

# TECHNOLOGY FORESIGHT FOR URBAN SUSTAINABILITY - REGIONAL COLLABORATION

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## **Introduction**

The APEC Center for Technology Foresight was established in Bangkok in February 1998 by the Royal Thai Government with the objective of serving and involving all APEC member economies in diffusing Foresight expertise across the APEC region. However, the aim is not just to assist member economies with their own Foresight efforts, but also to conduct research at a multi-economy level. Foresight should be able to contribute to issues which cross national boundaries – from air pollution to chicken virus, to electronic information distribution. Foresight philosophy and principles will be discussed in Section 2.

Prior to the selection of topics for multi-economy study the APEC Center developed a number of criteria which any Foresight study should meet: the issue must be of concern to most economies, with at least four agreeing to participate in the study; the issue must transcend national boundaries, so that it can go beyond what might be achieved by a national or bi-lateral study; there must be potential for sharing the results with all APEC members; the issue should be of general, public concern or benefit and no one that is likely

to be dealt with by the private sector; and finally, the issue will have important technological components but not necessarily “high-tech” ones.

The subject of Megacities as a topic for study merged from discussions at a Technology Foresight Symposium held at Chiang Mai, Thailand in 1997 attended by over one hundred participants from sixteen different economies. It was agreed that issues of sustainability in Megacities would be increasingly important in the 21<sup>st</sup> century and that Foresight could assist policymakers and planners with resolution of problems. Megacities are often defined on the basis of population size – over 5 million or over 10 million for example but there is no universally agreed definition. Any definition needs to be set in a historical context – thus in the 1950s only New York exceeded 10 million but in 2000 there are approximately 20 cities world wide exceeding 10 million and by 2020 there will be many Megacities of over 20 million. It is not clear if there is an optimal size for a city but it is clear that the sheer scale of Megacities creates an added level of complexity in both the genesis and resolution of problems.

Thus as the Asian Development Bank states: ‘Urban environmental conditions in the Asia-Pacific region are threatened by uncontrolled population growth, industrialisation and increasing vehicle densities. The economic impacts of pollution in Asian urban areas, in terms of productivity and health costs, have been estimated to range from 1 to 5 per cent of their GDP’ (1).

Urbanisation has been particularly pronounced in the Asian and Pacific region in the second half of the last century. By the year 2025 Asia will become predominantly urbanised with an urban population of 2.5 billion or 55% of the total population, and 20 of the world’s Megacities, with population exceeding 10 million, will be in Asia.

Megacities have both positive and negative values. They generate high-than-average proportions of their economy’s output of goods and services: are centers of innovation in science, the arts and lifestyles; contain many of the cultural assets of the economy and offer some of the better opportunities for people to lead full and satisfying lives. Yet they also offer potential shortages of water, environmental pollution, traffic congestion and a

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proliferation of slums, crime and social alienation. Increasing concern has been expressed as to whether such cities are sustainable in the longer term. The concepts of “sustainable societies” and “sustainable development” had their origin in the mid-1970s, when concern over the environment and an expanding world population began to grow in many industrialised nations.

The originators of the term sustainable development had a particular definition of the word sustainable in mind: *capable of being continued*. Thus, sustainable development is development (activity) that is capable of being continued. An oft-cited definition of sustainable development is the following, adopted in 1987 by the United Nations World Commission on Environmental and Development, the so-called Brundtland Commission (WCED 1987): “A sustainable condition for this planet is one in which there is stability for both social and physical systems, achieved through meeting the needs of the present without compromising the ability of future generations to meet their own needs.” The Brundtland Commission’s definition was not only about sustainability in the various senses of the term but also about equity: equity among present inhabitants of the planet and equity among generations.

