

# Green Cities

## New Approaches to Confronting Climate Change

OECD WORKSHOP PROCEEDINGS  
LAS PALMAS DE GRAN CANARIA, SPAIN  
11 JUNE 2009





## ACKNOWLEDGEMENTS

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The OECD Workshop *on Green Cities: New Approaches to Confronting Climate Change*, is part of the OECD programme of work on regional development, directed by Mario Pezzini, Deputy Director, Public Governance and Territorial Development and headed by Marcos Bonturi, Head of the OECD Regional Competitiveness and Governance Division.

The conference was co-ordinated by Lamia Kamal-Chaoui, Head of the Urban Development Programme, in collaboration with Suzanne-Nicola Leprince, and Marie-Claire Guttery and with the support of Michael G. Donovan and Olaf Merk. The content of the conference agenda has also benefitted from valuable suggestions from Jan Corfee-Morlot (Environment Directorate) and Hiroshi Kobayashi (Regional Sustainable Development Division). The proceedings were edited by Victoria C. Elliott, writer/editor at the Lawrence Berkeley National Laboratory, and prepared for publication by Sophia Katsira, Laura Woodman, Jeanette Duboys and Erin Byrne, OECD Secretariat.



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## AGENDA

### “GREEN CITIES: NEW APPROACHES TO CONFRONTING CLIMATE CHANGE”

*OECD Workshop, Alfredo Kraus Auditorium, Las Palmas de Gran Canaria, Spain*

**Thursday 11 June. 9:00 to 19:00**

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#### **Background and objective of the meeting**

City governments play a critical role in addressing the global challenge of climate change. Though output in cities is responsible for the majority of global carbon emissions, a groundswell of local initiatives has placed local government on the front lines of environmental management. Cities in many ways are bellwethers and testing grounds for emerging trends in climate solutions. In light of these developments, during the 2008 OECD Roundtable of Mayors and Ministers, Secretary-General Gurría proposed, “Momentum is building to mainstream policies for the ‘green economy’ and climate smart cities....How cities develop will determine our collective ability to address climate change....The time has come to bring the experience and the capacity of cities to deal with the development and climate change challenge to the front of the climate debate. We need to empower cities to do the right things on climate change and we need to learn from their experience.”

Despite widespread experimentation and rhetorical endorsement, the actual implementation of climate change planning remains confined to a few pioneering cities. A variety of factors ranging from inadequate budgeting to lacklustre public support has prevented the mainstreaming of climate change planning at the local level. “Green cities” have also not been immune from the effects of the economic crisis: a tight credit market has limited the range of environmental projects that governments can realistically pursue. At a moment when momentum has been building for cities to “go green”, it is unclear how their governments can attain the necessary funds to engage more actively in climate change adaptation and mitigation projects or if they can (within the context of allocation of funds from the national fiscal stimulus package), priorities could be given on short term objectives ignoring long term challenges.

This workshop aims to respond to this call by exploring practical tools cities can use to fight climate change and catalyse their economies. These tools all have concrete objectives: the production of “green collar” jobs, increased national support, enhanced financing of “eco-solutions”, water conservation, and more climate friendly operation of ports. Throughout this workshop, attention will be given to collaborative frameworks, both those that foster inter-departmental co-operation within cities and those that generate synergies between regional and national bodies.

This one-day workshop is organised by the OECD and the City of Las Palmas de Gran Canaria with the support of the government of Spain.



## WORKSHOP AGENDA

9:00 – 10:00	<b>Registration and Coffee</b>
10:00 – 11:00	<p style="text-align: center;"><b>Opening Speeches and Welcoming Statements</b></p> <ul style="list-style-type: none"> <li>• <b>Mr. Jerónimo Saavedra Acevedo</b>, Mayor, City of Las Palmas de Gran Canaria, Spain</li> <li>• <b>Mr. Marcos Bonturi</b>, Head of the Regional Competitiveness and Governance Division, OECD</li> <li>• <b>Mr. José Miguel Pérez García</b>, President of Gran Canaria’s Council, Spain</li> <li>• <b>Mr. Don Paulino Rivero Baute</b>, President of the Government of the Canary Islands</li> <li>• <b>Mrs. Carolina Darias San Sebastián</b>, Delegate of the Government in the Canary Islands</li> </ul>
11:00 – 12:30	<p style="text-align: center;">SESSION 1-A</p> <p><i>Inside the “Green” Policy Toolbox: Innovations in Urban Planning and Governance</i></p> <p>Cities and regions have been leaders in addressing climate change. Many are adapting to the “green economy” with programs relating to recycling, waste prevention, brownfields redevelopment, green building, sustainable public transit, and jobs in “clean-tech” sectors. Mayors and regional leaders around the world are reducing their city’s carbon footprint by renewing investment in public transit and enforcing land use provisions that make cities more dense and walkable. Local authorities have mandated renewable energy requirements, recycling standards, clean energy service provision, and limits on urban sprawl. This session will address innovations in planning tools that attempt to mitigate climate change and adapt to its effects. Such tools encompass: local climate change action plans, ecosystem planning, green development codes and zoning ordinances, subsidising green architecture, building materials, and roofs, pedestrian and bicycle planning, energy-efficient street lighting, urban landscaping, densification, and the “greening” of schools and government buildings. These changes also call for an adaption of the current urban governance systems and modes. Cities have experimented with a wide variety of management structures to build environmental competence throughout an administration and create a common vocabulary of sustainability across departments. The competence for climate change policy is almost always concentrated in a city’s department of the environment raises issues of collaboration with other departments calling for innovative institutional solutions.</p>

Moderator:

- **Mr. Vincent Fouchier**, Vice President OECD Working Party on Urban Areas, IAURIF, Director for the Master Plan for the Region Paris –Ile de France, France

Panellists:

- **Mr. Michael G. Donovan**, Urban Specialist, OECD
- **Mr. Masashi Mori**, Mayor Toyama City, Japan
- **Ms. Hélène de Largentaye**, Sustainable Development Adviser, Paris City Council, France
- **Mrs. Marlene Potthoff**, Deputy Director, Climate Protection Agency Region of Hanover, Germany
- **Mr. Eduardo Jorge Martins Alves Sobrinho**, Secretary for Green and Environment, City Hall of São Paulo, Brazil
- **Mr. Jinchuan Chen**, Deputy Director of Planning Department, Beijing Municipal Committee of Communications, China
- **Dr. Ayman I.K. El-Hefnawi**, Vice Chairman of General Organisation for Physical Planning, Egypt

Questions for discussion:

1. How can urban planning strategies reduce a city's vulnerability to climate change by directing new development away from areas at greatest risk, and by adopting land use practices that mitigate climate change impacts (*e.g.* urban forestry and green spaces, compact cities, use of more light-reflecting urban surfaces, etc.)?
2. How cities are adapting their current urban governance system to deal with climate change issues? What are the advantages and disadvantages of the different approaches? When a department is responsible for climate change policy, how does it coordinate with other departments? What are the best innovative institutional solutions?
3. To what extent have climate change plans been followed by active enforcement? What types of plans are heavy on implementation and light on rhetoric? What have been the main obstacles for implementation?
4. What role can local governments play to sensitise and engage citizens and the business sector in sustainable energy use and local-scale adaptation efforts? What other local actors and knowledge resources need to be engaged?
5. What types of new private/public partnerships with private companies has "green" urbanism produced? What have been the advantages of these types of partnerships and joint ventures?
6. In the context of a privatisation of public utilities, to what extent can municipalities have a significant impact on local climate change action through energy, transport, water and waste services?
7. Standards and codes dictate virtually all aspects of urban development. How have cities changed existing zoning and building codes to accommodate more sustainable cities? What legal obstacles prevent such changes?
8. What is the state of inter-municipal cooperation around climate change compared to other issues like transportation, economic development, and financing? How widespread are resource-pooling strategies, such as projects to purchase energy-efficient products or pool scientific know-how to lower policy development costs?

<p>11:00-12:30</p>	<p style="text-align: center;"><b>SESSION 1-B</b></p> <p style="text-align: center;"><i><b>The Potential of the Green Economy</b></i></p> <p>The dialogue on climate change needs to directly address scepticism by demonstrating that protecting against climate change can provide an opportunity to maintain and enhance the competitive posture of urban regions. A group of pioneering cities have demonstrated that energy efficiency conserves natural resources, strengthens resilience to meteorological disruptions, and leads to substantial savings in fossil fuel. However, it remains less clear how cities have transcended the trendiness of this field to build lasting jobs and markets that benefit industries outside of “cleantech” sectors. In other words, what is the second move of the “first-movers”? The seemingly contradictory local government reaction to the current economic crisis has added confusion. Some have responded by eliminating once promising green building programs while others have justified increased funding for climate solutions in the hopes that its market will generate “green jobs”. A number of questions need to be answered to understand how the innovation in pioneering green cities can have “ripple effects” throughout the larger economy in the context of the current recession.</p> <p><u>Moderator:</u></p> <ul style="list-style-type: none"> <li>• <b>Mr. Keith Thorpe</b>, Head of Urban Policy Support, Cities and Urban Policy Division Department for Communities and Local Government, United Kingdom, UK Delegate to the OECD Working Party on Urban Areas</li> </ul> <p><u>Panellists:</u></p> <ul style="list-style-type: none"> <li>• <b>Mrs. Jan Corfee Morlot</b>, Senior Climate Change Analyst, Nobel Prize award, OECD</li> <li>• <b>Dr. Nam-Geon Cho</b>, Korea Research Institute for Human Settlements, Advisor to the Ministry of Land, Transport and Maritime Affairs, Korea</li> <li>• <b>Mr. Mat Santamouris</b>, Chairman of the Organising Committee for the European Union-Cool Roof Council (EU-CRC)</li> <li>• <b>Mrs. Christina Raissis</b>, Director, Strategic Growth and Sector Development, Economic Development, Culture and Tourism, City of Toronto, Canada</li> <li>• <b>Dr. Fabio Grazi</b>, Senior scientific coordinator of the Spatial Economies, Energy, and Climate Change (SEECC) program, International Research Centre on the Environment and Development (CIRED), Paris, France</li> </ul> <p><u>Questions for discussion:</u></p> <ol style="list-style-type: none"> <li>1. What are some of the most promising examples of opportunities for linking climate protection measures to efforts to catalyse economic development goals and create new employment opportunities?</li> <li>2. What financial incentives help engage enterprises in public-private partnerships for addressing climate change goals?</li> <li>3. What expected and unexpected economic opportunities are present in the supply chains for low-carbon technologies, such as renewable energy, recycling equipment, LED lighting, concentrated solar and clean tech?</li> <li>4. How have cities measured the labour intensity of the green economy? Under what conditions does it produce more or less jobs than traditional sectors?</li> </ol>
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	<p>5. What opportunities exist for green economic strategies to benefit low-income neighbourhoods and distressed areas? Does “greening” leave them behind?</p> <p>6. How has the green building sector fared amidst declining real estate construction?</p> <p>7. How can climate change mitigation/adaptation policies be shaped to help ensure that the resulting economic benefits remain rooted within a city's local economy (<i>i.e.</i> that the economic developments are 'place based' and cannot be outsourced to other areas).</p>
12:30 – 14:30	<b>LUNCH</b>
14:30 – 16:00	<p style="text-align: center;">SESSION 2- A</p> <p style="text-align: center;"><b><i>Green Government: Why Co-operation across Levels of Governments is Essential?</i></b></p> <p>Given different mandates, expertise, and the multijurisdictional fluidity of most environmental problems, collaboration amongst neighbouring municipalities, regions, and the national government, is of paramount importance. This consists of horizontal accords between localities or regions/states along with multi-level frameworks to facilitate cooperation between national, regional, and local governments. For example, some municipal governments often develop joint climate change adaptation plans; others pool their buying power together and negotiate directly with manufacturers of recycling equipment and renewable energy providers. Likewise, national governments can clearly support cities through improved funding and support of a suite of energy saving, locally administered programs. They might also enable by implementing guidelines for local authorities, disseminating information on best-practices, and suggesting voluntary certification schemes. In some situations local governments may assist national governments by participating in emerging carbon markets or even the Kyoto mechanisms, notably by hosting and/or developing joint implementation and Clean Development Mechanism offset projects. In other situations, regional or local authorities are often responsible for the issuance of emission permits and/or for monitoring, reporting and verification of emissions. Holistic approaches involving local, regional, and national government, though necessary, add complexity and generate the questions below.</p> <p><u>Moderator:</u></p> <ul style="list-style-type: none"> <li>• <b>Mr. Adam Ostry</b>, Chair of the OECD Working Party on Urban Areas</li> </ul> <p><u>Panellists:</u></p> <ul style="list-style-type: none"> <li>• <b>Ms. Lamia Kamal-Chaoui</b>, Head Urban Development Programme, OECD</li> <li>• <b>Ms. Sara Pasquier</b>, Energy Expert, International Energy Agency</li> <li>• <b>Ms. Beth Jines</b>, Assistant General Manager, Environment L.A., United States</li> <li>• <b>Mr. Juan Carlos Zentella Gomez</b>, Deputy General Director for Land Planning, Mexico</li> <li>• <b>Mr. Meinte de Hoogh</b>, Sr. Policy Officer, Ministry of Housing, Spatial Planning and the Environment, Directorate Spatial Planning, Climate Adaptation Department, Netherlands</li> </ul>

	<p><b><u>Questions for discussion:</u></b></p> <p>What should be the respective institutional role of national and local levels for climate change policies?</p> <ol style="list-style-type: none"> <li>1. What explains the divergence between those regional governments that have assumed leadership in environmental projects and others that have done relatively little?</li> <li>2. How can regional authorities become more involved in environmental monitoring and reporting? What are the risks?</li> <li>3. What types of cooperative arrangements between different levels of governments could be adapted to pursue climate-change mitigation and adaptation objectives?</li> <li>4. What are some key examples of climate change response measures that can lead to benefits for other important realms of urban governance, for instance, related to housing and sanitation, health and security, and economic growth?</li> <li>5. What are some key areas of potential conflict between climate change response measures and policies/programs for other core urban governance needs?</li> <li>6. How existing regional and urban policies implemented by national governments are being adapted and reframed to foster climate friendly policies?</li> </ol>
14:30 – 16:00	<p style="text-align: center;"><b>SESSION 2B</b></p> <p style="text-align: center;"><b><i>Financing climate friendly initiatives</i></b></p> <p>Perhaps the most common obstacle to the growth of the “green city”, especially during the current economic crisis, is the lack of funding for environmentally friendly infrastructure. Urban climate change policies will have consequences for city’s budgets for which new solutions are required. Because sustainable building practices and energy offers cost benefits in the long-term rather than the short-term, ecologically sound practices are often bypassed in favour of more carbon-intensive programs. In response to this situation, city governments have assembled a creative suite of green financial arrangements and additional financial tools designed to generate capital for environmental projects. These include a range of fees and charges to reduce waste, congestion, pollution, revolving loan funds, building financial partnerships, and the use of clean venture capital. Current urban finance systems can also be made considerably greener, since they are often biased towards developing land, sprawl and car transportation, but fail to encourage reduction of energy and waste, brownfield redevelopment and urban densification. Greening taxes and fees can provide more incentives for sustainable local development. To make existing programmes more fiscally and environmentally sound, city governments have illustrated the savings of sustainable practices by energy efficient purchasing, green procurement, pooling financial resources to increase buying powers and financial incentives for engaging enterprises in public-private partnerships for addressing climate change goals. The possible wider application of sub-national cap-and-trade schemes could be linked to the design of intergovernmental transfers to sub-national governments. In light of the credit crunch, a number of questions come to light.</p> <p><u>Moderator:</u></p> <ul style="list-style-type: none"> <li>• <b>Mr. Olaf Merk</b>, Economist, Urban Development Programme, OECD</li> </ul>

	<p><u>Panellists:</u></p> <ul style="list-style-type: none"> <li>• <b>Mr. Brian Field</b>, Urban Planning and Development Adviser, European Investment Bank</li> <li>• <b>Mr. Ola Göransson</b>, Head of Section, Division for Sustainable Development, Ministry of the Environment, Sweden</li> <li>• <b>Mr. Jonathan Koehn</b>, Environmental Affairs Director, City of Boulder, Colorado, United States</li> <li>• <b>Ms. Mila Freire</b>, Senior Urban Analyst, World Bank</li> <li>• <b>Mr. Ángel Luis Tadeo</b>, President of Commerce, Industry and Navigation, Las Palmas</li> </ul> <p><b><u>Questions for discussion:</u></b></p> <ol style="list-style-type: none"> <li>1. What does climate change imply for the budgets of cities? To what extent are the costs of retrofitting infrastructure to adapt to climate change integrated into municipal finance?</li> <li>2. Municipalities often depend on revenue from gas, road tolls, property taxes, parking, and building applications that are based on carbon-intensive forms. How does the current financial system award environmentally damaging practices and how can this be reversed to create more sustainable urban environments?</li> <li>3. What new instruments could be used to finance climate friendly projects?</li> <li>4. What does the introduction of sub-national cap-and-trade schemes imply for current urban finance mechanism, in particular intergovernmental transfer design?</li> <li>5. How could environmental pricing and other environmental fiscal instruments (EFIs) reform the current urban taxation system?</li> <li>6. How can local governments effectively track their environmental footprint through green tendering and budgeting? What initiatives have succeeded and why? Which initiatives have failed and why?</li> </ol>
16:00 – 16:15	COFEE BREAK

16:15 – 17:45	<p style="text-align: center;"><b>SESSION 3A</b></p> <p style="text-align: center;"><b><i>Blue is the New Green: Emerging Trends in Water Management</i></b></p> <p>How will climate change effect water resources and how can the public sector adapt its water management to these changes? Water resource issues interact with a wide range of socio-economic and environmental sectors, including health, agriculture, energy, biodiversity, industry and navigation. Indeed, there are few activities that do not in some way depend on water resources. This sector is also a particular concern because many cities around the world are already facing significant water stresses, due to competing demands (of urban/industrial, agricultural, recreational and ecological protection purposes), pollution of surface water sources, and over-exploitation of groundwater sources. Climate change is likely to greatly exacerbate this situation, as shrinking glaciers and snowpacks (a primary source of freshwater for many areas) shrink, as rising sea levels lead to salt-water intrusion that contaminates groundwater aquifers, and as more extreme cycles of precipitation and drought make it more difficult for water managers to make planning and investment decisions.</p> <p><u>Moderator:</u></p> <ul style="list-style-type: none"> <li>• <b>Mr. Gregoire Allix</b>, Journalist, <i>Le Monde</i>, France</li> </ul> <p><u>Panellists:</u></p> <ul style="list-style-type: none"> <li>• <b>Ms. Aziza Akhmouch</b>, Expert, Regional Competitiveness and Governance Division , OECD</li> <li>• <b>Mr. Wouter Jonkhoff</b>, Advisor to the Commissioner of the Waterboard of Rijnland Economist, the Netherlands</li> <li>• <b>Mr. Antonio Paruzzolo</b>, President of Thetis, Venice, Italy</li> <li>• <b>Mr. Paul Hickey</b>, Head of Environmental Services, Anglian Water, United Kingdom</li> <li>• <b>Mr. Eric Lesueur</b>, Director, Veolia Water, France</li> <li>• <b>Mr. Mohamed Cherif Fourti</b>, Director of the Environment Observatory, Ministry of Sustainable Development, Tunisia</li> <li>• <b>Ms. Laura Grape</b>, Senior Environmental Planner, Northern Virginia Regional Commission, United States</li> <li>• <b>Mr. Iñigo Joaquín de la Serna Hernáiz</b>, Mayor of Santander – President of Sustainable Development Commission of the Municipalities and Regions, Spanish Federation</li> </ul> <p><u>Questions for discussion:</u></p> <ol style="list-style-type: none"> <li>1. What types of ‘adaptive management’ practices can urban water resource managers use to effectively cope with the uncertainties arising from changing and more extreme hydrological patterns?</li> <li>2. What are the most effective methods of encouraging water conservation among key players within an urban environment (households, business and industry, etc)?</li> <li>3. What types of improvements to urban water management infrastructure are most critical for reducing vulnerability to climate change impacts (<i>e.g.</i> for water conservation measures, preventing saltwater intrusion, managing stormwater overflow events)?</li> </ol>
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	<ol style="list-style-type: none"> <li>4. What feedbacks between climate change and urban water resource management may be possible, <i>e.g.</i> will warmer temperatures increase water demand?</li> <li>5. What is the state of the art in wastewater recycling systems, anaerobic sewage treatment, and tidal energy projects? To what extent have these projects benefitted from assistance from national governments?</li> <li>6. How can adaptive water resource management strategies help cities to prepare for climate change impacts on water quality and quantity and to avoid subsidence and exacerbation of flood risk?</li> </ol>
16:15 – 17:45	<p style="text-align: center;"><b>SESSION 3B</b> <b><i>Managing port cities</i></b></p> <p>A large share of the world population lives in port cities, which are both victims of climate change’s rising sea levels and contributors to greenhouse gas emissions. The maritime sector has often been cited for producing pollution, which particularly affects surrounding residents. The maritime transport industry’s contribution to global greenhouse gas emission, for example, is estimated to be between 1.5% and 4.5%. There is a need for port-cities to adapt to climate change: CO<sub>2</sub> emissions of ports and the maritime sector could be reduced with 30% by 2020, by more renewable fuel use, reducing speeds, and modernising ships, cargo-handling equipment and trucks. Ports and port-city authorities have a crucial role in effectuating this change. Momentum is building for port initiatives connected to climate change, illustrated for example by the “World Ports Climate Declaration” that was signed by around 55 global ports. A certain trade-off between climate change activities and cost competitiveness of ports could form a rationale for international coordination of climate change actions related to ports, so as to avoid a “race to the bottom”. Environmental conservation could, however, also form a competitive advantage. However, the different economic aims of a port on the one hand and the city region on the other hand, often creates tension. This emphasises the need for effective regional governance mechanisms.</p> <p><u>Moderator:</u></p> <ul style="list-style-type: none"> <li>• <b>Mr. Néstor Hernández López</b>, Deputy Mayor, Urban Planning, Housing, Environment and Water</li> </ul> <p><u>Panellists:</u></p> <ul style="list-style-type: none"> <li>• <b>Mr. Javier Sánchez-Simón Muñoz</b>, President of the Port Authority of Las Palmas, Spain</li> <li>• <b>Mr. Faustino García Marquez</b>, Architect – President for Ideas Contest for the Collaboration of Las Palmas de Gran Canaria Coastline, Spain</li> <li>• <b>Mr. Ricardo Martínez Vázquez</b>, Director of Casa Africa / Ministry of Foreign Affairs and Cooperation, Spain</li> <li>• <b>Mr. Joan Alemany y Llovera</b>, Director of RETE Ports / International Association for the Collaboration between Ports and Cities, Spain</li> <li>• <b>Mr. Javier Sanchez-Reaza</b>, Economist, Regional Competitiveness and Governance Division, Public Governance and Territorial Development Directorate, OECD</li> </ul>



	<p><b><u>Questions for discussion:</u></b></p> <ol style="list-style-type: none"> <li>1. What has been the progress made with respect to climate change mitigation by different global ports within the OECD?</li> <li>2. How can ports combine climate change awareness and global competitiveness? What mechanisms could avoid a “race to the bottom”?</li> <li>3. To what extent can advances in climate change adaptation and mitigations provide a competitive advantage to ports?</li> <li>4. What can city and regional authorities do to balance port competitiveness and environmental sustainability? Which governance mechanisms are helpful in finding this balance?</li> <li>5. What have ports done to minimise their environmental footprint—either through adopting more sustainable technologies on land or limiting idling and fuel consumption on water?</li> </ol>
17:45-18:30	<p style="text-align: center;"><b>Closing Remarks</b></p> <ul style="list-style-type: none"> <li>• <b>Mr. Jerónimo Saavedra Acevedo</b>, Mayor of Las Palmas, Spain</li> <li>• <b>Mr. José Miguel Pérez García</b>, President of Gran Canaria’s Council, Las Palmas, Spain</li> <li>• <b>Mr. Paulino Rivero Baute</b>, President of the Government of the Canary Islands</li> <li>• <b>Mrs. Carolina Darias San Sebastián</b>, Delegate of the Government on the Canary Islands</li> </ul>

**OPENING SPEECH BY THE MAYOR OF LAS PALMAS DE GRAN CANARIA,  
JERONIMO SAAVEDRA ACEVEDO**

Ladies and Gentlemen,

First of all, I would like to welcome most sincerely all the participants in this important event, especially authorities, public and private institutions, as well as the experts from more than 34 countries who are here today.

The motto of this Workshop, “Climate Change and Sustainable Cities”, without any doubt, points out one of the most important challenges for the present and future of mankind.

The difficulty of the challenge makes co-operation a must, without any distinction between country, race or ideology, to promote co-operation and consensus between the different towns and municipalities of the world in which we live to be able to leave it to the future generations with all its beauty and harmony.

Our city and the Canary Islands have a huge history bound to nature and environmental care that we must not forget. Across the ages our citizens have been able to work together for economic development, maintaining traditions, and culture and the conservation of natural resources.

The Canary Islands has also multiple personalities who have contributed to the islands’ development in these fields. From painters who have promote traditional culture, such as Nestor de la Torre, to important naturalists as Viera y Clavijo during the XVIII century, Sventenius founder of the marvellous Jardín Botánico or the extraordinary artist Cesar Manrique who created harmony between architecture and the environment.

This Town Hall has made a great effort since June 2008 to prepare today’s workshop and has also been supported by several public and private institutions to whom I would like to thank their co-operation and invite them to keep working on this direction to reach the established objectives in this workshop and which are summarised below:

First: Contribute to find solutions that promote the sustainable development of the cities and the mitigation of climate change.

Second: Favour, co-operate and promote the exchange of experiences at all levels: economic, social, cultural and environmental.

Third: Promote the development and modernisation of the global production model, and especially in our city, encouraging activities related to the green economy as we have been doing from my government. This Workshop is an example of these activities.

The work we have been doing in Las Palmas de Gran Canaria has not been very publicised but, the activities and its effectiveness can be clearly identified by the promotion of renewable energy, energy saving, waste prevention, brownfields redevelopment and the cleaning of the seabed through the extraction of sand at Las Canteras beach. This work is essential to maintain the ecosystem and for which I would like to apologise for the inconvenience it causes.

A great interest has been shown for this Workshop which is attended by outstanding experts, 34 state representatives, several important international institutions and more than 300 people registered. I would like to let them all know that Las Palmas de Gran Canaria offers them all its hospitality and affection, especially for those who come from other countries. I hope you have a wonderful time here and productive results in your work.

I am sure that all cities will appreciate and consider the advices that we all expect from this OECD Workshop.

In this sense, I would like to be grateful to the OECD and the Town Hall staff for the excellent and hard work they have done organising this event.

Finally, I would like to read some words from the Cuban poet José Martí: "El verdadero hombre no mira de qué lado se vive mejor sino de qué lado está el deber" (*The real man is not the one that looks on which side he will be better, but on which side work should be done*) Today, our mission is to share solutions to build a more sustainable Planet and cities.

The Workshop is now officially open.

## **OPENING SPEECH AND WELCOMING STATEMENT BY MARCOS BONTURI, HEAD OF THE REGIONAL COMPETITIVENESS AND GOVERNANCE DIVISION, OECD.**

I would like to thank all of the participants and especially to Mr. Jerónimo Saavedra Acevedo, Mayor, City of Las Palmas de Gran Canaria and the Government of Spain for sponsoring the conference. Mayor Saavedra outlined his commitment to climate change issues during the OECD Regional Policy Forum – “Global Crisis, Regional Responses” on March 30 in Paris and I’m looking forward to learning more about the environmental challenges and progress made in Las Palmas.

Cities generate somewhere between 60 and 80% of world energy use and 76% of the world’s energy related CO<sub>2</sub> according to a recent study by the International Energy Agency. There is no doubt that improvements in urban design, housing stock, public transit, and waste management are crucial components of a strategy to combat climate change and improve the physical health of urban dwellers. The good news is that many cities have already realised this message and are on the front lines of climate change mitigation and environmental conservation.

The participants in this Conference were jointly selected by the OECD and the Las Palmas government because of their commitment to curtailing the environmental footprint of their cities. This is being done through actions ranging from anti-sprawl land-use policies to urban forest restoration projects to public information campaigns. This conference seeks to take stock of some of the most promising initiatives, such as the installation of energy efficient technologies, climate-sensitive urban planning, and the approval of financing measures to catalyse the green economy. Through the several sessions, participants will assess the extent to which greening cities can indeed produce significant economic advantages. The climate change issue now more than ever is politically visible at the local level. Rather than simply encourage the formation of new policies, this Conference seeks to understand which “green” policies have worked and why. Given the recent creation of “green new deal” programmes in the United States and Korea, we need to begin develop more serious metrics on the actual outcomes of these programmes.

These issues have been important to the OECD community since at least the late 1980s when the OECD began working on climate change economics and policy. Today the OECD works closely with governments to assist them to identify and implement least-cost policies to reduce greenhouse gas (GHG) emissions in order to limit climate change. Our research covers:

- policy analysis on mitigation and adaptation;
- sector-specific analysis in agriculture, energy, transport, waste and tourism;
- cross-cutting issues such as clean innovation and taxation; and
- fora for policy dialogue such as the OECD Mayors’ Roundtable on Urban Development Strategy.

It is hoped that the proceedings of this conference, which will be included in a forthcoming book entitled *Competitive Cities and Climate Change*, will inform the policy debates that are occurring in City Halls throughout the world.

The diversity of the participants in this conference, who come from at least 30 thirty countries and five continents, truly make this an *international* conference. I look forward to learning from you today and in the future.

**SESSION 1-A**  
**INSIDE THE “GREEN” POLICY TOOLBOX:**  
**INNOVATIONS IN URBAN PLANNING AND GOVERNANCE**

## THE NEW MEANING OF METROPOLITAN PLANNING IN THE ILE DE FRANCE REGION

*By Vincent Fouchier<sup>1</sup>*  
*Institut d'aménagement et d'urbanisme, Ile de France*

*Cette ville qui n'a de sens que giratoire...<sup>2</sup>*  
(This city, which is one big roundabout...)

The premise of this article is that metropolitan planning can give cohesion to the sustainable development of a large urban area, as opposed to having a scatter-shot series of local projects. Our argument is based on the experience gleaned from the revision of the Ile de France regional master plan, at a time when planning is to some extent being re-examined.

### **A renewal of planning methods**

#### *Strategy + planning + operational projects*

In today's metropolitan environments, planning and strategy involve a series of non-specialised, **indicative**, contractual and regulatory procedures and topics. In the case of the Ile de France, the master plan is both a framework for regional action and a document in the hierarchy of urban planning standards that takes precedence over urban planning documents of lesser priority.

Strategy and planning have in common the fact that they call into play a whole range of partners, areas and institutional stakeholders whose numbers have been increased by decentralisation. With a population of 12 million, the Ile de France is a mosaic of different areas, each with its own identity, processes, and governance: 1 281 municipalities (whose mayors are responsible for urban planning), a hundred or so inter-communalities (town/district administrative groupings whose chairman is responsible for planning) and eight *départements* (whose policies also have an impact on regional planning). A joint framework encompassing the entire metropolitan area is clearly needed. This is a political project that must find one or more legitimate channels, and planning offers extensive potential for co-ordinating the various stakeholders.

Metropolitan planning is being considered from all angles. Sustainable development concerns have stimulated the development of metropolitan policies that take account of sustainability issues and are forcing planners to re-assess the content and methods involved. How can metropolitan planning:

- Prepare for the future when forecast trends can quickly be overturned by disruption and uncertainty?
- Express a universally accepted view when different stakeholders with divergent interests all claim that their view is in the public interest?

- Plan specific actions when so many valid options exist, and when implementation inevitably relies on an array of scattered initiatives that are difficult to control?

As a potential solution to the shortage of new housing and the lack of imagination in new construction, one often hears talk of de-standardisation, de-regulation and abolition of all forms of planning as a way of giving free rein to initiative and the market.

If we are over-hasty in considering the issues, we may be tempted to abandon the idea of metropolitan planning altogether. But how can we then ensure consistency in metropolitan development? How can we ensure the “profitability” of public spending (particularly in terms of transport)? How can we lend medium- and long-term visibility to private investment, which also needs guaranteed returns?

Large-scale planning projects, the high-profile transformation of certain metropolitan areas into showcase districts and architecture with symbolic value (for example, the tower block myth, with exaggerated press coverage) can in theory contribute to metropolitan strategy and promote its value, but such things cannot replace a planning strategy completely. Besides, how can these projects be implemented without planning? No large-scale urban operational project can succeed unless it is integrated into a larger-scale controlled planning scheme, for example in terms of transport or the environment (water, biodiversity, etc.).

In fact, the challenge is threefold: we need to come up with a collective roadmap that will serve as a reference, ensure that this will not be compromised by a series of contradictory local or individual initiatives, and implement operational projects in a coherent manner.

The polycentrism of the 1994 master plan was based mainly on the new towns and a very small number of other areas for which the state had control of the main planning levers (including absolute control of the master plan, real estate, the public planning body, finance, etc.). But the regionalisation of the planning system, followed by the handing back of responsibility for the master plan to the Ile de France region in 1995, changed things completely.

Linking long-term strategy, spatial planning and operational programming has become the key to metropolitan action, for instance for climate change policies; and it is here that planning comes into its own. In the Ile de France, the connection was greatly reinforced by the 2008 draft master plan, drawn up on the basis of a discussion process to change regional policies, the strategy for which had already been outlined in the 2006 “Regional View”.

So planning essentially becomes the framework for a metropolitan structure that provides its own construction tools and shares its plans with a number of project managers.

### ***The strength of planning lies in the consultation process***

Planning relates necessarily to governance. Things have changed considerably in this respect in the Ile de France since the early days of state-controlled planning, particularly in the 1960s. Beyond decentralisation, which was sanctioned by the review of the French Constitution in 2003 (and which declared that “the French Republic is decentralised”), it is important to emphasise that all forms of consultation are now obligatory.

An efficient metropolitan strategy now relies necessarily on a “collective authority”, and planning must adapt to that. Respect for the principles of subsidiarity as defined in the treaty establishing the European Community (under which the EU does not take action – except in areas that fall within its exclusive competence – unless it is more effective than action taken at national, regional or local level) and

the absence of hierarchy between authorities, leads to consultation on metropolitan issues and the planning tools associated with them.

All the actors involved must find their place and an opportunity to express themselves in a transparent process; priorities have to be shared. To ensure that a metropolitan project is not just the sum of multiple local projects requires strong conviction, the ability to negotiate and, preferably, significant implementation incentives, combined with the legal muscle to prohibit “local deviations” and the power to block decisions.

The planning option, which modifies the top-down approach whose legitimacy was imposed from above, leaves room for a more negotiated spatial project, which itself creates coherence between sectoral policies. Planning is veering markedly towards a more collaborative approach, which will guarantee greater compliance with implementation guidelines.

Prior consultation followed by a public inquiry leads to the modification of the content of planning documents, to make them easier to understand and adopt, more informative and less “technical”. More and more metropolitan areas worldwide, like Paris/Ile de France, are introducing new ways of involving citizens: for example, the US advocacy planning initiative,<sup>3</sup> the new initiatives in Los Angeles (“Compass”) or in Cambridge, Massachusetts (“Cambridge Futures”), all of which involve citizens in their metropolitan planning discussion processes.

The use of planning tools is changing radically. The fact that all maps are available in digital format, including the general map, which has prescriptive force, profoundly changes the nature of such documents. Now that they are no longer inaccessible, they are more transparent.<sup>4</sup>

### ***Define the strategic geography, but also consider the ordinary town***

A historical analysis of active state-controlled planning before decentralisation cannot simply be reduced to an assessment of the areas in which the state has invested resources. With the old master plans, what was the effect of planning on the metropolitan system as a whole? Is the knock-on effect of operations of national interest, particularly the new towns, sufficient to develop an entire urban area in a consistent direction, given for example that, since the 1965 master plan, the five new towns have accounted for less than 10% of new housing built in the Ile de France?

One of the new challenges facing metropolitan planning, particularly in response to environmental imperatives post-Kyoto, is to co-ordinate the development of the existing urban fabric outside the major planning operations. In the Ile de France between 1990 and 2005, approximately 60% of housing construction projects were governed only by general urban planning regulations, that is, not in controlled planning areas or housing estates. Metropolitan strategies cannot be deprived of such potential, and planning can help capitalise on it.

The problems to be dealt with are less quantitative than in the past, particularly during the baby boom, when they justified a heavy-handed approach to urban planning. Today, they call for a more qualitative approach and a combination of solutions in planning and urban management. Global warming, energy consumption and renewable energy are all placing different demands on existing developed sites. The heavy-handed approach to planning will not be an appropriate response to the challenges posed by the ageing of the population.

Finally, and for similar reasons, we can no longer confine ourselves to an argument based on the new infrastructure. Level of service is equally if not more important: aspects such as quality, frequency, speed, reliability, comfort and safety must be a part of the planning process. It was in this spirit, moreover, that



the law provided for the master plan to “co-ordinate the travel offer”,<sup>5</sup> taking precedence over the urban transport plan.

The “physical” response allowed by spatial planning in the sense of the urban planning rule is not sufficient to resolve metropolitan problems. It is, however, a prerequisite.

### ***Integrated planning***

Sustainable development in large urban areas calls for collaborative thinking and action. Planning must become an integrating force, a conduit for metropolitan cohesion in the face of scattershot local initiatives.

First, the scales of time and space must be integrated, because few problems can be resolved immediately in a single area. Then we can build a long-term future based on short- and medium-term initiatives.

In this respect, the Ile de France is fortunate to have both a regional institution covering the “functional” urban area and a document like the master plan to address medium- and long-term issues. This cannot afford to disregard the larger scale of the Paris Basin, which itself poses a series of problems (the battle against urban sprawl, economic strategy, mobility, etc.). These can only be addressed through increased co-operation between neighbouring regions (through the chairmen’s conference, the “C8”) and with the state, but without a formalised regulatory framework.

It is also necessary to integrate the solutions to sectoral issues that can no longer be dealt with separately:

- A solution to the pressing need for more new housing cannot be found by going through the official channels that deal with housing alone: it requires the mobilisation of the real estate sector, the provision of amenities and services, improvements, etc.
- Economic attractiveness does not depend solely on the real estate sector but is heavily determined by a series of non-economic factors, *e.g.* quality of life, educational level, accessibility and social integration. The urban riots of 2005 did far more damage to the image of the Ile de France Region than the purported lack of available real estate.
- The response to climate change response cannot come only from technical improvement in buildings or vehicles: cities have to adapt in order to facilitate new forms of proximity and alternative means of transport.

Planning design can now rely on some exceptionally advanced tools. An environmental assessment can now interact directly with the project design, thanks to the potential for cross-referencing a vast amount of data from geographic information systems. It is becoming possible to precisely test the territorial and quantitative impact of regulations as they are being written, and to give priority to urban development in the areas that offer the greatest opportunities (available real estate, accessibility by rail now or in the future, housing/employment balance, etc.) and the least constraints (flooding, risks, environmental quality, biodiversity, etc.), while at the same time ensuring metropolitan cohesion.

### ***A modest, flexible approach to planning***

It has become common practice for local authorities to promote their own area, which can sometimes result in the formulation of appealing but unrealistic objectives, including in planning documents. Planning

strategy, whether articulated prior to the planning stage or actively part of it, is itself becoming a vehicle in which urban areas promote themselves, displaying their ambitions and specificities: planning must reflect this. It is not surprising to discover a decade or two later that these ambitions, elevated to the status of objectives, have not been realised. For example, the population growth forecasts on which previous master plans were based have generally proved to be wrong. To illustrate this, we may recall that the 1965 master plan proposed the construction of new towns in response to the prediction that the population of the Ile de France would grow to 14 million by 2000. In 2009, we are still 3 million short of this figure. It is therefore advisable to be cautious in the use of forecasts. Their primary function must be to speculate about the range of possibilities, which can turn out to be wider than predicted. Similarly, economic growth and employment are by nature unpredictable, particularly with regard to globalisation, as is evident from the current crisis. Planning is an element that can enable us to guarantee certain conditions for development, but not development *per se*.

Planning can also have an effect on the use of private cars through the choice of the location and form of urban expansion, but changes in the cost of fuel or public attitudes, for example, which are much less easy to control through planning, often have a much greater impact.

The same applies to emerging issues associated with greenhouse gases and energy. Planning, taken in its regulatory sense with respect to land use, can only have an impact on a limited part of the problem to be dealt with. It is important to ensure that planning fully plays its part while being linked to an array of similar public and private policies, with a view to meeting set objectives. Planning, programming and the territorialisation of public policies must therefore go hand in hand.

Faced with the current uncertainties and upheavals, the first effective response is to seek flexibility and robustness, and to avoid confining planning within an excessively rigid framework. However, the right balance must be found to maintain one specific aspect of planning's added value, namely its ability to offer a transparent, collective expression of the main guidelines of the long-term regional development programme.

The monitoring and assessment procedures that accompany planning have a central function. Planning can no longer be set in stone until the appointed completion date. We have to accept that it will change, without undermining the fundamentals, for example based on a phasing according to the observed growth rate or the resources available for its implementation.

### **The Ile de France long-term master plan (“SDRIF”): an integrated tool against global warming**

Stretching across the Paris agglomeration and its large metropolitan area, the Ile de France Region has understood the importance of a comprehensive vision for the future since the beginning of the 20<sup>th</sup> century. It possesses a planning document unique in France. Its Regional Master Plan (*Schéma directeur de la région Ile de France*, or SDRIF) is not only a long-term strategic framework for co-ordinating a broad range of public policies and private actors. Remarkably, for a region the size of Ile de France, it is also a land use document that regulates local master plans.

The capital region, with 11.4 million inhabitants, is the only global city in Europe beside London. One of the unique features of the region is its institutional situation: of a total of 1 300 municipalities, each (including central Paris) has a mayor in charge, among other things, of urban planning. There are also eight counties, which makes regional metropolitan governance a challenge in and of itself. The SDRIF, then, is a key tool for co-ordinating local urban policies in a wider and long-term framework.

In 2004, the region's elected assembly, the Regional Council (*Conseil régional d'Ile de France*), began the long process of revising the SDRIF in order to better respond to the challenges of the present. A

“world region” that stands out for its economic competitiveness and quality of life, the Ile de France shares a number of concerns with other big metropolitan areas: a critical housing shortage, new forms of competition and changes in its economic fabric, global warming and rising energy costs, social and territorial inequalities, and residents’ demands for a higher quality of life.

On 15 February 2007, the Regional Council approved the first version of a new SDRIF, which offers a concerted response to these challenges. It then consulted again with its partners, modified the document and approved it in September 2008. Its goals for the next 25 years are to build the world’s first “Eco-region”, adapt to the global warming context, reduce social inequalities, and develop a dynamic Ile de France capable of maintaining its international rank.

These goals translate into a series of ambitious objectives: to build 1.5 million new housing units by 2030 and expand affordable housing; limit sprawl by directing new construction towards existing urban spaces; implement one of the most ambitious transportation programmes in the region’s history; revitalise priority sites while boosting the region’s most competitive areas; and promote the Ile de France’s rich natural resources.

