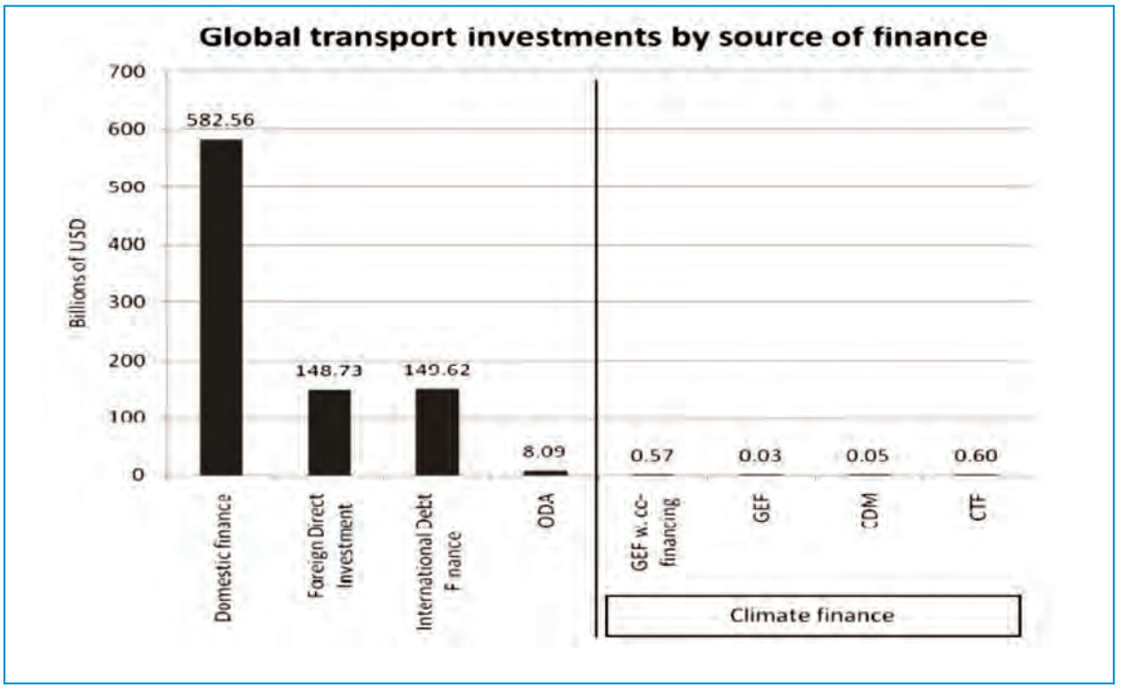
Considered	Overlooked
— Financial costs to government — Travel time/congestion delay — Vehicle operating costs — Per-mile accident impacts — General environmental impact	— downstream congestion — parking facility costs — vehicle ownership costs — energy and pollution impact — and use impacts — impacts on mobility for non-drivers — public health impact

Sustainable urban transportation project sometimes can not be evaluated properly with conventional economic evaluation model and rejected by public budget provider. Thus, including all issues related to sustainability is critical for financing sustainable urban transportation project. However,

still not much development has been achieved for comprehensive economic evaluation model. Also data required for new economic evaluation model has not been collected, not only for developing economies, but also for developed economies.

Sustainable urban transportation system is quite new for developing economies. It requires new finance and capacity to perform it. Figure 6 shows global transportation investments by source of finance. Most of fund comes from each economy's domestic finance. Considering lack of capacity for new sustainable urban transportation system, this domestic finance is not easy to be spent for sustainable urban transportation than conventional road project. Hence, global support for financing sustainable urban transportation system is urgently needed, and new financing mechanism should be developed. Private sector investments for sustainable urban transportation also should be promoted, considering lack of public funding.