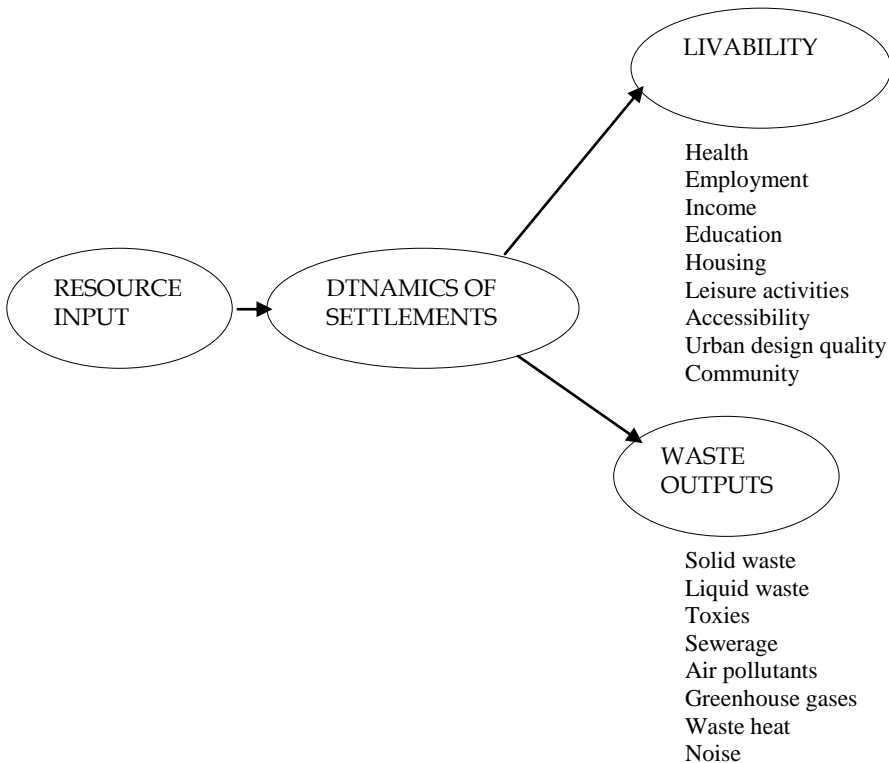
Sustainability needs to be considered in terms of its geographic scope. Activity may be globally unsustainable; for example, it may result in climate change or depletion of the stratospheric ozone layer. Activity may be regionally unsustainable, perhaps on account of the production and spread of tropospheric ozone or acidifying gases that kill vegetation and cause famine in one region but not in other parts of the world. Activity may be locally unsustainable (particularly in individual cities), perhaps because it results in hazardous ambient levels of carbon monoxide or because the noise it produces makes habitation impossible.

It has been suggested that a city can be conceived of as an ecosystem (Figure 1). The attainment of a sustainable city can be defined as reducing both the resource inputs to the city (principally land, water, energy and building materials), and its waste outputs (solid, liquid and gaseous, including sewage, toxins, air pollutants and greenhouse gases), while simultaneously improving human livability in the city (income, employment,

education, housing, leisure activities, accessibility, community and health). The sustainable city concept implies sustainable city sub-systems such as transportation, water, and waste disposal.

The APEC Center for Technology Foresight decided to tackle three significant issues of Sustainable Cities in the APEC context, namely Water Supply and Management, Sustainable Transport and Health Futures for Megacities. I will discuss the Sustainable Transport study in another paper at this meeting and will concentrate in this paper on Healthy Futures for Megacities and the implications for regional collaboration.

**Figure 1. Extended Metabolism Model of Human Settlements (2)**





## **Foresight – Philosophy and Principles**

Various definitions of Foresight have been proposed, but the one adopted by the APEC Center is: “Foresight involves systematic attempts to look into the longer-term future of science, technology, the economy, the environment and society with a view to identifying the emerging generic technologies and the underpinning areas of strategic research likely to yield the greatest economic, environmental and social benefits.”

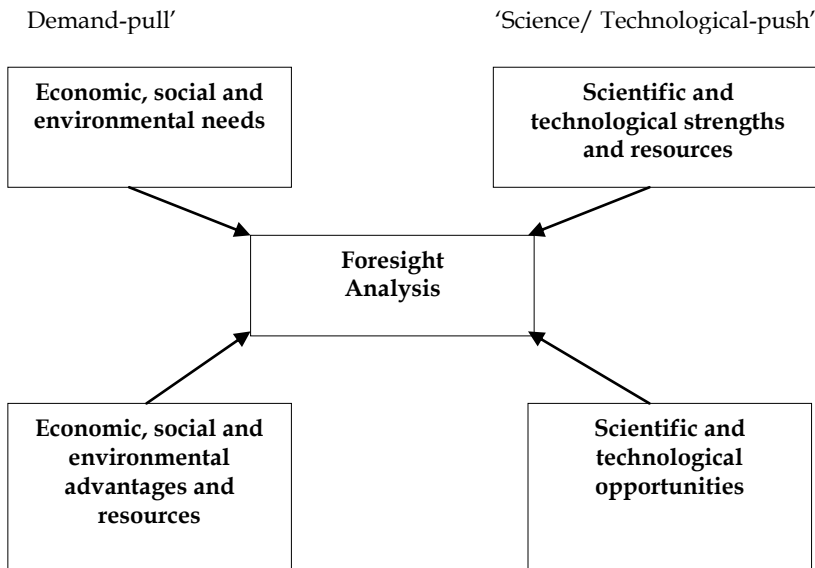
There are a number of implications in this definition:

1. The attempts to look into the future must be systematic to come under the heading of ‘Foresight’;
2. These attempts must be concerned with the longer-term, typically 10 years and possibly 5 – 30 years;
3. Foresight is a process rather than a set of techniques and involves consultation and interaction between the research producers, research users, policymakers and the community;
4. One focus is on the prompt identification of emerging generic technologies i. e. technologies whose exploitation will yield benefits for several sectors on the economy or society. Such technologies are still at a pre-competitive state and can be targeted for selective funding to ensure rapid development;
5. Another focus is on strategic research ie. basic research carried out with the expectation that it will produce a broad base of knowledge likely to form the background to the solution of recognised current or future practical problems; and
6. Attention must be given to the likely social benefits (and disbenefits) of new technologies and not just their impact on industry and the economy. The social dimension of Foresight has been increasingly emphasised in recent studies throughout the world.

It is important to stress that Foresight is not the same as technology forecasting which assumes that there is an unique future. It is then the task of the forecaster to predict, as accurately as possible, what this will be. By contrast, foresight is concerned not so much to predict the details and timing of specific developments as to outline the range of possible futures which emerge from alternative sets of assumptions about emerging trends and opportunities. Exactly which one is arrived at depends upon the choices made in the present. Foresight offers the change to shape the future through wise decision making.

The essential elements of Foresight are shown in Figure 2. In conducting a Foresight study it is necessary to maintain a balanced perspective between the 'science-push' and 'demand-pull' factors that influence future developments.

**Figure 2. Factors Influencing Foresight**



- Science-push factors include the creation of new technological or commercial opportunities by scientific research, and the strength and resources to exploit them.
- Developments in technology and production can create a use for existing and novel science through the mechanism of demand-pull. Demand factors include the priorities and needs of the broader community.

There can be problems in communication between proponents of science-push and demand-pull, particularly their different time perspectives. The time horizon of those making the demands may be too short for an effective dialogue. Looking ahead together, through Foresight, can bridge this gap in many cases.

There are many different techniques and methodologies for Foresight eg. extrapolation, Delphi surveys, consultation, scenario writing, patent analysis, critical technologies (3,4). From much experience, including that presented at the recent International Conference on Technology Foresight in Tokyo in March this year (5), it is clear that the economic, instrumental and cultural contexts of different countries influence the choice of methodology used. In some cases combinations of methodologies can be extremely useful eg. the APEC Center has used scenarios plus Delphi Surveys in two of its studies on Water Supply and Management and on Technology for Learning and Culture. The challenge for the APEC Center has been to develop techniques suitable for use in the APEC context where there are 21 economies involved with a wide range of economic, social and technological development.

Because of the interactive nature of Foresight the outputs of the process can often be as important (or even more important!) as the products. We can list the process benefits as the six Cs:

- **Communication** – bringing together disparate groups of people and providing a structure within which they can interact and communicate;
- **Concentration** – providing opportunity to focus on an issue;



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- *Co-ordination* – enabling different groups to form productive R&D partnerships;
  - *Consensus* – so a clear picture of alternative future directions and research priorities can be formed;
  - *Commitment* – generating a sense of commitment to the results among those who will be responsible for implementing changes in light of the foresight exercise; and
  - *Comprehension* – to encourage those involved to understand the changes happening in their business, or professions, at a global level, and to exert some control over these events.

The success or otherwise of a Foresight exercise can be gauged by assessing it against these six criteria.

Finally, experience has shown that Foresight can be carried out at several levels, ranging from bodies responsible for the co-ordination of overall national policy through industrial associations down to individual companies or research organisations. Thus, some Foresight exercises need to be more macro level, or ‘holistic’ in scope whilst others need to be focused at a more micro-level. Furthermore, the Foresight activities at different levels should be fully integrated, the results from higher and/ or lower levels of Foresight being fed into the process, and the results in turn feeding into subsequent Foresight efforts at higher or lower levels.