Such ambitious plans cannot be imposed from above, and the Regional Council has made sure that the elaboration of a new plan for Ile de France was as inclusive as possible. The result has been a constant innovation in public partnerships and participative democracy: new alliances for piloting the revision of the SDRIF, over 50 public workshops and forums, novel “citizens’ conferences”, a detailed floor debate in the Regional Assembly and an unprecedented public review process.

This paper will explain the most innovative aspects of the SDRIF project, both in terms of process and content, a strategic plan for a sustainable, socially cohesive, and competitive metropolitan region, focusing on innovations related to climate change objectives.

### *A unique planning system, transformed in the 1990s*

Since the 1920s, when haphazard construction took over the outskirts of Paris, the capital region has been required to implement a master plan. This regional plan has since been revised several times to meet new challenges and has shaped the Ile de France of today, most remarkably through the new towns, rapid regional transit system, and highway network that were built in the post-war years.

Today, the region enjoys a planning system unique in France. As in the case for other regional plans, the SDRIF serves as a strategic vision for the development of the region over the next 25 years. It reconciles the myriad policies that influence the evolution of the region and co-ordinates a series of other strategic documents, such as the region’s traffic plan. But unlike other regional plans in France, the SDRIF is also a prescriptive land use document, controlling spatial growth across the region. Local master plans must be compatible with its orientation.

In both its guises, a number of key missions are conferred upon the SDRIF by national law:

- control urban growth and land use;
- guarantee the international rank of the capital region;
- correct social, economic, and spatial disparities in the Ile de France;
- co-ordinate transportation options;

- preserve the region's open spaces and rural areas;
- respect the principles of social diversity and mixed-use development and fight against air and noise pollution.

In particular, it determines land use; the means of protecting and making the most of the environment; the location of infrastructure and key services; and the preferential location of urban growth and industrial, craft, agricultural, forestry and tourist activities.

The SDRIF in effect today dates to 1994. Since then, a series of laws have profoundly modified the legal and institutional framework of planning in France. This legislation has introduced the prerogatives of sustainable development, reinforced inter-municipal planning and governance, promoted greater coherence among the different areas of public policy, reinforced local democracy and public reviews in the planning process, and required detailed environmental evaluations for all new plans.

One crucial transformation in the past decade has been specific to the Ile de France. Like its predecessors, the SDRIF of 1994 was created and continues to be enforced by the national state, a singular status reserved for the capital region. A 1995 law, however, turned over the prerogative of revising the SDRIF to the Regional Council. For the first time, the regional government is at the helm of the planning process in the Ile de France.

Meanwhile, the regional government must work in association with the national government and in close partnership with the local governments of the metropolitan area. The national state has retained key prerogatives in the realm of land use and urban development; particularly in promoting "national interest" projects, regulating local planning, and guaranteeing that regional policies do not interfere with the prerogatives of local governments.

### ***An unprecedented co-operation for a shared regional project***

Learning from the lessons of the SDRIF of 1994, whose effectiveness was limited by the lack of institutional momentum it generated, the Region has gone far beyond its legal obligations and engaged its various partners in the creation of a shared regional project.

Three forums have been organised to synthesise these reflections and debates at key points in the revision of the SDRIF. The last of them, in October 2006, presented the fruit of over two years of participatory planning: a watershed document entitled *A Regional Vision*, voted by the Regional Assembly to define the collective goals for the Ile de France and serve as a mandate for the writing of the new SDRIF.

The first drafts of the new SDRIF were unveiled in the fall of 2006 and then went through *a democratic process of revision*. Thousands of requests for modifications from associations and public institutions were processed. Then the Regional Council discussed the plan in detail over two days and one night of debates; it considered over 300 amendments before approving an initial version of the new SDRIF on 15 February 2007.

Today, this collective creation of the region's future continues with an *unprecedented review process*. Official opinions on the plan have been collected from a series of public partners designated by national law. In the fall of 2007, public review hearings were held in 187 locations, in order to give the 11 million residents of the Ile de France an opportunity to suggest modifications. This public enquiry was ended by a formal positive conclusion of the independent commission and some minor modifications of the project.

The Regional Council has finalised drafting of the SDRIF, and a national decree will be necessary to give the new SDRIF a legal value.

This exceptional co-operation will be continued after the plan's final approval, in order to ensure that the regional project is translated into reality. The Regional Council has announced plans for a series of *partnerships for the implementation and evaluation* of the future SDRIF. The institutional framework already established for the revision process will be maintained, in the form of an executive committee, a technical committee and a "regional conference".

A new collaboration between the Region and the National State in the regulation of local planning and construction, a regional land agency, and contractual agreements with local governments, will also help co-ordinate the myriad actors of Ile de France around a collective project for the region's future.

The consultation and participative process on this scale has given legitimacy to the project. The former SDRIF was adopted by the national state, with virtually no institutional consultation and buy-in from regional institutions: in 1993-94, it was rejected by almost every single county council and from the Regional Council. The state imposed it nevertheless, and the plan has not been voluntarily implemented since then. Extensive consultation is an efficient way of supporting climate change objectives.

**Box 1. Figures illustrating the intense institutional and public consultation on the 2008 draft Master Plan**

- 39 regional workshops and 12 thematic workshops
- 5 000 participants in the four forums, symposiums and conventions
- 3 public debates
- 50 000 responses to a regional survey
- 200 000 explanatory leaflets distributed by the Region
- 1 076 letters addressed to the chairman of the inquiry commission
- 3 045 comments noted
- One public inquiry throughout the Ile de France (187 locations, 343 surgeries held)
- A favourable recommendation unanimously declared by all 19 inquiry commissioners

***Challenges and objectives for sustainable development***

The SDRIF project identifies three major challenges for the Ile de France, each with a wide range of consequences in the master plan's more sectoral topics:

- *Promote social equality and create a better balance and solidarity between the region's different territories.* The goal is to reduce regional disparities, which have an important impact on quality of life and social cohesion, and also on international appeal (the 2005 riots in Paris' suburbs left a bad impression of the capital abroad for some time). Such social disparities are exacerbated by diverse local problems such as airport noise, lack of public transport, lack of green spaces, etc.;

some jurisdictions suffer from the cumulative effect of all these problems and are calling for a strong public policy to resolve them, through the regional master plan.

- *Respond to the major transformations and crises being produced by climate change and the rise in fuel costs.* The goal is to adapt the region to the new challenges of energy and global warming, and to promote urban development that leads to more public transport uses (less car use) and higher densities (less consumption of land).
- *Develop a dynamic Ile de France capable of maintaining its international rank.* The goal is to help the region's territories to be successful and appealing on an international scale in the globalised economy. Some parts of the region are already well positioned and produce a large part of the value-added: these need to be better structured and connected to adapt to the new economy. Other parts of the region have potential, but need concerted help, both in terms of international connectivity and global approach for a better territorial attractiveness.

In response to these wide challenges, the SDRIF identifies five major goals.

*Respond to the current housing shortage with an ambitious construction programme.*

Housing in the Ile de France is in deep crisis, owing to insufficient construction. Prices are as a result so high that low-income and even medium-income families can no longer afford to buy or to rent a flat. The demographic exchanges between the region and outside are negative, partly due to this housing shortage. An illustration of the problem can be given by a simple comparison: the Ile de France now ranks the lowest among other French regions in terms of housing construction per 1 000 inhabitants.

The SDRIF aims to build 1.5 million dwelling units in the next 25 years, a marked increase over current construction rates of 60 000 units per year, and compared with the trend since 1990 of less than 40 000 units.

*Make Ile de France the first "Eco-region"*

The area has an exceptional number and diversity of open spaces, the legacy of its historically dense urbanisation. The SDRIF aims to take advantage of the region's natural resources and give all residents access to a high-quality environment. A key point in this respect is the goal of reducing land consumption for urban uses. The project opens much less space for new urban areas than the former Master Plan (1994). This is crucial if car dependency is also to be reduced.

Many environmental resources have to be protected through the regional master plan, not only in terms of protected areas, but also in terms of the relationship between areas of environmental value. For instance, ecological corridors have been introduced in the SDRIF, to ensure that animal and plant species can migrate from one place to another. This represents a new dimension in a master plan.

*Guarantee the region's economic competitiveness, attract new jobs, and stimulate growth*

One of the roles of the SDRIF is to express the territorial strategy for economic development in the region. As an answer to the third challenge explained before, the SDRIF has to create the optimal conditions for economic activities of all kinds. This is an uphill task for the Regional Council, for two reasons: first, prospective studies of job location until 2030 are very uncertain. Second, a large proportion of municipal taxes derive from economic activity; and local authorities are fearful of losing financial resources if the Regional Council chooses to locate employment outside their jurisdictions.

### *Implement a new transportation policy that ranks among the most ambitious in the region's history*

The goals for the next 25 years are to reduce automobile dependency, rationalise the extensive public transportation system, and better articulate transportation planning and new urban projects. The transport strategy of the SDRIF is based on a determination to develop the quality and efficiency of the public transport network. While it is already one of the best in the world, more could be done. Two new circular metro lines are expected to better link the metro lines converging on Paris' centre, one at 5 to 8 kilometres from the city's centre and the other at 15 to 20 kilometres. The idea is to propose a full network, like the existing one at the centre of Paris, but a little less dense.

To restrain urban sprawl, the SDRIF will considerably cut back the road projects proposed in the former Regional Master Plan (1994). It will also limit the new extensions of rail lines far from the centre, for the same reason. These choices make a real difference with the former SDRIF, making possible a marked decrease in car dependency and hence less CO<sub>2</sub> emissions and energy use.

### *Provide the region with quality equipment and services*

The plan seeks to reinforce social cohesion by ensuring that these services are accessible to all the region's residents. Again, access by public transport and co-ordination with urban development are key elements.

### *A spatial project for sustainable development*

These goals correspond to a spatial project that promotes a better organisation of the region and real solidarity between its different areas.

### *Restrain sprawl in the metropolitan region*

Both population and employment have migrated from the centre of Paris. Since 1975, within a radius of 10 kilometres from the centre of Paris, 10 000 jobs and 9 000 inhabitants have been lost; the decrease in jobs has mainly occurred within a 5 kilometre radius. Conversely, between 15 and 35 kilometres, the growth was more demographic than economic.

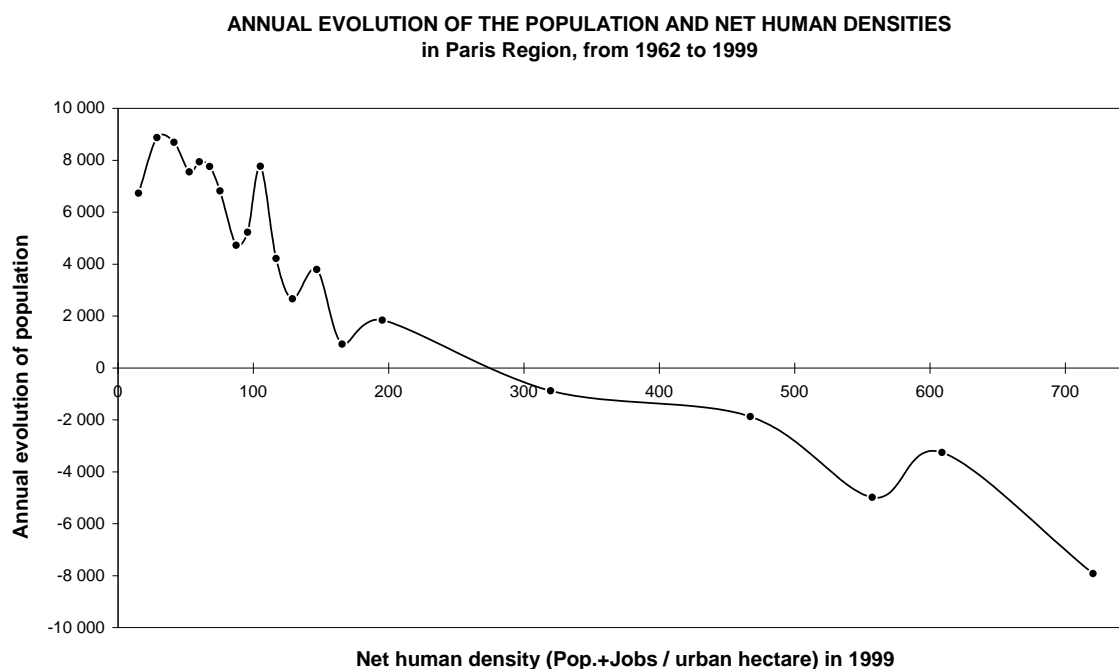
Urban sprawl in recent years has considerably slowed. In 1962, the rate of growth of sprawl annually was more than three times higher than it was in 1990. It was also closer to the centre of Paris than it is today. The problem of sprawl in the metropolis is now very different from in the 1970s, and it would be a mistake to continue to apply the same (inefficient) tools to constrain it.

### *Increase urban densities*

The "density gradient" between the centre and the periphery is important. Within a 10 kilometre radius of the centre, the human net density falls from 600 inhabitants+jobs/urban hectare to only 100. Outside a 10 to 15 kilometre radius, the density gradually decreases, reaching 20 inhabitants+jobs/urban hectare at 50 to 70 kilometres from the centre.

The shape of the gradient has not changed for a long time. But the average human net density has fallen from 90.8 to 85.4 in the period from 1982 to 1999: a 5.9% decrease, mainly in the last decade, thanks to a period of slow growth. This explains why, despite zero demographic and economic growth, urban sprawl is still running at the same pace than before: around 1 430 hectares are urbanised each year in Paris Region. This trend is not sustainable.

Figure 1.



Source: Fouchier, after RGP-INSEE.

#### *Making sense of the relationship between density and mobility*

At the Paris region scale (10.8 million inhabitants), the statistical relation between car ownership per person and net human density for the 1 300 municipalities is clear: the denser the zone, the lower the car ownership.

Car ownership is 0.27 car per inhabitant in Paris *intra muros* (which has smaller households), compared with 0.52 in the rural zones in 1999 (the regional average is 0.38). Between these two extremes, there is a wide spectrum of car-ownership rates. Geography, morphology and socio-economics can considerably modify car ownership rates, even for areas of similar density.

Outside Paris, long distances, lack of public transport, fluidity of traffic and availability of parking make car use very convenient and even necessary in less densely built areas. The situation is totally inverted in the densest sectors, where owning and using a car is less attractive because of the cost and scarcity of parking spaces, congestion, and because public transport is a viable option.

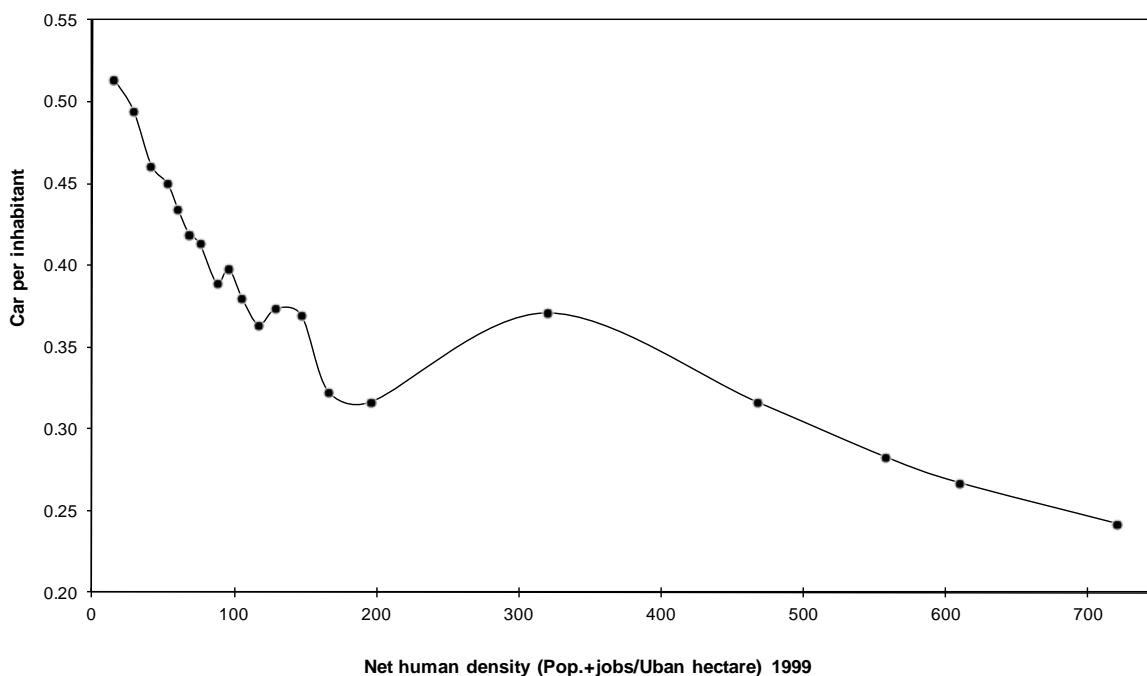
Density offers the freedom of not using a car. Households without a car range from one in ten in the least dense areas to six in ten in the densest areas.

The hidden fact is that density is one of the two faces of proximity: a geographical proximity. But distance can be erased by movement and replaced by mobility, which is the second face of proximity.

Rapid population growth has occurred in zones where densities are the lowest, not in Paris and its very close suburbs. This rapid growth in the less dense zones, where car ownership is higher, is the main source of increase in the number of cars in the region.



Figure 2. Number of Cars per Inhabitant According to net Human Density, 1999



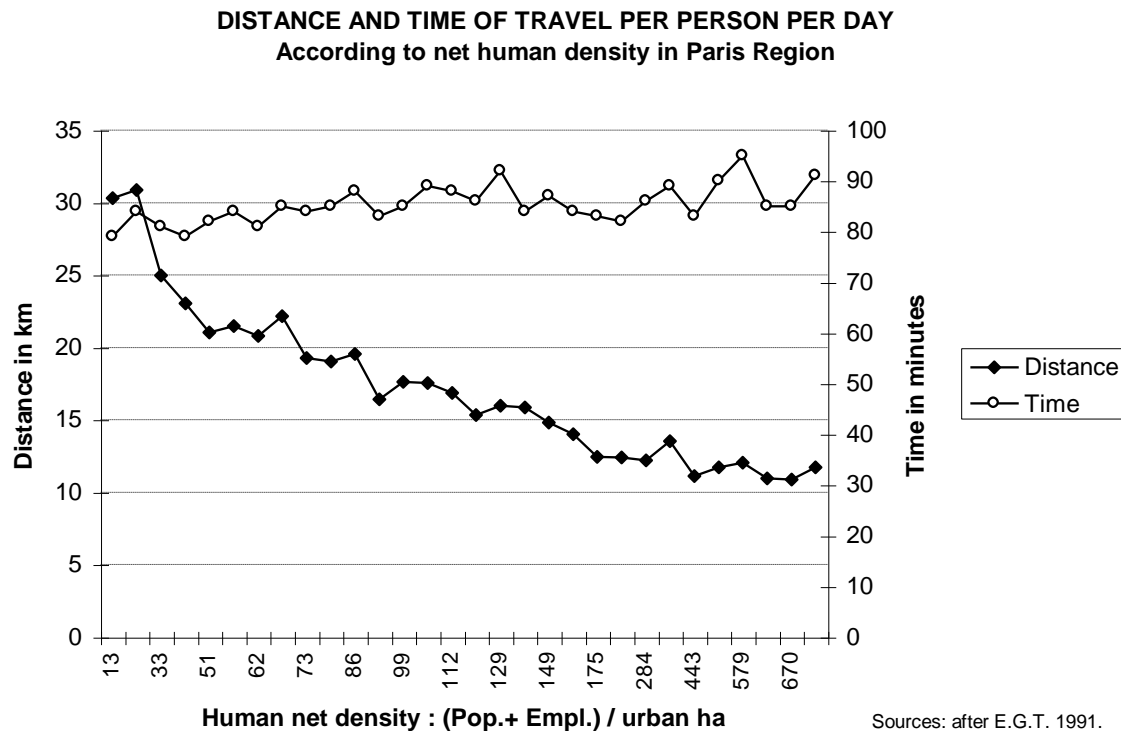
Source: Fouchier, after RGP-INSEE, in Paris Region.

The increase of car ownership per person is six to seven times more rapid in low-density than in high-density zones, where it is almost stabilised.

This can be attributed to various factors. A generation of suburban children arriving at driving age, an increase in household purchasing power, car ownership among new suburban inhabitants, a rising rate of employment among women (who need a car to go work), all increase the effect of rapid demographic growth in the periphery.

Car ownership must of course be distinguished from mobility, since residents may own a car and not use it. The distance covered per person per day, whatever the mode of and reason for the trip, reveals a very distinct curve: the higher the net human density of the residence district is, the lesser the distances travelled daily. Residents of municipal districts with a high net human density travel distances that are 2.6 times less than their counterparts in municipal districts with lower densities: 11.7 kilometres/day, as opposed to 30.3.

Figure 3.



- Distance travelled is of some value in measuring physical proximity, but not the time required to travel this distance. A long distance may be covered more quickly than a short distance depending on the means of transportation, the topographical characteristics and the saturation of the networks used. For the individual, transportation time is a variable as important as distance and costs. And we can measure that, whatever the density, the daily time of travel in Paris region is the same.
- This point is an essential one. The main reason worth noting is an average trip speed that is lower for residents of high-density areas, due both to congested networks and to a modal split less in favour of the car (usually faster than public transport). For public authorities in charge of planning, the main lesson is that the improvement in accessibility afforded by expensive new infrastructures is turned by individuals into a gain of space and not a gain in time.

The split of urban functions, often linked with the extension of low density, is additionally responsible of the increasing the importance of the car as the mode of transport. The efficiency of public transport in uni-functional zones (industrial zones, for example) will never be as attractive as that of cars. A large part of recent urbanisation consists of the relocation of facilities or activities formerly located in denser spaces, which are better served by public transport. The new out-of-town shopping and leisure developments compete with those staying in the city centre and encourage automobile use.

When cities relied on inefficient means of transport, proximity was only possible through density and mix of activities. But accessibility is not now dependent on proximity. Density is then almost useless. Proximity has to be evaluated in terms of time and not distance. The increasing speed of travel makes it possible for people to live further from work and other activities, thanks to technical progress and the construction of new infrastructure. Accessibility is then multi-form, and cities can expand.

Today, public authorities have a choice: do they want to extend urban areas, taking the risk of breaking the physical links of proximity, through increased mobility (by car) or more telecommuting? Do they want to intensify cities and take advantage of proximity, through an increased use of public transport?

A large urban area such as the Paris region, even without population growth, tends to need more and more built spaces. Where and at how dense this construction should be is a central question treated in depth by the Regional Master Plan project (SDRIF). Its purpose is to deal with the challenge of climate change.

### *The compact city, through density and urban quality*

Planning in the Ile de France has long aimed for a polycentric region with strong, structured territories outside Paris. While the new SDRIF continues this heritage, it also emphasises the importance of a compact region and focuses new attention on the historically dense urban core of the agglomeration. With the goals of limiting traffic and curbing urban sprawl, the SDRIF encourages higher density in existing urban spaces and affirms a priority for areas serviced by public transportation. As a prescriptive land use document, it reworks the map of constructible land, seeks minimum densities for new urbanisation, and places conditions on the urbanisation of certain areas.

But density is only sustainable if it translates into urban spaces with a high quality of life. That is why the revision of the SDRIF has been placed under the sign of urban “intensity” – linking the creation of dense neighbourhoods to the production of quality public transportation, parks and open spaces, services, and jobs.

Every potential area for densification has to be used, and the SDRIF tends to find all kind of methods for this:

- the general map of the SDRIF (which must be respected by local plans) identifies preferential sites for densification: the rules of the SDRIF prescribe that municipalities make their best efforts to turn them into high-density urban districts, either because they are under-used today, or because it plans new public transport links, which will give them a new value.
- The SDRIF makes it compulsory for all municipalities to increase their local average densities. It will no longer be possible for a local authority to refrain from construction: every municipality must take part in the regional efforts.
- Other rules expect that districts around public transport stations (express railway, metro, tram) will also be densified, to make better use of the offered accessibility.
- As a “balance” with the important reduction of the surface of new possible urban extensions, the SDRIF makes it compulsory to build the new districts (*i.e.* not densification of existing urban areas) with a minimal housing density, much higher than current practice.

France’s government, as well as the Chamber of Commerce and other institutions, have debated with the Regional Council over these choices, which they consider too ambitious and not necessarily welcomed by mayors and citizens. Densification represents a major shift in planning in the Ile de France. The principle of densification is now generally well accepted at the regional scale, but the level of ambition and the local application of this principle is less appreciated.

The counterpart of this *ville compacte* is the plan’s strong effort to preserve and mobilise the region’s open spaces, whose economic, environmental, and public uses are now better acknowledged. Two

particularly important steps in this direction are the strengthening of a network of green spaces that runs through the central agglomeration and the creation of “biological corridors” in the outer areas of the region.

Finally, the new SDRIF continues long-standing efforts to develop the metropolitan area around a network of strong, structured centres. The plan’s ambitious transportation program plays a key role in this effort; it will help structure the region’s urban core and give a boost to the new dense neighbourhoods called for in the SDRIF. In addition to reinforcing the region’s historically “radial” transportation system, which spans outward from Paris, the new SDRIF calls for a number of new high-capacity lines running around the centre of Paris.

#### *A network of strategic areas and priority sites*

The SDRIF also identifies the specific territories in which efforts need to be concentrated and co-ordinated in order to realise this ambitious project.

It distinguishes two kinds of territories:

- **Strategic areas**, which will play key roles in achieving the economic and environmental objectives set out in the plan. These include, for instance, the new towns and national project sites (where the state can impose urban development for national reasons).
- **Priority sites**, which are particularly concerned by the SDRIF’s goal of reducing social inequalities and strengthening solidarity across the metropolitan area.

In addition, the SDRIF accords *waterways* a strategic role in its spatial project. Rivers link the region’s different areas and touch upon all of its goals for sustainable development: the concern for a vast, interconnected ecosystem; the search for sustainable forms of transportation and economic growth; and the goals of urban requalification and a higher quality of urban life through the re-opening of waterways to the city.

### **Notes**

1. Vincent.fouchier@iau-idf.fr.
2. Quotation from the novel *La revanche de la colline* by Hervé Prudon (Série Noire collection, 1996), set in one of the Ile de France’s new towns.
3. [www.partizipation.at/advocacy-planning.html](http://www.partizipation.at/advocacy-planning.html)
4. See the regional master plan reference guide at [www.iledefrance.fr/referentiel-territorial-sdrif/](http://www.iledefrance.fr/referentiel-territorial-sdrif/)
5. Article L141-1 of the urban planning code.

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## DEVELOPING AN ECO-MODEL CITY IN JAPAN TOYAMA'S COMPACT CITY STRATEGY – REDUCING CO<sub>2</sub>

*By Masashi Mori  
Mayor of Toyama City, Japan*

Toyama City has adopted projects that aim to reduce CO<sub>2</sub> emissions by promoting a strategy called *Compact City Formation*. I believe that the city's efforts can offer something applicable to other cities worldwide.

### **Introduction: Challenges the city faces**

#### *Geographical overview*

As is well-known, Japan is a small island nation in the Pacific Ocean. Toyama City is located centrally on the Sea of Japan coast of the main Japanese island. Facing to the east of Toyama is the magnificent 3 000-metre *Tateyama Mountain Range*. To the north of the city lies Toyama Bay, a 1 000 metre-deep treasury of marine life. All this contributes to an area of first-class natural beauty, stretching across 4 000 metres from the top of the mountains to the sea bed (Figures 1 and 2).

At the gateway to the *Tateyama Mountain Range*, a tourist bus ride between snow walls is one of the most popular attractions (Figure 3). These snow walls are formed when snow is ploughed after a long winter. The walls, which can be as high as 20 metres, are an amazing sight created by nature and man. Tourists from all over Japan visit these snow walls, and many have also recently come from Asian countries such as Korea, China and Taiwan.

**Figure 1. The location and geography of Toyama City**



**Figure 2. The Sea and Tateyama Mountain Range**



**Figure 3. The snow wall of Mount Tate**



### *Low population density*

Toyama City had 417 513 inhabitants as of 1 May, 2009, in an area of 1 241.85 square kilometres. Population density is 336.2 persons per square kilometre, the lowest among prefectural capitals in Japan. There are some reasons for this. First, Toyama City has a large habitable area, thanks to its flat terrain. Second, Toyama's citizens prefer to own their homes. Third, Toyama has a high rate of road development, which encouraged the city to expand into suburban areas. Finally, lower land prices in the suburbs and relatively expensive collective housing accelerated the development of detached houses in the suburbs. Flight from the city centre has become a major problem.

### *High car dependency*

Until recently, Toyama's citizens were dependent on vehicles. The number of cars per household is 1.75, the first or second highest among Japanese cities; 84% of commuters are car users (Figure 4). As a result, the number of bus users has decreased significantly and the use of public transportation has declined.

As for local bus service, the number of riders decreased by 67% between 1989 and 2004 (Figure 5). In other words, ridership has fallen to one-third in the past 15 years, and residents have come to depend increasingly on cars.

**Figure 4. Commuter transportation**

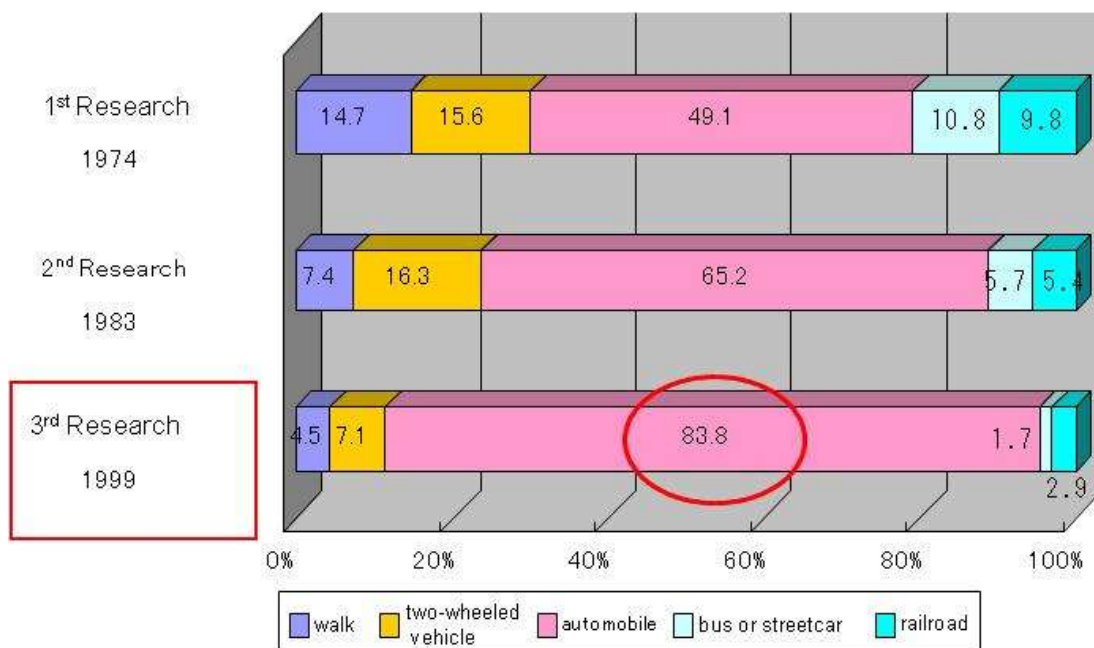
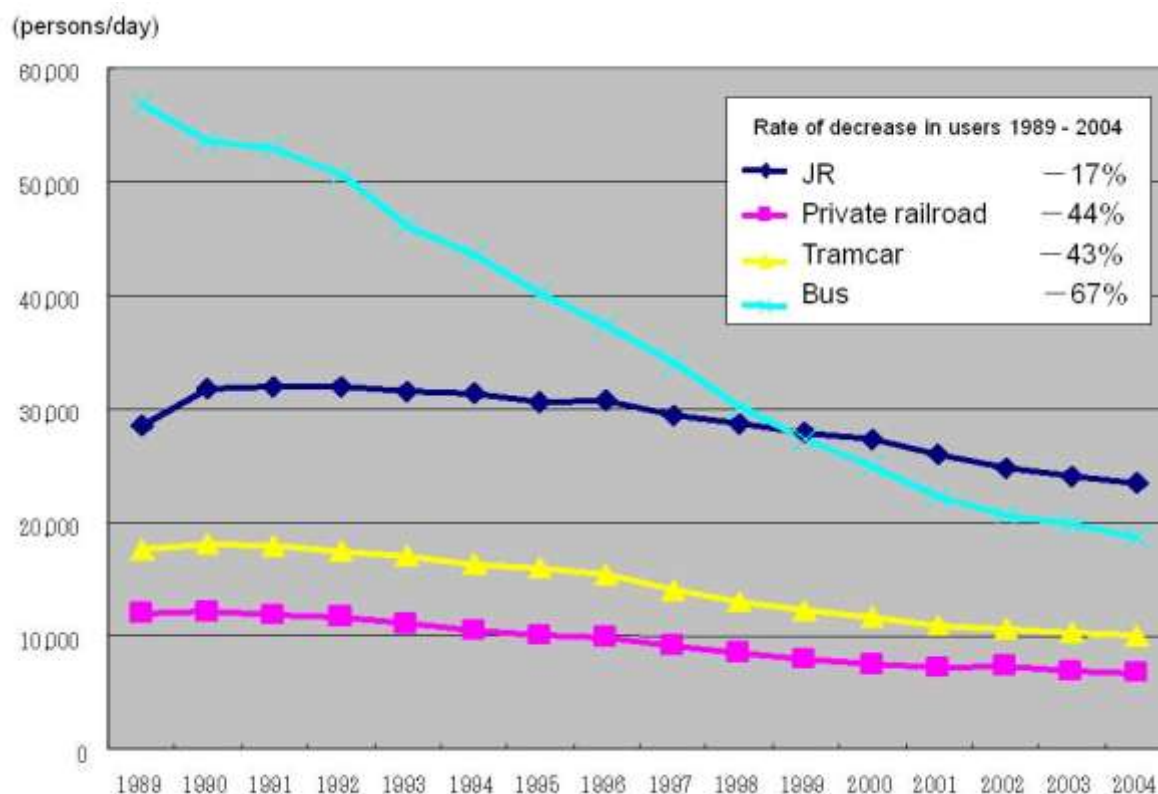




Figure 5. The decline of public transportation



## “Compact City” strategies for Toyama

### *Plans for a compact city with better public transportation*

Toyama City so far has been engaged in typical, expanding city planning. If this continues, it will entail various adverse effects, such as:

- a larger amount of carbon dioxide emissions;
- ever-rising administrative costs caused by the extension of streets that need snow removal and garbage collection;
- an extremely inconvenient city for people without cars, and
- an unattractive city with a hollowed-out city centre.

All public transportation in Toyama City converges on Toyama Station, which has inspired the concept of “Compact City Formation”. The intent is to concentrate city functions (*e.g.* business, residential, commercial and cultural amenities) in the city centre and along railway lines, by improving public transportation (Figure 6).

### *Aiming for population growth along public transportation routes*

The first step toward a “Compact City” is to enhance the quality of public transportation and to make the city centre a more attractive place. In achieving these goals, the city will see a gradual migration of

citizens from the suburbs into the areas where convenient public transportation is available. Toyama City has started a long-term (about 20-year) city plan, aiming to increase the number of people living in the best-served transportation areas (targeted areas) by 14% of the total population, from the current 28% to 42% (Figure 7).

Figure 6. Targeted areas and public transportation network

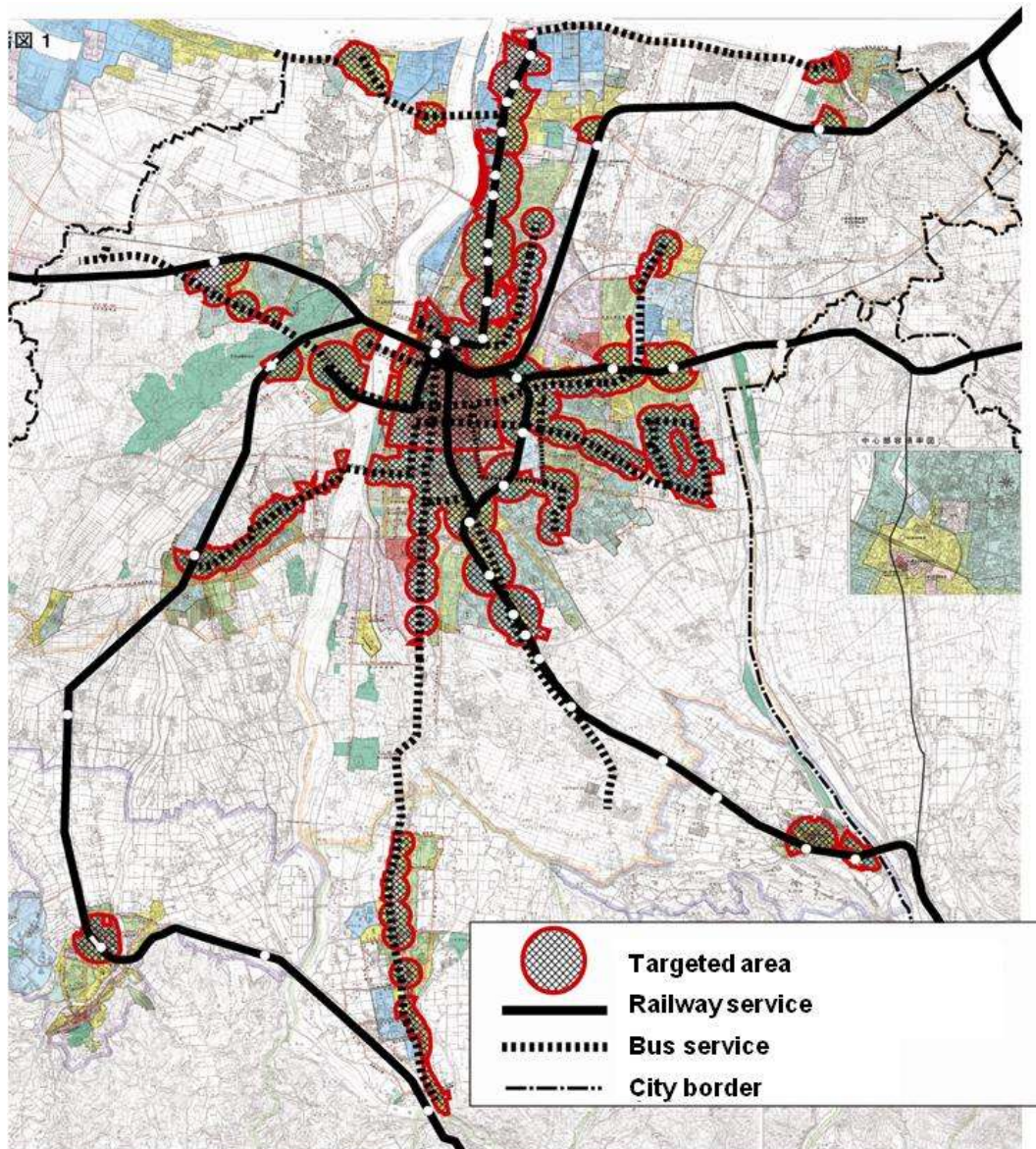
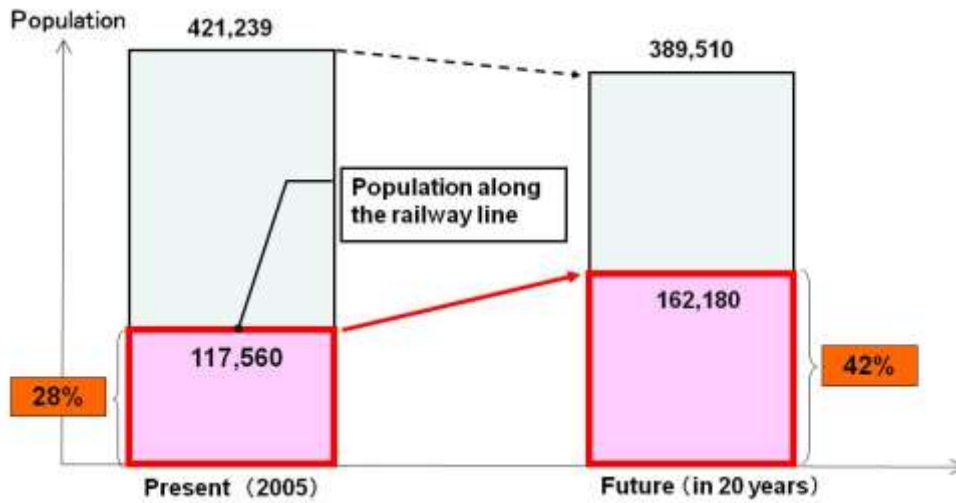


Figure 7. Planned demographic change in the targeted area in 20 years



### The Toyama Light Rail Transit Project

#### Introducing a total design

Public transportation in Toyama was once trapped in a vicious circle: the fewer the passengers, the less frequent the train service. However, the city administration was able to recover passenger traffic by heavily investing in the Light Rail Transit (LRT) system, which has been able to offer better service.

The LRT line used to be operated by the West Japan Railway Company (JR West), and was scheduled to be phased out in February 2006. Two months later, however, Toyama City restarted it as Toyama Light Rail Transit, the first full-scale LRT system in Japan. It was a project of Toyama City, the first of its kind in Japan, to convert a local JR line that had suffered from ever-decreasing numbers of passengers into a full-scale LRT. It is a public private partnership project, with facilities installed by the public sector and operated by the private sector. The new Toyama Light Rail Transit provides a much better quality of transportation, such as:

- more frequent train service,
- existing stops remodelled as barrier-free and some brand-new stops, and
- an introduction of a user-friendly train, which is low to the ground (Figures 8 and 9).

Figure 8. Improved service quality after the introduction of LRT

	JR Toyama Port Line		LRT
Service schedule	every 30~60 minutes	→	every 15 minutes (10 minutes during peak hours)
First train/Last train	5am/9pm	→	5am/11pm
Stops	9 stops (excluding for Toyama Station)	→	13 stops
Vehicles	Railway vehicles	→	All low floor vehicles
			Flat fare of 200 yen

Figure 9. Installation of new tramcars

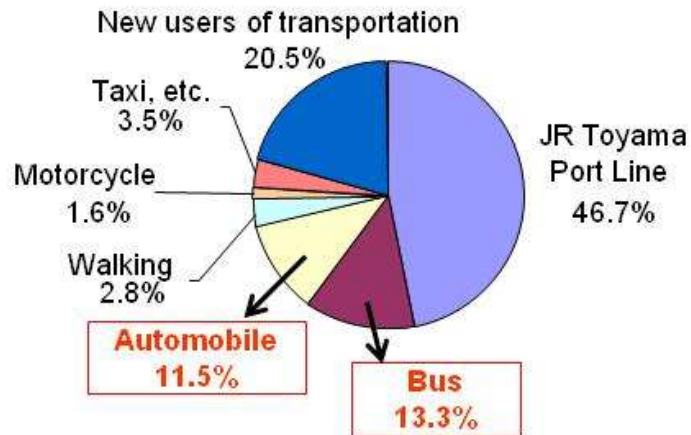


### *Effect of Toyama LRT*

After the new Toyama LRT service started, the number of passengers has more than doubled, from 2 266 per day to 4 988. About 25% of passengers have switched from cars to bus service, which is helping reduce the burden on the environment (Figure 10).