Figure 6 Global transportation investments by source of finance



Because transportation sector is one of the major sources of energy consumption and Green House Gas, it is critical to create sustainable transportation system for future of the world. Considering urbanization trend and vehicle ownership increase in Asian developing economies, much of the global effort should be given to Asia to achieve sustainable growth. To achieve it, new comprehensive economic evaluation model covering sustainable issues and financing mechanism should be developed.

Chapter 8. Clean Transportation and Carbon-Free Electric Vehicles : Perspectives at short and long term

Henri Boyé
Ministry of Sustainable Development
Paris, France

This is an overview of policies for fuel saving in the transportation sector and their implications on world oil demand : short and long term perspectives about clean transportation, and carbon free electric vehicles.

Transport Stakes. There are two opposite trends : Transport fuel demand will increase, in quantity. New technologies will be developed in order to improve energy efficiency in transport sector. However there is still a huge uncertainty on the impact of these trends on oil demand. Worldwide, at present, transportation fuels account for roughly half of the world's oil consumption. Transportation's share increases to 60 % if we include bitumen for road asphalt, along with lubricants and the energy used in refinery production of diesel and gasoline. Oil use in the transport sector will thus remain a driver of total global oil demand.

In France, transport is the most GHG emitting sector in France, with 26 % of national GHG emissions and 32 % of final energy consumption (51 Mtoe). Transport is one of the bigger source or CO2 emission, and also urban pollution. The French « Grenelle de l'Environnement » process, (from 2007-2008) has fixed a very ambitious objective : decreasing by 20 % GHG emissions to 2020.

Transportation and Oil demand. In the transportation sector, oil (and its derived products, mainly gasoline, jet fuel and Diesel fuel) combined with the internal combustion engine appeared one century ago as the panacea, offering the possibility of new low-cost technological developments. Its rapid growth led to this unprecedented boom in transport. Oil currently holds a virtual monopoly on the transport market, representing over 95 % of the energy requirements in this sector, distributed between four main modes, with a share of about 1.6 billion tonnes (more than 75 % of the total).

Determination of Transportation demand. There are four main drivers to take into account for the evaluation of the transportation demand **:**

1) population revenues,
2) mobility,
3) regulatory and fiscal policies, and
4) motorization.

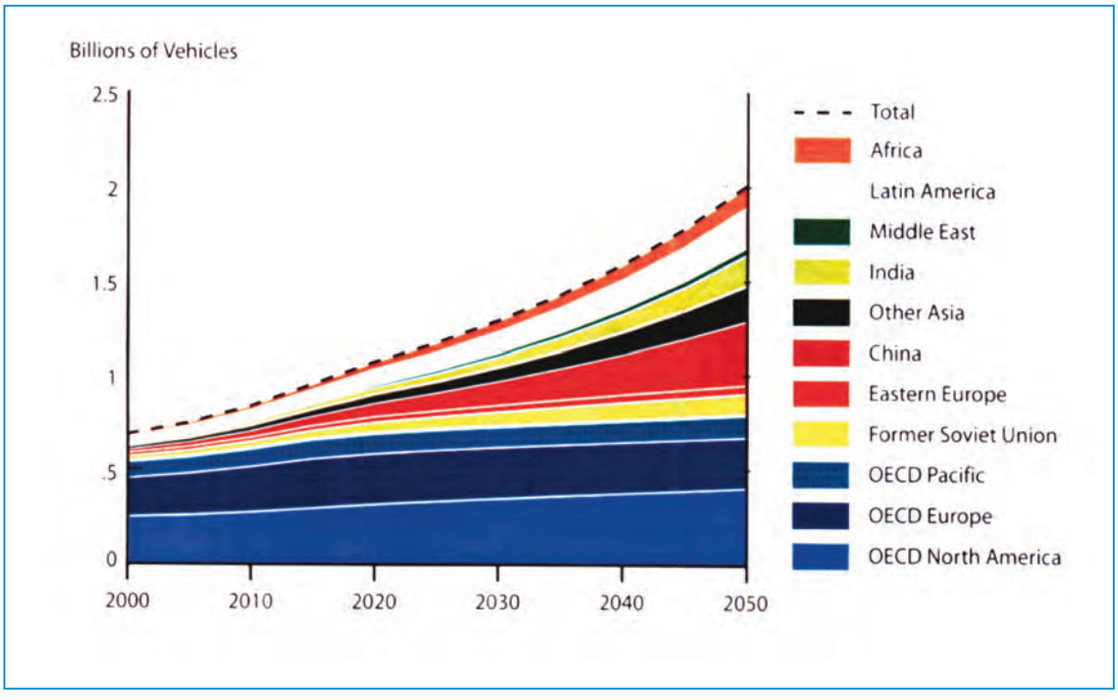
The driving forces of transport fuel demand are first related to the anticipated growth of population and revenues, mostly in emerging economies. As a result, mobility will increase. The actual impact on oil demand is depending on regulatory and fiscal policies, on the development of new types of motorization and on the deployment of substitutes to petroleum products.