## **The Foresight Approach Used in the Healthy Futures of Magacities Project (6)**

### **Scenario Development**

Given the breadth of the topic and the diversity of professionals involved, the APEC Center decided to use the scenario development technique to carry out the study. Scenario development is a way of envisaging what the future might hold for a particular economy, industrial sector, organisation or, in this

case a Megacity. It is an attempt to identify the major drivers that are likely to shape the future and to gauge the impact that these will have on a particular entity and its relationships with society, stakeholders or customers (or in this case inhabitants).

Rather than using straight line projections from past trends, scenario development attempts to develop stories about possible and plausible futures. Despite its use of stories, scenario development follows a systematic sequence of steps. A focus for the work is first established, followed by examination of the 'key drivers' – social, economic, political and environmental. Key drivers can be defined as 'major' sources of change that impact on the future.

The next step is the 'scenario logic' or pattern of interactions that explain how the key drivers could contribute to determine future directions. The key drivers are divided into 'predetermined elements' (i. e. what is inevitable, like demographic factors) and critical uncertainties (i. e. what is unpredictable or a matter of choice such as public opinion). The critical uncertainties are prioritised as to importance and uncertainty. This analysis is then used to create scenarios – stories of future worlds that convey a range of possible outcomes. The key issues and policy implementations are then identified.

### **The Study Procedure and Outcomes**

A focus for the study was developed through a short Discussion Paper prepared by colleagues from the Kenan Institute of Private Enterprise, Kenan Flagler Business School, University of North Carolina at Chapel Hill, USA and the National Center of Environmental Health, Center for Disease Control and Prevention, Atlanta, USA. This Paper discussed the concept of health of a city in the broadest sense.

According to the World Health Organisation (WHO) Healthy Cities Program, a healthy city is 'one that is continually creating and improving those physical and social environments and expanding those community resources which enable people to mutually support each other in performing all the functions of life and in developing to their maximum potential'. This

definition reflects a similar definition of health in a living organism (cf. Figure 1).

According to Herbert Girardet, an author and consultant with the United Nations Habitat II project, "A city is a living thing. It has a complex metabolism, a voracious appetite and very poor eyesight. Improvements in transportation and communication mean that its feeding ground is now global and the consequences of its consumption distant and forgettable." If this is true, then can the largely unrestrained growth that results in the creation of a Megacity occur without significant hazards developing for both the residents of the Megacity and others who are indirectly impacted by its existence?

A healthy living organism must be able to grow and develop in an environment that permits effective responses to both challenges and threats and offers the opportunity to continuously improve its condition. The same is true of cities. Cities must be able to grow, develop, meet challenges and assure a decent quality of life for all its inhabitants. If a significant portion of a city is poor, excluded, or disadvantaged, the city cannot be healthy. Health will not exist while large segments of the population are uneducated, lack opportunity, or remain unemployed. A healthy city does not exist when children are undernourished, abandoned (at any age), grow up in a physically polluted environment or do not receive moral and ethical guidance.

Something that does not continue to grow, develop, reproduce or sustain itself, and successfully respond to new challenges is not "healthy" even if it is not invaded by disease – or even if the community is not racked by poverty. "Growth", however, does not necessarily imply either population increases or geographic expansion, but rather refers to the ability of individuals and society to be creative (taking initiatives that appear desirable) and to adapt and change in response to external pressures. Change is inevitable, and therefore successful adaptation to change is essential in any system that hopes to survive. Continued responses to environmental changes, population growth, increasing mobility through transportation improvements, and the search for wider economic and educational opportunities have continued to push the growth of cities to the level of Megacities.

Many Megacities have mega-problems, for they often do not grow in a balanced fashion. Responses to the imbalances require considerable vision, energy, and effort to achieve effective policies and feasible interventions.

The issues identified in the Discussion Paper were under three general headings:

- Natural environment, e. g. geography and climate;
- Manmade environment, e. g. air, water, sanitation, noise; and
- Quality of life, e. g. overcrowding, traffic congestion, crime.

The Discussion Paper was then distributed to a small group of experts, including an expert from the WHO Health Cities Program, and a Core Group met in Bangkok in February 2000 to critique the paper and to develop scenarios. The Core Group identified key drivers in the development of Megacities and speculated on possible, even improbable, events which could occur to change the position of development. These are listed in Table 1.

Based on these inputs, three scenarios were created for the year 2020 and named by their creators as 'Econologic City', "Monopolis" and 'Fat City". These are given in detail in the APEC report (6) but a brief summary is as follows.