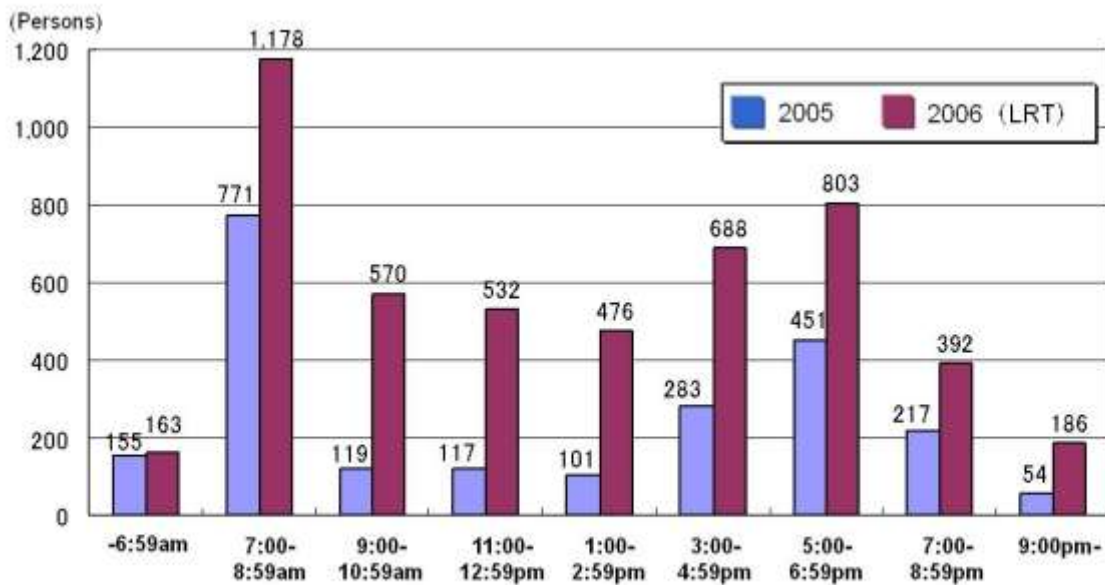
This increase is more marked during the daytime than during commuting hours (Figure 11), thanks to trips by residents in their 50s, 60s, and 70s. It is hoped that a larger number of elderly residents who live close to the line will use it, and that it will help them lead active lives.

Figure 10. Previous means of transportation of weekday users



Source: Questionnaire survey conducted by Toyama City.

Figure 11. Number of passengers by time periods



### *Networking the LRT: Loop Line Project*

As the next step, another project under way is to bring back the loop line, which had fallen out of use, into the current tramcar system in the city centre (the Loop Line Project). The city is laying railway tracks and extending the existing line into a complete loop so as to vitalise the downtown district and to increase the flow of people. As was the case with the LRT, the principle of “public installation and private operation” is being applied to the project. The city government will fund the installation (laying railroad tracks and buying new tramcars), while the private sector (Toyama Local Railway Ltd.) will be operating it.

Along the tramcar circle, public facilities such as a library and rental houses for the aged are located in high concentration, making the substantial investment focused and more effective.

The existing LRT and the Loop Line, as well as the tramcars and the railroad extending south, which are both planned to be converted to the LRT, will be integrated into a full transport network.

Figure 12. Location of the Loop Line Project and the New Extension



Figure 13. Image of the Loop Line



## **Keys to success: good governance and strong leadership**

### ***Public/private partnership***

In most Japanese cities, the railroad business is operated by financially independent enterprises. However, in smaller cities, it is difficult to run the business based only on revenue from fares. In Toyama's case, public installation and private operation has made it possible to run a sustainable railroad business.

A total of about 5.8 billion yen of public funds was spent on the new Toyama LRT project. Of these funds, JPY 2.2 billion came from the national government, JPY 900 million from Toyama Prefecture, and Toyama City paid the remaining JPY 2.7 billion. JR West, which terminated its operation of the JR Toyama-ko (Toyama Port) Line, contributed JPY 1 billion to Toyama City.

At the operation stage, the City of Toyama supports the costs of maintenance, repair and improvement of facilities, while Toyama Light Rail Company, a third-sector rail company, is responsible for the operation costs and services.

### ***Skilled and enthusiastic resources***

At the city assembly in May 2003, the mayor declared that Toyama Light Rail Company would take over the JR Toyama-ko (Toyama Port) Line, and inaugurate a new LRT system in 2006. The city administration immediately established a new section in the department of city improvement, to specialise in LRT preparation, including planning, construction and inauguration. At the same time, Toyama Light Rail Company co-operated with other private railroad companies, gathering staff familiar with railway regulations, schedule planning and operations.

The construction started in February 2005 and was completed in only 14 months. The project ran on schedule, thanks to JR West's excellent personnel and equipment and the construction companies organising this project. No matter how difficult the problems they faced, they never gave up and managed to work them out. I would like to express my deepest gratitude for their efforts.

### ***Reaching a consensus through a dialogue with the citizens***

Many cities have difficulty securing their citizens' consent to construct a tram line on the streets, owing to their reluctance to pay any extra tax for the construction or their opposition to reducing the number of automobile lanes.

Toyama City's project for a new tram car line, however, was realised in about three years, an exceptionally short period of time. This success can be attributed to:

- the citizens' consensus, reached quickly through a dialogue; and
- the understanding and support from the city assembly, the various organisations involved, local enterprises and residents.

For the purpose of gaining their consent, I held more than 200 meetings in three years in the districts not only near the line but over virtually all the city, explaining the significance and purpose of the project. (I make it a rule even now to hold talks with people about various policies more than 70 times a year.)

During the talks, I especially emphasised the significance of investing for the future, aiming for a society where residents do not have to rely on cars in light of population decreases and ageing.

I also believe our success was the result of our effort, not only of promoting the LRT, but showing a clear vision to our citizens of the city’s future public transportation, and the liveable and convenient compact city it could become.

**4. Conclusion: Toward the reduction of CO<sub>2</sub> by shaping a “Compact City”**

Last year, Toyama City was chosen as one of the “eco-friendly showcase cities” leading Japan in reducing greenhouse gases to create a low-carbon society. The city aims to reduce the level of CO<sub>2</sub> emissions by 30% of 2005 levels by 2030, and 50% by 2050 (Table 1). I intend to achieve that goal with our unflagging commitment, in co-operation with the residents and businesses of our city.

**Table 1. CO<sub>2</sub> reduction targets of Toyama City (from 2005 levels)**

	Mid-term (by 2030)	Long-term (by 2050)
Transportation sector		
Private sector (households)		
Private sector (businesses)	Reduced by 30%	Reduced by 50%
Industrial sector		



**CLIMATE CHANGE IN PARIS:  
CITY PLANNING, STRATEGY AND GOVERNANCE FOR A COMPACT CAPITAL**

*By H  l  ne de Largentaye  
Sustainable Development Adviser, Paris City Council, France*

- 1. Paris, a compact city: facts and figures**
- 2. Urban and transportation planning, climate change**
- 3. Prospects**

**Paris: Facts and figures**

The legacy of history explains many features of Paris at the beginning of the twenty-first century. Paris's history can be divided into three periods. Until the end of the eighteenth century, it was the fortified capital of monarchies. Then it modernised, thanks to the industrial technology of the nineteenth and twentieth centuries. It is now a global city in transition towards a post-Kyoto model.

Paris has developed in concentric circles, starting with Philippe Auguste's fortifications and ending with Thiers', which were dismantled at the beginning of the twentieth century. These fortifications, erected for military and tax purposes, account for today's high-density *intra muros* (the area inside the ring road or *boulevard p  riph  rique*). This type of development also accounts for the gap between the historical centre and the suburbs or "*banlieue*", generally less affluent and ignored by Paris' rich and powerful core.

The nineteenth and twentieth centuries left different legacies. On the one hand, Paris owes to its prefect Baron Georges Eug  ne Haussmann its main urban amenities (sewage, lighting, water), its beautiful avenues, streets, squares, parks, six- or seven-storey buildings and its railway stations. Thanks to the 1900 Universal Exhibition, the Metro was built. But on the other hand, factories located in Paris or on its outskirts polluted the capital. In the twentieth century, subsidised housing (*habitations bon march  *), generally made of poor and energy-consuming materials, were built, especially in the north and eastern parts of Paris, as well as in the suburbs. The sociological gap increased between the upper classes living in the central and western parts of the city (where corporate headquarters were also located, *i.e.* the "*Triangle d'or*" in the eighth *arrondissement*) and the lower classes, living in the north, east and increasingly in the suburbs. Commutes became longer and less comfortable, despite a relatively good public transport system planned on a radial scheme, rather than in response to the needs of workers living in suburbs.

In the 1970s, the city adapted to automobiles, with highways, tunnels and underground parking lots, contributing to pollution, even though almost all industrial plants had left Paris as a result of the long-term trend toward de-industrialisation, as white-collar jobs replaced blue-collar jobs in many European urban centres during the second part of the twentieth century.

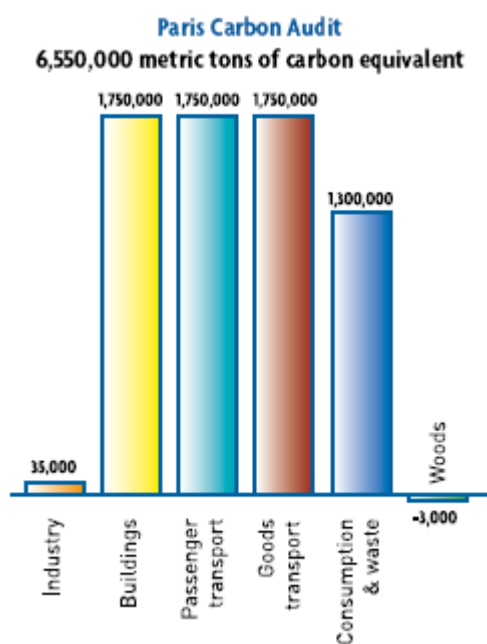
After large numbers of agricultural workers and immigrants flowed into Paris during the first part of the twentieth century, Paris's population rose above 3 million, and decreased after that. It has slightly picked up again since 1999. Conversely, the population of other "departments" of the Ile de France Region rose, and its total population stabilised at around 11.2 million. Today, 2.2 million Parisians live within

105 hectares, representing 19% of the region’s population. Paris is one of Europe’s most compact cities (with a density of 247 residents/hectare) and the largest cosmopolitan city in France (its population is 15% non-French, most of that non-European).

The administrative status of Paris, dating back to 1977, when its Mayor was elected for the first time, remains a problem. The perimeter of the Paris municipality (which constitutes a department) is smaller than the area covered by the population that considers itself Parisian, in other words by those who live and vote in Paris but also by those who work in Paris but live outside its perimeter, and therefore do not vote in the capital. Hence, programmes involving transportation, housing, economic development as well as taxation and public expenditure do not always fit the population’s needs. This is a major source of inequality and inefficiency, and gives rise to resentment against the capital.

### City, transport and climate change planning<sup>1</sup>

In the past three years, the Paris council voted in favour of three major plans: the city plan (*Plan local d’urbanisme*, PLU, 2006), the *Paris Mobility Plan* (*Plan de déplacements de Paris*, 2007), the *Paris Climate Plan* (*Plan de climat de Paris*, 2007). All these plans are geared towards climate change objectives.



**Paris’s carbon footprint<sup>2</sup>** was calculated for the first time in 2006. Taking the “TEC” (*tonne equivalent carbone*) as a unit, Paris’s footprint was equivalent to 6.55 million TEC in 2005. That breaks down into 53% for transport (split equally between passengers and freight), 27% for buildings, 20% for consumption and waste, and less than 1% for industry. At the same time, the Paris administration’s carbon footprint amounted to 69 000 TEC in 2005, *i.e.* a small proportion of the total carbon footprint of Paris (although this is a politically sensitive figure). Within this carbon footprint, administrative buildings, and heating in particular, are the largest contributor (53%), followed by transport (39%).

The **PLU** (which has an annex, the Project for Planning and Environmental Sustainability or PADD, the *Projet d’aménagement et de développement durable*), was made mandatory, once it was approved. It has several major targets. First of all, it aims to ensure the harmonious development of Paris, combining housing (with a special emphasis on subsidised housing), green areas, economic activities (mostly offices) and public buildings (schools, crèches, hospitals, sports centres, libraries and homes for the elderly), mitigating the west/north and east division mentioned above and enhancing social cohesion (as opposed to “community” zoning, a feature of American cities). Secondly, in line with the PLU, slums and insalubrious buildings, often located in outlying districts, are to be renovated. The idea is to build a smooth transition between the capital and its suburbs. For example, in two or three places, the ring road will be covered with gardens, municipal facilities, and pedestrian lanes, to convert these polluted sites into clean and silent areas. In all, 10% of the territory of the city is being renovated. The PLU sets an upper limit for building heights (37 metres), although this regulation is currently under review, and there may be a few waivers that allow for skyscrapers in four or five places in Paris, provided such exceptions are accepted by the Paris City Council.

The 2007 Paris Transportation Plan aims to increase public transport (metro, tram, clean buses, RER) as well as “soft transport” – walking, bicycles (*Vélib*), boats on the Seine, (*Voguéo*) – so as to reduce the need for private cars, thereby reducing greenhouse gas emissions (GGE). It also aims at reducing time spent on commuting from home to work, which can amount to 3 hours/day for workers living in the outer districts. However, transportation is typically an issue that must be dealt with at a regional and even national level. Indeed, increasing numbers of people working in Paris live in the suburbs (and vice versa, in the case of Paris La Défense, outside the capital’s limits, where many financial services are located). Residents complain about the inadequacy of the public transportation networks linking the centre to the suburbs, a legacy of the nineteenth-century rationale according to which all infrastructure converged on Paris.

The Paris Climate Change Plan, unanimously adopted in October 2007, goes beyond the European Union’s Kyoto commitments: greenhouse gas emissions and energy consumption are to be cut by 25% (instead of the 20% level endorsed by the EU) by 2020 (compared to their 2005 levels) and renewable energy should account for 25% of energy consumption by 2020 (rather than 20%). Even more ambitious targets have been set for the administration (30% for each of these three objectives). It is of paramount importance for the City Hall to set an example, and municipal management must adapt to these new energy constraints. They involve a wide variety of activities: running the vehicle fleet, greening municipal buildings and squares, renovating and maintaining buildings (heaters and air conditioning), maintaining streets (pavements, road surfaces, lighting), and collecting and processing garbage. As a result, municipal procurements have to be redrafted to include environmental clauses. Urban planning regulations must also be reviewed (for example, to allow solar power equipment on roofs). A municipal renewable energy power station is being studied. Subsidised housing (more than 200 000 homes) must comply with strict energy standards (50 kilowatt/hours and 80 kilowatt/hours/square metre/year for new and renovated buildings respectively) and will have to be radically renovated, an expensive proposition that will have a major impact on the City’s budget.

As for most of the 100 000 Parisian buildings that belong to private individuals or companies, (and many of which were constructed over 100 years ago), it will be even more difficult to persuade their owners to adopt new energy standards. So far, there are no mandatory rules but only financial incentives partly funded by the state.

A common feature of these three plans is that they were all formulated after consulting local populations, following a “bottom-up” process of up to two years before being submitted to the City Council. The 20 *Mairies d’arrondissement* have held well-attended meetings chaired by local representatives. In the case of the PLU and the transport plan, questionnaires were sent out to more than 1 million Parisians, and the response rate (14%) was judged quite satisfactory. As for the Paris Climate Change Plan, the private sector (as represented by a business club or “*club des entreprises*”) and institutions such as the Paris public hospital network (AP-HP), national education authorities and many non-governmental organisations were also consulted. It is now becoming common for local development agencies to go about their town and city-planning tasks at a neighbourhood level after consulting with residents (“*zone d’aménagement concertée*”). Residents are well aware of environmental issues and require high sustainable development standards in their everyday life, *i.e.* a neutral ecological footprint, involving houses with solar energy, gardens, public amenities, rain recycling and efficient waste-processing, and pedestrian and bicycle lanes leading to public transport stops. Around 100 hectares of such “*éco-quartiers*” are being set up (for example, the planned 40 hectares at *Clichy Batignolles*). A series of indicators, tailored to the requirements of each area, are established to monitor progress on a regular basis. These “*éco-quartiers*” are mostly located in the less affluent northern and eastern parts of Paris, and should be ready in four or five years.

## Prospects

What can we learn from the brief experience gained from these three plans? First of all, **municipal agents** must be motivated by climate change issues and must learn to work together on such projects, reaching beyond the limits of their assigned tasks if necessary. So far, climate change and sustainable development issues were dealt with by a small team belonging to the department in charge of parks and gardens. But, as we have seen, climate change involves a wide scope of activities, including those covered by subsidised housing, transportation, municipal buildings, city planning, waste management, and even economic, social and cultural departments. With a few exceptions, climate change concerns the entire municipal staff (50 000 agents working in 21 departments). Even the financial department can contribute significantly to climate change, by setting up a carbon accounting system, negotiating the City's "energy-saving certificates" and defining internal management indicators. A reform is under way to give one of the departments horizontal responsibility for covering climate change and sustainable development, relying on a network of correspondents working in each of the 21 departments. This new organisation will require a clear, comprehensive commitment and strong political and administrative leadership.

Secondly, we must find the **right territorial scale** for action and for achieving climate change objectives, not to mention economic and social goals. We have seen that the present boundaries of Paris, inherited from the past, are not the most appropriate, and lock Paris into a territory that is too small for efficient city-planning. Bringing together citizens who share the same concerns and setting up the right kind of governance is a real challenge, and one whose time has come. *Paris Métropole*, which the Mayor of Paris launched in 2006, and which started with a dozen co-operation conventions signed with mayors of surrounding towns (as well as the *Département de Seine-St. Denis*) and involving housing, transportation and economic development projects has now grown into a body of 87 members, including six out of eight departments and the Ile de France Region. Whereas the Region has no formal climate change plan, its *SDRIF* (*Schéma directeur de la Région Ile de France*, the regional development and city-planning master plan for the Ile de France Region) has similar objectives and aims to make the Ile de France the first European "éco-region". *Paris Métropole* was set up according to a "bottom-up" approach: every town or community has joined on a voluntary basis, and each member, regardless of its population, is allotted a single vote (including Paris). *Paris Métropole* will be governed by a Bureau with a president elected for a year. At the same time, the President of the Republic launched the idea of an administrative "**Grand Paris**" in 2007 (Paris plus the three surrounding *départements*), although its implementation has been deferred to 2012. In 2008, he also launched an international consultation for architects to design the future "*Grand Pari(s)*", by projecting themselves 20 years into the future. By and large, a consensus already exists between *Paris Métropole*, the Region (for transport and other economic interests) and the state for decisions regarding environmental issues (a "*sustainable mega-region*"). An agreement on transport and housing schemes may be concluded, provided financing problems are solved. As for the territorial perimeter of the "Grand Pari(s)", an archipelago of cities and towns alternating with rural areas, from Paris to the Channel (Le Havre being the port for Paris) is one of the scenarios being put forward.

**Educating and empowering citizens** are other aspects of these Parisian policies that could be improved, following Barcelona's example, which emphasises the role of schools, and of other cities' practices aimed at bringing climate change issues down to micro-local levels. In the same way that it prepared for the Climate Change Plan, Paris had covered the first stage of its "Agenda 21" in 2008,<sup>3</sup> *i.e.* a sustainable development audit of its territory drafted by municipal personnel and reviewed by its population. These mini-forums came up with many suggestions concerning everyday life. In the next two or three years, **primary schools** (for children aged 6 to 11) could organise climate change and sustainable development sessions, where teachers would inform children about climate change issues and ask them to suggest a few actions in their schools and neighbourhoods or to exchange ideas with other schools. Follow-ups using indicators would be a part of the exercise.

Another way forward would be to put climate and sustainable development issues on the agenda of the 121 **district councils** in Paris that meet four times a year to discuss local issues such as cleanliness, street lights, gardens, etc. These could also put forward suggestions on climate change policies. Other examples along the same lines include meetings for neighbours living in the same buildings, initiatives at workplaces, retirement homes, etc. Experience with the climate change plan in Paris indicated that it is difficult to attract the interest of the immigrant population in peripheral neighbourhoods, who are not used to social life outside their communities. But there are other ways of reaching them, such as Paris' councils for foreigners, or *conseils de la citoyenneté des Parisiens non-communautaires*.

The **social and economic dimensions** of sustainable development are often neglected when dealing with climate change, its main environmental component, together with biodiversity. Care must be taken not to increase inequality because only the better-off can afford the investment necessary to fight climate change. Paris' Council is contemplating a financial facility aimed at low-income Parisians to encourage home insulation, replacing boilers, etc.<sup>4</sup> Similar incentives, including tax rebates and 0% interest loans, exist at a national level (as a result of the "Grenelle agreements") for housing and for clean cars (through the *bonus/malus* mechanism) but they are not specifically targeted at low-income households.

Paris' economy has a relatively small impact on climate change (see Paris' carbon footprint above), with the major exception of the tourism industry, because of air transport, which dramatically increases the capital's carbon footprint (4.4 million TEC, not included in the 6.55 million TEC referred to in diagram pp.2). However, it is beyond the scope of the Paris authorities to curb air travel, an international activity.

Vice versa, climate change policies can have favourable effects on the economy, given the many jobs and opportunities related to the "green economy". Paris brings together the headquarters of large multinational companies specialised in public utilities. The municipality is a stakeholder of a company producing central heating by incinerating garbage. A "sustainable development"<sup>5</sup> cluster based in eastern Paris brings together start-ups, universities and laboratories. Most firms, whatever their size, are now aware of climate change challenges<sup>6</sup> and some have even carried out internal audits. But the City needs to work with the private sector to fulfil its ambitious objectives. Municipal procurements and private/public partnerships offer great opportunities to achieve these goals, in construction, transportation, waste processing and renewable energies industries, as well as in other fields.

We end up considering sustainable development rather than just climate change. For the Paris Council, a body which derives its legitimacy from elections, it is difficult to implement environmental policies without considering their social, economic and even cultural impacts. That is why sustainable development, a comprehensive notion covering the empowerment of citizens, is a more relevant concept for local governments. However, elected representatives are trapped in a contradiction between long-term issues and their short-term mandates. It may be the duty of experts to help people understand that the longer they wait before tackling environmental issues, the higher the price they will have to pay in terms of global warming and its disastrous human consequences.

## Notes

1. The documents quoted in this section are available on the City of Paris's website: *Paris.fr*
2. Bilan Carbone™ is the standard measure used by the French agency for environment and energy management, ADEME, for calculating carbon footprints. Greenhouse gas emissions (GGE) can be expressed in either tons of carbon dioxide equivalent (tCO<sub>2</sub>) or tons of carbon equivalent (1 TEC= 3.66 tons of CO<sub>2</sub>).
3. See « *Document de restitution du diagnostic partagé du territoire parisien* » November 2007; « *Agenda 21, Paris s'engage* ».
4. The *Crédit Municipal* has recently started micro-credits for Parisians.
5. The name of this cluster is “Advancity”, or *Ville et mobilité durable* (sustainable city and mobility).
6. See the “barometer of sustainable development” (*baromètre du développement durable*) of Paris' Chamber of Commerce.

## **AN EXAMPLE OF A PUBLIC-PRIVATE PARTNERSHIP AS AN INSTRUMENT OF CLIMATE PROTECTION IN AN URBAN REGION WITH RURAL SURROUNDINGS**

*By Marlene Potthoff*

*Deputy Director, Climate Protection Agency, Region of Hanover, Germany*

- 1. Origins and objectives**
- 2. Agency structure**
- 3. Areas of activity, campaigns and projects**
- 4. Results and outlook**

### **Origins and objectives**

The Hanover region covers an area of approx. 2 300 square kilometres and is inhabited by about 1.2 million people. In relation to the Land of Lower Saxony, this figure accounts for a 15% share in the overall population, for 18% of all jobs and 20% of its gross domestic product. The capital of Lower Saxony, Hanover, has approx. 516 000 inhabitants and is the centre of the region. For a large part of Northern Germany, Hanover is a transport hub and an administrative and financial centre.

Hanover ranks among the most renowned trade fair venues on an international scale, hosting top-class events such as the CeBIT IT trade show, the HANNOVER MESSE industrial technology fair and the LIGNA Forestry Fair. In addition, the City of Hanover joined forces with the 20 towns and local communities in the county to host the EXPO 2000 world exhibition as an attractive, internationally-minded region.

Climate protection has played a crucial role in this region for over 20 years. Pioneering initiatives in this field included the establishment of a climate protection centre for the City of Hanover in 1988, the preparation of a carbon reduction study for the Hanover region in 1990 and the EXPO 2000 world exhibition with its motto of “Humankind – Nature – Technology”. The so-called KLEX (Klimaschutz Expo Region Hannover; Climate Protection for the Hanover Expo Region) programme ensured that climate protection was a key component of this world exhibition, which attracted a high degree of interest. The KLEX programme included showcase projects to demonstrate best practice but also the development of social marketing campaigns to promote climate protection at a very early stage in order to raise awareness and generate interest in this key topic among the general public.

Following the EXPO 2000, and with a view to changes in the administrative structure of the region, the successful campaigns for the use of solar energy and the upgrading of buildings were to be supported by a sound political framework. For this purpose, the Climate Protection Agency for the Hanover Region was founded in summer 2001. Its aim is to promote climate protection at a local and regional level. Activities to achieve this goal include the support of the 21 local communities in their local climate protection initiatives and the coordination of the communities and all relevant stakeholders in the Hanover region in order to establish a closely linked, cost-efficient and successful collaboration.

Among other tasks and responsibilities, the Climate Protection Agency implements climate protection campaigns using a wide variety of tools to address the relevant target audience, creates and maintains networks and sets up a service centre as a central facility for all parties involved and all citizens with an interest in climate protection. These initiatives are geared towards creating incentives for investment primarily via communication activities. There is a general political consensus on linking environmental policy objectives of general public interest to activities and tools to promote the economy. For this reason, the Climate Protection Agency was established as a non-profit organisation.

### **Climate Protection Agency structure**

The Climate Protection Agency is a non-profit entity with twelve shareholders (see Figure 1). It is the responsibility of the Shareholders' Meeting to supervise the management of the Climate Protection Agency and to provide consultancy in compliance with applicable legislation. The shareholders' obligation to pay annual contributions ensures the basic funding of the agency. Shareholders and other partners contribute additional funds on a project-specific basis.

On the public-sector side, the agency shareholders include the City of Hanover, the federal state capital of Lower Saxony, and the Hanover Region (a public institution), but also municipal entities such as Stadtwerke Hannover AG, the public utility company, and üstra, the City of Hanover public transport operator. The private sector is represented by the energy supplier E.ON Avacon, which serves several regions, and six medium-sized enterprises doing business in the climate protection field. These six companies include two wind power businesses, a solar systems wholesaler, two engineering offices focusing on solar technology and building services, and a project planning and design firm with links across Europe.

A shareholder with a special status is the *Förderverein* (sponsoring association) of the Climate Protection Agency, which comprises other companies and institutions with an interest in energy efficiency and renewables. At the time of its establishment in 2001, this association had nine members. This number has increased significantly – there are currently 54 members. The non-governmental organisations represented in the *Förderverein* include associations advocating the interests of tenants, consumers, and craftsmen, institutions doing research in building and energy technology, and other non-profit entities. Companies from various industries have already become members of the *Förderverein* to benefit from the networks created by the Climate Protection Agency: this range includes municipal and private housing companies, local energy suppliers and trade fair organisers but also manufacturers and merchants in the solar and heating technology fields, craft businesses, architects and energy consultants.

The Advisory Board of the Climate Protection Agency is composed of representatives of the political parties, industry associations, environmental organisations and institutions of higher education in the Hanover region. This board has an advisory role and may submit proposals for activities to the Shareholders' Meeting.



Figure 1. Shareholder structure

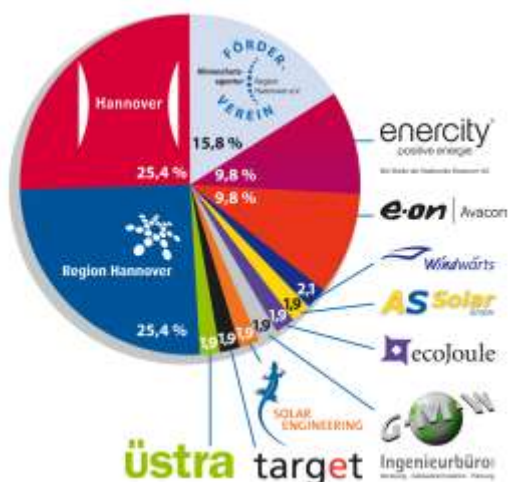


Figure 2. Regional co-operation



During the past eight years, a regional climate protection industry network has been developed jointly with these partners. This network serves to co-ordinate all activities pursued by the Climate Protection Agency. Campaigns are devised and planned at the so-called stakeholder forums, which are convened twice a year. These forums provide regional and local market information at an early stage, the opportunity to approach new partners and many synergies for the internal activities and marketing efforts of the participants. This arrangement thus provides an umbrella structure for all climate protection activities in the Hanover region under which all stakeholders are co-operating very closely (see Figure 2).

## Areas of activity, campaigns and projects

### *Climate Protection Region*

Several public stakeholders, among them the Region and Federal State Capital of Hanover and the Climate Protection Agency, have joined forces in the so-called ‘Climate Protection Region of Hanover’. This initiative aims to dramatically reduce regional greenhouse gas emissions whilst creating and securing as many jobs as possible. The concept of climate protection is not confined to renewable energy sources and the efficient use of energy in private households and industry and commerce. It also enables the development of innovative products, services and processes, and thus opens up new markets. Since the activities of local authorities, energy suppliers and funding, marketing and research institutions are merged under a single roof, the network created in the Climate Protection Region of Hanover plays a pioneering role in promoting proactive climate protection in Germany.

The Region of Hanover has developed a climate protection framework programme to be adopted in mid-June 2009, which is to be used as a key instrument to define climate protection objectives that are binding upon political decision makers, and to develop specific actions in support of these objectives. Amongst other items, this programme reiterates that local authorities must lead by example. It also announces actions to be taken in order to enhance the efficiency of buildings in the ownership of regional authorities.

In parallel to this process, the communities in the region are developing climate protection action plans at the local level. Already in 2008, the Federal State Capital of Hanover had adopted a plan to implement specific actions pertaining to public buildings and facilities, as well as to gas and electricity procurement from, and generation by, Stadtwerke Hannover AG, the municipal utility. Most of the 20 communities in the surroundings are currently preparing similar action plans in collaboration with the

Climate Protection Agency. Authorities, inhabitants, associations and organisations, as well as local initiatives, are cooperating very closely to conceive specific actions to promote climate protection at the local level. These actions will be summarised in a catalogue, which will constitute a binding guideline (also in political terms) for the community concerned until 2020 and beyond. Since autumn 2008, the preparation of such action plans has also been co-funded by the national climate protection initiative launched by the Federal Ministry for the Environment, which covers 80% of the cost. This support has significantly increased the willingness of the communities to adopt their action plans.

In an expert report issued by the Wuppertal Institute for Climate, Environment and Energy in 2004, specific actions were proposed to develop a sustainable energy system for the Hanover region. This report relies on national scenarios to be transferred to the regional and local levels. If these actions are implemented, the Hanover region can achieve a reduction of more than 60% of energy-related carbon emissions by 2050, compared to the 1997 baseline. This percentage is equivalent to almost 500 million tonnes of this greenhouse gas. The Wuppertal Institute identified three crucial lines of action to be pursued in order to achieve this goal: *i)* Increase in efficiency in electricity and heat demand by saving energy; *ii)* Increase in efficiency in conventional energy supply, in particular by using combined heat and power; *iii)* Expansion of the use of renewable energy sources. The Climate Protection Agency has aligned its activities in nine areas to implement these actions in the Hanover region.

### ***Energy efficiency in new and old buildings***

Compared to the 1990 level, the target is to reduce carbon emissions by 40% by 2020. Corresponding efforts must be made at all levels of society to achieve this climate protection objective defined by the Federal government. In Germany, by far the largest saving potential has been identified for the 39 million private households. In particular, owners of detached and semi-detached houses can contribute to achieving these savings by upgrading their homes to increase energy efficiency. In an ideal scenario, the energy cost of a detached house can be reduced by up to 90% by fitting thermal insulation and installing new heating systems and windows. In order to involve the owners of detached houses built before 1977, the Climate Protection Agency offers free advice on how to increase the energy efficiency of old buildings under the heading 'Starting well-advised'. This campaign aims to provide initial guidance to home owners on the magnitude of energy savings that can be potentially achieved by upgrading the building. In addition, home owners should be made aware of the importance of protecting our climate and be directed to the regional and national funding programmes offered. This free advice provided by the Climate Protection Agency is not in any way related to, or biased by, any manufacturer, product or construction trade. Despite this fact, regional building contractors and other commercial enterprises are involved in the campaign in a sponsoring role. They may launch their own activities on the basis of the consultancy provided, for example by offering their products for sale at local trade shows.

Beyond the energy efficiency upgrade of old buildings, the Climate Protection Agency also actively supports, together with several partners, the construction of new residential buildings conforming to the passive house standard. Building owners and developers are still requesting more information in this regard. The range of activities offered includes information events and materials provided to the public and industry events and training sessions aimed at experts and opinion leaders. In addition, a regional network of communities, planners, architects, crafts and trades and builders' merchants is being created. In this arrangement, the Climate Protection Agency acts as a neutral facilitator.

### ***Electricity efficiency***

According to calculations published by Deutsche Energieagentur (German Energy Agency), the electricity saving potential amounts to a total of 23 terawatt hours for private households alone until 2020.

If these savings were achieved, carbon emissions would drop by 11.5 million tonnes. By comparison, the potential saving amounts to only 5.5 million tonnes for the industry, commerce and service sectors.

For this reason, the Climate Protection Agency has been conducting a more comprehensive electricity saving campaign directly addressing private households since 2008, following an initial campaign in 2002/03. This campaign includes free consultancy provided on the site where energy consultants analyse the electricity consumption of households and offer tailored advice on how to use electricity efficiently. Low-income households form a special sub-group of the target audience. These households are particularly affected by any increase in power or gas prices. Initiatives and campaigns to promote climate protection often fail to address this group effectively, which is why the Climate Protection Agency closely collaborates with local welfare organisations, churches and job centres.

### ***Energy efficiency in companies***

Activities tackling the issue of energy efficiency in companies are centred around the ‘e.coBizz’ campaign. This campaign aims to reduce the energy consumption of small and medium-sized businesses with up to 100 employees by providing professional consultancy and advice. This initiative enables businesses to combine required refurbishment and conversion works with an increase in energy efficiency in order to lower their energy expenditure and to enhance their competitiveness. On behalf of the Climate Protection Agency, expert consultants with relevant qualifications provide help and support to businesses when it comes to determining the highest possible energy saving. This consultancy activity has been co-funded by the German government for the last two years.

To meet the demand for industry-specific consultancy, the Climate Protection Agency is also involved in the professional and further training of energy consultants. Separate seminars for engineers and presentations and workshops dealing with specific technical issues were used to create a pool of appropriately qualified experts.

### ***Solar energy***

The primary objective of all activities in the field of solar energy is to expand the solar systems market, which includes both solar heat generation and photovoltaic systems to generate electricity. In this endeavour, the Climate Protection Agency mainly addresses two groups: first, consumers, who are usually home owners, and second, service providers such as craft businesses in the sanitary, heating and air-conditioning sector. The campaigns targeted at these two groups are the ‘Solar Regional League’ and the ‘Solar Heat Quality Panel’.

The ‘Solar Regional League’ is a competition in which all 21 towns and communities in the Hanover region take part. They have been competing since 2004 to install the largest number of photovoltaic and solar heat systems. Winners are awarded once a year at a special event. Over the years, this competition has become a true ‘event’ for the communities, which has significantly contributed to creating a growing appreciation of solar energy at the local community level. At the same time, the Climate Protection Agency is using this campaign to collect information on the number of solar systems installed in the region. In 2008, 3 351 solar heat generation systems were reported, which equalled a total solar collector area of 32 077 square metres. These systems were mainly installed by private households. The total nominal output of the 1 504 photovoltaic systems reported amounted to 12 998 kW<sub>peak</sub>. The Wuppertal Institute (see pp. 4) defined a solar collector area of 488 570 square metres and a photovoltaic output of 48 750 kW<sub>peak</sub> as the installation targets for 2020.

In the Hanover region, the demand for solar systems has increased continuously during the past few years. In parallel to this trend, however, it should be noted that the qualification and expertise of service

providers has not developed at the same rate. The ‘Solar Heat Quality Panel’ is organised by the Climate Protection Agency and its partners to offer continuing training to craftsmen interested in solar technology. Related workshops have been organised since 2006. They have enjoyed an excellent response on the part of specialised tradesmen.

### ***Bioenergy***

As the core bioenergy project of the agency, the ‘Heating with Wood’ campaign concentrates on providing information on state-of-the-art wood heating systems to consumers. The Climate Protection Agency offers publications that contain comprehensive information about this topic, as well as presentations at local exhibitions and conferences, in order to support consumers in their decision to purchase a modern heating system that can process wood pellets or chips. The campaign provides unbiased advice independently of any product or manufacturer. It aims to drive the marketing and distribution of wood fuels produced in the region whilst reducing the dependence on fossil fuels. The campaign expressly focuses on fully automatic heating systems that conform to stringent limits in terms of soot particle emissions.

A tried and tested means to involve home owners is the ‘Regional Pellet Day’. This day is a open-house event during which many private wood heating system owners open their doors and welcome visitors to inform them of the features of this technology and to share their experience in operating a wood heating system on a daily basis. Since it turned out that wood fuels have become more and more accepted by the public over the years, and that many consumers are already well-aware of the subject, the primary aim of the ‘Pellet Day’ is the sharing of experience among home owners.

### ***Wind power***

By a decision taken by relevant policy makers, 400 megawatts of wind power output were set as the overall target for the Hanover region, and priority locations for wind turbines were identified. Until 2008, an output of 288 megawatts could be implemented, not least because of the re-powering of previously installed wind turbines. As a result, more than 160 000 households can currently be supplied with electricity from renewable sources.

However, as is the case in many other regions, there is a high degree of resistance, in some parts of the Hanover region, against issuing permits to install high-output wind turbines with a total height in excess of 100 metres. For this reason, the Climate Protection Agency has made it one of its key tasks to increase the appreciation of wind farms among the inhabitants and to provide information on the benefits of this renewable generation option.

To achieve this goal, the agency publishes brochures and organises workshops, panel discussions and information events, as well as the annual ‘Windfestival’. This event for the whole family has been developed by the agency on the basis of a marketing tool originally employed at EXPO 2000. The ‘Windfestival’ is also an important networking event due to the close collaboration with local associations prior to and after the event.

### ***Combined heat and power***

Combined heat and power generation (CHP) uses energy much more effectively than conventional generation systems without heat extraction, and is thus a particularly efficient method. In the City of Hanover, the system of centralised CHP generation in combined heat and power stations for public supply is relatively well-advanced. In 2005, the share of CHP electricity amounted to 30% compared to a nationwide level of only 12%. The amount of district heat supplied in the Hanover city centre is even to be doubled. On the other hand, the potential for decentral CHP stations that exists in the rest of the region has

neither been fully identified nor developed. This is where the work of the Climate Protection Agency starts. Together with several partners, the agency launched a new campaign in 2006/07 to raise the awareness of this technology for decentralised energy supply and to open up a related market in the Hanover region. This campaign was based on a new funding scheme offered by the local energy supplier, which included an annual amount of EUR 500 000.

The Climate Protection Agency for the Hanover Region took over head responsibility for the new CHP campaign, the associated networking activities, the preparation of appropriate written information (leaflets), the provision of consultancy, public relations activities and the assistance with feasibility studies. The campaign addresses businesses, housing companies and owners of blocks of flats, which is where a particularly high potential for the installation of combined heat and power stations has been identified, together with the associated climate protection effects. The agency published specific information documents for each of these target groups. In addition, a week of related events was organised where a large number of site visits were offered. Furthermore advice over the phone is offered by the agency.

Already in the first year (2007), 51 combined heat and power stations with a total output of 1 355 kilowatts were funded in the region, the major part of which was installed in blocks of flats. The conditions for the expansion of decentralised CHP generation have again improved as a result of the new nationwide compensation scheme for CHP electricity that took effect on 1 January 2009.

### ***Environmentally friendly mobility***

Since the inception of the Climate Protection Agency, environmentally friendly mobility has always been one of its areas of activity. In this regard, the agency mainly concentrates on networking activities. For example, the agency organises working meetings ('stakeholder forums') twice a year, covering environmentally friendly mobility and natural gas vehicles. At this forum, representatives from industry and commerce, authorities, associations and initiatives and public transport operators in the region meet to exchange information and agree on actions to be taken.

As one of seven international partners, the Climate Protection Agency participated in the 'MOVE' EU project from 2006-08 (International Cluster for Mobility Management Development and Research Dissemination). One of the tasks of this project was to develop evaluation methods for mobility management. In this context, the agency took part in the national mobility conference 'Clean Moves' held in April 2007 at the Hanover Trade Fair.

The agency also addresses consumers by organising the 'Natural Gas Vehicle Day', which is an event held to provide information on the use of natural gas technology in both privately owned and company cars. Since 2006, this day has been organised once a year. It has become the largest consumer exhibition in Lower Saxony that concentrates on alternative fuel technologies for vehicles.

## **Results and outlook**

### ***Results***

The Climate Protection Agency model has become well-established in the Hanover region. Among the general public, at the authorities and in industry and commerce, the agency is recognised as a central institution dedicated to climate protection. In 2006, the shareholders and the advisory board and sponsoring association members voted in favour of continuing the work of the agency beyond the first five-year contract term. The transaction volume handled by the agency rose from 1.09 (2002) to EUR 1.9 million (2008).

The success of the agency is also reflected by its growing network, especially with regard to the involvement of a larger number of business partners. For example, an additional medium-sized enterprise became a shareholder when adopting the shareholders' agreement for the period from 2006-11. In 2008, E.ON Avacon, the supraregional energy supplier, became the twelfth shareholder on the company's own initiative. Other companies joined the network by becoming members of the sponsoring association of the agency. The number of members has risen continuously from nine in 2001 (the year in which the association was founded) to currently 54 members.

The agency's information and consultancy offerings are much appreciated by the general public. In 2008, about 1 600 telephone and email inquiries were received. More than 3 000 contacts were documented at the information desks of the agency provided at 20 events held in the entire region. In 2008, the regional climate protection portal at [www.klimaschutz-hannover.de](http://www.klimaschutz-hannover.de) maintained by the agency recorded an average of 900 page views per day.

It is difficult to quantify the effects of the activities of the Climate Protection Agency because of the large number of stakeholders involved and the wide variety of factors that actually trigger investment in the target groups. Specific elements of the campaigns are evaluated on a regular basis. For example, feedback is provided on events attended by business partners with their sales stands as regards their success, measured by the number and quality of sales negotiations held and appointments made.