There is a wide consensus on population growth hypotheses in the next decades. At the same time, the revenue per capita is assumed to grow more specifically in non-OECD economies.

Impact on Automobile demand. There are two main factors, the number of Vehicles per capita and revenues, and the global growth in Light Duty vehicles.

Vehicles per capita ownership is linked to the revenue. In OECD economies, we may anticipate a stabilization of car ownership. However, there is a huge growth anticipated in emerging economies. Just remind you that in 2009 more cars were sold in China than in the US. At the same time, light duty vehicles market will grow in developing and transition economies, driven by the economic growth. As a result, we may anticipate a significant growth of oil demand from the transport sector.

The following diagram shows the perspectives in number of vehicles, in Asie, China, India in particular, going over 2 billion vehicles by 2050.



According to the IEA, oil demand for transport would increase by 18 Mbd between 2007 and 2030 in its WEO 2009 reference scenario. CO_2 emissions would increase by 25%. Considering that the business as usual scenario is not sustainable, and the IEA has produced an alternative scenario, but difficult to implement.

So transport fuel demand will increase. But at the same time, different technologies will be available in order to improve energy efficiency.

Energy efficiency in transportation

Energy efficiency is a major challenge. We must remind that the efficiency of internal combustion engines averages only 20% in urban uses.

It is useful to look at past efficiency trends, since they provide insight into what the future might hold. Comparisons between efficiencies in different economies also provide pointers.

Since 1980, fuel efficiency has improved in all IEA economies. It has risen by an average of 20% within the vehicle stock as a whole. But important regional differences should be noted. The average car in the United States uses about 35% more fuel per kilometre than the average European car. This gap can be attributed to fuel tax and sizes of income, and also of technological variations. first response fro.

Increasing energy efficiency standards is a first response from policy makers worldwide. For example, the United States have set up the average fuel efficiency standard of 35.5 mpg in 2016 and the European Union has decided to reduce the CO_2 emissions of car down to 95 g/km in 2020.

The fuel consumption of vehicles is directly related to the power delivered by the engine in response to the speed requested by the driver. Significant improvements on traditional ICE Internal Combustion engines may increase fuel efficiency. For instance, this may be achieved on gasoline or diesel engines with new combustion processes (direct injection, lean burn engines, CAI) downsizing and/or cylinder deactivation, variable compression ratio or valve train. New technologies may be developed to reduce pollutant emissions of diesel engines through particulate filters, oxidation catalyst improvement or NOx absorber. Efficiency improvement may reach 20 to 30% for gasoline engines and 10 to 15% for diesel engines.

Hybrid technologies will have a major impact in order to improve energy efficiency. Electrifying the propulsion systems of vehicles provides a number of functions that can help reducing energy consumption. This is achieved by optimizing the operating conditions of the heat engine and by recovering a variable fraction of the available energy during braking. The simplest systems which make it possible to eliminate idling, yield fuel savings of 5 to 7% in the standardized European cycle. The most complex systems which provide more functions lead to saving up to 40%.