*Econologic City* is one of the top 5 cities in the world, in terms of wealth and standard of living. Major environmental redesign has provided cabling for electronic connectivity, and open and safe meeting spaces to facilitate social connectivity. Energy sources are 'alternative', water is recycled and transport is low-polluting. Econologic City is highly IT committed and internet connected, with an electronic communication system that underpins community involvement and responsive government, as well as a strong health care system. Migration to Econologic City is strictly limited but would-be residents find ways around the system to get hold of that precious "EC-card".

**Table 1. Key Drivers and Uncertainties in the Development of Megacities, identified at the Core Experts Meeting**

<b>Key Drivers</b>	<b>Uncertainties</b>
Expected significant influences on the development of Megacities	Possibilities but unpredictable influences; new developments in these area could have a major impact (positive or negative) on the health of the Megacity, if they occurred.
1. Demographic	Genetic or medical revolution transforms the implications of ageing/ reproductive technologies/ epidemics/ bioterrorism
2. Digital Economy/ Global Knowledge Economy	Ownership and regulation of the Internet/ backlash against modern information and communications technologies.
3. Economic Performance	Natural disasters/ disasters following from technology, eg. major antibiotic resistance/ plagues.
4. Education and Capacity Building (information skills)	Reaction against cultural dominance of 'western' world / mono-culture.
5. Technology based health delivery	Personalised health management/ backlash against technology/ 'smart health care'
6. Governance/ Polity Capital	International and national regulation/ public-private-NGO partnerships/ 'aid with positive strings'.
7. Environmental Hazards	Climate change/ food contamination.
8. Social Values	'Virtual communities'/ social alienation.
9. Inter-Group Tensions	Rise of nationalism/ immigration controls / tribalism
10. Transnational Activity	War / education / labor mobility.

*Monopolis*, the intelligent tropical megacity places great emphasis on survival and self-sufficiency. With substantial independence from national government, Monopolis has been radically redesigned, with more efficient resource allocation, mixed use land planning, innovative transport modes, and a target of 4 square meters of open space for every resident. Monopolis is a city of advanced and accessible technology, significantly internet-linked throughout the city, to the region and internationally. Regulations are stringent, with slums demolished and private cars banned!

Finally, *Fat City* 2020 is bulging at the seams, a vibrant cauldron of intercultural and intellectual interaction. It is not really a Megacity at all, but rather a concentrated network of self-governing communities. The corrupt and convoluted bureaucracy has been superseded by rational and open

administration, a positive development reinforced by significant local democracy and participation. With low unemployment, concern for the elderly and disadvantaged and substantial decision-making at community level, Fat City is a megacity on a human scale.

It is important to emphasize that the scenarios constructed were alternative vision of future Megacities, not best or worst case scenarios. While they contained some surprising elements, nevertheless, all aspects of the scenarios were intended to be plausible.

Following the Core Experts Meeting the Discussion Paper was revised and the scenarios were refined to reflect some issues more clearly, including some of the policy debates already occurring around them. All of this material was then used as background for an APEC-wide meeting of 46 experts from 10 member economies, held in Bangkok in May 2000. These experts provided further inputs of issues based on their experience, together with material relevant to their national Megacities. The scenarios were then reviewed and analysed, in order to draw together a comprehensive set of issues and policy actions relevant to healthy futures for APEC Megacities over the next two decades. Technologies relevant to the issues were explored in general discussion.

## **Key Issues in Healthy Futures for APEC Megacities**

The preparation of the Discussion Paper, and the scenario-planning process used in the Experts Meetings, led to the identification of fifteen key issues which are discussed in detail in the APEC report (6). Many of these are interlinked but a conceptual approach to grouping them is given in Figure 3. This is based on the concept of the city as a living organism.

**Figure 3. The Megacity as a living organism: A conceptual approach to the key issues identified in the study**

### **Issues Related to Inputs**

As noted above, cities have a voracious appetite and Megacities even more so. They exist and grow because of the inputs they receive from vast distances outside the cities. Improvements in communication and transportation mean that they draw on global resources, both economic and physical as well as human. Here we group the issues of:

- Population dynamics – changing size and age distribution in cities; and
- Resources – ensuring adequate supplies of energy, water, food and building materials.

### **Issues Related to Dynamics of Megacities**

The inputs to Megacities must be adapted and used to ensure that cities are able to grow, develop, meet challenges and ensure a decent quality of life for all their inhabitants. Using the analogy of a living organism, the dynamics of Megacities can be likened to the digestion and utilisation of inputs to provide sustenance for thinking, breathing and movement.