A total of 5 112 households in the 21 communities in the region received advice and consultancy in the first project phase of the 'Starting well-advised' consultancy campaign to promote the energy-efficient upgrade of buildings from 2004 to the end of 2007. The success of this initiative was evaluated by a written survey carried out in 2006, in which 200 home owners took part who received advice and consultancy six to eighteen months before the survey date. It was found that about one third of the owners had already invested in upgrading their homes while another third was planning on making such an investment, and the remaining third did nothing. Most frequently mentioned activities included the installation of new windows, the thermal insulation of external walls and the replacement of the heating system. On the basis of this information, an investment of approx. EUR 500 000 per community could be determined. The ratio of funds employed to investments triggered was roughly equivalent to 1:25.

An analysis conducted for the City of Hanover showed that the rate of building upgrades currently equals 2%, which is twice as high as the national average yet still too low to achieve ambitious savings targets.

In this regard, one of the problems encountered is the demographic trend in Germany. More and more owners of houses built before 1980 are older than 70 years, which is why it is difficult to generate an interest in longer-term investments among this part of the population. The continuing training that the Climate Protection Agency provides to its energy consultants is currently dealing with these issues.

### ***Outlook***

The climate protection programmes launched by the communities support the national target of reducing carbon emissions by 40% until 2020 compared to 1990. This target is easily achievable in the public sector and in the power generation industry. In contrast, it is much more difficult to influence energy demand across all consumer groups. According to the experience gained by the Climate Protection Agency, this goal can only be achieved by employing a mix of legal instruments (such as the Renewable Energies Act – EEG – and the Act Governing Combined Heat and Power – KWK-G), national and local funding programmes and information and consultancy campaigns.

In addition, a fundamental paradigm shift among policy makers and in the energy sector is required to achieve the savings targets both in the Hanover region and on a national scale. For example, climate protection aspects should be considered at all levels of political decision making and in each and every investment decision in order to utilise the tools of the market economy to a greater extent than previously. Following this approach, the contracts awarded by the public sector could lead to an increase in the demand for energy-efficient technologies whilst decreasing the energy consumption of public facilities in the long term. In the interest of raising consumer awareness further on an ongoing basis, the financial support and assistance provided to climate protection campaigns would have to be increased significantly. In addition, it will be necessary to also take unpopular political decisions, such as the identification of priority areas for wind turbines. The energy sector should make a significant financial commitment to agencies such as the Climate Protection Agency whilst also offering additional pricing and contracting models that motivate the customer to reduce the amount of energy consumed.

Finally, the energy price level and trend has a major impact on market activity. According to the experience gained in Germany in 2007, a high energy price leads to a significant increase in the interest of all energy users in efficiency-related activities and alternative energy sources. This also has a favourable influence on the information and consultancy activities in the field. It is worthy of consideration whether an increase in energy prices by tax gross-ups could be an important climate policy instrument.

**INSIDE THE “GREEN” POLICY TOOLBOX:  
INNOVATIONS IN URBAN PLANNING AND GOVERNANCE**

*By Eduardo Jorge Martins Alves Sobrinho  
Secretary for Green and Environment, City Hall of São Paulo, Brazil*

In the nineteenth and twentieth centuries, capitalism and socialism were not aware of the limits of the Earth’s environmental resources. Their concern was to reach a balance between economic and social. The twenty-first century requires another balance: economic, social and environmental.

The City of São Paulo has followed this approach: as a democracy, we can meet our goal of social justice, environmental balance and a culture of peace through dialogue.

To facilitate the work of environmental education, our programmes and projects were organised into six areas. Although this division is artificial, it serves as a resource for systematic teaching, and includes Earth, Air, Water, Green, Biodiversity and Environmental Education/Culture of Peace.

The City of São Paulo has decreased emissions of greenhouse gases by about 20% in the past four years, with the installation of biogas plants in landfills at Bandeirantes and Sao Joao. Methane at these plants has been converted into enough energy to supply a city of 700 000 inhabitants. Two auctions of international carbon credits were conducted, generated by the plants, helping to raise BRA 71 million. This amount was invested in projects and environmental improvements in areas where landfills are located.

The City has its own inventory of emissions of greenhouse gases, initiated in 2003 and completed in 2005. This document guides the City’s actions. At the time of diagnosis, 25% of emissions of greenhouse gases were attributable to garbage and 75% to energy use. Of the latter, 90% derived from the use of oil. Besides the biogas plants, other actions to reduce emissions include increasing urban forestation, the establishment of parks, encouraging bicycle use and vehicle inspections. The Secretariat has also promoted the model of the “Compact City”, a concept based on urban density, to make the city more liveable and to encourage energy efficiency.

São Paulo has also been a pioneer in developing a municipal policy to combat climate change. Through collaboration of the Secretariat for Green and Environment with other municipal agents and local specialists, Bill 530/2008 was drawn up, establishing the *Common Hall of Climate Change* in São Paulo. This project sets a target reduction of 30% of emissions in the coming years, directing strategies in various areas of the City’s activities. It also proposes gradually reducing the use of fossil fuels, adopting a target of 10% per year.

To improve air quality in the city, the Secretariat for Green launched the *Vehicle Environmental Inspection Programme* in 2008, the first of its kind in Brazil to be implemented at the municipal level. The programme has been developed gradually: in 2008, diesel vehicles registered in the city were inspected; in 2009, in addition to the diesel fleet, all motorcycles, and cars running on alcohol, petrol and gas and registered between the years 2003 and 2008 are now being inspected. Due to the less stringent official regulations in place for an older generation of cars, the Prefecture and the state government are working to extend inspections of the entire registered fleet by 2010. Today, these older cars are monitored by remote sensing, and the most polluting are called in for further inspection. Inspecting such vehicles can only benefit public health. The Studies of the Laboratory of Atmospheric Research of the USP (São Paulo University) estimate that average life spans are a year and a half shorter in São Paulo due to pollution from



vehicles, and Brazil's other cities are no different. The City management and the federal government have joined forces to work on the regulation of the Security Inspection, as well as with the state government, for inspections to be carried out in cities outside São Paulo.

For the first time, the bicycle has fallen within the sights of public policy in São Paulo. Bike lanes, *ciclofaixas* and *cicloredes* have been implemented. On-line networks for renting bicycles are forming, facilitating bicycle transportation. When the group Pro-Cyclist was established in 2006, bringing together representatives of various bodies in the Prefecture, only 19 kilometres of bike lanes existed in municipal parks, together with the remnants of the bike lanes of Faria Lima and Sumaré avenues. These served about 300 000 people who were using bicycles in the absence of any dedicated infrastructure. Today, the City's streets have 14.8 kilometres of new bike paths, another 16.1 kilometres under construction and 112.9 kilometres in different stages of the design process. The goal is to roll out 100 kilometres in the coming years. About 2 000 bicycle parking spaces have been installed in schools, libraries, parks and public agencies. A joint promotion between the Metro, the COM and municipal agencies made it possible for bicycles to be transported on trains and the subway on weekends and holidays, and established a bicycle loan project in conjunction with the Parada Vital Institute and Porto Seguro.

In the water sector, the Operation Defense of Water, an inter-sectoral project with the participation of four local and four state secretaries, was established for the protection and rehabilitation of water sources (Guarapiranga, Billings, and Cantareira and APA Varzea of the Tietê). An Environmental Civil Guard has been created, with a force of 340 men. Housing and urbanisation programmes have been developed in these regions, including land settlement, sanitation, removal of areas of risk vital for the conservation of water, as well as the creation of parks and the setting up of cultural and sporting programmes.

Another important project is the creation of the so-called *Linear Parks*, whose goal is to preserve areas in the valleys of the city's rivers and streams through the establishment of recreation areas, sanitation and clean-up of rivers. These help to conserve protected areas (APPs) that border on water courses and minimise the negative effects of floods. Seven parks have been established and are in various stages of deployment. Through an agreement with Sabesp, 42 streams in the City were cleaned up, and 50 will be recovered in 2009 to allow for the establishment of linear parks.

As for biodiversity and city forestation, tree planting has jumped from an annual historical average of 20 000 to 25 000 trees planted annually to 185 000 trees in 2008. In four years, the City has added 564 583 new trees. The Secretariat has also developed a programme providing for a total of 100 municipal parks in the city by 2012. In 2004, the city had 33 municipal parks; now there are 58, and 63 are in various stages of deployment, 42 of which will be finalised by 2012. Today all sub-prefectures have at least one park in deployment or in design.

Among the parks under development, it is worth noting three groups of strategic importance. The first is located in the south, on the edge of the Guarapiranga dam, expanding recreation options for the local population and controlling development in the region. The revitalisation of the so-called "Guarapiranga beach" includes the creation of five parks covering the whole uninhabited area around the dam. The second group is located in the north, in the Serra da Cantareira damping area. Ten million square metres are distributed between nine parks. Of these, six are in the expropriation stage. Both linear and traditional parks, they intend to create damping zones to protect the State Park of Serra da Cantareira, preserving the area at the foot of the mountain in the City of São Paulo. The third group is located in the south, and refers to a closed agreement between the City and the state government that provides as compensation for the work on the southern stretch of Rodoanel Mario Covas the deployment of 1 200 hectares of conservation units, divided into four nuclei: Jaceguava, Bororé, Varginha and Itaim. In addition, a strip of up to 300 metres around Rodoanel will be expropriated, which will link all four cores. The area covered totals 1 500 hectares.

In the field of Eco-Economy, in 2005, there was an effort by sustained shopping at auctions of municipal departments, and today several departments are developing the initiatives in the area, especially the Secretariat of Education. The City Hall of São Paulo was a pioneer in joining Greenpeace's the Cities Friends of the Amazon programme, which declares the commitment of the municipal government to eliminate the purchase of any timber from illegal sources and deforestation. As a result, decree 45.075/2005 was drafted, establishing environmental control procedures for the use of wood products and by-products of native origin in the municipal works and engineering services contracted for by City Hall. In 2009, the *Madeira Legal* (legal timber) agreement was signed between the state and municipal governments, construction firms and other sectors, under which the signatories undertake to promote information exchange and long-term co-operation, to encourage the commercialisation of alternative lumber and to promote the future use of certified wood.

São Paulo was the first city in the country to make mandatory the use of solar energy for heating water in new buildings. Solar energy must be used to heat water in residential multi-family buildings and commercial buildings that house business activities, as well as in public and private industrial buildings. According to projections of the Solar Cities Initiative, as stated in the law, if solar heating is used to supply a building of 20 floors with 80 apartments, with four residents per apartment, 40% of its hot water can be saved, preventing the emission of 10 tonnes of CO<sub>2</sub> equivalent per year.

In the area of Environmental Education and Culture of Peace, the *Open University for Environment and Culture of Peace* (UMAPAZ) was created, to offer programmes and activities of environmental education and co-existing from a transdisciplinary perspective. In its programming, the University seeks to articulate three dimensions: the individual, as part of community life; the human family, as a participant in a common destiny, built between its members and with other living beings; the construction, in time and space, of the fate and of the prospects of the community of life on Earth.

The UMAPAZ developed the *Earth Charter programme* with the municipal network of education, training teachers in the principles of respect and care for the community, ecological integrity, social and economic justice, democracy, nonviolence and peace. It was developed under the inter-sectoral policies *Green Environments* and *Healthy Project* (PAVS), which aimed to strengthen the integrated management of three departments: Green and Environment, Health and Development and Social Action, to develop an agenda for the protection and promotion of a green and healthy environment with a multidisciplinary approach. An environmental dialogue was launched with the Community Health Agents of the Municipal Secretary of Health and the Secretary for Development and Social Action, and 4 967 officers were trained.

Two other important initiatives deserve attention. The first is the reception, in the municipal parks, of dozens of community service providers, as a complement to alternative sanctions. Co-operation between the City and the Central Sanctions and Alternative Measures of the State, has enabled 100 people to work in 20 parks, in some cases as part of the team of park workers. The second is a project for the upkeep of municipal squares, developed by the Environment Department in partnership with the Department of Labour and sub-prefectures, which promote the care of green areas and create jobs. The project has been launched in ten sub-prefectures, with 280 caretakers who have been trained to take care of vegetation, make minor repairs and improve the visual landscape, and the regular use of the 154 squares and green areas of the city. They attend a course in gardening and receive a monthly assistance of BRA 488.25.

São Paulo's municipal priorities are education and health, which make up half its budget: 33% for education and 17% for health. It is important to be aware of city management so that environmental concerns can be incorporated into the projects and programmes of every department. In this way, São Paulo has fulfilled its responsibility in Brazil and the world to pioneer new ways of living together in the twenty-first century.

## GREEN TRANSPORTATION, EXPERIENCES OF BEIJING

By Liu Zhili, Liu Xiaoming, Yang Zhongwei, Ge Yu, Chen Jinchuan<sup>1</sup>

This paper presents the efforts under way to promote green transportation in Beijing, dealing mainly with the public transport system and the research into and demonstration of new energy vehicles. It deals only briefly with bicycle and pedestrian traffic, because they represent steadily developing trends of less interest than the public transport and new energy vehicles that have been developed in the past 10 years.

### Environmental problems and solutions in Beijing

Starting in the 1990s, Beijing began to confront serious environmental problems, air pollution being one of the most critical. Many causes of air pollution have been studied, including:

- *Industrial production.* Since there are many industrial factories in Beijing, their effluent is one of the main sources of air pollution. The fourth-largest iron factory in China is located in the west of Beijing city, and a chemical industry employing more than 10 000 workers is located in the southeast of the city. Many other factories, including those of the Jeep Corporation, are scattered all over the city.
- *Coal consumption.* Before the late 1990s, the citizens of Beijing consumed millions of tons of coal for heat in winter and for cooking. This was another major source of air pollution, which was once responsible for nearly 40% of pollutants.
- *Landscape.* Beijing covers an area of about 1 085 square kilometres, with a population of about 13 million. The city is surrounded with mountains at west-northwest-north. To the south and east of the city is one of the three largest plains in China. The main direction of wind is from northwest to southeast in winter and from southeast to northwest in summer. It is difficult for the pollutants to dissipate given this topographical situation.

In order to clean the air, the municipal government decided to take measures to deal with pollution, including relocating factories and constructing natural gas piping systems. The battle against air pollution has been undertaken in multiple stages. The Clean Air Act is now in its thirteenth phase.

The landscape and industries of Beijing, and the residential use of coal have been in place for many years, but environmental problems became more and more serious starting in the late 1980s. The principal reason for this development was the expansion of the transportation system.

### Challenges from vehicles

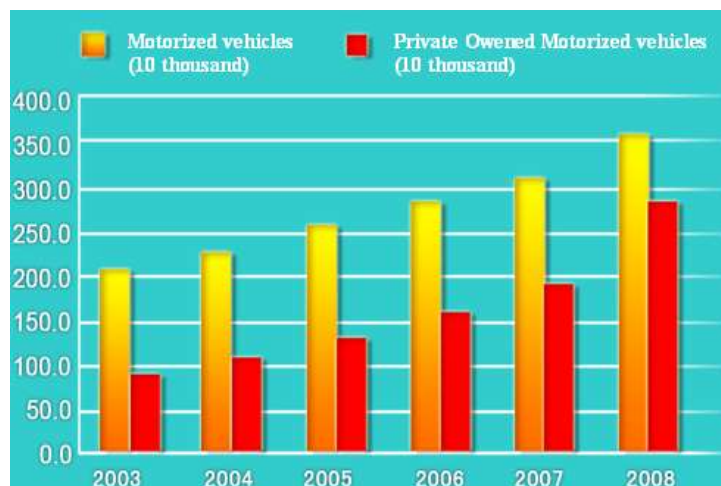
Before the late 1980s, the two main means of transport in Beijing were bicycles and foot. According to the results of the first Personal Travel Survey in the city, conducted in 1986, the percentage of traffic on bicycles and on foot was about 70%. Buses were the dominant motorised vehicle at the time, accounting for nearly 26% of passenger traffic. A typical scene of the time can be seen in the following picture.

Figure 1.



By the 1990s, car ownership in Beijing had increased dramatically, as shown in the following figure. The average vehicle runs 15 000 to 25 000 kilometres annually, and most run on petrol and diesel. According to some surveys, almost 60% of the SO<sub>x</sub>, NO<sub>x</sub> and CO fumes are from vehicle exhaust.

Figure 2.



### Vision and ideas of green transport in Beijing

Since before the Olympic Games, Beijing realised that it was necessary to make the future green and sustainable to protect its historic city.

Beijing has a long history, and relics of its past are scattered throughout the city. Its historic centre, an area of about 60 square kilometres, has preserved the architecture and residential style of the past. The protection of this district was an important part of the construction of the modern metropolitan area.

### ***Clean air***

To deal with serious air pollution, Beijing Environmental Protection Bureau has issued more than 12 acts promoting better air quality. During the Olympic Games, which were held in Beijing in 2008, the air quality of Beijing City became a matter of international concern and was ultimately proved to be excellent. A green Beijing is one of the government's principal objectives for the future.

### ***Catering to the national policies on energy consumption reduction and exhaust reduction***

Developing a high GDP increasing rate with less energy consumption and fewer emissions is one of the most important national policy objectives. As China's capital city, Beijing is at the forefront in developing new energy resources and green vehicles as an important next step of development, to help cope with the world-wide fuel shortage and to alleviate traffic congestion.

Just as culture enriched Beijing, the dominant conception of development since the Olympic Games has been to promote not only a scientific and technical Beijing but a Green Beijing. This concept has been particularly developed in the transportation system. In recent years, the government has invested great effort in the development of public transportation and new energy vehicles.

### **The priority of public transport development**

Beijing's municipal government values the capacity of the public transport system to solve the city's traffic problems. Many measures have been undertaken to promote the dominant position of the public transport system among urban transport systems, despite an increase in car ownership of about 1 million between 2006 and 2008. In 2008, the market share of public transport in the urban passenger transport system was about 38.6%, as compared with only 29.8% in 2005.

### ***Vision of the government***

The priority for public transport policy is to create an effective, efficient, safe and comprehensive transport system, with rail transit and Bus Rapid Transit (BRT) as its backbone and the bus system as its principal support, and multi-mode co-operation.

In 2004, a white paper was published recommending that the market share of the public transport system in Beijing city be increased to 40% and that a basic network of rail transit and BRT be put in place.

At the end of 2006, the government issued the *Declaration on Priorities in Public Transport*, in which priorities were set out for the public transport system in four main domains: land use, investment, right-of-road allocation and tax incentives.

Within the *Beijing Energy Safe and Emission Reduction Action Plan* of 2009 (see more details at <http://news.sohu.com/20090714/n265198398.shtml>), the government promised to enhance the construction of an *Intelligent Transport System*. Starting in 2009, buses will be replaced by clean fuel vehicles and new energy vehicles. To protect air quality, vehicles that do not meet pollution standards will be weeded out and the green fleet promoted.

### ***Main measures taken so far***

#### ***Construction of rail transit network***

The importance of the rail system was not recognised until traffic congestion became very serious around the year 2000. The first metro line in Beijing was opened in October 1969, ahead of those in

Singapore, San Francisco, Washington, Seoul, etc. However, until 2001, there were only 41 kilometres of track on the two metro lines. In order to establish a sustainable transport system in the future, Beijing is planning for its rail system to be a backbone of passenger transport. A comprehensive rail system and extensive construction are planned, with 300 kilometres added by 2010, and 561 kilometres by 2015, at a rate of more than 50 kilometres of newly built rail lines every year. In addition, some measures to increase ridership have been undertaken:

- Since 2003, six new rail routes have been built in Beijing, with a sharp increase in operating mileage of about 130 kilometres. Eight rail routes now operate every day in the city, carrying about 4 million passengers daily.
- Train operating intervals have been cut 14 times to improve the level of service and the capacity of the rail transit system. The shortest interval is 2 minutes and 15 seconds.
- Electronic technology is now used for the fare collection system; a new integrated circuit (IC) card system, the Auto Fare Collection (AFC) system, is used.
- Low fare standard. Passengers can ride the rail transit system for as long as they want at a fare of CNY 2 for one continuous trip.
- Several park-and-ride parks have been constructed, with shuttles that charge passengers a low fee of about CNY 2

#### *Improve and adjust the bus system*

Beijing's bus system has been greatly extended. About 22 million bus vehicles now operate every day on about 987 bus routes, carrying about 15 million passengers daily. With the opening of the newly built rail transit route, 430 bus lines have been adjusted to become feeder lines. There is no doubt that now and in the future, buses will play a major role in urban passenger transport. However, in the 1980s, thanks to the sharp increase in car ownership and usage, the percentage of passenger traffic carried by the bus system declined yearly. Many factors contributed to this, but the poor level of service was probably one of the most important. As a first step toward enhancing bus service, the government launched a promotional campaign in 2006, instituting the following measures:

- *Design and construction of transfer stations for the bus network.* New terminuses (zoo station, Liuli Bridge station and Xizhimen station) have been built for transfer between rail and bus, between bus and car, and between bus and long-distance coach.
- *Numerous bus-only lanes.* A network of 258.5 kilometres now exists, with many lanes used exclusively for buses during peak hours every day.
- *Low fares with IC card payment.* Passengers who pay with an IC card pay only CNY 0.4 for one ride; students pay only CNY 0.2.

#### *Construction of BRT routes*

Nanzhongzhou, the first BRT line in China, was constructed in 2004 and carries about 160 000 to 200 000 passengers every day on routes totalling about 16 kilometres. Thanks to its great success, Beijing decided to plan and construct a BRT network. Three BRT lines are now operating, and one line is under construction. The four BRT lines fan out from the central part of the city to the suburbs.

### *Next steps in public transport*

- In the next few years, Beijing will continue to construct new rail transit routes. Every year, a new route will open, and 100 kilometres of newly built routes will be added every two years. By 2015, there will be a network of three-ring, four-latitude, five-longitude and seven radiating lines comprising a total of 561 kilometres.
- The bus system will be improved. Bus lines will be adjusted as rail construction continues, and a series of transfer terminals will be constructed around the city to establish a hierarchical bus system.
- Buses will be replaced by clean-burning vehicles. By 2008, more than 8 000 bus vehicles that meet Euro-III standards had been introduced. Battery electrical vehicles (BEV), hybrid electrical vehicles (HEV) and fuel cell vehicles (FCV) have been tested and verified on bus routes. In the future, all bus vehicles will be replaced by clean-type vehicles, especially new energy vehicles that use battery and other resources, instead of gasoline or diesel.

### **New energy vehicles**

China has made research on new energy alternatives a major component of national policy. As China's capital, **the top 3 super city**, (a super city is a city with more than 1 million residents; it is a definition from the Chinese urban system) Beijing leads national policy and serves as an example for the whole country and has taken advantage of convenience in using national resources. The Olympic Games gave an enormous impetus to the demonstration use of new energy vehicles.

### *New energy vehicles research in China*

To reform energy use, improve air quality and enhance the national motor vehicle industry, work began during the eighth Five-Year-Plan on battery-powered electric vehicles (BEV). This research was sponsored by the Ministry of Science and Technology of the People's Republic of China (MOST) and the National Development and Reform Commission (NDRC). During the tenth Five-Year-Plan, MOST started a special project on BEV application preparation. During the eleventh Five-Year Plan, the MOST project combined research, study and manufacture to promote the development of BEV. Under these project funds, universities, public transport firms, research institutes and some commercial corporations came together and formed a project group to work on a breakthrough on the application of BEV. This group handled development and patenting, set technical standards and produced vehicle units and components.

Starting in 2001, two demonstration vehicles, a BEV equipped with a lithium-ion battery and a lead-acid battery BEV, began to carry passengers on Bus Route 121 in Beijing. During the Universiade 2001 in Beijing, a green fleet of BEV shuttles carried athletes, coaches and spectators. In May 2005, a 14-vehicle BEV fleet equipped with lead-acid batteries was introduced for passenger transport in the city. In October 2006, a production permit was obtained for a patented lithium ion battery BEV in China. Based on the results of these trials, the executive committee of the Olympic Games authorised the use of 50 BEVs at the Games within the central park.

### *Demonstration during Olympic Games*

Thanks to the demonstration during the Olympic Games, the feasibility and reliability of the BEV vehicles was tested and verified, especially as regards battery stations, the rapid battery-change system, intelligent supervision and dispatch system and administration of vehicle operation.

Three types of new energy vehicles were prepared for the Olympics, as shown in the following table.

Vehicle energy type	Vehicle type	Vehicle number
BEV	Venue BEV	320 (415 during the Game)
	Sanitary BEV	6
	Coach BEV	50
Hybrid Electrical Vehicle (HEV)	HEV Car	75
	HEV Coach	25
Fuel Cell Vehicle (FCV)	FCV Car	20
	FCV Coach	5

During the four-day *Lucy Beijing* test event, one FCV car, two FCV coaches and 40 BEV Venue vehicles were tested, as shown in the following photographs.

Figure 3.



Figure 4.



During the Olympics:

- Forty BEV coaches served more than 145 000 athletes and delegates, with a total operation of 131 000 kilometres.
- Five BEV coaches served as shuttle buses from Central Park in the Olympic Village to the No. 6 station.
- Operating on 38 routes around 35 venues, 415 Venue BEVs operated on 266 500 kilometres and served 592 200 passengers.
- 20 FCV cars served for the MOST and the Beijing Transport Management Bureau, operating 970 times, a total distance of 76 000 kilometres.

#### FCV Coach

Factory of Coach	Number of coaches	Kilometres operated
Tsinghua University	3	21 000
Fujian Motor	3	5 554
Dark	3	4 365

#### HEV Coach

Factory of Coach	Passengers served	Kilometres operated
FAW	660 000	155 000
DFM	750 000	145 000



## HEV Car

Factory of Car	Passengers served	Kilometres operated
CHERY	N/A	1 735 000
CHANGAN	70 800	429 000

### *Future development of new energy vehicles*

After the Olympic Games, 50 BEV coaches served as buses every day in Beijing, on several bus routes, such as the tourist No. 5, the temporary Line 6, the Financial Street line, etc.

In the next several years, HEV and BEV vehicles will be introduced in the public transport system and BEV vehicles introduced for the sanitary service vehicle fleet. By 2012, a total of about 5 000 new energy vehicles are expected to be in operation.

Details of the projected numbers of different new energy vehicles in use in the next few years are shown in the following table, with estimates of the total annual savings in oil consumption and the reduction of CO<sub>2</sub> emissions.

	2009	2010	2011	2012	Subtotal
BEV Coach	100	200	300	300	900
HEV Coach	870	600	1500	500	3 470
Sanitary BEV	30	200	200	200	630
Total number of BEVs	3009	3010	4011	3012	13042
Annual fuel savings (in million litres)	7.3	19.8	39.0	53.4	119.4
Annual reduction of CO <sub>2</sub> emissions (in thousands of tons)	20.9	50.1	99.3	131.7	302.1

The schedule planned is as follows:

- By the end of 2009, the total number of new energy vehicles will be increased to 1 000, adding 50 BEVs to the existing 50, for a total of 100, adding 860 HEV buses to the ten operating now, for a total of 870 HEV buses and 30 sanitary BEVs.
- In 2010, an increase of 1 000 new energy vehicles is projected, including 600 HEV and 200 BEV. Four battery-recharging stations will be constructed on the fourth ring road around the city.
- In 2011, an increase of 2 000 new energy vehicles is planned, including 300 BEV buses, 200 sanitary BEVs and 1 500 HEVs. In 2012, an additional 1 000 new energy vehicles will be purchased.

### **Summary and conclusion**

The transport system must play a vital role in achieving a green city. Apart from giving priority to the public transport system and the introduction of new energy vehicles, improving the bicycle system and the pedestrian environment is crucial. Concrete measures being implemented in the City include the construction of bicycle lanes and pedestrian areas, and a public bicycle system.

Citizens are now aware of the importance of a greener style of living. Some non-government organisations have participated in the green transport campaign and have organised such events as the no-driving day, the green bicycle day, etc., which have become a special part of urban life in Beijing.

Since the Olympic Games, the goal of a Green Beijing has become one of the three guiding principles and dreams of the government and the citizens.

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## CLIMATE CHANGES IN EGYPT: EXISTING EFFORTS AND RECOMMENDATIONS

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### **Introduction**

Climate change is both a local and a global problem, and it requires action at all levels, including the city level, if it is to be addressed effectively. Strong linkages between the local, national, regional and global levels are essential if cities are to receive the support they need to be able to carry out the climate change activities assigned to them. However, neither this support nor the assignment of tasks can be properly targeted unless the needs and abilities of cities have been fully integrated during the development of conventions and multilateral environmental agreements. Additionally, the valuable work which cities are already carrying out in addressing air pollution, renewable energy and sustainable transport can only strengthen and improve global policymaking negotiations if a free flow of information is encouraged at all levels. Climate change is already part of daily life – now measures to combat it must become part of cities' formal work programmes and action plans. With the cooperation and support of partners at all levels, including the United Nations, future actions in the cities to reduce emissions will be key to global success in reducing global climate change (Shardul Agrawala *et al.*, 2004).

This background paper was prepared as part of the requirements for the OECD Workshop on “Green Cities: New Approaches to Confronting Climate Change” on 11 June 2009, at Las Palmas de Gran Canaria, Spain. It principally describes the subject of the workshop using secondary resources of information such as governmental and international reports rather than using primary ones, *i.e.* the author depends mainly on desk study and analysis (OECD Workshop, 2009).

### **Country background**

Egypt is located between 22° to 32° North and 24° to 37° East. It is bordered on the west by Libya, on the north by the Mediterranean Sea, on the south by Sudan, and on the east by the Gaza Strip, Palestine and the Red Sea. Its coastline extends for more than 3 500 kilometres along the Mediterranean Sea and the Red Sea coasts. The Nile Delta coast, about 300 kilometres long, is the site of a number of highly populated cities, such as Alexandria, Port Said, Rosetta and Damietta.

Egypt is the second most populous country in Africa. Its population is over 64 million and is growing at 1.66% per year. Cairo, the capital, has become a mega-city, with a population of 15 million (World Bank, annual report, 2003). Access to clean water and sanitation appears to be good: the World Bank reports that 95% of the population has access to “improved water resources”, and 98% of urban population has access to sanitation (World Bank, annual report, 2003). The per capita water availability is about 1 000 cubic metres of water per year – countries are sometimes described as water-stressed if per capita water availability falls below that amount.

The per capita income of Egypt is about USD 1 500 (World Bank, annual report, 2003), GDP is growing at about 5% per year. This ranks below average per capita income for Middle Eastern and North African countries but slightly higher than per capita income for low- and middle-income countries (World Bank, annual report, 2002). The poorest quintile can lay claim to only 9.8% of national income, while the

richest quintile claims nearly 40%. Consequently, almost one-quarter of the population lives in poverty (World Bank, Poverty and Climate Change adaptation, 2003).

Agriculture contributes 17% of the country's GDP and is the largest source of employment, constituting 30% of the labour force. About three-fifths of the country's agricultural production is in the low-lying delta (Strzepek *et al.*, 1995). Changes in the flow of the Nile, which supplies irrigation for agriculture, can have a major impact on the country's economy (Shardul Agrawala *et al.*, 2004).

### **Attention to climate concerns in national planning**

Egypt has signed or ratified a number of multilateral environmental agreements, and has a number of national-level environmental and sectoral plans that intersect with responses that might be required to manage climate variability and long-term climate change.

#### ***Climate policies and national communications to international environmental agreements***

Egypt was among the first Arab countries to join the co-operative global efforts to confront climate change. After the Rio de Janeiro Earth Summit in 1992, it ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1994 and signed the Kyoto Protocol in 1999. Its First National Communication to the UNFCCC was published in 1999.

The country faces many risks due to climate change and sea-level rise, mainly in relation to agriculture, water resources, human health and the coastal zone (particularly the Nile Delta). It also includes economic loss for sea-level rise in several coastal cities. However, a large range of adaptation options are available, although implementation arrangements for them seem somewhat weak.

#### ***National policies of relevance to climate change***

In 1982, Egypt established the Egyptian Environmental Affairs Agency (EEAA), which subsequently led to the creation of a Ministry of State for Environmental Affairs in 1997. In 1995, the EEAA launched two major programmes:

- *Support for the National Action Plan* (SNAP), sponsored by the United States Country Studies Programme (USCSP).
- *Building Capacity for Egypt*, to respond to the UNFCCC, which was sponsored by the Global Environment Facility (GEF) and implemented by the United Nations Development Programme (UNDP).

These two programmes facilitated 25 studies on various topics, such as GHG emissions inventory, GHG mitigation and adaptation technology assessment, climate change adaptation options, and abatement costs. Results and recommendations were disseminated through several conferences, seminars and workshops.

### **Attention to climate change concerns in donor portfolios and projects**

Egypt receives about USD 1.5 billion in donor aid per year, or about 1.5% of its gross national income (GNI). An analysis of donor projects in Egypt using the OECD/World Bank Creditor Reporting System (CRS) database reveals that roughly 33% (in terms of investment dollars) and 25% (in terms of number of projects) of donor portfolios in Egypt are potentially affected by climate risks. This includes activities in sectors that may be impacted by climate change, as well as those development activities that may influence the vulnerability of natural or human systems to climate change. These numbers are only indicative, given

that any classification based on sectors suffers from problems related to over-simplification. Nevertheless, such measures can serve as a crude barometer for assessing the degree to which particular projects or development strategies may need to take climate change concerns into account.

Donor strategies do not mention climate change, although several stress the concern for water scarcity in Egypt. Some donor strategies and projects explicitly cater to improved water management and conservation in Egypt, including a shift to less water-intensive crops. Although they may not explicitly recognise climate change, any measures to promote efficiency of water use must be synergistic with the adaptation that would be required because of the additional stresses on water availability posed by climate change (Shardul Agrawala *et al.*, 2004).

Meanwhile, several donors have also emphasised basin-wide co-operation on the Nile waters, particularly through the Nile Basin Initiative (NBI), which was established in 1999. If successfully implemented, such an initiative can help reconcile the water use and development priorities of all riparian countries, including their capacity to adapt to any reductions or other changes in Nile flows from climate change. Climate concerns, however, are not yet an explicit part of the NBI agenda.

Relative to water resources, there are fewer donor projects on coastal zones, although some do focus on issues such as coastal and marine resource management, and conservation of coastal wetlands.

The absence of climate change concerns in such projects, however, could be a significant omission, given the local subsidence at several locations on Egypt's coast (particularly around the Nile Delta), which would exacerbate the impacts of climate change-induced sea-level rise and saline intrusion.

### **Emission scenarios and selected mitigation projects in Egypt**

Total CO<sub>2</sub> emissions in Egypt are expected to increase from nearly 75 million tons in 1990-91 to about 261 million tons in 2016-17, with an average annual growth rate of 4.9%. Industry is expected to be the major contributor to CO<sub>2</sub> emissions by 2016-17, with a share of about 49%, followed by the electricity sector at 29% and the transportation sector contributing 14%.

Based on a technology assessment study, three GHG (Greenhouse Gases) mitigation scenarios were developed: a) fuel substitution, b) renewable energy and c) energy efficiency.

Energy savings for the three scenarios combined are expected to reach about 208 peta joules (PJ) by 2016-17, resulting in a reduction in CO<sub>2</sub> emissions of 18.4 million tons.

A number of mitigation projects have been initiated in Egypt, which include the following:

#### ***Technology Co-operation Agreement Pilot Project (TCAPP)***

Acknowledging technology transfer as one of its highest priorities, Egypt is focusing on initiatives such as the Technology Co-operation Agreement Pilot Project (TCAPP) in co-operation with the US Country Studies Programme. The TCAPP is chartered to develop consensus among key Egyptian organisations on a set of high priority, climate-friendly, technology issues aimed at successful commercialisation.

Results are expected to produce candidate technology transfer areas for consideration under the guidance of the National Climate Change Committee. Market development plans for selected technologies are currently under way.

### ***Promotion of wind energy for electricity generation***

This is an active programme within the Ministry of Electricity and Energy through the New and Renewable Energy Authority. Supported by many international donors, this project aims to install 600 megawatts of wind turbines by the year 2005; 300 megawatts are already contracted through different donors, and most of them are scheduled to be operating by 2003.

### ***Fuel cell bus demonstration project***

Through the Global Environment Facility (GEF), UNDP is supporting fuel-cell bus demonstration projects in Cairo, São Paulo, New Delhi, Beijing and Mexico City to reduce GHG emissions and other pollutants. The demonstration in Cairo features eight fuel-cell buses as well as hydrogen production and supply facilities. The programme will run for five years, with three years devoted to driving, monitoring and testing performance. Service was implemented in 2001.

### ***Hybrid electric bus technology***

The overall objective of this project is to introduce a viable hybrid-electric bus that will have significant benefits and sustainability in various segments of the country. The project is funded by GEF and implemented by UNDP and the Egyptian Social Development Fund. The project will be applied to high-priority historical sites, starting with the Giza plateau, where the Pyramids are located.

### ***Natural gas motorcycles***

This is a Canadian technology project developed to reduce the emissions of GHG by converting two-stroke engines used in motorcycles to compressed natural gas (CNG). The project will be implemented in three phases: identification of capabilities and barriers, demonstration of the technology, and finally a hand-over and transition to the local market.

### ***Methane recovery from landfills***

This project involves the recovery of methane generated in landfills, in co-operation with the Canadian government and Industry Canada. The proposed work plan involves the design and construction of two bioreactor landfill cells in Cairo. After the completion of the project, the team will hand over the two bio-reactor cells to the Cairo Solid Waste Management Authority. On-site training will be provided to the Egyptian staff for future operation and monitoring. A general policy of encouragement of building up solid waste landfills has been implemented, and associated landfills started their operation in Alexandria in October 2001.

### ***Integrated solar thermal/natural gas programmes***

The New and Renewable Energy Authority (NREA) has prepared a programme for implementing a series of solar thermal power plants. This includes an *Integrated Solar Combined Cycle System (ISCCS)* with a 100-150 megawatt capacity at Kuraymat.

The GEF/World Bank-funded project began in 1997, and a second project of like capacity is anticipated to be put into operation before 2005.

### ***Energy efficiency improvement and emissions reduction project***

This four-year UNDP/GEF project was designed to achieve reductions in GHG emissions through policies that promote demand-side management and energy conservation while creating an enabling

environment for energy efficiency. The project focuses on the transmission and distribution of electrical systems, co-generation and market support for emergency energy service companies.

### ***Fuel switching***

Egypt's current energy policy calls for shifting the demand from liquid fuel oil to natural gas, given the abundance of natural gas supply, which is estimated at 43 trillion cubic feet. Fuel switching is at present being undertaken in electricity generation, industry and residential sectors. The USAID-assisted *Cairo Air Improvement Programme* (CAIP) furnished Cairo's municipal bus companies with 50 CNG-powered rolling bus chassis, while the government of Egypt is contributing the bus bodies. CAIP also helped to equip the CNG bus maintenance garages required for these fleets, and introduced CNG-related safety standards for fuel tanks, fuelling stations and fuel systems. The private sector has since 1996 been building and operating 27 CNG fuelling stations and converting over 27 vehicles, including taxis, to CNG. This has served as an example for public/private sector partnerships. The USAID Commodity Import Programme helped in purchasing fuelling equipment for many of these CNG filling stations (Shardul Agrawala *et al.*, 2004).

### **Recommendations**

It is clear that a number of important economic and commercial centres in Egypt will be exposed to the adverse effects of climate change, with the coastal cities of the Nile Delta, in particular, being most affected. It is urgent that strategic adaptation policies and plans be put in place and those strong institutions and systems of supervision to enforce environmental laws be established.

Most importantly, a national institute for climate change should be set up to build capacity and train human resources, design the required institutional systems and co-ordinate action among various sectors. The institute would focus on the study of possible adaptation policies, while also spreading awareness of climate change effects and publicising success stories in the different sectors.

The use of wind and solar energy for water desalination must be promoted, and adequate financing for scientific research in these areas must be provided. Local human resource skills in the field of mathematical regional circulation models must be developed so as to allow future projections with the high degree of accuracy required for policy formulation. Studies should be undertaken to determine the possible adaptation choices for the water, agriculture and coastal sectors that would make use of simple and low-cost technologies. Environmental laws should be firmly enforced, and environmental assessments of projects must be made mandatory. National projects should take into consideration expected climate change effects. A comprehensive institutional mechanism for the protection of coastal areas must be established with the aim of co-ordinating the efforts of the research community and implementation agencies. Non-governmental organisations should be encouraged to raise awareness among decision makers and the public on the dangers posed by climate change and the necessity of reducing over-consumption (Mohamed El Raey, 2004).

### **Key challenges, policy recommendations and main obstacles for implementation**

Urban activities generate close to 80% of all carbon dioxide (CO<sub>2</sub>) as well as significant amounts of other greenhouse gases. Direct sources of greenhouse gas emissions include energy generation, vehicles, industry and the burning of fossil fuels and biomass in households. Cities around the world do, however, carry out a vast range of activities related to increased energy efficiency, improved air quality and public health. The introduction of renewable energy, cleaner production techniques and the establishment of regulations to control industrial emissions contribute directly to the reduction of CO<sub>2</sub>. An emphasis on energy efficient housing and construction, focusing on simple measures such as solar water heating,

adequate insulation, double glazed windows and improved architectural designs for heating or cooling can dramatically reduce the energy consumption of a city's housing

Mainstreaming climate change in development planning is essential; UNHABITAT has reiterated that urban planning is important in managing climate change because well planned cities provide a better foundation for sustainable development rather than unplanned cities. Both adaptation and mitigation actions of environmental change require urban planning. Among others, urban planning can help to mitigate the urban heat islands by creating open spaces and parks as heat sinks in urban areas, reducing ecological footprint by planning for an efficient, compact and mixed uses buildings and shift to a public transport –based movement. In the urban planning literature, there is a complete shift on mitigation actions with longer term adaptive measures, for example preventing flooding and landslides, protecting or relocating vulnerable settlements, improving drainage and preventing new developments in areas subject to hazards or natural threats (World Bank, 2009).

Urban planning and its influence in considering climate change is still a new field in the Egyptian context. This needs to be explored, and could be one of the greatest challenges that faces the urban sector in Egypt. Four key challenges face policy makers in enhancing the urban environment:

- Giving stakeholders incentive to contribute to the enhancement of physical urban environment;
- Mobilising urban assets and resources strategically and achieving synergetic effects that will enhance the physical urban environment;
- Reducing social costs associated with public intervention to enhance the urban environment;
- Inter-municipal action to combat climate change. A lack of horizontal collaboration among municipalities within urban regions can also hinder actions to combat and adapt to climate change. In many cases, the administrative structure of governance does not fall precisely within metro-regions' boundaries, so that carbon-relevant functions, defined economic interchanges, flows of materials and energy, and transportation between activities and households in the city's core area and localities overlap across multiple jurisdictions. This requires that city officials engage in the sometimes challenging task of co-operation with other local governments.



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**SESSION 1-B:  
THE POTENTIAL OF THE GREEN ECONOMY**

## UNITED KINGDOM: CITIES AND CLIMATE CHANGE

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### Introduction

The *Stern Review on the Economics of Climate Change*, published in November 2006, demonstrates the severity of the threat posed by unchecked climate change. It makes a compelling case for urgent and long-term collective action by national, regional and local government and companies to mitigate its effects and adapt to its consequences.

The Stern Review saw a key role for government at all levels in providing a policy framework to guide effective adaptation and mitigation by individuals, organisations and companies in the medium and longer term. It identified four key areas:

- High-quality information and tools for risk management to help drive efficient markets.
- **Land use planning and performance standards** to encourage private and public investment in buildings and other long-lived infrastructure to take account of climate change. Properly designed and planned urban development must become a low-carbon way of accommodating growth.
- **Long-term policies for climate-sensitive public goods**, including natural resources protection, coastal protection, and emergency preparedness.
- A **financial safety net for the poorest in society**, who are likely to be most vulnerable to its impacts and least able to afford protection.