As a result, the potential fuel economy is significant. A reduction of 20 to 50% is feasible, based on non engine and engine improvements using technologies that I described before.

New motorization. Another way to reduce consumption and CO_2 emissions is to develop alternative engines. This is the case of vehicles with dedicated engines such as natural gas, DME or may be hydrogen on the long term.

Electric vehicle is an option developed recently in some OECD members: but it is penalized by the short range (100 to 200 km under real conditions of use) associated with today's batteries.

The hybrid power pack combining electric and thermal engine looks very promising in the medium term.

Why New types of motorization? Why electric car? Which electric vehicles? There is a wide range of solutions**.** Some definitions and acronyms are indicated hereafter. From Conventional vehicle with internal combustion engine, or (ICE), Battery Electric Vehicle (BEV), Hybrid gas-electric vehicle (HEV), Plug-in hybrid electric vehicle (PHEV), EREV Extended Range Electric Vehicle

Electric Vehicles with Extended Range, and Plug-in Hybrid Electric Vehicles. Some Solutions are presented*:* a Hybrid-Gasoline-Electric Engine Car and a Plug-in Hybrid Car. Plug in Hybrid is a very promising technology.

And for the future, there are projects of Plug in Hybrid – Solar, and Vehicle to Grid –in connection with the new smart grids and the modernization of the electric network, a future intelligent infrastructure, with the new technologies of information and telecommunication.

Electric bikes and scooters, *(with a picture of the speaker, demonstrating an electric assisted bike, at Paris la Defense, presented in the "Energy and Climate College" in the general Council for environment and Sustainable development).*

Electric Vehicle is a "born-again" today, at a time that can be considered as a true renewal, after an already long story, since 1834.

The beginning of EV. **Once upon a timeat the beginning, was the golden age of EV.** The Father of the electric car is Thomas Devanport, (1802–1851), a blacksmith from Vermont, USA, is considered as the inventor of the electric motor, and back in 1834 he patented the first electric car driven by batteries**.** In the late 1890s, EVs out-sold gas cars 10 to 1.

« La Jamais Contente »**,** an electric vehicle, was the first automobile vehicle in the world, above 100 km/h, in 1899, a record duly homologated. (Soon beaten by other electric cars, and afterwards by many ICE vehicles)

A quick look back to the story of EV's, shows that there were recurrent optimistic expectations for EV through the 20th century, but never proved correct. We must admit a relative failure of the last French attempt 15 years ago. But we assist now to a real current renewal of EV.

There is a current renewal of EV, with several drivers for technical progress, economical, a better economic competitiveness with oil price increasing, and environmental awareness.

Technological progress of batteries improving Range and Power, improving performances and reducing the costs.

New and diversified offer in Electric vehicle, with an involvement of nearly all the car manufacturers worldwide, all eager to present clean and innovative vehicles..

Environmental awareness (for Climate change, reduction of GHG, and Air quality in the cities**).** One of the biggest advantages of electric cars is that they do not pollute the environment and emit less harmful to the nature gas. That's why the mass use of electric cars will bring slowing down the global warming.

Future Vision : Many converging factors create a favorable environment for EVs.

We present 6 main stakes : Geopolitics, Environmental, Sociological stakes, Institutional regulation stakes, Technological stakes, Economical stakes.

Geopolitical stakes (cost of energy and reduction of energy dependency)
Environmental stakes: Climate Change, water and soil pollution, air quality
Sociological stakes pollution impact on health, awareness for environment,
Institutional Regulation stakes, with the Kyoto protocol, the Copenhagen and Cancun meetings, and the international, European and national regulations.
Technological context: there are real Batteries improvements. The market is getting mature.
Economical stakes With the Automotive industry crisis, EV can be a growth driver. The economic competitiveness must take into account amortized costs, global costs. EV can become an opportunity for another kind of mobility.