Here we group the issues of:

- Governance – running an efficient and equitable city;
- Infrastructure – building roads, sewers, communications and services;
- Mobility – transporting people by public and private means;
- Planning – looking to future development;
- City Structure – eliminating inequalities by adequate design; and
- Waste Management – efficient disposal of wastes and elimination of pollution.



## **Issues Related to Quality of Life**

The study has reinforced the view that people cannot have a healthy life in an unhealthy city and that the rationale for ensuring a healthy and sustainable city is to maximize the quality of life for its inhabitants which in turn leads to a successful economy.

Here we grouped the issues of:

- Social Connectedness – getting people together;
- Participation of individuals and communities – ensuring a voice in running the city;
- Livelihood Opportunities – ensuring training for employment in the knowledge economy;
- Heritage – preserving the past;
- Safety – ensuring people and property are safe;
- Living Environment – providing adequate housing and recreation facilities; and
- Health Care Delivery and Health Provision – ensuring adequate health care facilities for all.

## **Policy Outcomes**

This study has dramatically reinforced APEC Minister's views as expressed at the Manila Ministerial Meeting in 1996 that the topic of Sustainable Megacities required urgent attention to ensure future wealth creation and social stability of APEC economies. Through consultation with experts across the APEC region, this study has identified a set of key issues critical to the health of Megacities, and policies that need to be developed to address these. It has been emphasised throughout this study that none of these issues is resolvable in isolation, integrated policy making and implementation is essential. Yet this remains hampered by the fragmentation of public responsibility, both horizontally (different agencies dealing with the

same concern) and vertically (different levels of government). The lack of involvement of stakeholders in the policy formulation and decision-making processes is an equally important problem which impedes the development of healthy Megacities.

The experts identified the following key policy areas as critical to the future of Megacities:

- Managed growth, of both population size and Megacity area, to ensure sustainability;
- Integration of land use and transport planning;
- Effective participation of all stakeholders in decision-making, via both 'top-down' and 'bottom-up' processes;
- Equity for all city residents, including especially disadvantaged groups such as recent migrants, workers in the informal economy and ethnic minorities;
- Good governance at all levels;
- Implications of the development of knowledge-based city for employment;
- Multi modal and sustainable transport systems;
- Integrated information and communication technologies especially their application in health, education and skills training, governance, public participation and commerce;
- New approaches to funding and operating 'megaprojects' for infrastructure and services, including assessment of the effectiveness of public-private partnerships;
- Reduction of pollution by cleaner production systems, improved waste management and a shift from private to public transport; and
- Better understanding of population dynamics and migration to urban areas.

While individual Megacities can tackle these within their own economic systems, there is already a wealth of experience that can be drawn on through regional collaboration to:

- Share their experience of the fifteen key issues;
- Facilitate the development of standards data bases in technical areas;
- Set up benchmarking criteria for healthy cities;
- Support multi-economy and multi-disciplinary R&D programs in areas such as public health, transport systems, water supply and management, technology for learning and culture, environmental protection and cleaner pollution; and
- Develop efficient and effective frameworks for public-private partnerships for infrastructure development.

## **Conclusion**

The major challenges to the sustainability of APEC's Megacities can appear overwhelming. The Foresight approach was helpful for defining and assessing these challenges, providing a mechanism for grasping the complexity of the problems and for reconciling the many different perspectives and areas of expertise required to solve them. The Foresight process also enabled excellent networking across cultures and levels of development. The study outlined the core elements of Megacities that need to be addressed in order to move towards healthier futures, and identified critical areas for research and the development of policy.

The study firmly concluded that, with more and more of the world's population going to live in Megacities, the goal of healthy Megacities is both realistic and essential. Megacities that function well will make a highly significant contribution to the economic wellbeing of the whole economy but there is no room for complacency. Generating healthier Megacities depends crucially on political vision and will to understand the threats to future Megacities, and to implement major changes. Equally crucial is the much wider participation of Megacity residents from all sections of the community in decision making. It is vital to recognise the symbiotic relationship between the health of the Megacity and the of its residents. You cannot have healthy people in an unhealthy Megacity, and you cannot have a healthy economy

without healthy people. For the millions of people living in APEC's multiplying Megacities, actions to create healthy Megacities are the critical link between the first APEC goal of increasing prosperity, and the second – improving quality of life.

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