Urban environments in the UK already perform relatively well. The largest 56 cities in England account for 63% of all jobs and 58% of the population but generate only 50% of carbon emissions.<sup>1</sup> But UK cities are also feeling the effects of environmental problems, with “urban heat islands” formed from concentrations of rising temperatures. This has prompted many British cities to take the initiative and develop their own programmes to address climate change.

Improving the environmental performance of towns and cities, and enabling them to adapt to climate change, needs action across the board: buildings need to work better and consume less energy and transport systems need to promote more efficient means of travel. Urban planning needs to create places where local vitality reduces the need for unnecessary journeys, and where green space mitigates the impact of climate change as well as providing a place for relaxation.

## National policy responses to climate change

The government's *Climate Change Act 2008* became law in November 2008.

The two key aims underpinning the Act are:

- to improve carbon management and help the transition towards a low-carbon economy in the UK; and
- to demonstrate strong UK leadership internationally, signalling that the UK is committed to taking its share of responsibility for reducing global emissions in the context of developing negotiations on a post-2012 global agreement at Copenhagen in 2009.

Key provisions of the Act include:

- **Legally binding targets:** Green house gas emission reductions through action in the UK and abroad of at least 80% by 2050, and reductions in CO<sub>2</sub> emissions of at least 26% by 2020, against a 1990 baseline.
- **A carbon budgeting system** that caps emissions over five-year periods, with three budgets set at a time, to set out a trajectory to 2050. The first three carbon budgets will run from 2008-12, 2013-17 and 2018-22, and were set earlier this year.
- The creation of the *Committee on Climate Change*, a new independent, expert body to advise government on the level of carbon budgets and where cost-effective savings could be made. The committee will submit annual reports to Parliament on the UK's progress towards targets and budgets to which the government must respond, thereby ensuring transparency and accountability on an annual basis.
- **Further measures to reduce emissions** include powers to introduce domestic **emissions trading schemes** more quickly and easily through secondary legislation; measures on **biofuels**; powers to introduce pilot financial incentive schemes in England for **household waste**; powers to require a minimum charge for **single-use carrier bags**.
- On adaptation, the government must report at least every five years on the risks to the UK of climate change, and publish a programme setting out how these impacts will be addressed. The Act also introduces powers for government to require public bodies and statutory agencies to carry out their own risk assessment and make plans to address those risks.
- A requirement for the government to issue guidance in 2009 on the way companies should report their greenhouse gas emissions, and to review the contribution reporting could make to emissions reductions by 1 December, 2010. Requirement also that the Government must, by 6 April, 2012, use powers under the *Companies Act* to mandate reporting, or explain to Parliament why it has not done so.

The *Energy Act 2008* complements the *Climate Change Act*. It implements legislative aspects of the Energy White Paper 2007 to improve energy efficiency and reduce carbon emissions by developing low-carbon infrastructure. This includes creating a regulatory framework to allow private sector investment in Carbon Capture and Storage (CCS) projects; strengthening the drive towards greater and more rapid deployment of renewable energy in the UK; supporting greater use of smart metering of energy usage; and cleaning up fossil fuel usage.

The *Planning Act 2008* completed the trio of key government legislation to underpin the UK's long-term energy and climate change strategy. This act creates a duty on local councils to take action on climate change in their spatial development plans. It also provides for the government to produce national policy statements (NPSs) for nationally significant infrastructure projects. These will be used as the policy framework for decisions by a new Infrastructure Planning Commission (IPC) established under the Act as the authority for granting development consent for major infrastructure projects like airports and power stations.

In July, the government published a suite of strategy documents setting out how it intends to deliver the carbon budgets. The *Low-Carbon Transition Plan* sets out the suite of policies and programmes across the different sectors of the economy. This is supported by a *Carbon Reduction Strategy for Transport*; and *Low-Carbon Industrial Strategy*. The UK government also published its *Renewable Energy Strategy*, which sets out how the UK will meet its contribution to the EU's renewable energy target for 2020.

### **UK government policy initiatives that help cities tackle climate change**

There are a wide range of UK government policy initiatives that are helping UK cities to reduce carbon emissions and address climate change:

#### ***The built environment***

More than a quarter of the UK's carbon emissions arise from domestic energy use, so there is an urgent need to find more energy-efficient ways of building and maintaining homes.

The government's commitment to more sustainable homes began with the *Millennium Communities* programme, launched in 1997. English Partnerships, now part of the Homes and Communities Agency (HCA), has developed seven sites to set new standards of design, building quality and energy efficiency in challenging locations. Good progress is being made on all the sites, particularly at Greenwich (London), Allerton Bywater (near Leeds) and New Islington (Manchester). Other sites are at South Lynn (near King's Lynn), Telford, Oakgrove (Milton Keynes) and Hastings. The Millennium Communities have done much to influence and direct the house-building industry towards improving environmental quality and the creation of high-quality sustainable communities.

In December 2006, the government announced a target that all new homes would be zero carbon (that is, creating no net carbon emissions over a year) within 10 years.

In July 2009, the government confirmed that the zero carbon standard would involve a combination of high energy-efficiency measures; some onsite renewable energy measures; and some offsite renewable provisions, recognising that it is neither technically feasible nor cost-effective to require that all the heating and electricity requirements be met from onsite renewable measures.

Other steps being taken to support sustainable new homes include:

- The *Code for Sustainable Homes*, which came into force in April 2007. The aim is to deliver a step change in sustainable home-building practice. The code sets out minimum standards for waste management and water efficiency and drainage systems and mandatory energy efficiency ratings, so that the environmental performance of new housing will be transparent to citizens.<sup>2</sup> New homes that use micro-renewable technology such as wind turbines and solar panels will also gain extra points in the code;

- A continuing programme of revising and updating building standards. These include energy – the government is currently consulting on new standards to be introduced in 2010; and water efficiency (new standards were introduced earlier this year). These build on the standards set out in the Code for Sustainable Homes, to ensure that improving environmental performance is not just a matter of reporting performance, but of enforceable compliance to help tackle climate change effectively. They include improvements to insulation standards in new homes, and the use of more efficient heating systems, including condensing boilers. These measures will deliver increased energy standards for new buildings, including 22% in houses and 18% in flats.

The Department for Communities and Local Government announced a further package of measures in 2006 to put climate change at the heart of the land use planning system.<sup>3</sup> These include:

- A **planning policy statement** on planning and climate change<sup>4</sup> introduced in December 2007. This sets out how regional and local planning policies should contribute to reducing emissions and stabilising climate change by promoting low-carbon lifestyles and reducing reliance on the private car.
- **New single regional strategies**, combining previously separate regional economic and spatial strategies, are to come into operation from 2010 onwards. In addition to regionally specific issues, they will have to demonstrate clear priority outcomes in three priority areas: the economy, housing, and climate change and renewable energy.
- A **consultation paper on microgeneration** was issued in April 2007. This has led to changes in permitted development rights to give people greater freedom to install microgeneration devices (*e.g.* solar panels) on their homes.

The government has a wide-ranging programme to improve the energy efficiency of existing homes. The main lever is funding provided by the UK's energy suppliers for the installation of energy-efficiency measures (the *Carbon Emissions Reduction Target*). The energy suppliers are obliged to meet the target for carbon savings by installing energy efficiency measures, which are subsidised for the home owner. A new scheme is being introduced for the energy suppliers to fund measures at the community scale (the *Community Energy Savings Programme*).

As part of the implementation of the *Energy Performance in Buildings Directive*, the UK has introduced *Energy Performance Certificates* (EPCs) for all homes bought and sold and rented from December 2007. These provide information to households on the energy performance of their home (on a rating scale from A to G) and what they can do to improve it to reduce carbon dioxide emissions.

The government consulted earlier this year on a *Heat and Energy Savings Strategy*, with proposals for introducing further policies to tackle carbon reduction in existing homes. The government will publish its final strategy later this year.

The government is prioritising development on previously developed (“brownfield”) land in the right place, and building housing at the densities that make local services and public transport systems viable, to promote and retain vitality within our towns and cities. This helps reduce unplanned urban sprawl on greenfield land that has contributed to climate change by making new development dependent on private car use rather than public transport.

The government's national target for England that at least 60% of new homes are to be built on brownfield land has been exceeded. Well in excess of 70% of all new homes nationally are being built on previously derelict land.

In areas of lower density, like some suburbs, selective new build is helping to enhance vitality and quality of place by creating the densities that can support local services.

The *Sustainable Communities Plan* (launched in 2003) emphasised the importance of developing within existing urban areas, such as East London and Milton Keynes, and regenerating towns like Corby and Aylesbury to assist them in attracting and accommodating new development. Following Kate Barker's report on housing supply, the government has identified growth points within towns and cities in England, to complement the still-important growth areas.<sup>5</sup>

The *Growth Points* initiative is designed to provide support to local communities that wish to pursue large-scale and sustainable growth, including new housing, through a partnership with government. A key criteria for gaining growth-point funding is to demonstrate that new development will contribute to sustainable long-term growth, including exemplar projects that will address climate change.

The government's eco-town programme has been developed as a response to the challenges of climate change, the need for more sustainable living, and an acute shortage of affordable housing. The plans are for five eco-towns by 2016 and up to ten by 2020 as part of the plans to build 3 million homes by 2020. Eco-towns will be new settlements of between 5 000 and 20 000 homes, with good links to existing towns. At least 30% of the new homes will be affordable housing. All new buildings across the developments should be zero-carbon – promoting sustainable and healthy living for existing and future generations.

In July 2009, the government announced the locations of the first four new eco-towns. They are Rackheath (Norfolk), northwest Bicester (Oxfordshire), Whitehill Bordon (East Hampshire) and the China Clay Community near St. Austell, Cornwall.

Schemes at the four confirmed sites are proposed or supported by local authorities. The developments, which will include 4 000 homes on a disused airfield at Rackheath, near Norwich, and 5 000 in the town in Cornwall, must still go through the planning process. Construction is expected to be under way by 2016.

A second wave of at least six eco-towns is planned. The government is making up to GBP 5 million available for councils to conduct further planning work on these proposals.

The *Homes and Communities Agency (HCA)* – the government's national housing and regeneration agency in England – is supporting the delivery of new social housing projects that can benefit from new and existing low-carbon technology. A key criteria for new social homes to be supported by HCA funding is that they are built to higher energy standards than the current building regulations. The HCA is responsible for the *Carbon Challenge* programme of exemplary zero-carbon developments. It is also funding the development of community-level low-carbon energy schemes, such as district heating schemes, to support new or existing developments.

HCA will carry out post-occupancy evaluation on 15% of social housing schemes and all HCA-funded private schemes to ensure they meet the required Level 3 of the Code for Sustainable Homes [www.homesandcommunities.co.uk](http://www.homesandcommunities.co.uk).

The Commission for Architecture and the Built Environment (CABE), the government's advisor on architecture, urban design and public space – has established a sustainability website to help promote learning and best practice at all levels in tackling climate change through sustainable design, planning and construction and high-quality public space. Preparing towns and cities for a changing climate [www.sustainablecities.org.uk](http://www.sustainablecities.org.uk).

The UK Meteorological Office (Met Office) has created a climate analysis tool, *UK Climate Projections 2009*, to provide the most comprehensive climate projections ever produced. Funded by the



Department for the Environment, Food and Rural Affairs, it allows projections to be broken down to regional level to allow cities, businesses and organisations to understand the challenges ahead and prepare for the possible effects of climate change now.

The *Environmental Transformation Fund* (ETF) aims to speed up the commercial use of low-carbon energy and energy-efficiency technologies in the UK, and raise their profile in the energy market. This should help to reduce the carbon intensity of energy production, and reduce overall energy demand – which is crucial to achieving our climate change and renewable energy goals for 2020 and beyond.

### **Local action on global climate change**

Many UK cities are already leading the way on tackling climate change. The *Nottingham Declaration* is a public commitment by local authorities in England to recognise the impacts of climate change and take action against it. Actions include delivering carbon dioxide reductions at the local level by improving energy sourcing, travel and transport, waste production and disposal, and the purchasing of goods and services.

The *Nottingham Declaration* also requires local authorities to champion carbon reduction and encourage their local community to work towards this aim. Well over 200 local authorities have now signed the Declaration (or its equivalent) since its launch in 2000, [www.nottinghamdeclaration.org.uk](http://www.nottinghamdeclaration.org.uk). A climate change *Action Pack* for local authorities was launched in July 2006.

In November 2007, the leaders of the eight largest regional cities in England signed a *Declaration on Climate Change* with the central government. Agreed commitments included achieving or exceeding national targets for reducing carbon emissions in line with national legislation, showing leadership by engaging public sector agencies, employers and communities in making specific carbon-reduction commitments, and building on the Stern Review to develop economic impact models to inform future decisions.

An increasing number of cities are publishing climate change action plans setting out what they will do to meet their carbon-reduction targets.

London, which accounts for 8% of the UK's total greenhouse gas emissions, launched the *Mayor's Climate Change Action Plan* in 2007, setting out how London will contribute and show leadership in meeting this global challenge. London has also developed a *Climate Change Adaptation Strategy* and is a member of the C40 Cities Climate Leadership Group, a group of the world's largest cities committed to tackling climate change.

The Association of Greater Manchester Authorities published its own "Mini-Stern" review in August 2008, to assess the economic impact of European Union and UK climate change legislation on the Manchester city-region and the North-West. It puts forward a strong case for early action to reduce greenhouse emissions in the region, to avoid the considerably higher long-term costs of cutting emissions that could rise to 20% of GDP.

Manchester has an imaginative programme to reduce carbon emissions called *Manchester is my Planet*. Since 2005, the city has been working in partnership with neighbouring local authorities, universities, businesses and over 20 000 individuals towards a low-carbon future for the region. Through the pledge campaign, encouraging individuals to reduce their carbon footprint, and a number of innovative green energy projects, *Manchester Is My Planet* aims to make Manchester the coolest and greenest city on earth (see [www.manchesterismyplanet.com](http://www.manchesterismyplanet.com)).

The City of Birmingham ran its first Climate Change Festival in June 2008 to encourage local residents to sign pledges to reduce their own carbon footprint and learn about climate change and their home city.

Local authorities can also do a lot to boost the environmental efficiency of their cities through Energy service companies (ESCos). These are an example of local authorities using existing powers to tackle climate change, by entering into joint ventures that can develop sustainable energy schemes. The Department for Environment, Food and Rural Affairs (DEFRA) is exploring with the English Core Cities (the eight largest regional authorities outside London) how these can be more widely implemented.

The government's *Climate Change Programme Review*, announced in March 2007, included a GBP 4 million fund to create a local authority best practice support and improvement programme on tackling climate change. In addition, the post-2008 local government performance framework has focused on climate change to incentivise local authorities to reach the levels of the best.

Central government is supporting the cities of Bristol, Leeds and Manchester as part of a *Low-Carbon Cities Programme* to help them develop city-wide carbon reduction strategies. The vision is of a city-wide carbon-reduction target led by the public sector, supported by the private sector and owned by the entire community. They are supported by the Energy Saving Trust and the Carbon Trust, which have considerable experience in working in partnership with major cities. The aim is to develop effective climate change strategies that can be taken forward through a supportive and flexible partnership. It will provide a basis for learning and best practice that can be adopted by the other core cities and beyond.

### **Exemplar Projects**

Another important lever to minimise carbon emissions is through the use of exemplar projects, which can play a key role in offering guidance and best practice in tackling climate change.

#### ***Thames Gateway***

In the Thames Gateway, an area of 4 000 hectares of brownfield land stretching from East London to the Thames Estuary, there are plans to build 120 000 houses and create 180 000 jobs by 2016. A feasibility study has been undertaken to explore the scope for making this a low-carbon development area. This has involved looking at the sources of climate change gases across five sectors: transport, water, waste, energy use in buildings and logistics. The results of the study provide an evidence base from which the Thames Gateway will be able to set strategic priorities in climate change reduction, consistent with the UK government's reduction target of 60% by 2050.

The 2012 London Olympics will be located in the Lower Lea Valley, which forms part of the Thames Gateway. There is a commitment to make the London Olympics a low-carbon Games by:

- using environmentally sound venues and infrastructure to reduce energy use and, wherever possible, use low-carbon and renewable energy sources;
- using sustainable transport services using low-emission vehicles to ensure full public transport access to all venues; and
- a programme of environmental and social benefits to offset unavoidable carbon emissions associated with the Games.

### ***The SmartLIFE project***

SmartLIFE is a project funded by the European and UK governments bringing together three European growth areas: Cambridgeshire, Hamburg in Germany and Malmö in Sweden. Led in the UK by Cambridgeshire County Council, it is designed to tackle issues around growth in housing, aiming to deliver quality, energy-efficient buildings using new skills and innovation. It offers professional and vocational training in sustainable and modern methods of construction (MMC), a practical demonstration area and exhibition centre.

The project is run in collaboration with Cambridge Regional College (CRC), which, as part of a Centre of Vocational Excellence in Construction, brings extensive expertise in construction training to the project, while providing a site for a Business and Training Centre built at its Science Park Campus. This training centre was supported by a GBP 3 million contribution from the CLG Growth Area Fund. It provides a unique and truly innovative approach to community development, drawing on transnational experience and resources, and using training, advice and practical support to transform the challenge posed by major growth into an opportunity to promote low-carbon development.

### ***Northstowe in Cambridgeshire***

Northstowe is the name of a proposed new community in Cambridgeshire planned as an exemplar of sustainability in the use of renewable energy resources and reducing carbon emissions.

At Northstowe, the aim is to achieve up to 50% reductions on energy and mains water use compared with conventional housing, using technologies and design approaches such as micro-generation (through the use of photovoltaic panels or tiles on roofs and supply electricity, local biomass and windpower generation); solar water heating through roof-mounted collectors, and reduced energy use through more energy-efficient design and high-performance insulation materials. Homes will also use the latest technology in water-efficient fittings, rainwater collection and grey water recycling and reduced waste water through sustainable urban drainage techniques.

Plans for Northstowe, which are still under review, include the construction of around 9 500 homes, a town centre area, schools and employment areas. The Northstowe development is being led by the Homes and Communities Agency and the developers Gallagher Estates.

The *Carbon Challenge* aims to fast-track the delivery of new communities, of 200 to 500 homes, at Level 6 of the Code for Sustainable Homes. The purpose is to speed up the response of the home building industry and its supply chain to the delivery of truly sustainable homes, paving the way to building zero-carbon new homes by 2016. HCA will disseminate the lessons learned about skills and technologies helping the industry to gear up to meet the new standards.

The new communities will build on lessons learned from the *Design for Manufacture* (GBP 60 000 home) competition ensuring that lessons learned about manufacturing efficiencies from off-site construction, minimising construction waste, etc., are harnessed. We will also ensure that the lessons from the former *Millennium Communities* programme are applied. The programme helped to set standards for twenty-first century living by promoting innovative building technologies, increased economic and social self-sufficiency, high urban design standards and sustainable development principles.

Quality of design is a key component of the *Carbon Challenge*, ensuring that these communities are great places to live in.

### ***Emerging technologies***

The UK leads the way in developing a number of low-carbon technologies that will play an important role in the future. These include:

- marine energy technology (including wave and tidal stream energy);
- offshore wind power, organic LED materials technology;
- ultra-efficient panel lighting, control systems for smart electricity meters;
- intelligent electricity grid management;
- and battery chemistry and management.

We have some of the best offshore wind, wave and tidal energy resources in the world, and we have invested in developing test facilities for ground-breaking technologies such as the European Marine Energy Centre in Orkney.

### **Notes**

1. Communities and Local Government, *Analysis of Local and Regional CO2 Emissions Estimate*, DEFRA, 2003.
2. *Code for Sustainable Homes – A Step Change in Sustainable Home-building Practice*, Communities and Local Government, 2006.
3. *Building a Greener Future: Towards Zero Carbon Development*, Communities and Local Government, 2006.
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5. *Government Response to Kate Barker's Review of Housing Supply*, HM Treasury/ODPM (2005).

## THE POTENTIAL OF THE GREEN ECONOMY

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To confront climate changes and to overcome the global economic crisis, “Green Growth” became Korea’s new national vision on 15 August, 2008. Since then, the ministries of the Korean government have proposed numerous policies to support Green Growth. The “Green New Deal Project” in particular includes 36 key projects, expected to create 960 000 new jobs by 2012. This is a new growth engine leading Korea’s Green Growth in preparation for the global environmental regulations after 2012.

Green Growth is the best solution Korea can adopt to resolve the current economic crisis. These projects have a bright future, since they can be funded easily, and related legislation works are in process to support their actions. Regional/urban policies including four major river restoration projects are expected to achieve the objectives of the Green New Deal, through cutting CO<sub>2</sub> emissions as well as creating new jobs. Korea is hoping for another miracle from Green Growth, a new paradigm for the future.

### Introduction

We are living in the green era.

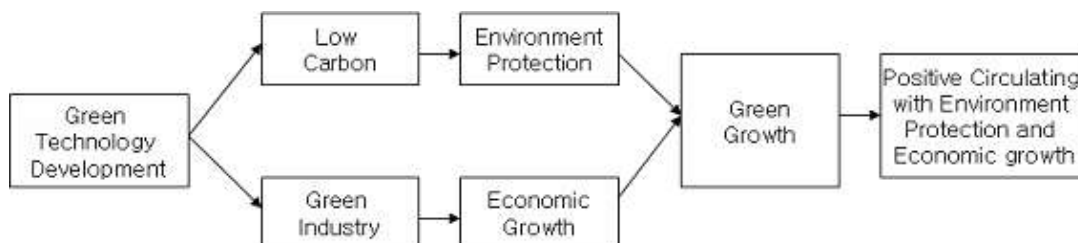
We entered the era of “Green Growth”<sup>1</sup> when President Lee Myung Bak declared visions of Green Growth on Korean Independence Day, 15 August, 2008. Since then, ministries of the Korean government have proposed numerous policies such as *Developing Strategies of Green Energy Industry* (2008.9.11), the *Comprehensive Basic Plan on Responding to Climate Change* (19 September, 2008), the *Green New Deal Project* (16 January, 2009), *Promoting Strategies on New Growth Engine* (13 January, 2009), and *Comprehensive Measures on Green Technology R&D* (13 January, 2009).

Green Growth policy is becoming a worldwide trend. The United States, European Union and Japan see it as an opportunity to establish a “Green Lead market” for reasons similar to Korea’s decision to establish Green Growth as an agenda for national policy. Korea is the world’s thirteenth-largest economy, and attaining such high-growth economic activity must inevitably entail emitting a considerable amount of CO<sub>2</sub>. Its CO<sub>2</sub> emissions in 2005 were 0.59 billion tons, the seventh-highest in the world. Per person, emissions were 12.3 tons, the fourteenth highest in the world. The increase in Korea’s total CO<sub>2</sub> emissions from 1990-2004 was 90.1%, and the per person increase 69.5%, the world’s highest rate in both cases. Of the fuel consumed domestically, 97% is imported, which leaves Korea very sensitive to international oil prices (Prime Minister’s Office, 2008).

Korea does not take a convention on climate change mandatorily. Yet, it is predicted to implement the convention on climate change from 2012. Its need to transform carbon-emitting structures to confront climate change is therefore increasing. As global warming continues, international regulations on carbon emissions will be intensified, making Green Growth the most prudent course to take.

Green Growth in Korea can be defined as maximising the synergies of “green” and “growth” and using them as an economic growth engine (Kim, 2009). The concept is to find new growth opportunities by turning current economic growth patterns into eco-friendly growth patterns. Figure 1 shows the basic concept of Green Growth.

**Figure 1. The concept of Green Growth**



Source: Lee et al., 2009.

## Strategies of the Green New Deal Project

### *Direction for Green Growth*

The Korean government has set three objectives and ten strategies to support Green Growth more efficiently.<sup>2</sup> The three objectives include realising a new paradigm of national development; improving the quality of life and the environment; and making a contribution to the international community. To achieve these objectives, the following strategies have been established.

#### *1. A paradigm shift to a low-carbon society with lower greenhouse gas emissions*

Maximise eco-efficiency in using resources, while minimising environmental impacts. Low-carbon and eco-friendly policy measures will be pursued to decouple environmental degradation from economic growth.

#### *2. Green technologies as future growth engines*

Green technologies will be encouraged in order to reduce greenhouse gas emissions and to create new growth engines. Green technology standards, which now stand at from 50% to 70% of those of leading nations, will be improved so that they reach 90% by 2020. Convergence among IT, BT, NT and GT<sup>3</sup> will be fostered to develop technologies for renewable energy, clean fossil energy (IGCC, CGS), composition of solar energy and artificial sun. Apply global standards on green technologies and increase international competitiveness.

#### *3. Enhanced corporate competitiveness, as a new exporter of green industries*

Knowledge-based industries will replace factory-intensive industries as new growth engines in a post-manufacturing world. Climate-friendly industry will be cultivated as a future industry. Improve energy efficiency and foster eco-friendly industry.

Promote the finest green products, such as green cars, green semiconductors and green fabrics, in order to drive national income to USD 30 000 a year.

#### *4. Creation of new green jobs*

New jobs will be created by renewable energy and environmental improvement programmes. Renewable industry alone is expected to generate 950 000 new jobs in 2030. Nurture a green-collar class through transforming existing industries into green industries, and green re-education. Develop education programmes for green human power.

#### *5. Green transformation for transport, buildings, urban and land use planning*

Improvement in social systems will lead to higher quality of life and environment.

The competitiveness of cities will be enhanced by implementing eco-friendly urban and land use planning schemes incorporating energy, environment, transport and land use issues, improving air quality and expanding ecological areas. Design a carbon-free city, promote green office buildings, green home businesses. Improve efficiency of road-focused transportation and logistics. Expand investment and develop technologies on public transportation and rail systems. Extend bicycle lanes.

#### *6. A green revolution in Korea*

From consumption patterns to overall life styles, the green daily revolution will be set in place. For every day practice of low-carbon, a public campaign for enhancing green values in society (the eco-living movement) will be launched. Form nations' consensus through interactions. low-carbon life styles will be introduced, by measures such as a stronger regulation for CO<sub>2</sub> emissions of vehicles and an eco-labelling system, which will seek to manage the demand side and disclose information of environmental footprint.

#### *7. Green education and cultural policies*

Green culture campaigns will be widely promoted, using media and education as channels. The idea of greenness will be the centrepiece of culture and tourism.

#### *8. Eco-friendly taxation schemes and active financial support*

The existing taxation system will be revised to incorporate more climate-friendly elements, while financial support for promoting investments in green industries will be strengthened. The transition to low-carbon, green consumption and production patterns will be encouraged by a broader appliance of the "polluter-pay-principle", such as price restructuring, to reflect environmental costs and the promotion of green products.

#### *9. Korea as a global green leader*

The national image and Korea's brand power will be strengthened through the promotion of "Green Korea".

#### *10. Contributing to the international community*

Korea will actively participate in the post-2012 negotiations and take on a green leadership role. The reduction target for greenhouse gases will be announced by this year. Active diplomatic efforts in the environmental arena will be pursued, including efforts to host international organisations and environmental conferences in Korea. Increasing Green Growth industry projects undertaken by the Official Development Assistance (ODA) in developing countries.

### The promotion of Green Growth

The Korean government organised the Presidential Committee on Green Growth to research and frame policies regarding Green Growth in January 2009. The Presidential Committee on Green Growth was founded with the vision of making Korea a world leader among developed countries in Green Growth. The three goals it seeks to attain are 1) transforming Korea into an energy-independent nation, 2) promoting green technology and industry as engines of future growth, and 3) building Korea's reputation as a green nation.

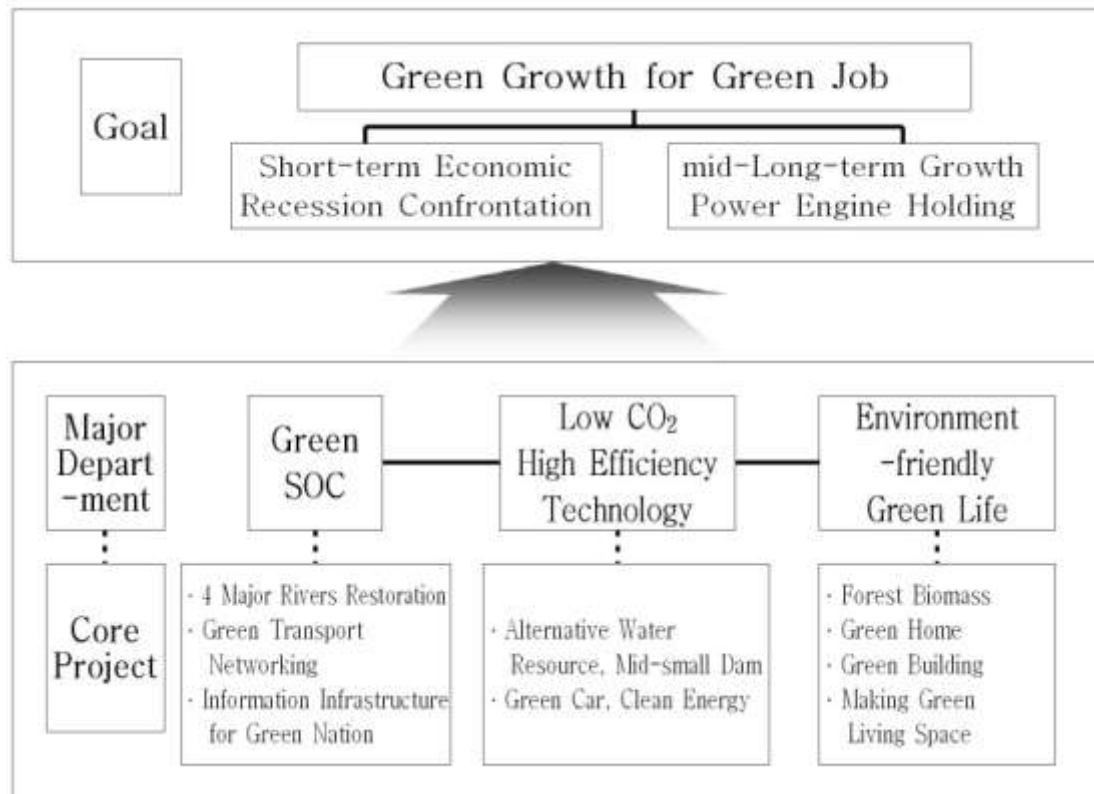
The Korean government is also preparing to co-ordinate with the private sector to promote the *Green New Deal Project* efficiently, to encourage technical development and attract investment. Private corporations will be approached to facilitate interactions between the public and private sector, and a public-private committee organised to deal with private corporations' suggestions and problems.

Figure 2. The relationship between Green New Deal Projects and new power engines





Figure 3. Goals, projects and strategies of Green New Deal policy



Source: Ministries of Government (2009).

### ***The objectives and business of the Green New Deal Project***

Korean government announced the *Green New Deal Project* in January 2009, combining Green Growth strategies (low-carbon, eco-friendly and conserving resources) with job creation policies. The *Green New Deal Project* is a set of projects creating jobs with government funds, and Green Growth policy-building potential to achieve both policy/projects at the same time.

The *Green New Deal Project* is a multi-purpose project with three goals: to create jobs, encourage growth and halt global warming.

The policies of the *Green New Deal Project* share the basic conception of UNEP's Five Priority Sectors underpinning a global *Green New Deal*:

1. clean energy and clean technologies, including recycling;
2. rural energy, including renewable and sustainable biomass;
3. sustainable agriculture, including organic agriculture;
4. reduced emissions from deforestation and forest degradation (REDD);
5. sustainable cities, including planning, transportation and green building (UNEP, Press Release, 22 October, 2008).

The initial objective of this *Green New Deal Project*, combining green growth and job creation policy (New Deal), is to create 960 000 jobs through KRW 50 trillion<sup>4</sup> investments over the next four years (2009-12).

There were 267 proposals gathered regarding *Green New Deal Projects* from 20 government ministries last year, reaching an estimated budget of KRW 145 trillion. Through a close analysis of the proposals, the government integrated these proposals based on their relevance to core projects. Nine core projects and 27 related projects were classified, constituting a package of policies. This made it possible to define Green New Deal approaches and enabled funding support to be done effectively.

### *Classification of the Green New Deal Project*

The Green New Deal Project was chosen after a consideration of international discussion on the environment, **like the Rio agenda**. Because conserving and securing water resources is an essential element of this agenda, the restoration and improvement of four major rivers is the top priority among nine core projects of the Green New Deal Project. Securing alternative water resources and installation of lowering equipments to monitor and prevent flood damage. Eco-friendly medium and small dams will be built to solve regional water shortage problems. This is not just a simple engineering/construction project, but a mixed programme of securing water resources, preventing water damage, improvements in water quality and creation of green living space.

Sub-projects of the *Green New Deal Project* are chosen based on their relevance to advance the green economy, foster economic growth and create jobs. The industries included in this project (nine core-projects and 27 sub-projects) can be classified into four types:

- 1) resource-saving projects, such as re-use of resources and development of clean energy;
- 2) projects that enhance the quality of life and the environment, for instance utilisation of green transportation, provision of clean water and so on;
- 3) preventative works for the future of the earth and the safety of the next generation by reducing carbon emissions and securing water resources;
- 4) measures for enhancing energy efficiency, such as constructing industrial/information infrastructure and technical development.

The sub-projects of the *Green New Deal Project* are listed according to their relation to “greenness” and their effect on growth and job creation. As a job creation public investment programme, the project’s detailed plans were selected based on investment in the public sector.

**Table 1. Classification of Green New Deal Projects**

9 core projects	27 sub-projects
Four Rivers restoration and improvement of riverside	Disaster hazard zone improvement project Clean Korea Action Project Greening of waterfront area
Building green transportation network	Building multi-modal transfer facility Expanding Bus Rapid Transit system Building bike routes nationwide (model project for rapid bicycle routes)
Expanding green homes, offices and schools	Replacing LED lights for public facilities Developing green IT Training Green Home Doctors
Making green living space	Greening of rooftops and wall surfaces Constructing ecologically appropriate roads Making culture space for unused facilities
Making information infrastructure for the Green Nation	Operation of comprehensive management system for building and energy Promoting use of electronic documents Computerising underground road facilities
Securing alternative water resources and building mid-small dams	Developing overseas water industry Developing technology of transforming seawater into fresh water Recycling of wastewater
Producing green cars and supplying clean energy	Ensuring independent technology of green cars Producing vehicles using bio-ethanol Supplying bio-ethanol for energy
Expanding re-use of resources	Energising biomass Making biomass production base Redevelopment of waste dumping sites
Activating use of forest biomass	Disaster protection, restoring damaged forests Application of forest biomass Making theme park in countryside

Source: Ministries of Government (2009). Note: The first four parts of the table relate to regional/urban policies.

### ***Expected effects***

Following are the expected effects of the Green New Deal Project being promoted by the Korean government.

1. Maximise policy effects by converging Green Growth strategy with new job-generating policy, connecting with finance, as a whole package.
2. Integrate green industries to intensify connections among industries and prevent overlapping investment.
3. Create new jobs through proceeding with investment and regulatory change. Promoting 36 projects in 2009-12, with an investment of USD 38.5 billion, will create 960 000 jobs, as well as 100 000 jobs for young adults aged between 15 and 29.
4. Revitalise the regional economy. In particular, the Four Major Rivers Restoration Project, transforming deserted riverside area into water resorts and cultural areas would benefit residents.

The difference between these politics and ordinary government projects is that conventional welfare policies are simply expenditures that diminish the national wealth. Green Growth policies will boost growth far more than expenditures on welfare.

### **The case for regional/urban policies with Green New Deal Projects**

Cities are a major source of emerging modern environmental problems, and energy consumption by urban residents is a major source of CO<sub>2</sub> emissions. According to the relevant studies, cities emit about 70% of the total amount of CO<sub>2</sub>. Korea needs a strict strategy for cutting emissions because of its high energy consumption structure. The building and transport sectors are known to produce about 43% of greenhouse gases in Korea. Therefore, it will be easy to confront climate change, if environmental policies are set to save energy and cut CO<sub>2</sub> in the cities.

Several policies have already been implemented to save energy or reduce CO<sub>2</sub> emissions in the cities prior to the advent of the era of Green Growth. For example, elevators in public buildings only operate above the fifth-floor level, and cars are running every other day on the matching date of their number plates to save energy. Moreover, government officials are encouraged to wear shirts without ties to save energy in the summer season. Registration fees are waived for those who purchase light-duty cars with engines of under 1 000 cubic centimetres, and 50% of the toll is discounted for these cars on toll roads. Government subsidies are awarded when a public institution buys hybrid cars.

The Korean government is trying to revive the economy by increasing employment through *Green New Deal Projects* with urban policies in the era of Green Growth, and in the long term to confront climate change. The basic directives of regional/urban policies relating to *Green New Deal Projects* are intended to save energy, substantially cut CO<sub>2</sub> emissions, and promote job growth (Ministries of Korea, 2009). Some cases of regional/urban policies are as follows.

#### ***The restoration of four major rivers***

This is the core project of Korea's *Green New Deal Project*.<sup>5</sup> Its aim is to renovate the nation's land, and consists of five primary tasks: create adequate water supply; flood control; water-quality improvement and ecosystem recovery; creation of multi-purpose space for citizens; and regional development along rivers.

1. ***Adequate water supply***: To secure 1.25 square metres of water per person. A plan to secure enough water (1.25 square metres) by building more dammed pools, dams and water reservoirs for irrigation, in response to water shortages (800 million square meters by 2011, 1 billion square metres by 2016) and droughts. Korea is a nation now subject to water shortages.
2. ***Flood control***: To improve flood-control storage by 890 million square metres. Rainfall has been concentrated in Korea's summer season, and damage from localised downpours has recently increased. A plan has been instituted to prepare for a 200-year flood in response to the potential flood damage caused by localised downpours and climate change.
3. ***Water quality improvement and restoration of the ecosystem***: To purify water to Grade 2 level by 2012. The office will improve the water quality of 90% of the water of the four rivers by 2012. To this end, it will focus on the management of 34 highly polluted riverside areas. The office will create 695 kilometres of eco-friendly river with wetlands and aquatic plants for water purification and clean up farmland around rivers and block the direct inflow of pesticides and fertilisers. The office will try to improve the management of small rivers flowing to the four major rivers to maximise the effect of the restoration.

4. ***Creation of multi-purpose areas for citizens:*** Under the plan, the office will utilise rivers to promote leisure, tourism, culture and Green Growth, etc., and transform them into an eco-friendly area, which will ultimately raise local residents' living standards. About 1 411 kilometres of bicycle routes will be built along the rivers, which will create a national green transport network by connecting bike paths with roads.

Walk paths and sports facilities along the rivers in urban areas will provide for leisure and recreation, to facilitate various types of experiential tourism, such as visiting wetlands or riverside hiking, etc. Moreover, planting trees along the riverside to create a green belt has also been proposed to reduce carbon dioxide emissions.

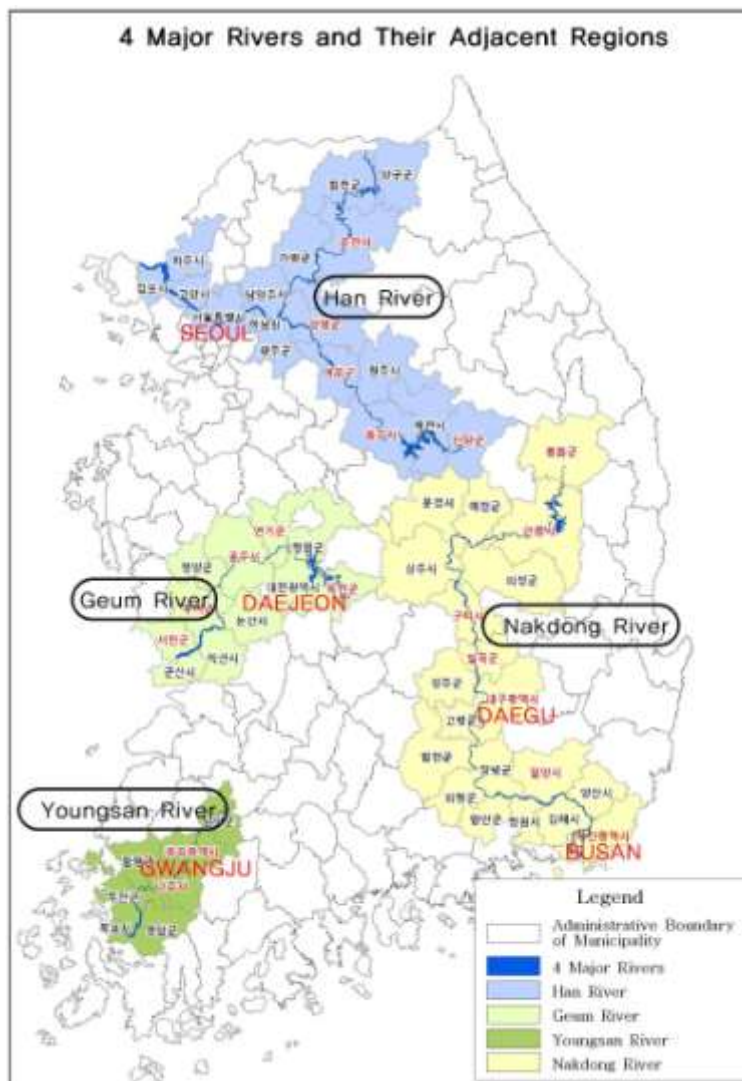
5. ***Promoting regional development along rivers:*** Under the plan, the office will be undertaking various sub-projects that can be implemented in line with the restoration project, in co-operation with other government agencies. This will contribute to regional development and economic revitalisation. For example, the Ministry of Culture, Sports and Tourism will initiate a project to restore the cultural and historic heritage around the four major rivers and develop cultural tourism. The Ministry of Agriculture, Fisheries and Food will give a face-lift to rural areas near the rivers. The Ministry of Land, Transport and Maritime Affairs will transform existing cities into more liveable and attractive cities.

The Four Rivers Restoration Project will be implemented under the following directions in consideration of the characteristics and the current state of four rivers.

- *Han River:* lay a foundation for flood-control policy of South Han River and the promotion of leisure tourism;
- *Nakdong River:* dredge and build dams to respond to water shortage and flood damages;
- *Geum River:* achieve regional development by restoring cultural heritage and to restore ecosystem;
- *Youngsan River:* focus on water quality improvement and flood-control policy.

The *Four Rivers Restoration Project* will help prevent flood and drought damage, solve water problems and prepare for a potential water crisis. More importantly, it will provide an opportunity to develop Korea into a water superpower. The project is also expected to have other beneficial effects, such as restoring the ecosystem of Korea's rivers, revitalising local economies through job creation, and improving living standards thanks to the promotion of cultural tourism, leisure activities, etc.

Figure 4. The four major rivers of Korea and their adjacent regions



In addition to this, the government proposes to plan similar projects on the other national rivers and local streams by 2010, and implement them step by step.

The four major rivers are relevant to five metropolitan cities and 50 medium/small cities, which cover 55% of Korea's population and 30% of its land. It is expected that green jobs will be created and the regional economy will be activated by promoting business relating to the four major rivers. An estimated 280 000 jobs will be created through this restoration project, thanks to an investment of about USD 14 billion between 2009 and 2012.