There are many cleaner transportation options: Walk and bike more, City Car Share:
Take public transit: there are lots of electric, in tramway, metro, trains, trolleybus, etc.

Electric vehicle networks are useful, for exchange of experience

In Europe, AVERE a European network , members including Users, NGO's, Associations, Interest groups, Public Bodies, Research & Development entities, Vehicle and Equipment Manufacturers, Electricity Utilities http://www.avere.org.

In Australia, Aeva Australian electric vehicle Association http://www.aeva.asn.au.

What about the price? Consumers will not automatically make the switch to electric vehicles, if running costs are high. Smart grids with EVs, Components of increasingly sophisticated local energy networks Energy efficiency of the transport system will be improved, thanks to new technological developments. What could be the implications on world oil demand? As a result, the consumption per unit may be reduced by 14% in 2020 and 36% in 2030 in an optimistic case. This scenario is based on a market share during the next decade of around 50% for hybrid cars and 7% for electric cars. The impact on unit consumption is therefore slightly under mobility development which may reach 50%.

Air transportation and energy. The demand for air transport is increasing very rapidly (from 4 to 6% of the global demand). But the climate change challenge is putting a strong pressure on the aviation sector. Energy consumption may be reduced thanks to different new technologies and operational measures. As a result, it's possible to reduce, by a factor of 2, CO_2 emissions of the transport sector by 2050 compared to 2005.

There are also interesting innovations for energy efficiency for aircrafts, as the nose wheel drive system, which has already undergone successful testing in the laboratory, comprises two highly efficient electric motor units built into the rims of the aircraft's nose wheel. The fuel cell system used for delivering electrical energy is capable of powering the nose wheel of an aircraft weighing up to 70 tons. The fuel cells, which are direct electrochemical energy converters, produce electricity from hydrogen and oxygen and are significantly more efficient than an internal combustion engine with a coupled generator. When used for short haul journeys involving up to seven take offs and landings per day, electrical maneuvering on the ground could allow for savings of between 200 and 400 liters of kerosene per day, and reducing the operating time of the engines by 1200 hours per year.

The development of new transport fuels will also impact oil demand. This is already the case for biofuels, but also GTL or CTL. In 2030, alternative liquid fuels may represent 6 Mbd in a reference case and 10 Mbd in a high case. On the top of that, we may also consider natural gas, electricity and in the long term hydrogen.

The implementation of these technologies will be enforced by new regulations decided in many economies. In Europe, the European Policy in Support to Electric Vehicle is presented in three groups of measures:

1. Demand-side measures

Incentives are necessary, in order to help the consumers to switch to for EV and clean efficient vehicle. It will be probably necessary to compensate the gap, if investment costs are too high**.**

2. Infrastructure

Is necessary, and must be planned and organized. A recharging station network is necessary. The recharge infrastructure for electric vehicles is, in large part, already available – in the form of domestic socket, there is a need for normalization and standardization. But there is also the issue of localization of charging points, Technologies of charge, pricing, energy storage, parking management, etc. City transport planning method must integrate electric vehicles. At Macro-scale: activities, parking and modal split and at Micro-scale: street level. A Model supporting strategic decisions for urban space and further analyses of urban mobility and energy demand is useful and necessary.

3. Education and training

We need skills and knowledge. Education is a long-term process and therefore in order to ensure

that we have a qualified workforce in few years time, we need to take decisions on school curricula and training programmes already today. So, the capacity issue must be addressed, with will and commitment, to prepare the future and the clean transportation of tomorrow.

As a conclusion and a vision for the future, an *A. T. Karney survey* predicts that EV-PHV will account on 25- 50 % of new cars sales, by 2020.

Is this prediction realistic or optimistic?

Anyway, there are still many challenges ahead for the development of clean transportation.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