### *Creating a green transportation network*

The *Green New Deal Project* proposes to cut CO<sub>2</sub> and mitigate traffic congestion from transportation by building bike paths. To make the bicycles a green transport mode in the city, it is essential that car users switch to bicycles for commuting. Green transportation will be possible in the city once bike commuting has become a reality.

There are some possibilities for using bicycles for the purpose of commuting or work. According to a census survey of Seoul households in 2002, 221 million trips, 44% of a total of 503 million car trips, were under 5 kilometres. These accounted for about 8.47% of all trips generated in Seoul (Lee, 2004). If the roads are improved adequately to permit bicycle traffic in Seoul, there are many possibilities for car users to switch to bikes.

At present, bicycles are mainly used for leisure trips. The government plans to connect bike paths nationwide. April 25 has been designated as Bicycle Day. Bicycle riding events have been held to promote the construction of bike routes. If the bike routes connect nationwide, leisure trips will be increased, which will also result in health benefits.

Then, investment in railroads will be increased, and the opening of the railroad, which has been under construction, will be advanced to increase the number of rail passengers. The BRT (Bus Rapid system) has also been extended to increase public transportation usage in metropolitan areas. A multi-modal transfer centre will be built where cars and public transportation connect, to facilitate the use of public transportation.

It is expected that about 16 000 jobs will be generated through the construction of green transport networks with investments of about USD 8.5 billion between 2009 and 2012.

### ***Green homes, offices and schools***

In 2008, Korea's transportation sector consumed about 19.3% of the total energy of Korea's energy consumption, while the housing and building sectors shared about 22.3%. Reducing energy consumption and CO<sub>2</sub> emissions in the building sector is a vital component of Green Growth.

Green business in the building sector will be introduced by integrating a green certificate system promoting CO<sub>2</sub>-reducing green home and green buildings. About one million green homes that are able to save energy as well as reduce CO<sub>2</sub> will be constructed in the new town, while another one million green homes for replacing current homes will be provided in the future. The green home will use renewable energies such as solar light, thermal heat and wind power for its power sources.

In the future, public buildings will be transformed into energy-saving green buildings, and construction of public buildings over a certain size will be mandated to use energy efficiency measures.

Energy-saving systems will be set up by constructing environmentally friendly green public buildings for CO<sub>2</sub> reduction, using environmentally friendly materials when remodelling or replacing old facilities. About 20% of lights will be replaced by LED (light-emitting diode) lights to save energy in public buildings.

Ponds, green space and rainfall use facilities will be supplied to elementary, middle and high schools, where green space is insufficient and energy efficiency is low. They will be upgraded to green schools with the help of environmentally friendly paint and highly efficient lighting facilities.

New schools will be built introducing green-building and energy-saving technology, using renewable energy, such as like solar energy, making eco-friendly green space and rainfall use facilities. Existing schools will be transformed into green schools by making small ponds, remodelling of interiors and exteriors, replacing old windows with energy-saving windows, and high efficiency and eco-friendly lighting, etc.

Universities with a tendency to waste energy must be changed into green campuses. There will be some incentives for realising energy savings, after setting up energy-saving targets for the national and

public universities. The reason is that there are 23 universities among 109 institutes in Korea with excessive energy consumption, and universities shared 14% of the electricity consumed.

It is expected that about 150 000 jobs will be generated through green school building, with investments of about USD 7 billion between 2009 and 2012.

### ***Making fresh green living space***

The national and urban spatial structure must be changed to reduce CO<sub>2</sub> emissions, in order to lead Green Growth in the cities and the nation. First, waterfront space will be reserved by remodelling eco-rivers in city centres. Urban streams in local towns will be revived as environmentally friendly eco-streams and 100 projects for liveable rivers will be undertaken. This project aims to refurbish current concrete cover into waterfront space. This project is similar to the Cheonggyecheon (stream) project<sup>6</sup> in Seoul, an urban improvement project that transformed a tarmac-covered road and elevated highway into a natural stream with fresh water. The government will co-operate with local governments to reserve waterfront space in local cities and towns. Dry streams and rivers covered with concrete in city areas will be reshaped into natural streams with waterfront space in this project.

In addition, making green roofs and building surfaces will be built to mitigate the urban heat island effect, to save energy and to preserve green space. The road sector contributes 27% of CO<sub>2</sub> emissions in Korea, and construction of eco-roads, which minimise environmental pollution, is planned.

It is expected that about 15 000 jobs will be generated through these projects, with an investment of about USD 500 million between 2009 and 2012.

## **Successful keys to Green New Deal Projects**

### ***Securing financial resources***

While establishing policy, the government has tried to overcome the unrealistic limits of previous environmental and Green Growth policy. Agreement was reached on the necessity of environmental protection, but progress was complicated by lack of funding. However, the *Green New Deal* policy, combining financial and supporting system, is viable in combination with the existing Green Growth policy.

A total of USD 38.5 billion is expected to be needed from 2009 to 2012 to implement the *Green New Deal Projects* and also to maintain financial robustness through setting priorities and rearranging the commencement of work and restructuring.

### ***Legislating basic law on Green Growth***

The Korean government is collecting broad opinions from each government body to draw up the basic law on Green Growth to support low-carbon Green Growth legally and institutionally. This basic law on Green Growth will involve merging all the laws relevant to energy, new and renewable energy, sustainable development, climate change strategy, etc.

The passage of this law will intensify promotion of green business, green economy, and support for green industry. It is also expected that an environmentally friendly tax system will be introduced, based on the “polluter-pay-principle”, and imposing heavy taxes on goods or services causing environmental pollution, emitting greenhouse gases, or with low energy efficiency. The bill will introduce a cap and trade system for carbon dioxide (Wang *et al.*, 2009).



### ***Informing the public***

The first task for this policy is to reduce public uncertainty and fears about the *Green New Deal Project* in the early stages. Most environmental agencies doubt whether the project is really effective to lead Green Growth. They point out the facts that many *Green New Deal Projects* are civil engineering works and effective only in the short term. The government must expand popular consensus about the necessity for *Green New Deal Projects*.

### ***Setting priorities***

*Green New Deal Projects* include 36 projects, nine core projects and 27 sub-projects. To optimise the investment, priorities must be set. The projects involve many ministries, and local authorities have been given a major role in implementation. Projects that will rapidly create jobs and make other projects possible should be prioritised, and synergies should be created by packaging related projects (Do *et al.*, 2009).

### ***The green way of life***

It is essential to spread the concept of energy saving and Green Growth to make the *Green New Deal Projects* successful. An education campaign promoting the green life and possibly an exhibition can excite public interest in energy savings and the effects climate change. Local and central government officials must be educated about energy savings and Green Growth, and education programmes and instructor training strengthened.

The green city needs not only physical facilities, like paved bike roads or construction of green homes, but popular consensus, so that behaviours can change.

In the transportation sector, there are plans for climate-friendly eco-driving and a bicycle-riding campaign. The government has held bicycle festivals in major cities throughout the country, designating 25 April as a bike day. The government is planning to improve bike routes to make it easier for citizens to use bicycles in their daily life.

“Green Life Culture” is also a subject under close consideration in Korea. Legislation will gradually restructure prices and strengthen the principle that polluters should pay, which will encourage citizens to adopt low-carbon life styles. The government is prepared to give incentives for supplying eco-friendly products and encouraging green consumption.

Furthermore, the government has a plan to launch a campaign of energy saving in association with social groups. The campaign involve an energy savings and greenhouse gas reduction movement, such as 333 saving campaign, wearing extra underclothes and turning off one lamp. Whether the green way of life becomes a reality will play a major role in the success of Green Growth and Green New Deal projects.

### Box 1. The 333 saving campaign

There are three ways of saving energy in the household, workplace and automobile, the major sources of energy use.

- **Household:** unplugging electrical equipment, turning down lights, limiting indoor temperature;
- **Workplace:** switching off lights and computers at lunch, reducing the frequency of elevator service;
- **Automobile:** using public transit, driving at an economical speed, and weekly car-free days.

### Conclusion

Environmental problems should be considered a future growth industry and cultivated as an economic driver at a time of climate change and global economic crisis (Lee *et al.*, 2008). Green Growth is now Korea's comprehensive national vision, which includes energy and environmental reforms as well as jobs, economic growth, land revitalisation, corporate competitiveness and changes in life style. Green Growth, sustainable growth that reduces greenhouse gases and air pollution, introduces a new national paradigm for creating more jobs and a new economic engine promoting green technology and clean energy. *Green New Deal Projects* for Green Growth are a prudent choice for Korea's global future and national development.

As President Lee Myung Bak put it in his speech in August 2008, Green Growth could make possible another miracle on the Korean Peninsula, to follow the "Miracle on the Han River".

### Notes

1. The concept of Green Growth was first mentioned in *The Economist* in 2000, then spread to the world at large through the Davos Forum (Presidential Council for Future and Visions, 2009). In Korea, the concept of Green Growth was formed in a process of promoting Green Growth, Seoul Initiative from ESCAP, Asia and Pacific Environmental Development in March 2005 (Office of the Prime Minister, Korea, 2008). Discussion on a policy of Green Growth was initiated as President Lee Myung Bak announced that Korea would participate in a global long-term plan to reduce greenhouse gas emissions by half, at the G8 summit in Toyama, Japan, in July 2008 (Presidential Council for Future and Visions).
2. This section is summarised and rewritten from the home page of Presidential Committee on Green Growth, Korea.
3. IT: Information technology; BT: biotechnology; NT: nanotechnology; GT: green technology.
4. The current exchange rate: USD 1 = KRW 1 300. KRW 50 trillion is about USD 38.5 billion.
5. This section is summarised and rewritten from the news centre, the home page of MLTM.
6. An innovative stream restoration project in Seoul, which was redeveloped between July 2003 and September 2005 by then Seoul Mayor and now President Lee Myung-Bak. The 5.8 kilometre-long stream, which had been covered with a cement road, and an elevated highway were transformed into natural stream after restoration. Since then, the Cheonggyecheon (stream) has become a symbol of Seoul as an eco-friendly city (<http://cheonggye.seoul.go.kr>).

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# THE POTENTIAL OF THE GREEN ECONOMY

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## **Introduction**

The built environment is not just the collection of buildings; it is in fact the physical result of various economic, social and environmental processes strongly related to the society standards and needs. Economic pressures related to property and labour market, investment and equity, household income and the production and distribution of goods, in combination with social aspects related to culture, security, identity, accessibility and basic needs, and finally, in association with environmental influences related to the use of land, energy and materials, define and determine the built environment we live in.

The continuously increased urbanisation, combined with the degradation of the urban climate and the recent upsurge of concern for the environment as well as the recent technological developments in the field of new energy technologies, defines the major priorities and considerations for urban buildings and structures and offers major technological and financial opportunities.

The present paper aims to discuss some major questions regarding the potential of green economy and in particular to reply to the following questions:

1. How environmental programs in cities can improve the living conditions and the economic potential of low income population? In particular how measures to improve environmental conditions in areas where low income population is living, have to be designed to create jobs locally and generate an important financial outcome?
2. Is it possible and how to generate additional economic outcome and create new jobs through the application of innovative environmental technologies in cities, like meta-materials etc.?
3. Is retrofitting of existing buildings the most powerful procedure to enhance economic activity in cities, generate wealth and new jobs while improving the quality of life of urban citizens?

## **How environmental programs in cities can improve the living conditions and the economic potential of low income population**

Low income population is living in areas suffering from serious environmental problems like temperature increase because of the heat island phenomenon, high surface temperatures creating discomfort conditions, high anthropogenic heat and lack of vegetated surfaces. In parallel, they live in houses of not sufficient quality and are vulnerable to outdoor extreme conditions. For example in Athens, areas of Western Athens presenting a severe thermal and environmental problem are habituated by relatively low income population.

This is very characteristic in countries under development, but it is also apparent in developed countries. For example in Greece only the 8% of the low income population is living in insulated houses with double glazing while the corresponding percentage for high income population is exceeding 70%.

A recent study carried out in almost 1 100 households in Athens, has shown that the relative cost of heating and electricity is much higher for poor than rich people. Figure 1, gives the mean heating energy consumption per person and area unit. As shown, the lower the income the higher the cost of heating per

person and unit of surface. It is obtained that the cost per person and m<sup>2</sup> for the lower income group is to about 127% higher than the corresponding cost of heating for the richest group, (Santamouris et al, 2007b).

In parallel, it is found that the lower the income the higher the cost of electricity per person and unit of area. As calculated, (Figure 2), low income people pays almost 67% more per person and square meter than high income people.

Urban heat islands can also intensify heat waves over cities which are periods of abnormally hot, and often humid, weather. Sensitive populations are at particular risk from these events. According to Eurosurveillance, an estimated 22 080 excess deaths occurred in England and Wales, France, Italy and Portugal during and immediately after the heat waves of the summer of 2003.

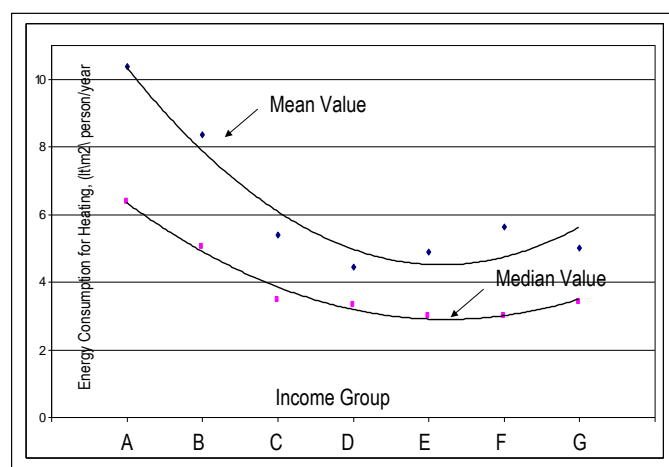
Summer Indoor environmental conditions in low income housing are characterised by increased temperatures exceeding highly comfort conditions. Measurements of indoor temperatures in almost 60 low income houses without air conditioning, insulation and double glazing, have been performed in Athens, during the whole summer of 2007.

For almost 50% of the measurement period, indoor temperatures were higher than 34°C, presenting maximum close to 40°C. Hot spells of more than 38 hours above 30°C have been recorded, (Figure 3). It is also found that during the period of heat waves, indoor temperature increased almost by 1°C per day.

Retrofitting of open urban areas in locations where low income population is living aiming to fight heat island and improve environmental conditions in general may be a very important tool to improve living conditions and the economic potential of local people. Redesign of open spaces and restructure of the local networks may improve comfort conditions, increase the number of external visitors, enhance local commerce and business dexterity and create jobs. In parallel, the construction procedure may help to transfer knowledge in the area and enhance employment.

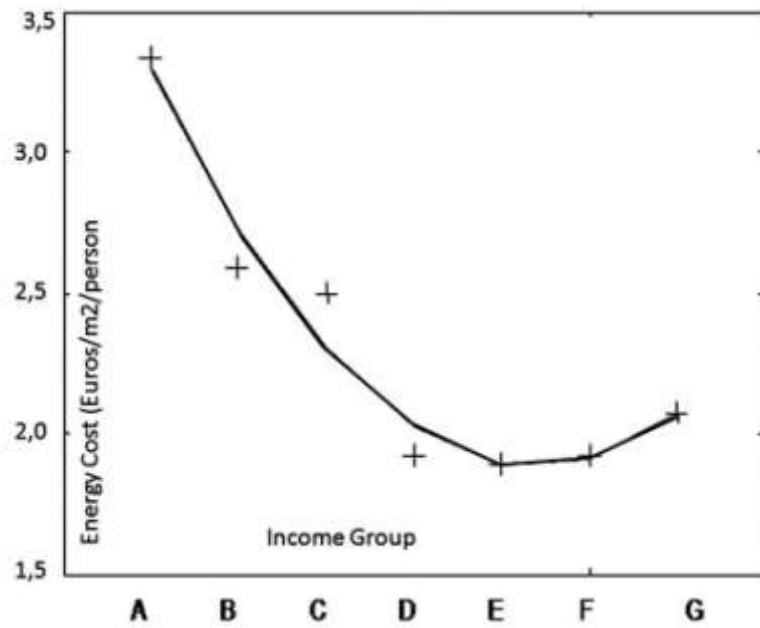
Recent projects aiming to improve the environmental conditions in open urban areas in the major Athens area have shown that it is possible to improve considerably outdoor thermal conditions during summer, enhance comfort conditions, fight local pollution, decrease the energy consumption and generate local jobs. In parallel, the whole design procedure has allowed to educate young engineers and scientists on bioclimatic technologies. Finally, it has allowed the demonstration of new and advanced materials and techniques, while it has offered opportunities for alternative industrial procedures.

**Figure 1. Mean and median primary energy consumption for heating, (lt oil /person/m<sup>2</sup>/year), for all income groups**



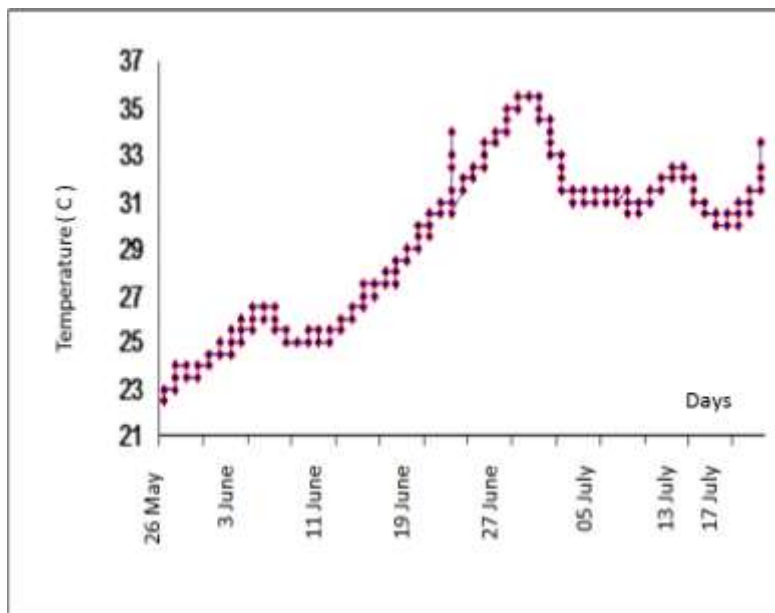
Source: Data are from Santamouris et al, 2007b.

Figure 2. Variation of the median electric energy cost per m2 and person for all income groups



Source: Data are from Santamouris *et al*, 2007b.

Figure 3. Evolution of indoor temperature in a low income residential building in Athens during the 2007 heat wave



## **Generation of additional economic outcome and creation of new jobs through the application of innovative environmental technologies in cities**

Various mitigation techniques to fight heat island and improve environmental conditions have been proposed. Selection of appropriate materials to be used in the urban fabric can contribute to the improvement of the urban microclimate, the decrease of the energy loads of the buildings and the reduction of air pollution.

The main properties of a material controlling its surface temperature are the solar reflectance and the infrared emittance. Increased values of reflectance and/or emittance result in lower surface temperatures. Regarding the building's performance, lower surface temperatures decrease the heat penetrating into the building and, therefore, decrease the cooling loads in case of air-conditioned buildings, or create more comfortable thermal conditions in case of non-air-conditioned buildings. Regarding the urban environment, it contributes to the decrease of the ambient air temperature, mitigating the heat island effect.

The recent development of advanced reflective materials like the common cool materials presenting a high reflectivity in the infrared, the nanotechnology based cool materials using phase change components, the cool asphaltic products, and the thermochromic materials may provide a very important opportunity to enhance industrial development, create jobs and generate additional economic outcome.

Fabrication and proper use of such innovative materials may enhance the retrofitting potential of open spaces and buildings, provide opportunities for a better thermal environmental and create additional economic outcome and jobs.

Santamouris *et al*, (2007), has reported the expected reduction of the cooling needs of low income housing for 29 locations in the planet. Table 1. As shown the expected absolute reduction of the cooling load varies between 5 to 70 kWh/m<sup>2</sup>, as a function of the local climate characteristics. Lower absolute contributions correspond to small cooling loads but represent a high percentage of the load, up to 70%, while high absolute contributions correspond to high cooling loads and a lower relative reduction of the load, (> 20%). As a mean value, the use of reflective coatings in the roof of this type of buildings in the selected areas may decrease their cooling load up to 30-35%.

**Table 1. The calculated cooling load for both scenarios and the expected energy savings**

SN	Station	Cooling load (kWh/m <sup>2</sup> )			Percentage (B – A) / A
		conventional	high refl. Roof	difference (B – A)	
1	Abu Dhabi	265.4	212.0	-53.4	-20.1%
2	Aden	287.1	222.3	-64.9	-22.6%
3	Alexandria (Nouzha)	69.4	34.5	-34.9	-50.3%
4	Bagdad	142.3	105.3	-37.0	-26.0%
5	Baku	44.4	23.6	-20.9	-46.9%
6	Bamaco	211.5	145.4	-66.1	-31.3%
7	Bangui	141.9	87.3	-54.6	-38.5%
8	Basrah	193.5	151.8	-41.8	-21.6%
9	Belem	146.0	92.4	-53.6	-36.7%
10	Belo Horizonte	26.1	6.1	-20.0	-76.7%
11	Brazzaville	117.0	69.1	-47.9	-40.9%
12	Cairo	106.2	63.0	-43.2	-40.7%
13	Casablanca	30.4	8.7	-21.6	-71.2%
14	Dakar	122.6	62.8	-59.7	-48.7%
15	Damascus (Kharabo)	65.3	32.7	-32.6	-49.9%
16	Khartoom	285.3	212.8	-72.5	-25.4%
17	Mogadiscio	256.5	194.8	-61.8	-24.1%
18	Monrovia	160.0	103.5	-56.6	-35.3%
19	Muscat	198.4	145.8	-52.6	-26.5%
20	Ndjamena (Fort Lamy)	258.4	187.9	-70.5	-27.3%
21	Paramaribo	148.3	94.0	-54.3	-36.6%
22	Port Soudan	263.6	198.0	-65.6	-24.9%
23	Pretoria	24.0	4.9	-19.1	-79.5%
24	Rabat	29.4	9.5	-19.9	-67.7%
25	Sanaa	26.8	7.6	-19.2	-71.7%
26	Sao Paulo	6.1	0.8	-5.3	-86.2%
27	Tabriz	34.7	15.8	-18.8	-54.4%
28	Teheran	85.3	54.8	-30.5	-35.7%
29	Walvis Bay	256.6	190.5	-66.1	-25.8%

In parallel, Table 2, gives the calculated number of hours with an indoor temperature above 30°C, 27.5°C and 26°C when reflective roofs are used. Results show that for all temperature bases, a very important improvement of indoor comfort may be achieved by using reflective roofs. The specific reduction of the hours above a threshold temperature depends highly on the distribution of the ambient temperature during the day, and the overall climatic conditions. As expected the higher the temperature base the higher the benefits. For the temperature base of 30°C, the 50% of the calculated cumulative distribution corresponds to 3 400h and 1 700 for the conventional and the reflective roof building respectively. The corresponding values for the temperature base of 27.5°C are 6 400 and 4 400, while for the base of 26°C the corresponding values are 7 400 and 5 800 respectively.



**Table 2. Reduction of the hours with indoor temperature above 30, 27.5 and 26 C, for the conventional and the building with the reflective roof**

SN	Place	Hours Above the following Indoor Temperature								
		30°			27.5°			26°		
		Conventional	Reflective roof	Reduction of discomfort hours	Conventional	Reflective roof	Reduction of discomfort hours	Conventional	Reflective roof	Reduction of discomfort hours
1	Abu Dhabi	5987	5349	10.7%	6968	6255	10.2%	7516	6849	8.9%
2	Aden	7818	6778	13.3%	8521	8006	6.0%	8661	8456	2.4%
3	Alexandria (Nouzha)	1996	691	65.4%	3295	1970	40.2%	4003	2789	30.3%
4	Bagdad	3467	2822	18.6%	4041	3544	12.3%	4384	3913	10.7%
5	Baku	1222	513	58.0%	2061	1275	38.1%	2540	1829	28.0%
6	Bamaco	6452	4310	33.2%	8058	6952	13.7%	8496	7935	6.6%
7	Bangui	4393	1575	64.1%	7594	5561	26.8%	8373	7513	10.3%
8	Basrah	4251	3765	11.4%	4906	4407	10.2%	5221	4832	7.5%
9	Belem	4536	2022	55.4%	7287	5412	25.7%	8230	7303	11.3%
10	Belo Horizonte	196	0	100.0%	1342	245	81.7%	2776	923	66.8%
11	Brazzaville	3314	1037	68.7%	6450	4414	31.6%	7602	6497	14.5%
12	Cairo	3190	1688	47.1%	4279	3207	25.1%	4753	3979	16.3%
13	Casablanca	462	34	92.6%	1501	402	73.2%	2362	996	57.8%
14	Dakar	3210	764	76.2%	6487	3603	44.5%	7749	5744	25.9%
15	Damascus (Kharabo)	1847	740	59.9%	2735	1743	36.3%	3218	2296	28.7%
16	Khartoom	7228	6167	14.7%	8089	7308	9.7%	8467	7885	6.9%
17	Mogadiscio	8201	6981	14.9%	8732	8623	1.2%	8750	8747	0.0%
18	Monrovia	5312	2816	47.0%	7666	6271	18.2%	8267	7655	7.4%
19	Muscat	5583	4617	17.3%	6749	5896	12.6%	7460	6653	10.8%
20	Ndjamena (Fort Lamy)	7269	5822	19.9%	8214	7454	9.3%	8539	8049	5.7%
21	Paramaribo	4724	2429	48.6%	7228	5569	23.0%	8232	7312	11.2%
22	Port Soudan	6769	5592	17.4%	7883	6956	11.8%	8340	7704	7.6%
23	Pretoria	239	6	97.5%	1162	176	84.9%	2060	620	69.9%
24	Rabat	518	25	95.2%	1511	431	71.5%	2299	1035	55.0%
25	Sanaa	327	7	97.9%	1474	343	76.7%	2469	1012	59.0%
26	Sao Paolo	19	0	100.0%	280	24	91.4%	733	140	80.9%
27	Tabriz	874	239	72.7%	1670	881	47.2%	2173	1354	37.7%
28	Teheran	2417	1638	32.2%	3071	2453	20.1%	3388	2843	16.1%

The use of cool materials used in the outdoor environment may decrease urban temperatures. Recent application of cool materials in open public urban areas in Athens, has shown that it possible to decrease maximum ambient temperatures up to 2°C, (Gaitani *et al*, 2009).

Given the urban climatic problems and the quality of housing in developing and developed countries, the potential to use advanced cool materials is extremely high. This may create new jobs in industry while it may enhance local employment in places where such projects may apply.

**The potential of retrofitting of existing buildings to enhance economic activity in cities, generate wealth and new jobs while improving the quality of life of urban citizens**

The building sector is one of the most important economic players worldwide. The total world’s annual output of the buildings sector is close to USD 3 trillion and this is almost one-tenth of the global economy, (Confederation of International Contractors Association, 2002).

Buildings present very high energy consumption and important environmental problems. The absolute energy consumption continues to increase and given the rapid increase of the world population and the development of third countries, it is expected that the absolute energy consumption will grow considerably the next decades.

Building energy and environmental technology has a spectacular progress during the recent years. New systems, techniques and materials have been developed and are available into the market allowing to reduce substantially the energy consumption of buildings and improve indoor environmental conditions.

Decrease of the operational cost of buildings associated with the energy use, is very important for low income social classes. Many recent studies and documents highlight the high potential for energy conservation in the buildings sector. The United Nations Environmental Program, (UNEP 2007), estimates that the potential for energy conservation in the building sector and related greenhouse gas emissions is in the order of 1.8–2 billion tonnes of CO<sub>2</sub> per year. The challenge is much higher in the developing countries where the building stock is increasing very fast. As reported by UNEP, 2007, only in China, 2 billion square meters of new building space is added every year.

In particular in Europe, retrofitting of the existing building stock presents by far a much higher technical and economic potential than the construction of new buildings. Recent developments on passive cooling technologies can help to improve the indoor environmental quality of low income households. High reflective coatings for the urban environment and for buildings are low cost and easily accessible and when used can substantially reduce outdoor and indoor temperatures and enhance comfort in most warm climates. In addition, recent knowledge and developments on heat dissipation techniques and in particular ground cooling and ventilation technologies can improve the design and positioning of openings in urban buildings, to enhance indoor air speed, improve indoor comfort and decrease indoor pollutant concentration

Important research has been carried out recently on appropriate and advanced ventilation techniques, (Santamouris and Wouters, 2006). The main achievements deal with: a) Better understanding of the air flow phenomena and of the expected comfort benefits, in particular in the dense urban environment, and development of efficient and practical procedures to design natural and hybrid ventilation systems and configurations, b) Technological developments mainly on the field of hybrid and mechanical ventilation that contribute highly to a more comfortable and healthy indoor environment.

Extensive experimental and theoretical research to understand better the air flow phenomena in dense urban environments, has permitted to develop simple and accurate models to calculate the wind field in the canopy layer, and based on this to develop simple and accurate sizing techniques for windows and other natural ventilation systems.

Proper design of windows permits to increase air speed in households and improve comfort by cooling down the human body through the mechanisms of convection, radiation and perspiration. In parallel to increase air flow rates to achieve lower indoor temperatures, improve indoor air quality and health conditions. In particular,

Night ventilation is one of the more efficient passive cooling techniques for low income households. It is reported that the use of 12 ach per hour during night, with one ach during the day, may provide comfortable indoor conditions. Given that the urban environment decreases considerably the cooling potential of night ventilation, appropriate design of openings is very important.

Use of solar chimneys to enhance air flow in buildings is a well known technique that can be easily integrated in low income households. Solar chimneys are natural draft components, using solar energy to build up stack pressure and thus a driving airflow through the chimney channel. Solar chimneys can improve the ventilation rate in naturally ventilated buildings in hot climates. It is found that the impact of solar chimneys is substantial in inducing natural ventilation for low wind speeds. Recent research has permitted to optimise the design and operation of solar chimneys, and thus to improve indoor environmental conditions in overheated houses.

New efficient design of box fans, oscillating or ceiling fans when used can increase the interior air speed and improve comfort at very low cost. It is demonstrated that the potential of oscillating fans to extend the comfort zone. It is found that for an air speed of 1.52 m/sec, comfort is achieved at 31°C at 50% relative humidity, or at 32°C at 39%, or finally at 33°C at 30% relative humidity.

Satisfying the increased energy needs, particularly in less developed countries, without to compromise the atmospheric environment, clean and low cost systems and techniques have to be employed. Passive and active solar techniques combined with advanced conservation technologies seem to be the more appropriate and efficient solution to this problem. In parallel, energy efficiency and advanced solar energy systems can highly contribute, in conjunction with other measures, to make energy systems in developed and developing countries more sustainable.

Use of low energy units does not increase substantially the cost of buildings. The overall experience shows that improvements in the building's energy efficiency are associated with an increase of about 3-5% of the construction cost. However, this figure may vary as a function of various parameters. In parallel, the running costs of buildings are seriously reduced, reliability is increased, while the indoor environmental quality is considerably improved and productivity is increasing in service buildings. As mentioned by Olivier Luneau, SBCI Chairman and Director for sustainability at Lafarge, (UNEP 2007) : "To achieve improved energy efficiency in buildings you often do not need to use advanced and expensive high-tech solutions, but simple solutions such as smart design, flexible energy solutions and provision of appropriate information to the building users,"

Buildings represent more than the 50% of the national capital investment in the world. The sector employs more than 111 million people. This accounts for almost the 7% of the total employment, and 28% of the global industrial employment, (Confederation of International Contractors Association, 2002). On the other hand, given that every job in the buildings sector generates two new jobs in the global economy, it can be said that the construction sector is in a direct or indirect way linked to almost 20% of the global employment. Almost 74% of the employees in the building sector are in the low-income countries, (International Labour Organisation 2001). Given that in the developing countries only the 23% of the global construction output is produced, it is evident that the construction sector presents a much higher "employment intensity" in these countries, and therefore, the sector may play an important role in the human development and the quality life improvement for the poor, (CIB, 2002).

It is characteristic that a recent study carried out in Greece has shown that the financial investment potential for retrofitting of the existing building stock exceeds EUR 20 billion, may result in an energy conservation of about 15 TWh, and a decrease of the peak electricity demand close to 1.7 GW, while it may generate up to 100 000 new jobs.

## Notes

1. Contact email is *msantam@phys.uoa.gr*.

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## TORONTO'S GREEN ECONOMIC DEVELOPMENT STRATEGY

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This paper explores how the link is being made between economic development and environmental policies at an urban-region level, using Toronto, Canada as a case study. As an urban area of approximately 5 million people, the Toronto region is Canada's largest metropolitan area, comprising 15% of its population and nearly 20% of its GDP. The dense urban core of the region stands in stark contrast to the urban sprawl of the outer suburbs. The region is a magnet for highly educated immigrants and possesses a diverse and relatively robust economy that is offsetting a 20-year decline in manufacturing with growth in the services sector. The City of Toronto is well positioned to capture new investment and employment opportunities through the support and growth of emerging innovative green economic development policies, programs and initiatives.

The recent City of Toronto green economic development strategy notes that there are over 20 000 people employed in the green sector in the region, generating approximately CAD 2 billion of revenues annually for the local economy. The growth of the green sector of the economy must be encouraged positively and undertaken collaboratively by public, private and other community stakeholders. To this end, the City of Toronto has linked the challenges and opportunities that come with climate change with that of its long-term economic development strategy – Toronto's *Agenda for Prosperity*, designating "green" as one of its eight strategic directions. The paper concludes with summaries of a number of recent initiatives that explicitly link environmental endeavours with economic development.

### Introduction

*It's not either the environment or the economy – the environment is the economy.  
Canada can play an important role in the community of nations.<sup>1</sup>*

David Suzuki

This paper outlines some of the innovative ways that Toronto is linking its environmental and renewable energy policies and programmes with economic development objectives.

For the purposes of this paper, "green economic development" refers to activities that stimulate the economy, create jobs and clean up the environment. The City of Toronto has established green economic development goals as well as a number of programmes and incentives to inform and educate the public and the business community about green initiatives and to stimulate investment in and commitment to the green economy.

Overall, North American cities lag behind the green initiatives and renewable energy projects that have been instituted in many parts of Europe and around the world. There are a variety of reasons why this situation has arisen, but, in large measure, it can be attributed to Canada's extensive land mass. In the past,

the sheer size and plentiful resource base of the country led to land use and environmental policies and practices that were relatively consumptive in nature.

Today, these attitudes and notions seem antiquated, and concern for the environment and the treatment of land, water and air as finite resources are being addressed through a series of stepped-up public policies and actions. Businesses are beginning to understand the costs of their use of resources and are taking steps to review their manufacturing and development processes to look for ways to conserve energy and re-use materials.

This paper will describe some of the policies and strategies that Toronto is putting in place to improve both the environmental and the economic sustainability of the city.

To frame this discussion, it is useful to present the Toronto area from both a spatial and a socio-economic context.

## **Context**

### ***The demographic and spatial context***

Just over 2.5 million people live in the City of Toronto, which is situated within a Census Metropolitan Area (CMA) of approximately twice that number. A larger region, the Greater Golden Horseshoe, is comprised of over 8 million people. The CMA represents nearly one-fifth of Canada's GDP and is recognised as the economic engine of Canada. Toronto has a significant trade relationship with the United States, being only a 24-hour drive from 40% of the US population.

In North American terms, Toronto's population is relatively dense, but it is lower than many cities in Europe and Asia. The dense central core stands in stark contrast to the urban sprawl found in the municipalities surrounding Toronto in the outer suburbs. The spatial nature of development did not happen by accident. While the situation has often been positioned as the result of market demand for single-family housing and greenfield development, in reality, many policy decisions also laid the groundwork for urban sprawl. Until very recently, the City had a long history of higher taxation rates for commercial development and was not aggressive in pursuing new development, while the regional government (the Province of Ontario) implemented policies such as a commercial concentration tax and invested in a network of regional highways with the express purpose of encouraging expansion of the region beyond the City.

The environmental impact of urban sprawl on the region is considerable. Comparing commuting patterns in the downtown core (the financial district) to a suburban area (for example, the intersection of Highways 404 and Highway 7), it is clear that the environmental impact of living in the suburbs is far greater than living in the urban core. In the downtown core in 2001, transit accounted for 69% of trips and only 22% of auto drivers, with an average trip length of 16.5 kilometres. This can be contrasted with the much less dense suburban area, where transit accounted for merely 6% of trips and auto drivers accounted for 83% of trips, with an average length of 14.6 kilometres.

Concerted efforts are being undertaken by both local and regional governments to mitigate sprawl. The City has taken recent steps to reduce the commercial tax burden and the Province of Ontario in 2006 released its 30-year *Growth Plan for the Greater Golden Horseshoe* ([www.placestogrow.ca](http://www.placestogrow.ca)), which actively promotes densification. A continuing concern, however, is that the current provincial education tax may unintentionally create an economic incentive to construct new employment space outside the City. Addressing this concern could help to further facilitate the reduction of the associated environmental and congestion impacts of low-density urban sprawl by making greenfield development less profitable when compared to more sustainable infill development.

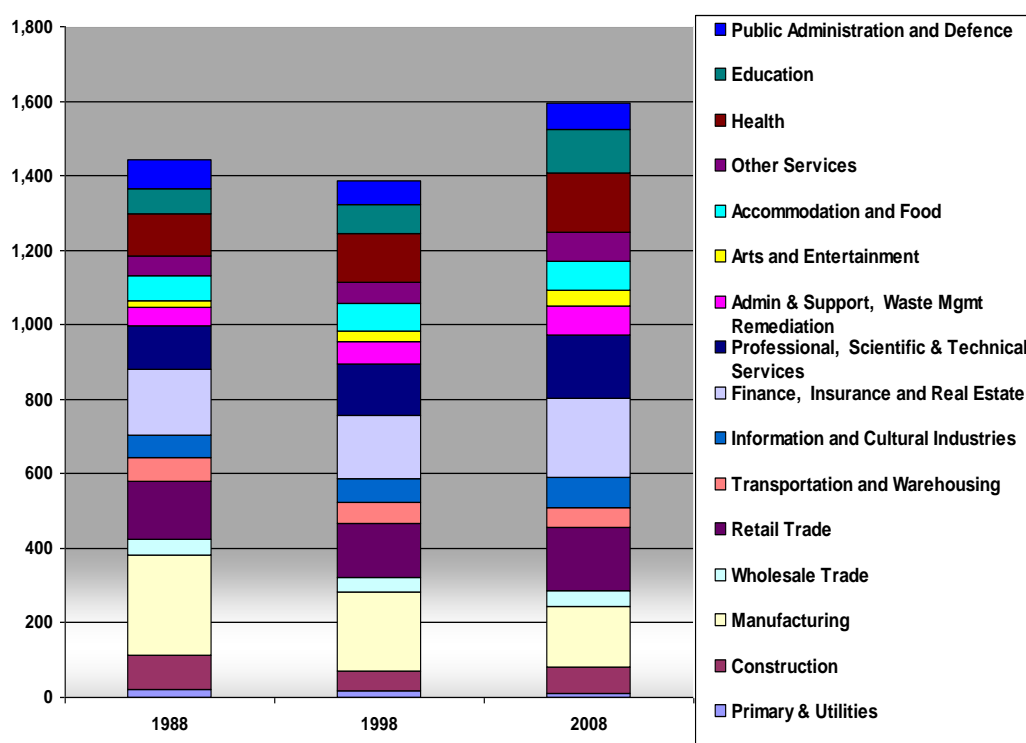
**Socio-economic context**

Toronto’s population growth is quite high relative to other cities in the OECD. As the region in the country where most immigrants first stay on arriving in Canada, Toronto benefits from the influx of large numbers of highly skilled immigrants – over 70 000 newcomers annually. While underemployment of newcomers is still often a challenge, Toronto undeniably benefits from this injection of new skills and labour into its workforce. The value of immigrants to Toronto’s economy and wider civic community is universally acknowledged, and great efforts are being made by both the private, public and non-governmental sectors to integrate immigrants more efficiently into the labour force.

In a North American context, the Toronto region is one of the leading metropolitan areas in terms of absolute employment growth. Toronto’s economy is well rounded and highly diversified. It has strong clusters in finance, food, professional services, life sciences, information technology as well as other dynamic sectors in entertainment and tourism. Toronto benefits from a well-educated and highly skilled workforce, with five universities and five community colleges and various institutions supporting its advancement.

With the advent of free trade and globalisation, like many other cities around the world, the mix of sectors in Toronto’s economy has changed over the past decades. Over the last 20 years, the decline in the manufacturing sector has been offset by growth in the services sector (see Figure 1).

**Figure 1. Jobs by industry in Toronto 1988-2008 (in 1000s)**



Source: City of Toronto Econometric Model (Version 6), 2009.



### *Green economic development*

The emerging green economy presents some unique opportunities to capture new investment and employment. Green economic development in the broadest sense includes a series of initiatives that clean the environment through waste reduction/diversion, green building standards and renewable energy projects. Toronto has a strong history of established service firms and technology companies that offer solutions to environment and energy issues. These businesses include environmental consultants that offer solutions for a range of environmental issues such as air quality, water and waste water as well as soil contamination. Technology companies have traditionally dealt with environmental cleanups or compliance services. Traditional environmental technologies include water and air quality products to reduce existing impacts on the environment.

It is estimated that there are more than 20 000 people employed in the green sector in the Toronto region, generating approximately CAD 2 billion of revenue annually for the local economy.<sup>2</sup> More specifically, approximately two-thirds of these are service firms and one-third are technology or product companies. Over 90% of these companies are considered small, with fewer than 100 employees, and an estimated 15% of these companies are exporting, with more than three-quarters of export sales going to the United States.

There are also a number of emerging and expanding businesses in the City that have seen significant growth over the past few years. Energy efficiency, green buildings and green design have been identified as key emerging and expanding sectors within the City of Toronto. The push for green buildings and various policy initiatives has encouraged the growth of green building design and construction expertise in the city. Other growth areas include water efficiency, which can also relate to green building design and pollution-prevention products and services. Table 1 shows the various forces acting on the market that push for more green offerings.

Concerns about the environment have become common, and consumers are demanding products and services that account for these concerns in their offerings. Many of these businesses, including those that are the backbone of Toronto's economy, have incorporated green practices in their traditional service offerings. For example, many bank and financial institutions are greening their operations and offering new financial products to their customers that are benefiting the environment. These include socially responsible investment funds, green mortgages and preferred lending.

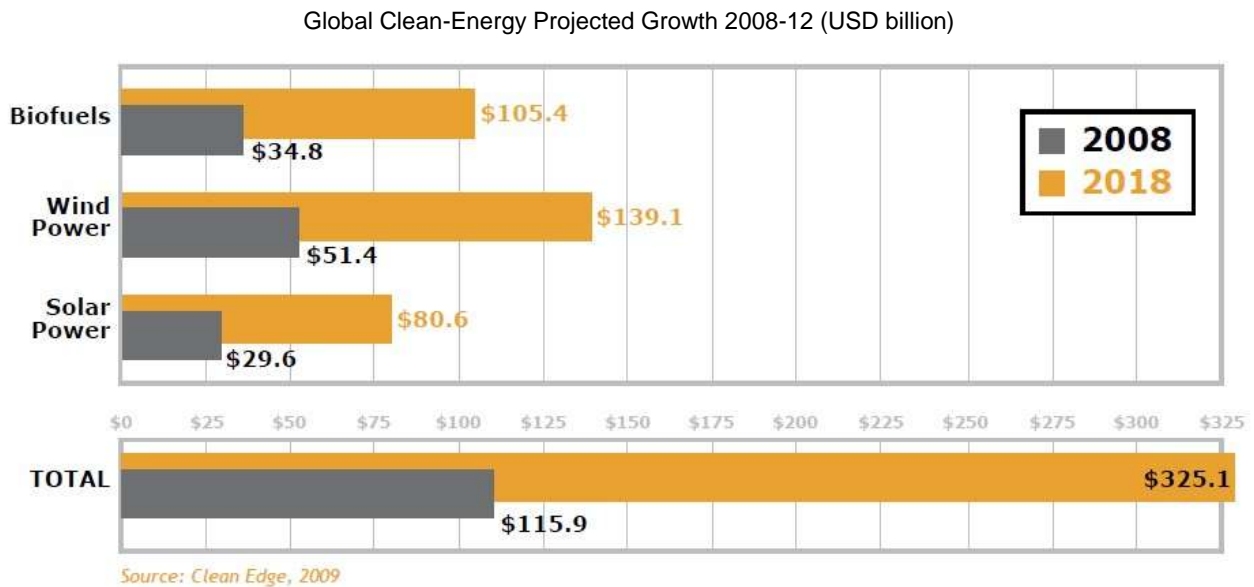
**Table 1. Five forces shaping the market for green products and services**

<b>Environmental issues</b>	<b>Resource adequacy and security</b>	<b>Policy and regulations</b>	<b>Finance and economics</b>	<b>Sociocultural</b>
<ul style="list-style-type: none"> <li>● Air quality – increasing smog, GHG</li> <li>● Waste management – landfill problems</li> <li>● Limited options for nuclear and hazardous waste</li> <li>● Accelerated growth and urban sprawl – gridlock</li> <li>● Extensive brownfields – urban core redevelopment</li> <li>● Largest truck route through Montreal/Detroit</li> <li>● Water quality and watershed protection</li> <li>● Increasing public awareness</li> </ul>	<ul style="list-style-type: none"> <li>● Planned phase-out of coal generation</li> <li>● Electricity supply and reliability</li> <li>● Rising costs of gas and electricity</li> <li>● Extensive supply of ethanol sources</li> <li>● Growth of new super powers demanding more resources</li> </ul>	<ul style="list-style-type: none"> <li>● Shifting political will</li> <li>● Commitment to long-term sustainable vision and solutions by all levels of government</li> <li>● International pressure</li> <li>● Ontario's Standard Offer contract</li> <li>● Funding for alternative energy technologies</li> <li>● Tightening environmental regulations</li> <li>● Emissions trading schemes</li> <li>● International agreements – governmental agreements – cross-border water quality, air quality, toxics,</li> <li>● Toxics and health</li> <li>● Green incentives/disincentives</li> <li>● More private sector power – industry groups, financial community</li> </ul>	<ul style="list-style-type: none"> <li>● Advances in manufacturing and materials improve costs of production for renewables</li> <li>● Availability of capital to fund new technologies – clean tech investment</li> <li>● Inability of municipalities to fund urban infrastructure renewal</li> <li>● Siting and financing new facilities</li> <li>● Emissions trading</li> <li>● Making public private partnerships work</li> <li>● Risks on insurance and savings</li> <li>● Rising health costs</li> <li>● Growth of new super powers demanding more resources</li> </ul>	<ul style="list-style-type: none"> <li>● Global awareness – emergence of a green culture – green retail, organic markets</li> <li>● Public awareness and engagement</li> <li>● Health concerns</li> <li>● Continued suburban growth/emergence of city cores (brownfields) – infrastructure issues</li> <li>● Consumption – what to do with all the stuff? – waste management</li> </ul>

Source: "People, Planet and Profit: Catalyzing Economic Growth and Environmental Quality in the City of Toronto", 2007 ([www.toronto.ca/business\\_publications/pdf/green\\_economic\\_development\\_22may2007.pdf](http://www.toronto.ca/business_publications/pdf/green_economic_development_22may2007.pdf)).

Given the potential insurance risks associated with climate change, many insurance companies are looking at green preferred premiums to benefit businesses that address environmental risks. The food service industry is another sector that is well established in the city. Many of the mainstream markets are providing green products to their customers, including organic offerings. Other traditional professional services like law and marketing have expanded to include an environmental element in their practices. Many small to medium-sized businesses are also recognising the green market and offering a responsible element to their business. It is clear that green products are a growing market. As Figure 2 illustrates, the potential for growth in clean energy, for example, is enormous.

**Figure 2. Projected clean energy technology growth, 2008-2018**



Source: Clean Edge Inc. ([www.cleandedge.com/reports/pdf/Trends2009.pdf](http://www.cleandedge.com/reports/pdf/Trends2009.pdf)).

The above discussion puts the City’s approach to green economic development into perspective. While promoting the green economy as a sector is indeed a strategic way to contribute to declining manufacturing activity in the city, and the desire to advocate for greener development and greener activities is an obvious desirable outcome, it is understood that the approach to greening in Toronto must be done strategically. We must encourage growth within the city in a positive way, rather than do so by adopting penalties for non-green development. Implementing penalties within the city could encourage “skipping out” to cheaper suburban locations, which will have a deleterious long-term effect. Therefore Toronto is continually seeking to find solutions that have a “triple bottom line” – solutions that encourage greening, reduce costs and create new markets. The City is in a position to play a unique role, establishing a vision for where we want to go and acting as a facilitator to rally the efforts of public, private and other community players in this effort.

**Linking climate protection measures with economic development goals**

Toronto has expressly linked the challenges and opportunities associated with climate change/protection with that of its long-term economic development strategy.

Toronto’s *Agenda for Prosperity* ([www.toronto.ca/prosperity/pdf/agenda-prosperity-report-full.pdf](http://www.toronto.ca/prosperity/pdf/agenda-prosperity-report-full.pdf)) was adopted unanimously by the City Council in January 2008.

This long-term economic strategy was developed under the leadership of the mayor and 25 business, community, academic and labour representatives over the course of a year of reviewing economic issues and opportunities. The Agenda sets out four guiding principles that provide a framework for moving forward and forms the basis of Toronto’s economic development policy. The four principles are:

- **Proactive Toronto** – to improve the business climate and make City Hall more responsive to the needs of the business community;

- **Global Toronto** – to recognise and increase connections with the rest of the world through the international diversity of our cosmopolitan population;
- **Creative Toronto** – to ensure that we provide the means to develop the brightest, most intelligent talent through education, culture and recreation;
- **One Toronto** – this builds on our Global Toronto principle and ensures that every person in Toronto, no matter what their country of origin or religion, is able to share in the wealth and prosperity the city has to offer.

“**Green**” is one of eight strategic directions underpinning the agenda that clearly provides a platform for economic growth. It is embedded all four pillars, in terms of contributing to a positive business climate through the implementation of new “green” incentives, positioning the city as a global leader through the advancement of new environmental solutions, supporting green industries as a new economic growth sector and providing opportunities for local employment through various local greening initiatives.

The Agenda for Prosperity proposes that “green” is a strategic objective that provides Toronto with the opportunity to:

- capitalise on our international reputation as a leader for environmental stewardship and our capacity for innovation as an opportunity for job creation and attraction. In particular, the window provided by virtue of Toronto’s Mayor David Miller as head of C40 is a unique opportunity.
- green the city, through supporting and showcasing green products, services and technologies and facilitating green building technologies. This is key to capturing productivity gains.
- collaborate, by developing partnerships with neighbouring municipalities and the businesses located in the region, as a means of generating support and awareness of green initiatives and job creation.

#### **Box 1. Deep-Lake Water Cooling**

Over the past five years, the heat generated by telecom and computing equipment, coupled with the effects of global warming, have created an unprecedented demand for air conditioning in the office towers of most urban areas. Engineers and environmentalists agree that the next five years will see demand increase even further, putting even more pressure on existing electricity grids. Thanks to Enwave and the City of Toronto, the City’s downtown core now enjoys an alternative to conventional air conditioning – one that’s clean, well-priced, and efficient.

Enwave’s Deep Lake Water Cooling (DLWC) is the world’s largest lake-source cooling system, and the ultimate in renewable, clean, green energy. Deep-Lake Water Cooling uses the icy-cold water of Lake Ontario as its renewable energy source. During the winter, the surface of the lake cools to about 4°C. As it gets colder, the water’s density increases, causing it to sink. In the summer, the surface water warms up, but it remains at the surface because it is not dense enough to sink. No matter how hot the summer, the water at the bottom remains very cold. Over the years, this cycle has created a permanent reservoir of cold water on the bottom of Lake Ontario. Enwave has positioned three high-density polyethylene (HDPE) pipes along the natural slope of the lake bottom to pump water from a depth of 83 metres and transport it to the Toronto Island Filtration Plant. There, the cold water is processed and directed to Enwave’s Energy Transfer Station at the city’s John Street pumping station. At this stage, heat exchangers facilitate the energy transfer between the cold lake water and Enwave’s closed chilled water supply loop. Once the energy transfer process is complete, lake water continues on its path to the city’s potable water system.

### **Box 1. Deep-Lake Water Cooling** *(continued)*

- Reduces electricity use by up to 90% compared with conventional air-conditioning.
- Eliminates 79 000 tonnes of carbon dioxide annually – the equivalent of 15 800 fewer cars on the streets of Toronto.
- Cuts 45 000 kilograms of polluting chlorofluorocarbon (CFC) refrigerants.
- Saves more than 61 megawatts of electricity annually – equivalent to the power demand of 6 800 homes.
- Eliminates the need to install cumbersome, expensive equipment and to dispose of it at the end of its useful life.
- Eliminates 145 tonnes of nitrogen oxide.
- Eliminates 318 tonnes of sulphur oxide.
- Provides fresh, potable lake water across Toronto.

At its capacity, DLWC will provide enough cooling for 100 commercial towers. Currently, some facilities that are connected to the cooling system include:

- Air Canada Centre
- Metro Toronto Convention Centre North
- Richmond Adelaide Complex
- Royal Bank Plaza
- Steam Whistle Brewery
- Union Tower
- Maple Leaf Square
- Trump Tower
- Commerce Court
- HBC Queen Street Bay Store and Head Office Tower
- Citibank Place
- Bay Dundas Centre
- TD Centre
- Queen's Park
- Metro Hall/Metro Centre
- City Hall (Old and New)
- RBC Centre
- Ritz-Carlton Hotel and Residences
- Toronto Rehabilitation
- Mount Sinai Hospital

Only the coldness of the lake water is harnessed, not the actual water, so DLWC provides a truly unique, green alternative to conventional air conditioning.

Source: [www.enwave.com/dlwc.php](http://www.enwave.com/dlwc.php).

## Toronto's Green Economic Development Strategy

As a companion to the Agenda for Prosperity, and providing more specific guidance as to a means of realising the opportunities suggested in it, the City developed a *Green Economic Development Strategy* entitled "People, Planet and Profit: Catalysing Economic Growth and Environmental Quality in the City of Toronto" (see [www.toronto.ca/business\\_publications/pdf/green\\_economic\\_development\\_22may2007.pdf](http://www.toronto.ca/business_publications/pdf/green_economic_development_22may2007.pdf)).

### ***Toronto's Green Vision:***

***To become a globally recognised green industry hub that catalyses innovation and fosters the development of new and emerging businesses that generate "sustainable value" to the City, local industry and its residences, while supporting the continued growth and sustainability of established businesses.***

The key objectives of the Green Economic Development Strategy are:

- to support the environment and clean energy sector development, firm formation, expansion and recruitment;
- to promote green business practices to ensure that the demand for environmental services is strong;
- to enhance business competitiveness and stimulate job creation.

A critical success factor for the *Green Economic Development Strategy* is ensuring that the strategy works in harmony with the other initiatives within the City of Toronto, including those initiatives that respond to the economic, social and environmental needs of its citizens.

The *Green Economic Development Strategy* "encourages the retention, growth and attraction of companies or organisations which offer products and/or services that directly or indirectly reduce the impact on the environment." Based on citizen attitudes, municipal leadership in environmental initiatives, and technology development efforts, the strategy describes how Toronto starts from an excellent position to become a global leader in this emerging green market.

### ***What is Green Economic Development?***

*Those programs or initiatives that encourage retention and attraction of companies which offer products or services that directly or indirectly reduce the impact on the environment*

### **Box 2. Toronto's Climate Change, Clean Air and Sustainable Energy Action Plan**

Toronto's bold new Climate Change, Clean Air and Sustainable Energy Action Plan ([www.toronto.ca/changeisintheair/pdf/clean\\_air\\_action\\_plan.pdf](http://www.toronto.ca/changeisintheair/pdf/clean_air_action_plan.pdf)) will see the City of Toronto and its residents, businesses and communities take action to cut greenhouse gas emissions, clean the air and create a sustainable energy future.

The plan was crafted with substantial public and stakeholder input and is designed to achieve and exceed the Kyoto greenhouse gas reduction target.

In addition to actions to green the City's internal operations, the plan outlines a number of actions that will benefit residents, businesses and community groups, including:

**Box 2. Toronto's Climate Change, Clean Air and Sustainable Energy Action Plan (continued)**

- a Live Green Toronto program to encourage Torontonians to adopt more environmentally friendly lifestyles and reduce energy use at home, work and on the road;
- a framework to renew Toronto's concrete high-rise residential buildings;
- a pilot program for residential solar hot water heating;
- a "one-window" source of information on federal, provincial, municipal, private sector and community programs related to energy and the environment;
- a plan to promote local food production and increase community gardens;
- community energy planning;
- a plan to double Toronto's tree canopy;
- the development of a strategy to adapt to climate change;
- a plan to shift taxis and limousines to low-emission or hybrid technology.

The plan calls for initial funding of CAD 42 million for energy conservation measures, CAD 20 million for renewable energy projects and CAD 22 million for retrofitting City facilities.

**Climate change adaptation**

In addition to taking concrete action to reduce emissions and mitigate climate change, Toronto is also preparing to adapt to the long-term changes in weather patterns that are already under way as a result of climate change.

Source: [www.toronto.ca/changeisintheair/index.htm](http://www.toronto.ca/changeisintheair/index.htm).

A number of the initiatives specific to the environment are covered under the City of Toronto's Green Guide (see [www.toronto.ca/greenguide/index.htm](http://www.toronto.ca/greenguide/index.htm)). The over-arching plan for these initiatives will be the *City of Toronto Environment Plan*, which is currently in development. The plan is an updated version of the 1999 plan that will set out the objectives and targets of the city going forward and will provide the guidance and context for the existing initiatives.

The *Green Economic Development Strategy* recommended actions dovetail with this broader framework and fall into six categories:

- stimulating a green market demand
- enhancing and leveraging partnerships with existing networks
- marketing the "Toronto Advantage"
- leading by example
- educating and expanding the workforce
- supporting existing business

Within these categories are specific recommendations, for example, to:

- Formalise a *Toronto Environmental Research and Commercialisation Initiative* to strengthen research partnerships in the fields of sustainable energy and environment; to seek avenues for commercialisation of these technologies, and to link local and international environmental research to business opportunities.
- Develop a *Sustainable Employment District Pilot* project to stimulate industrial ecology and economic competitiveness as a means of creating competitive advantage for companies in the area.
- Develop a *Green Home Innovation Centre* to showcase and provide education on environmental products and services to Toronto residents that leverages partnerships and current initiatives.
- Develop a training programme with the business, academic and labour communities to assist office operations and manufacturing companies to establish in-house expertise with respect to running and maintaining environmental systems.
- Investigate opportunities to expand the City's green procurement initiatives. As a first step, organise municipal workshops on Green Procurement and methods for stimulating environmental innovation within the City's operations, including a trade fair to demonstrate new and emerging environmental products and services for municipalities and the business community.

The following is an update on specific initiatives that are being implemented under the auspices of the *Green Strategy*:

#### ***One-window utility conservation programme for industry***

This initiative seeks to create a one-window utility conservation programme to be undertaken jointly between the City and its key utility providers, Toronto Hydro and Enbridge, targeted at the existing business community to support best environmental practices and build company industry leaders. Staff are currently working in partnership with utility companies to inform Toronto's businesses and industry about the benefits of conservation and available programmes offered by all three parties.

#### ***District energy project in the Discovery District***

This initiative seeks to develop a district energy project in Toronto's Discovery District – a section of downtown Toronto that is home to major universities, hospitals, institutions and associated firms – to support the sustainable use of energy, provide stability with respect supply and costs and stimulate new development in the area.

A five-year (2009-13) *District Wide Action Plan* (DWAP) for the Toronto Discovery District has recently been completed and is currently being implemented. The Action Plan is expected to achieve a 34% reduction in energy savings, a 41.4% reduction in demand savings and a 10% reduction in water savings. This translates into an estimated cost savings of CAD 16.3 million. The *Action Plan* is also expected to achieve large environmental benefits, including reducing greenhouse gas emissions by 83 000 tonnes, or 39.4%, which is the equivalent of taking almost 18 000 cars off the road. The *Action Plan* includes 29 buildings within the Discovery District.

#### ***Toronto Environmental Research and Commercialisation Initiative (VEENUS)***

This initiative proposes the formalisation of a *Toronto Environmental Research and Commercialisation Initiative* to strengthen research partnerships in the fields of sustainable energy and



environment; to seek avenues for commercialisation of these technologies, and to link local and international environmental research to business opportunities.

The Toronto Region Research Alliance (TRRA) has been tasked with capturing the green sector and environmental research currently under way in the Toronto region colleges and universities. Intelligence continues to be collected and posted on the TRRA website: [www.trra.ca](http://www.trra.ca). A charrette is being planned to bring together stakeholders to determine the feasibility of developing a *Green/Renewable Energy Commercialisation Centre*.

### ***Green Home Innovation Centre***

There are various initiatives under way to develop a *Green Home Innovation Centre* to showcase and provide education on environmental products and services to Toronto residents that leverages partnerships and current initiatives.

Examples of Green Home initiatives that have been launched recently with the support of the CMHC, include Canühome and the Now House:

The Canühome was launched in April, 2008 at the *Green Living Show* ([www.greenlivingonline.com/torontoshow/](http://www.greenlivingonline.com/torontoshow/)) and is a travelling exhibit that brings together a unique partnership in an innovative effort to stimulate sustainable healthy affordable housing across the private, commercial, educational and public housing sectors. In short, the project partners have created the Canühome exhibit to educate and empower consumers about what they can do to decrease their utility bills, improve air quality and help the environment. See [www.canuhome.com](http://www.canuhome.com).

Now House is a demonstration project that turned a 60-year-old World War II house into a near-zero energy home. The Now House produces as much energy as it uses on an annual basis. The retrofits reduced green house gas emissions for this home by 5.4 tonnes annually, reduced electricity use by 60% and will enable the home to produce enough energy to pay its own energy bills. The goal is to dramatically reduce the amount of energy used by existing houses in Canada by retrofitting them to net zero energy use. Now House was a recipient of a Green Toronto Award ([www.toronto.ca/greentorontoawards/index.htm](http://www.toronto.ca/greentorontoawards/index.htm)) in 2009 (see [www.nowhouseproject.com](http://www.nowhouseproject.com)).

### ***Environmental/mechanical systems training programmes***

It was proposed that a training programme be developed with the business, academia and labour communities to assist office operations and manufacturing companies to establish in-house expertise with respect to running and maintaining environmental systems.

At the present time, staff are evaluating the most appropriate method and partners to move forward on this initiative. Some of this work is currently being conducted through the Building Owners and Managers Association (BOMA) of Canada's Building Environmental Standards (BEST) programme ([www.bomabest.com](http://www.bomabest.com)). BEST showcases the future direction of the commercial real estate industry in Canada and BOMA Canada's role in providing the mechanisms to advance common practices across the industry.

The BOMA BEST certification builds on the *Go Green* and *Go Green Plus* programme by harmonising these separate certifications into one programme. With four possible levels of certification, users can progress through the programme and continually use the framework of the *Go Green Best Practices* and the *Go Green Plus* assessment to improve environmental performance and management.

### ***Green Procurement***

To get buy-in and leverage huge influence, the City of Toronto has to become a leader in managing its operations in a sustainable manner. Committing the City administration to “green thinking” for its own policies and operations demonstrates the value attached to sustainability performance. Fostering integration of innovative sustainability approaches into the city’s processes, structure and operations will be viewed as a lens for business opportunity and a strong signal for companies to locate to Toronto.

This initiative seeks to escalate green procurement and methods for stimulating environmental innovation within the City’s operations, including a trade fair to demonstrate new and emerging environmental products and services to municipalities and the business community.

The first *Green Procurement Marketplace* was held at Ontario Centres of Excellence’s Discovery 09 in May 2009. The event provided Toronto-based green businesses with an opportunity to present and exhibit their products and services. In addition, procurement and purchasing agents from over 140 organisations and businesses were invited to attend the Marketplace. More information can be found at [www.ocediscovery.com](http://www.ocediscovery.com).

### ***Integrating environmental design into building design and construction***

This initiative proposes the development of a training programme(s) with business, academia and labour to improve the skill sets of architects, building and design professionals with respect to incorporating integrated environmental design into building design and construction.

Staff are evaluating various opportunities and partners to collaborate with on developing this programme. For example, George Brown College currently has courses specialised in this area as part of its construction programme.

### ***Environmental industry capabilities database***

As a foundational effort to promote the green strategy, a key initiative to stimulate local company growth and to attract new companies to the area consisted of the creation of an environmental industry capabilities database and a Toronto consumer market prospectus in co-operation with environmental industry association(s) and other orders of government.

The first iteration of the database was produced by the Toronto Region Research Alliance (TRRA) and is available online at [www.trra.com](http://www.trra.com). The second phase of the project will provide deeper intelligence about the firms in Toronto’s green sector, which will help stimulate new investment and employment.

### ***Environmental workshops for small businesses***

Encouraging greening within smaller organisations is a difficult task, given the number of businesses in the city (over 85 000) and the range of sectors represented. However, given that the bulk of businesses are indeed small, and the future economic growth of the city is expected to continue based upon the success of these firms, a special effort is being made in this area.

Workshops are being developed with various chambers of commerce and the Toronto Association of Business Improvement Areas (TABIA), an organisation that represents 27 000 business and property owners in the City’s 71 *Business Improvement Areas* (BIA) to engage the participation of the small business community in the “Zerofootprint” initiative. Green Enterprise Toronto (GET) is producing two programmes that target SMEs, to provide them with opportunities to learn about green/renewable energy solutions. The first is a morning seminar series that showcases the products and services of

green/renewable energy firms. The second is a series of workshops that provides SMEs with the know-how to conform to ISO 14001 standards and develop an *Environmental Company Policy*. More information can be found at [www.get.com](http://www.get.com).

### ***Sustainable Employment District Pilot***

It was proposed that a *Sustainable Employment District Pilot* project could stimulate industrial ecology while at the same time creating competitive advantages for companies within the area.

The *Partners in Project Green* (PPG) initiative is being co-ordinated by the Toronto Region Conservation Authority (TRCA) with the support of several municipalities, including the City of Toronto. PPG is a growing community of businesses working together to green their bottom line by creating an internationally recognised “*eco-business zone*” around Toronto Pearson International Airport, Canada’s largest airport. Canada’s largest employment area, with over 12 000 hectares of industrial and commercial land, it is home to 12 500 businesses and more than 355 000 employees.

Through new forms of business-to-business collaboration, *Partners in Project Green* delivers programming that helps businesses reduce energy and resource costs, uncover new business opportunities and address everyday operational challenges in a green and cost-effective manner.

Major sectors include automotive supply chain, logistics and warehousing, food processing, plastics and aviation.

The *Partners in Project Green* initiative is being co-ordinated by the Toronto Region Conservation Authority (TRCA) and the Greater Toronto Airports Authority (GTAA), with the support of several municipalities, including the City of Toronto.

There are 12 major initiatives under way to deliver programmes, services, and projects, targeted at improving the financial and environmental performance of businesses in the *Pearson Eco-Business Zone*:

1. *Green Purchasing Blocks*: Through green purchasing blocks, businesses can access green products and services, ranging from office supplies to building technologies, at a reduced rate.
2. *Eco-Efficiency Audit/Implementation Programme*: A “one-window” eco-efficiency programme. The programme provides a free walk-through assessment; a cost-shared eco-efficiency audit with a pre-qualified consultant; an implementation plan; and assistance with handling grants and other incentives.
3. *Smart Commuting Initiatives*: The programme assists employees and businesses facing transportation issues to create transportation initiatives within the *Pearson Eco-Business Zone*.
4. *Waste Re-utilisation Projects*: “Waste” represents resources that businesses have paid for, but have been unable to extract value from. This programme assists in completing sector-specific feasibility studies, and facilitates waste aggregation, to make re-utilisation more feasible. Finding new uses for food processing wastes is an early focus.
5. *District Energy System*: This programme brings potential customers to district energy providers. In addition to linking current energy suppliers to existing consumers, viable business cases for new district energy systems are being developed by identifying energy demand clusters throughout the region.

6. *Co-ordinated Green Building Retrofit*: There are almost 20 million square metres of building area in the *Pearson Eco-Business Zone*. This programme is retrofitting conventional roofs to green roofs and is bringing together building owners and property management companies to reduce their costs and green their building stock.
7. *Municipal Eco-Development Policy Harmonisation*: Working with municipal partners to share and build knowledge and to identify and adopt common practices. Ultimately, policy innovations developed for *Pearson Eco-Business Zone* could be transferred to other industrial areas.
8. *Green Business Retention and Attraction Strategy*: In addition to greening existing businesses this programme helps to attract new green businesses. In partnership with its municipal partners, a formal strategy for green job development and retention is being developed.
9. *Business Best Practices and Regulatory Alignment*: Feedback from business participants indicated a disconnect between business practices for going green and the regulations introduced to encourage such activity. This programme acts as a bridge between businesses and regulators, and ensures policies and regulations to support businesses' best green practices.
10. *Ongoing Education and Outreach Programmes*: This initiative delivers education and outreach programmes to the business community and municipal staff. Education and outreach is both passive (*e.g.* posting case studies on the Web site), and active (*e.g.* developing and delivering "courses"), as well as fostering social networking.
11. *Greenspace Expansion*: The *Pearson Eco-Business Zone* features approximately 1 000 hectares of natural cover, with the potential for expansion to 1 230 hectares. In its efforts to enhance local green space, PPG work with local businesses to expand natural systems and employee access to these areas.
12. *Storm Water Improvements*: With roughly 8 000 hectares of impervious surface, the *Pearson Eco-Business Zone* faces a number of stormwater management challenges. PPG is working with businesses and municipal partners to promote onsite stormwater solutions, including vegetated swales, permeable parking or natural landscaping.

Additional information can be found on the website at [www.partnersinprojectgreen.com](http://www.partnersinprojectgreen.com).

### **Green strategies to support local job creation**

The previous section focused on a number of initiatives directed at building a more competitive green economic sector and facilitating climate change/environmental improvements at the firm level through various programmes, partnerships and pilot programmes.

Green strategies can also be a unique vehicle for social inclusion and local job development at the community level. Toronto has a strong history of inclusion. We have worked hard to build socio-economic supports to ensure that all the people in our city have equal opportunity to share in the benefits of a healthy, vibrant metropolis.

Mayor David Miller's *Tower Renewal Project* ([www.towerrenewal.ca](http://www.towerrenewal.ca)) is one of the best examples of how Toronto is working to ensure that the living conditions of low-income residents can be substantially improved through the use of green technology.

Toronto is a city of towers. The region has the second-highest number of high-rise buildings in North America (behind New York), numbering some 2 000 in total. The majority of these are apartment towers,

and over 1 000 of these buildings are in the City itself. Between the 1950s and 1960s, concrete apartment towers were the most popular building type. Thousands of units were mixed in with single-family homes, industry, shopping and vast open spaces.

Today, these concrete slab towers are aging and inefficient, while the open spaces around them are under-used and poorly maintained. These buildings can largely be found in lower-income neighbourhoods. The *Tower Renewal Project*, inspired by research conducted by E.R.A. Architects in conjunction with the University of Toronto, combines green technology with neighbourhood revitalisation projects to make stronger, greener communities across the city.

Officially launched last September at the foot of one of the towers, the first stage of the project has an operating budget of CAD 580 000 and identifies four sites of interest, representing six buildings and more than 2 400 units, including 1 000 units owned by the Toronto Community Housing Corporation. The *Tower Renewal Project*, still in its early stages, conceives five key elements:

1. *Green Infrastructure*: Apartment neighbourhoods that are close together can take advantage of connections to district and renewable energy installations, including geothermal heating and cooling and co-generation, turbine installations, solar hot-water heating, green roofs, stormwater retention and grey-water recycling.
2. *Urban Agriculture*: Some apartment complexes have large tracts of under-utilised derelict lands in close proximity. This land can be revitalised as urban farmland to generate food and developed into productive uses.
3. *External Cladding or Re-Skinning*: One of the most effective ways to reduce energy consumption is thermal overcladding, which is something like a winter coat for a naked building. A new shell of insulation, rain screening and exterior cladding is applied over the existing building. The overcladding can also support high-speed Internet cables, garbage separation chutes or even clean energy installations like photovoltaics. The hope is that this will generate new technologies and formation of new firms.
4. *Transit City*: As the city has grown and urban sprawl has continued to expand the boundaries of our region, the car has played a dramatic role in our development. Public transit was given a lower priority. Now, as we are looking to intensify the downtown areas of our city with new buildings, we are working to ensure that public transit is made more accessible. We are making system improvements to ensure that communities are better connected with transit than ever before.
5. *Community Improvements*: Improved access to natural areas, parks and public spaces, and enhanced public meeting spaces, such as community centres and libraries, all contribute to stronger communities. The addition of a mix of uses – new shops, restaurants or markets – will provide new services, build stronger communities and reduce the need for car trips.

The city is currently in the process of hiring consultants to conduct “community energy plan” studies on three of the four pilot sites. This work calls for the analysis of the sites and surrounding neighbourhood and the creation and design of a plan to make the buildings more energy efficient.

Tower Renewal is an example of “greening” that should also be of benefit to low-income communities and lead to greater economic and social inclusion. Beyond reductions in energy usage and carbon emissions, the project should make many of the City’s neighbourhoods and buildings better places to live, and will provide employment and education opportunities through the work required to achieve this goal. Efforts will be made to involve local residents in this work, and the infrastructure and support services that are added should help residents on an ongoing basis.

### **Box 3. Regent Park District Energy Plan**

Toronto Community Housing, Canada's largest social housing provider, and Corix Utilities, one of Canada's sustainable utility infrastructure leaders, have forged an innovative partnership, Regent Park Energy Inc., to run a cutting-edge, environmentally friendly green energy system in the revitalised Regent Park. The new joint venture will run a district energy system in Regent Park. The system will produce high-efficiency heating and cooling for all the residential and commercial buildings in Regent Park and will have the potential to generate electricity from green sources like co-generation, solar and geothermal. The energy generated by the district energy system will keep 400 000 tonnes of greenhouse gas out of the air over 30 years, the equivalent of taking 66 000 cars off the road for a year. The joint venture supports the Government of Ontario's Go Green action plan on climate change and the City of Toronto's Climate Change Action Plan.

Toronto Community Housing is investing CAD 36 million and will own 60% of Regent Park Energy Inc. to maintain majority ownership and control. Corix Utilities is investing CAD 24 million for a 40% stake, a significant vote of confidence in Toronto Community Housing's efforts to create a new, successful, mixed-income community in Regent Park.

When fully built-out in 2016, the Regent Park community energy system will serve 12 500 tenants and market condo owners, and commercial tenants. The system is in the process of being commissioned and will be operational by May 2009, when the first tenants move into their new homes in Regent Park (see [www.torontohousing.ca](http://www.torontohousing.ca)).

### **Business incentive programmes**

Under the current cost structure of development in the region, the City of Toronto continues to be a more expensive place to develop than surrounding suburban municipalities, some of which can offer greenfield sites that are easier to develop. It was clear that the City could advance the take-up of green activities and encourage new development through the implementation of some strategic business incentive programmes that are tied to the expansion and adoption of green/renewable energy policies.

#### ***Tax Incentive Equalisation Grant programme (TIEG)***

This programme provides property tax rebates for companies that are expanding their operations or for new companies moving into Toronto. To be eligible, the new buildings must meet Toronto's Green Building Development Standards ([www.toronto.ca/planning/greendevlopment.htm](http://www.toronto.ca/planning/greendevlopment.htm)) and have a construction value of CAD 1 million or more. Eligible development will benefit from a grant of up to 60% of the increase in the municipal taxes attributable to eligible new commercial and industrial construction over a 10-year period.

#### ***Brownfield Remediation Tax Assistance***

This is a component of the TIEG programme and provides property tax assistance. The programme is designed to provide assistance to brownfield properties where contamination has rendered the property vacant, under-utilised, unsafe, unproductive or abandoned.

Properties qualify for assistance where brownfield remediation is undertaken in order to develop the property for employment uses, excluding retail. Ancillary retail uses subordinate and directly related to, and dependent upon, a principal employment use, building or structure will be considered eligible, including ground-floor retail in an office building.

### ***Water Saver/Water Buy-back Programme***

Toronto's population will grow by 250 000 people in 2011, and more water services will be needed for the growing city. Reducing unnecessary water usage will help to avoid building an expensive infrastructure and contribute water for a growing population.

The industrial, commercial and institutional sectors make up 3% of Toronto Water customers, but use more than one-third of the water produced by the City. Some of this water is used needlessly and is costing residents money.

The City of Toronto WaterSaver Programme helps businesses that use a lot water to identify areas that may be wasting water and offers solutions and cash incentives. Industrial, commercial and institutional facilities that successfully reduce water use can:

- receive a rebate (30 cents per litre of water saved)
- control and reduce operating cost
- reduce the costs of installing permanent water-saving hardware and equipment
- run more efficiently.

This programme allows the City to buy back water or sewer capacity that has been freed up by participants who have reduced water use in their operations.

### ***Eco-Roof Incentive Programme***

The purpose of the *Eco-Roof Incentive Programme* is to provide incentives to industrial, commercial and institutional (ICI) property owners so that Toronto's building stock becomes more sustainable and better adapted to climate change. An "eco-roof" would include green roofs that support vegetation and cool roofs that reflect the sun's thermal energy.

The *Eco-Roof Programme* would provide incentives for the retrofit of ICI buildings in Toronto's designated employment areas. On a one-year pilot basis, the programme would also provide incentives for new large ICI buildings citywide that are subject to the proposed Green Roof By-law requirements ([www.toronto.ca/greenroofs/index.html](http://www.toronto.ca/greenroofs/index.html)). The programme would provide incentives of CAD 50 per square metre of green roof up to CAD 100 000 per award and CAD 2 to CAD 5 per square metre of cool roof, up to CAD 50 000 per award. Initial funding for Eco-Roofs was approved in 2007, totalling CAD 2.4 million over five years. Additional funding of CAD 200 000 per year would be provided by Toronto Water, to be specifically allocated to green roof projects. For more information, see [www.toronto.ca/livegreen/bus\\_eco-roof.html](http://www.toronto.ca/livegreen/bus_eco-roof.html).

#### Box 4. Zerofootprint Toronto

The City of Toronto is pleased to offer residents, businesses, neighbourhoods and community groups a new weapon in the fight on climate change, Zerofootprint Toronto!

Zerofootprint Toronto is an innovative Web site that lets you measure your carbon footprint, see the impact of your lifestyle choices, and get information and tips to help you reduce it. It combines a carbon footprint calculator with an interactive Web site that encourages you to join others in the fight against climate change.

At Zerofootprint Toronto, you can:

- calculate your “carbon footprint,” the amount of CO<sub>2</sub> you release into the air as a result of your everyday activities at home, work, and while dining, shopping and travelling;
- get practical tips to reduce your footprint, and see the impact they will have;
- customise the carbon calculator to reflect your lifestyle;
- compare your carbon footprint with the footprint of others;
- share and compare information and tips to reduce your footprint with others.

Source: [www.toronto.zerofootprint.net](http://www.toronto.zerofootprint.net).

## Conclusion

Toronto is in the process of advancing a number of different initiatives to advance its green sector. Its multiple objectives include: growing a robust new industrial sector and associated manufacturing and specialised service jobs, enhancing the quality of life through climate change and environmental improvements and creating some targeted initiatives to ensure that these benefits accrue to lower-income neighbourhoods. These initiatives are limited by staff and financial resources available to the city and could be accelerated and become more robust if they were more effectively supported vertically, for example, greater alignment of provincial and federal tax policies to support intensification of employment and transit-based employment, piggybacking support for environmental incentives like provincial and federal tax support for TIEGs, brownfield remediation and other initiatives.

As noted in the introduction to the City’s Agenda for Prosperity:

*“The current and ongoing trends of globalisation and urbanisation mean that place – and the attributes of place – matter more than ever in attracting increasingly mobile talent and capital. Economic, social and environmental issues of national and provincial importance play out in large urban regions, which offer an efficient place to deal with contemporary challenges. Cities are the front door of global change, and as such have become an urban paradox, where dense concentrations of people and activities are both the nexus of creativity and value-added activity but also locations where distress is often most acute.”* (pp. 8).

Toronto has, with little or no jurisdictional authority, but by virtue of being the order of government closest to the ground and at the “front door of global change”, boldly taken on the challenge of narrowing the distance between the environment and the economy. In so doing, its future is bright.



## Notes

1. Suzuki, David (2008), "Who will pay for our failure to act on global warming?" February 6, 2008 ([www.davidsuzuki.org/latestnews/dsfnews02060801.asp](http://www.davidsuzuki.org/latestnews/dsfnews02060801.asp)).
2. "People, Planet & Profit: Catalyzing Economic Growth and Environmental Quality in the City of Toronto" (City of Toronto: 2007), pp.10 ([www.toronto.ca/business\\_publications/pdf/green\\_economic\\_development\\_22may2007.pdf](http://www.toronto.ca/business_publications/pdf/green_economic_development_22may2007.pdf)).

## AGGLOMERATION, ACCESSIBILITY, ATTRACTIVENESS: THE ‘TRIPLE-A’ FACTOR OF URBAN ECONOMIC DEVELOPMENT

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This paper offers an economic policy analysis of urban economic development. It discusses findings from an integrated modelling analysis that accounts for feedback mechanisms between cities and more aggregated dimensions of the economy. For the purpose of presenting policy insights, three “A”-drivers of urban economic development are identified: agglomeration, which deals with spatial positive externalities arising from concomitance of size and proximity of the economic activities; accessibility, which relies on urban (transport and building) infrastructure endowment affecting the local market potential; and attractiveness, which has to do with expectations of future market performance and local environmental conditions. Special attention is given to the investigation of how spatial policies at the city scale may contribute to battle global and local environmental degradation arising from energy use, while still boosting local economic growth.

### Introduction

Despite repeated and widely supported claims for international action to enhance sustainable development, implementation has been slow and far from comprehensive. An important reason is the difficulty of translating the general and arguably vague notion of sustainable development into concrete principles and actions at local, regional and national levels, where governance is most concrete and effective (OECD, 2006). The analysis of the economy’s spatial dimension helps achieve a more effective environmental management contributing to a sustainable development, even as it allows for the distinction between sustainable and unsustainable land use, transport and trade. What is more, it makes it possible to link policy instruments and goals to concrete strategies concerning locations of settlements as well as firms, and inter- and intra-regional connections.

This paper considers spatial sustainability at the urban scale of analysis, as based on both local (*i.e.* air quality) and global criteria (*i.e.* carbon dioxide emission). We make use of the concept of “sustainable city” and mean a locational system where minimal degradation of the local environment is accompanied by minimal production of greenhouse gases (GHG). In other words, by carrying out policy measures aimed at more effective urban design, housing stock, traffic congestion and accessibility, local governments foster a strategy that controls climate change and raises the quality of life of urban dwellers. As a result, the city is not only lowering the likelihood of global climate change, but also contributing to raise its own competitiveness. The reason for taking action at the local level lies in the recognition that sustainable development can only come through institutions promoting businesses that create wealth, lead to technological progress and encourage innovative low-carbon technologies. A proliferation of such local initiatives that aim to expand the “green economy” can be observed. Examples of such initiatives are sustainable tourism, sustainable mobility and the green building sector.

Urban sustainability and urban economic development can then be seen as consistent with a range of development patterns of local systems, where environmental and socio-economic factors interact to contribute to that development. In this fashion, the fundamental principles of sustainable development,

which are broad and abstract in nature, can be given more concrete connotations. Treatment of urban economic development from an economic modelling and policy standpoint ideally requires combining dynamic, spatial (including environmental) and economic components of models. This might be operationalised at the concrete level of urban systems and transport (*i.e.* intra-urban commuting and inter-urban transportation) networks, which have more than once been called for in the literature of sustainable development (see van den Bergh and Verbruggen, 1999; Grazi *et al.*, 2007).

This paper attempts to offer such a comprehensive framework, discussing the policy implications that arise from modelling long-term paths of urban development on both economic growth and global carbon emissions. Against a backdrop of increasing fear that curbing global warming may turn out to have harmful economic consequences, due to the high costs of ambitious GHG stabilisation goals, this paper underscores the role of local urban policies as complementary to broader international climate strategies. In particular, we wish to emphasise the role that cities can play in reconciling climate control, economic growth and urban competitiveness. We distinguish between three factors that determine the urban economic development: agglomeration, accessibility, and attractiveness, cumulatively referred to as “the triple-A factor”.

## **The method**

From a methodological perspective, we set three different research questions: *i)* to what extent the “triple-A factor” matters in the climate change debate; *ii)* what the potential is for spatial policy at the city scale to achieve CO<sub>2</sub> mitigation; *iii)* what the inherent offsetting mechanisms and possible synergies are between local economic development strategies and broader international policy tools for climate change control. In order to find appropriate answers to the above set of questions, the paper has developed a model that accounts for feedback mechanisms between cities and more aggregate dimensions of the economy. Understanding those mechanisms is crucial for informing the design of policy that considers long-run trends of aggregate indicators of both local and global economic development.

The model is described elsewhere (Grazi and Waisman, 2009), but an outline description is given here for completeness. The framework developed in Grazi and Waisman (2009) allows for the interaction between metro-regions (cities) and the national macroeconomic activity, as well as carbon emissions affecting climate change. To achieve this, we draw on the new economic geography (NEG) theoretical approach (Krugman, 1991), which allows for agglomeration positive spillovers and advantages from trade in a set of metro-regional systems, with both local and transboundary (global) environmental degradation. The OECD Metropolitan Database is used to model the behaviour of metro regions. The NEG metro-regional model is built to be incorporated in the International Research Centre on the Environment and Development (CIRED) Impact Assessment of Climate Policies (hereafter referred to as IMACLIM-R) (Crassous *et al.*, 2006), a global computable general equilibrium (CGE) dynamic recursive model of economic growth, international trade, and CO<sub>2</sub> emissions. Modular integration with IMACLIM-R enables capturing the global environmental impacts stemming from all activities associated with urban land use and translating these through negative externalities into policy effects. The result is a quite accurate description of long-term patterns of urban, regional and global sustainability.

## **Results discussion**

Here we present insights from the modelling scenario analysis developed in Grazi and Waisman (2009) and offer an explanation of the mechanisms underlying economic growth, climate change control and city competitiveness. To this end, three factors of urban economic development are identified, namely *agglomeration*, *accessibility* and *attractiveness*. For each of them, we provide both qualitative and quantitative discussion.

## *Agglomeration*

The term agglomeration refers to the clustering of economic activities in space, which can be considered at different degrees of aggregation: small-scale agglomerations of highly specialised production sectors (industrial districts) like Prato's "textile city" in Italy, versus large-scale agglomerations that often cross over state or national boundaries, such as the United States' manufacturing belt (including northeastern and central northern states, roughly between Chicago and New York City) and the so-called European "Hot Banana" (the traditional regions of heavy industry of the northwest extending towards the Mediterranean) (Ottaviano and Puga, 1998). When firms and people concentrate in space, close proximity of all complementary types of production facilities allow economic agents to benefit from economies of scale, minimal transaction and communication costs, common labour markets and shared technical know-how. Many intermediate commodities and final goods become available at low cost in agglomerated economies (Grazi *et al.*, 2007). This is sometimes referred to as the "Silicon Valley effect" and it is what lies behind the concept of Marshallian externalities, which assumes that the combination of size and proximity of economic activity in agglomerations ensures a wider labour market, allowing for better coordination between workers and jobs. In this study, we refer to this phenomenon simply as "*agglomeration effects*", meaning all the advantages that represent all positive externalities associated with agglomeration (Anas *et al.*, 2001).

It is widely recognised (Fujita and Thisse, 1996) that economic activities are unevenly distributed through space, and that they are found clustered at different degrees of agglomeration (cities, regions, countries), with different impacts on the surrounding territory. Attempting to define the determinants of an economy's geographical distribution and why and in what circumstances agglomeration prevails over the tendency toward sprawl is necessary to draw a clear picture of concepts like balanced interregional trade and fair economic growth, which in turn are fundamental to a spatially sustainable economy. In other words, understanding agglomeration is central to the comprehension of sustainable spatial urban economic development. A recent branch of economics, the new economic geography (NEG), has been developed to analyse the relationship between location and distribution of economic activities. The birth of NEG dates back to Krugman's work (1991), although a first attempt to elaborate the functional forms posed by Dixit and Stiglitz (1977) can be traced in his previous work (Krugman, 1980). Since then, many other contributions have developed the analysis of economic (centripetal and centrifugal) forces that operate in shaping the space-economy. Among the most important are the works by Fujita *et al.* (1999). The underlying mechanisms of agglomeration vs. spreading forces occur via a threefold effect. Consider the case of two regions, across which the economy spatially distributes.

1. The first effect concerns the price index, which is induced to decrease due to an increased number of firms (varieties) playing in Region 1's market. In turn, the decreased price reduces each firm's demand for variety of the composite good, dragging down both the demand and corresponding marginal revenue. The price index effect thus clearly reduces firms' profits in Region 1, acting as a force for dispersion, which stimulates spreading (the partial equilibrium at the starting point was stable, forcing the firm to move back to Region 2).
2. The second effect is income related. In particular, the new economic structure in Region 1 demands additional labour, pushing up labourers' wages. As a result of the increased income in Region 1, demand for varieties increases, which fact shifts both demand and the corresponding marginal revenue upwards. In turn, profits in Region 1 increase. This effect acts as an aggregating force, stimulating agglomeration in Region 1 (partial equilibrium at starting point was unstable, and new firms will be joining Region 1).
3. Finally, a third force enters the picture in the long-run equilibrium, where wages in the two regions must be equalised by definition. As a result of unbalanced distribution of labour forces

due to labour mobility towards Region 1, wages in Region 2 are falling, decreasing the costs of producing in Region 2: as a result, both production average cost and marginal cost shift downwards. This gives rise to an increase in profit in Region 2, which causes other firms to move back from Region 1. This effect acts as an aggregating force, stimulating agglomeration in Region 2. Migration of firms ends only when wages are equalised across the two regions.

In the light of what has been stated so far, it is justifiable, in a more spatially detailed scale of investigation, to interpret urbanisation processes as the result of agglomeration prevailing over spreading forces.<sup>7</sup> On the one hand, a larger number of firms in fact implies shipment of production factors and intermediate commodities, which in turn implies transport, which in turn requires infrastructure. On the other hand, increased demand for labour also demands more infrastructure and services and a highly organised institutional structure. In the remainder of this discussion, expressions like “agglomeration”, “urbanisation”, “(urban) density”, “urban area” and “city” are used interchangeably.

### *Accessibility*

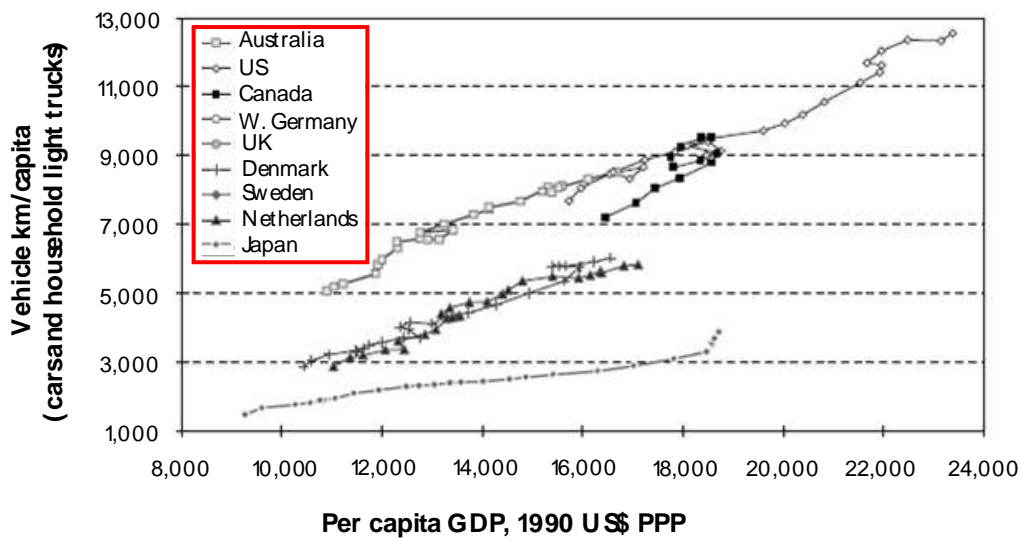
As discussed in the previous section, when looking at a small scale of agglomeration (*e.g.* cities and metro-regional), Marshallian technical externalities are the basis of spatial clustering of firms and individuals. Yet for larger, often transboundary agglomerations (*e.g.* the US manufacturing belt), where the economy acts as a network system in which local markets are interlinked, we need to consider the other forces at play. The spatial location theory (Smith, 1979) posits that locational preferences by economic agents emerge from the interplay between two effects: the market-seeking effect and the cost-saving effect. The market-seeking effect reflects the idea that in locating their production activity, firms’ preference goes towards the biggest market, which ensures the largest demand, whereas the cost-saving effect captures the tendency of firms to reduce their production cost by favouring the market closest and best-connected to the surrounding network. We consider the two effects jointly and refer to them as the *market-accessibility effect*. Hence, accessibility reflects the availability of a system of connections that takes place between the market and the surrounding network system and is a function of infrastructure endowment.

For the purpose of this analysis, which focuses on the interaction mechanisms between cities and local versus global environmental externality “supply”, we distinguish two types of infrastructure determining the degree of accessibility of a spatial market: building and transport infrastructure. The two differ via the notion of static versus dynamic spatial connotation: while building infrastructure mainly supports local interactions between agents and activities, transport networks have a longer-distance, global feature. Each is discussed in the succeeding sub-sections, along with their implications in the environmental debate, with special attention to climate change.

### *Transport*

Transport activity is vital for the health of the modern economy. Raw materials and commodities need to move from their source location to their final destination. People, and hence human capital, face increasing distances, mainly related to commuting from their residence to their place of work. Historically, GDP growth and the expansion of the transport sector have been strongly correlated, while road transport has grown even faster (Green and Shafer, 2003). Figure 1 shows the almost linear relationship over the recent decades between growth in the use of cars and per capita GDP growth.

Figure 1. Use of car and per capita GDP between 1970 and 1995



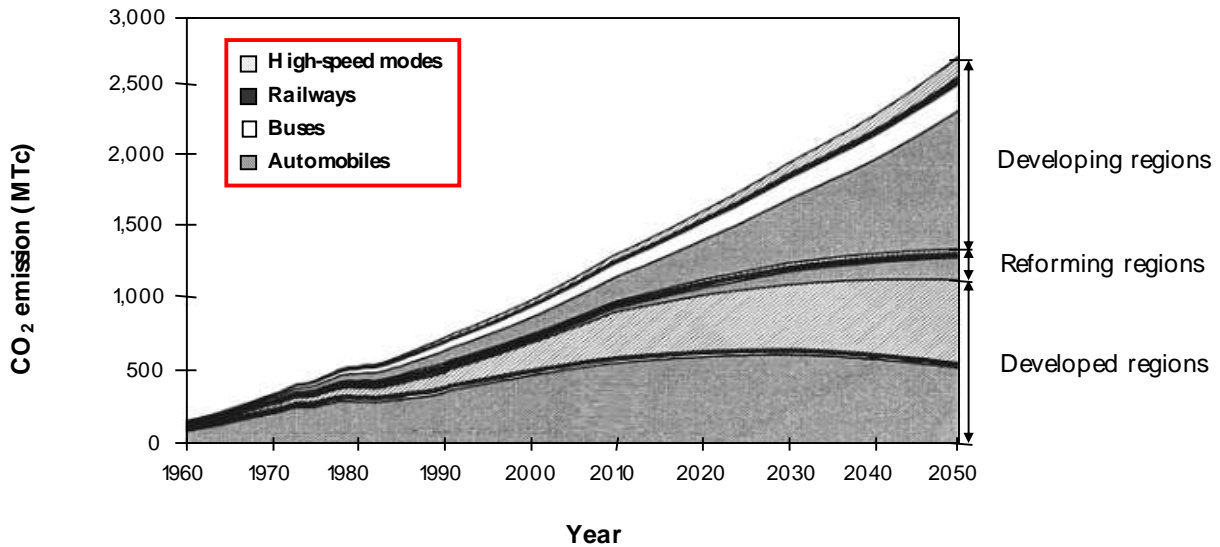
Source: IEA, 2001a.

However, there is a strong contrast between the increasing world-wide demand for mobility, and the associated environmental degradation. As the data seem to confirm, emissions of carbon dioxide (CO<sub>2</sub>), the principal greenhouse gas (GHG) produced by the transportation sector, have steadily increased along with travel and energy use over recent decades. According to IEA data (2001b), the transportation sector accounted for 24% of world energy-related CO<sub>2</sub> emissions. In developed countries, emissions of carbon dioxide from the transport sector are projected to grow at the rate of 2.5% per year up to 2020, while in the developing countries and economies in transition (*e.g.* China, Brazil, India, Indonesia) projections estimate a growth rate of 4.0% per year and 3.3% per year respectively (IEA, 2000). These numbers should give a measure of the relevance of transport to global warming. In contrast, the growth rate of greenhouse gas emissions from other major sectors is expected to be lower.

The rapid increase from transport of last two decades' world-wide CO<sub>2</sub> emissions is mainly due to trends in road transport, which overshadow the other transport modes, accounting for 91% of passenger travel and 75% of goods transported. Associated with passenger traffic, road transport accounts for 60% to 70% of increases in total emissions. The automobile is the main factor imputed in this figure, as travel patterns in most developed countries are progressively more dependent on it (IEA, 2001b). Levels of mobility and car ownership have risen substantially over the recent past, and that trend seems likely to continue. As a consequence of the increasing demand for mobility, car ownership by 2020 is likely to have risen by 50% from today's figures (CEC, 2001).

Transport is one of the most important energy end users. Given the rapidly growing rate of the global economy, the relatively low price of fossil fuels and the uncertain process of shifting to other energy sources, CO<sub>2</sub> emissions are likely to increase substantially during the 21st century if additional policy measures do not intervene to slow down this trend. Figure 2 gives an idea of the magnitude of the likely increase over time in carbon emissions from passenger transport modes.

Figure 2. Recent trends and future projections of CO<sub>2</sub> emissions from passenger travel modes



Source: Shafer and Victor, 1999.

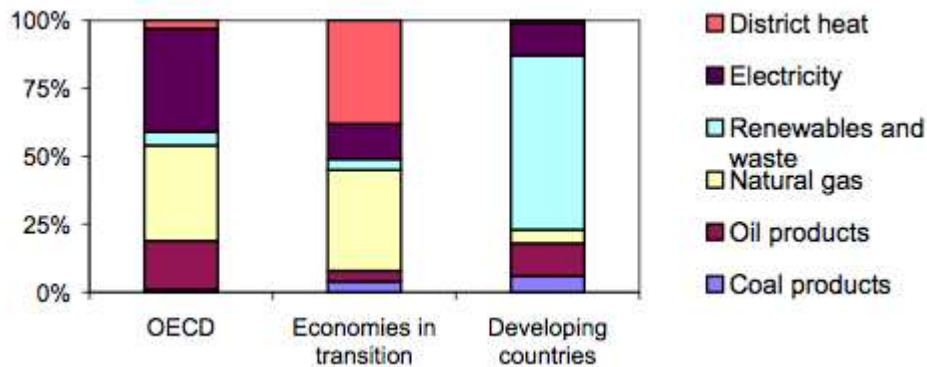
In order to reach higher effectiveness in climate change control, those policies need to take better account of the spatial distribution of emission sources. Modelling and analysis of climate change in the progression towards more effective climate policies have long been dominated by aggregate approaches with a national and international perspective. This has been accompanied by a neglect of spatial organisation and its impacts on transport. Here, the attention is focused on a complementary local-regional scale of analysis that can inform the design of spatial planning policies for combating greenhouse gas (GHG) emissions, and CO<sub>2</sub> in particular. The relevance of this has been underlined by, among others, Githeko *et al.* (2000), IPCC (2001), Grazi and van den Bergh (2008), and Grazi *et al.* (2008). An important contributor to GHG emissions at the local and regional level is urban transport. A local or regional scale of analysis makes it possible to assess the potential contribution of spatial organisation and related spatial planning to a reduction of GHG (mainly CO<sub>2</sub>) emissions from the transport sector.

### Buildings

Buildings are the formal expression of the spatial structure of an economy. Historically, new construction techniques have been gradually developed that have allowed for the vertical dimension of urban landscapes from the previous horizontal, single-family dwellings. This has gone along with an increased degree of freedom in managing urban space, and hence greater possibilities for effectively planning the available space. Indeed, the increased leeway for shaping building possibilities and the simultaneous demand for expansion of transport affords a large number of paths for urban spatial development, each affecting the economy differently: from urban sprawl to densification, from mixed to specialised land use.

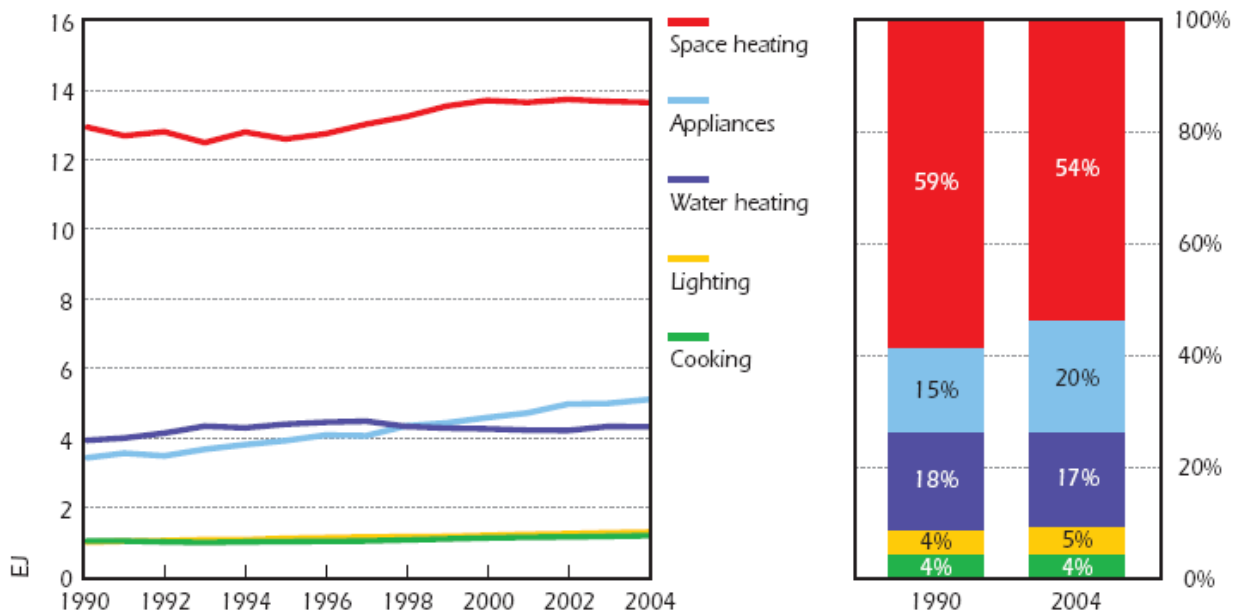
Besides being one of the key growth factors, the building sector is also one of the major energy-intensive sectors: taken together, residential and commercial buildings account for 40% of world energy consumption (IEA 2006). The building sector is also responsible for the 23% of GHG emissions (IEA, 2006). What is even more alarming is that this trend is expected to grow 1% annually up to 2030, according to IEA projections (2006). It is clear that improving energy efficiency in buildings is key to control climate change. Energy policies tending in this direction are being implemented at all administration levels. Figures 3 and 4 show the relevant contribution of the building sector to energy use.

Figure 3. Share of final energy use for residential and commercial buildings by source



Source: IEA, 2006.

Figure 4. Household energy use by end use



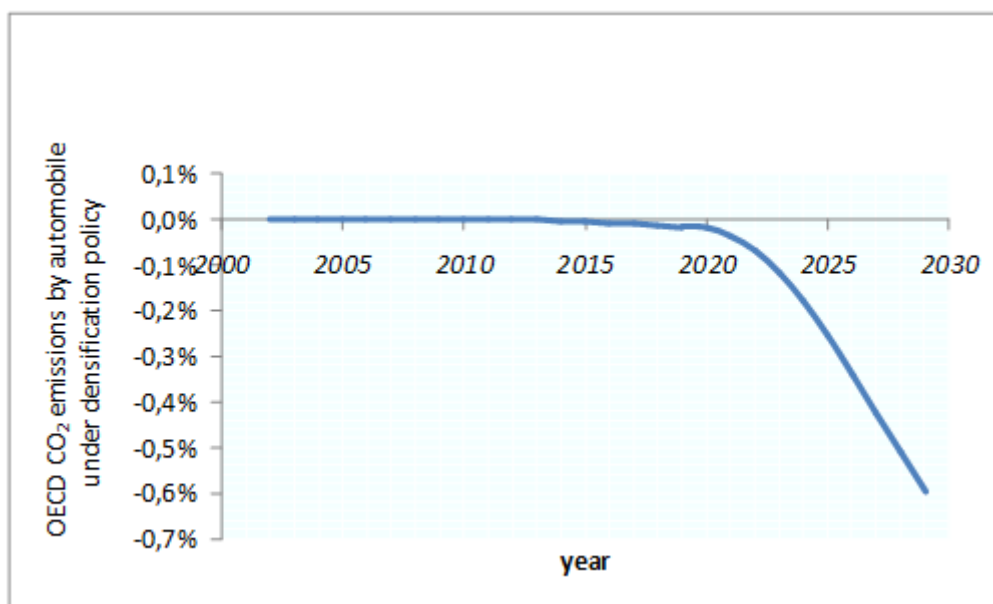
Source: IEA, 2007.

Let us now turn to consider the policy implications from general equilibrium simulations on the impact of densification policy aimed at reducing urban energy use (from building and transportation sectors) on more aggregated aspects of the economy, via the influence on infrastructure supply. We posit that the OECD governments decide to support infrastructure policies at the city scale that have the goal of reducing domestic dependence on energy import and reducing GHG emissions through lowering the need for transport. This type of policy takes the form of increased urban density in the 78 largest OECD metro regions. From a modelling standpoint, the spatial policy takes the form of a constant-over-time annual



additional increase of density with respect to the baseline scenario. More specifically, the additional density increase rate is set to double the density trends observed in the 2001-05 time frame. This implies that a differentiated rate is considered across the OECD (blocks of) regions. Conditional on their initial spatial setting, the metro regions will offer the potential for a diverse magnitude of the densification pattern. This is done to reflect the realistic view that the denser the metro region, the more difficult (*i.e.* costly) it is to make it more dense (as in the case of Japanese and Korean metro regions). In sum, we take a 1.7% annual rate of density increase for the United States and Canadian metro regions, 1.6% for those in Europe and Australia, 4.6% per year for the metro regions of Mexico and 0.56% per year for Japanese and Korean metro regions. Investments that are necessary to implement the infrastructure policy enter the general equilibrium computation as the reduced external costs the policy induces. A five-year delay is assumed between the time at which investments are put into operation and their actual effect on the urban structure. Figure 5 illustrates that the densification policy allows up to a 0.6% drop of OECD CO<sub>2</sub> emissions from automobile transport by 2030, thanks to the decrease of mobility at the urban scale associated with lowering commuting in denser urban areas.

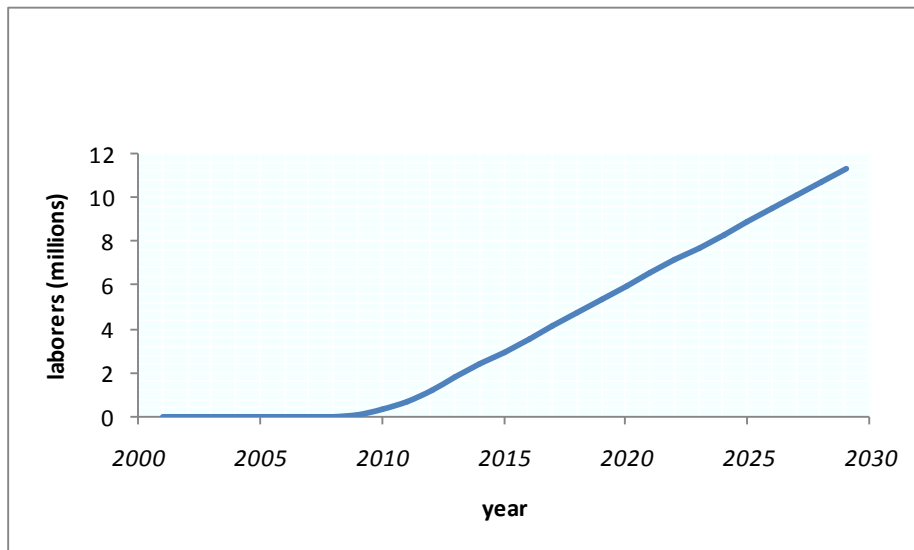
**Figure 5. OECD CO<sub>2</sub> emissions from automobile transport under densification policy with respect to baseline**



Source: IMACLIM-R simulations.

Such a densification policy acts through two mechanisms that have been described above. First, increasing density entails spatial reorganisation of buildings' infrastructure towards more intense construction activity. Second, transport infrastructure is implemented so as to reduce congestion externalities that are likely to happen when acting only on the building component (that is, in the case in which buildings are built to fill the voids in the metro-regional area). The net effect of such a co-ordinated policy at the city scale is the improvement of accessibility to the labour and goods markets, which ultimately allows a transfer of the labour force towards new ("green") production sectors that potentially emerge in such a context. Figure 6 illustrates the magnitude of the labour transfer at the OECD scale, which reaches more than 10 million workers by 2030.

**Figure 6. Labour force transfer in the OECD as a result of better accessibility in a densification policy context (in millions)**



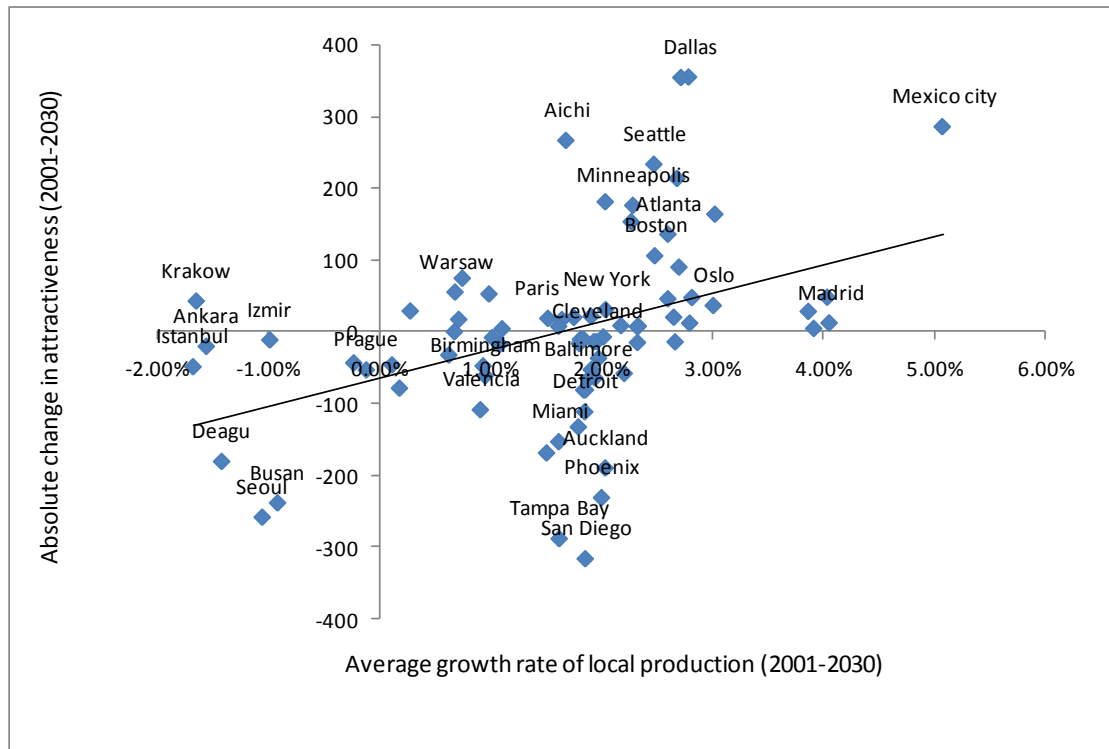
Source: IMACLIM-R simulations on OECD metropolitan data.

### *Attractiveness*

Previous studies define city attractiveness as the appeal to firms of carrying out activities in a particular urban market (Berg, 1999). This in turn depends on the size of production the firms are able to realise relative to that of other sites of the same network. Considering the attractiveness dynamically, this indicator measures the (myopic versus perfect) expectations on production volume that a firm can realise by producing in a certain location. The integrated modelling framework extends this concept and defines the attractiveness of a urban/metro-regional agglomeration as the resulting net effect of four different factors: expectation of production volume, capital return, market size and local environmental conditions.

Concerning the first three indicators, we find a positive correlation between these and attractiveness. For the sake of brevity, we present graphical results only for the impact of production on the attractiveness of the 78 metro regions included in the OECD metropolitan dataset (see Figure 7). Results show that expectations about production (as captured by average production growth rate over the time period considered) and attractiveness are positively correlated. This reflects the positive effect of higher expectations of local production on the attractiveness of the metro region considered.

**Figure 7. Change in attractiveness and volume of production across OECD metro-regions**

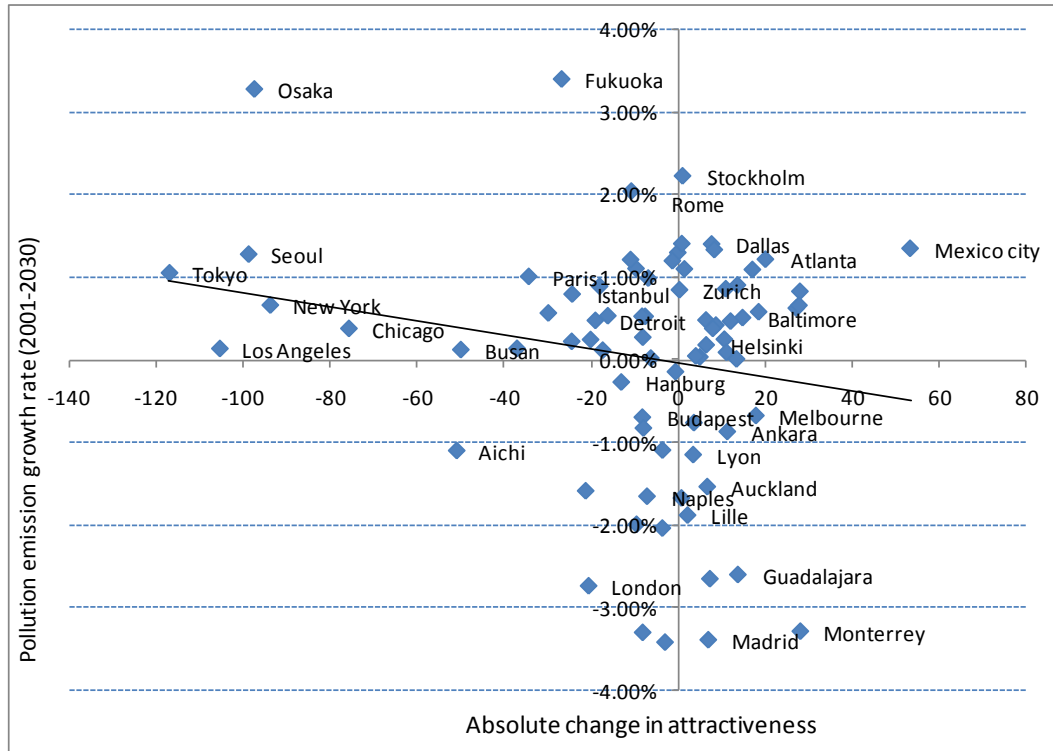


Source: IMACLIM-R simulations on OECD metropolitan data.

Allowing for capital return in the computation of the attractiveness indicator makes it possible to describe the production side of city economies in a more comprehensive manner. It in fact introduces a conceptual innovation of our approach with respect to standard NEG frameworks that better fits the modern structure of the production sector, where decisions are taken as a result of trade-offs between firms' profits and managers' and shareholders' interests. Results for the relation between capital return and attractiveness are not shown here, as they are qualitatively similar to those obtained for production expectations (see Figure 7). The analysis has in fact shown a positive correlation between return on capital and attractiveness that reflects the incentives for investors to settle in urban locations in which higher returns on investments are expected.

Finally, local pollution is considered as a driver of attractiveness, since firms compensate labourers for the negative externalities they suffer when entering the metro-region economy. In the modelling analysis behind this discussion, this is formalised through imposing a higher wage in the more polluted metro-regions. As a consequence, higher pollution is expected to undermine the attractiveness of a metro-region. In order to quantify the effect of production-induced local pollution on attractiveness it is necessary to isolate attractiveness from the positive effect of higher production (see discussion above). To this aim, we compare the change in attractiveness obtained in the absence of any local pollution with the one obtained when local pollution is actually considered. Figure 8 reports the results.

**Figure 8. Change in attractiveness and pollution emission across OECD metro-regions**



Source: IMACLIM-R simulations on OECD metropolitan data.

Local pollution positively affects the attractiveness (as captured by a positive difference between attractiveness with and without local pollution) when the metro-region considered features a slower growth (or even a decrease) of local pollution over the time period analysed. In other words, the attractiveness of a metro-region is negatively affected by local pollution. This justifies in particular the implementation of local policies to limit the production-induced negative externalities to enhance the attractiveness of the metro-region.

## Conclusion

This paper has offered an economic policy framework of spatial configurations of economic activities and labour population on the long-term development patterns of the local economy. The starting point for the analysis was the notion of urban sustainability, which defines a situation in which an urban agglomeration configuration is consistent with economic development, sustainable resource use, pollution and global carbon emissions affecting climate change. To study the relationship between spatial patterns at the urban and regional scale and sustainability in a way that is consistent with economic theory, we have presented an abstract of results from an integrated modelling framework, which has been described elsewhere. The modelling framework developed bridges two different approaches, namely the new economic geography (NEG) theory for the analysis of location choices of the spatial economy and the CGE framework for climate policy evaluation. In particular, the CIRED Impact Assessment of Climate Policies (IMACLIM-R), a global CGE dynamic recursive model of economic growth, international trade, and CO<sub>2</sub> (carbon) emissions, was employed. Modular integration with IMACLIM-R enables capturing the global environmental impacts stemming from all activities associated with urban land use and translates these through negative externalities into policy effects. The result is a quite accurate description of local

versus global sustainability and urban economic development, which helps inform the design of effective spatial policy to control climate change and boost local economic growth.

We accounted for three drivers of urban economic development namely, agglomeration, accessibility and attractiveness and jointly refer to them as the “triple-A factor”. *Agglomeration* deals with spatial positive externalities arising from the combination of size and proximity of the economic activity. We have provided information on the underlying economic mechanisms leading to agglomeration. *Accessibility* relies on urban (transport and building) infrastructure endowment affecting local market potential and global climate change. By means of simulations from the integrated modelling analysis based on the OECD metropolitan dataset, we have described the relation between spatial densification policies at the city scale and labour market, on the local scale, and aggregated carbon emissions from the automobile sector, on the global scale. A positive effect of the spatial structure of metro-regions has been found on both job creation and carbon emission reduction via a twofold simultaneous effect: on the one hand, densifying space leads to renewing the stock of buildings, which in turn acts favourably on the construction sector by boosting technical progress. This mechanism is finally responsible for respectively, increased labour opportunities in the construction sector and increased potential for energy-efficient buildings due to increased labour productivity and hence decreased construction costs. On the other hand, augmenting urban density produces a doubly beneficial effect, in that it reduces commuting distance and thus both automobile-related carbon emissions and local pollution. Finally, *attractiveness* has to do with expectations of future production, capital return, and local environmental conditions. The integrated modelling framework extends this concept and defines the attractiveness of a urban/metro-regional agglomeration as the resulting net effect of four different factors: expectation of production volume, capital return, market size and local environmental conditions. We have shown graphical results from a simulation exercise on the effect of each indicator and the metro-region’s attractiveness. The results reveal a positive effect of the first three indicators on attractiveness, which tends to increase with the intensity of the economic activity. As for the pollution effect, a negative sign is found in the correlation function between local environmental externalities from the production sector and metro-regional attractiveness.

Taken together, policies that affect urban form, such as spatial planning and/or transport pricing schemes, deserve more attention in both environmental and climate policy debates, as they can contribute to a reduction in local pollution and global greenhouse gases. Concerning climate change, combating CO<sub>2</sub> emissions through spatial and transport policies may be a wise second-best strategy with respect to other types of climate policies, such as externality taxes on fuels. Nevertheless, the two types of policy are generally complementary, and in the long run, may need to be implemented simultaneously. In addition to positive environmental effects, thanks to revealed general equilibrium feedback mechanisms between urban density, commuting external costs and labour productivity, it has been shown that implementing spatial policies at the city/metro-region scale may be compatible with urban economic growth.

## Notes

1. I am grateful to Laure Lampin and Henri Waisman for precious research assistance. All errors are mine.
2. According to Neary (2001), this happens for sufficiently low transport costs and a large share of expenditure on manufacture.

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**SESSION 2-A**  
**GREEN GOVERNMENT: WHY CO-OPERATION ACROSS**  
**LEVELS OF GOVERNMENT IS ESSENTIAL?**

## INNOVATIONS IN MULTI-LEVEL GOVERNANCE FOR ENERGY EFFICIENCY<sup>1</sup>

*By Sara Pasquier, Nigel Jollands and Emilien Gasc  
Energy Efficiency Unit  
International Energy Agency*

### Introduction

Recent IEA analysis highlights member countries' significant progress with developing energy efficiency policy (International Energy Agency 2009).

Despite creating a plethora of national and international regulations and voluntary programmes to improve energy efficiency, countries are far from achieving full energy efficiency potential across all sectors of the economy.

A major challenge, among numerous barriers, is policy implementation. One strategy that many national governments and international organisations have used to address the implementation issue is to engage regional and local authorities. To that end, many programmes have been created that foster energy efficiency action and collaboration among levels of government.

This report identifies programmes where multiple levels of government are actively collaborating to implement energy efficiency. This collaboration is referred to in this paper as 'multi-level governance for energy efficiency' (MLGEE).<sup>1</sup> By sharing lessons learned from daily practitioners in the field, the IEA hopes energy efficiency policy makers at all levels of government will be able to identify useful multi-level governance (MLG) practices across geographical and political contexts and use these to:

- design robust programmes
- modify existing programmes
- connect and share experiences with other policy makers in this field

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<sup>1</sup> The excerpts in this report are from the information paper *Innovations in Multi-level Governance for Energy Efficiency* prepared by Nigel Jollands (Energy Efficiency Unit Head), Emilien Gasc (consultant) and Sara Pasquier (energy policy analyst) at the International Energy Agency. For a copy of the complete paper, go to [www.iea.org/Textbase/publications/index.asp](http://www.iea.org/Textbase/publications/index.asp).

The Information Paper's preliminary findings were presented at the workshop on *Green Cities: New Approaches to Confronting Climate Change* hosted by the Organisation for Economic Development (OECD) and the Spanish government.

The paper was made possible by a Voluntary Contribution from the Government of Switzerland. The authors would like to thank the many people who were interviewed and who provided information on the diverse range of multi-level governance arrangements covered in this report.

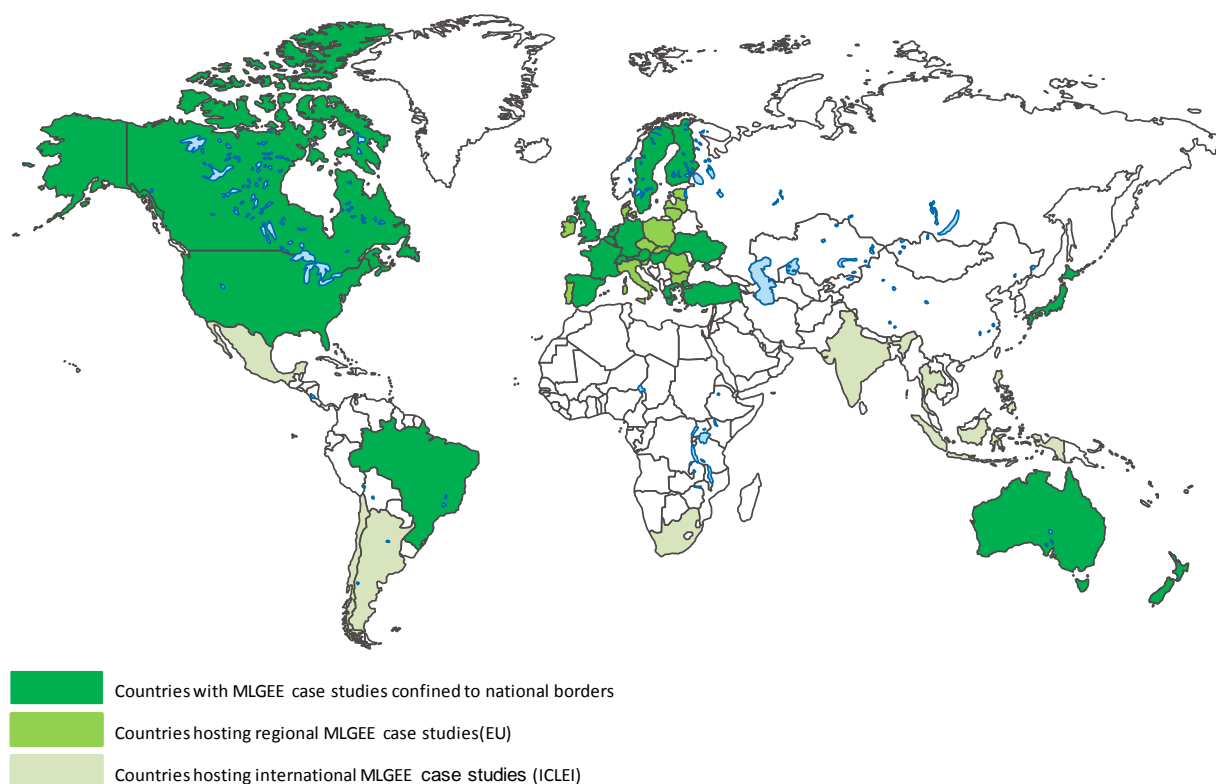
## Approach

The analysis in this report builds on past MLG frameworks and pays special attention to the motivations, objectives, organisational structures and funding dimensions of each MLGEE programme. It also provides insight into communication tools, evaluation processes, issues of jurisdiction and historical perspectives.

Unlike in previous MLG studies, the analysis in this report is based primarily on thirty MLGEE case-studies. Information on most of the MLGEE case studies was collected through in-depth, semi-structured phone and face-to-face interviews and written questionnaires filled out by programme managers.

The thirty case-studies are from twenty countries around the world (Figure 1). Most of these case-studies are drawn from Europe. Three are European Union (EU)-initiated arrangements and several others are EU-funded. North America and Oceania account for five and four case-studies respectively. Asia and South America provide one case-study each. ICLEI's *Cities for Climate Protection*, is global. No case-studies are from Africa.

**Figure 4. Geographical distribution of the case-studies**



## Summary of findings

The report finds that there is no one single “standard” MLGEE arrangement. Some governments take advantage of public-sector institutions already in place to coordinate programmes (for example, the French *Espaces Info Energie* are mostly hosted by public local and regional energy agencies),

while others use existing non-governmental associations (for example, the *WarmZones Company* in the United Kingdom is property of the charity National Energy Action). Still other MLGEE arrangements are formed under new structures to coordinate activities (for example, *Energy Efficient Cities of Ukraine*) or establish advisory committees and councils (*CONCERE* in Belgium).

Overall, the case-studies tend to rely on voluntary participation and tend to be initiated by national or international governmental bodies. Some involve grants (for example, the *Klimaatconvenant* in the Netherlands) and have been strengthened by recent economic stimulus funds (for example, the *State Energy Programme* in the United States and, indirectly, the *Covenant of Mayors* in the EU). Others include a competitive process where project proposals that best meet pre-set objectives are awarded funding (for example, *ECO-Model Cities* in Japan, *Wettbewerb Kommunalen Klimaschutz* in Germany) or public recognition (for example, the *European Energy Awards*).

Still other case-studies address capacity constraints and provide municipalities and/or households and businesses with energy audits (for example, the *Energy Efficiency Agreements* in Finland) and training and information on best practices (for example, *Energy Info Points* in France). Cooperation with municipalities may target government facilities (for example, *Crown Energy Efficiency Loan* for the municipal sector in New Zealand) or the wider local community (the *Local Promotion Program* in New South Wales, Australia).

### Motivations and objectives

From the thirty case-studies, we found five overarching motivations for establishing MLGEE arrangements (see Figure 5):

1. **Compliance with national/international legal provisions.** Most often, MLG arrangements are established specifically to achieve objectives set by national governments. These objectives commonly relate to international agreements on CO<sub>2</sub> emissions reductions (Kyoto Protocol, EU “burden sharing”-related decisions) or energy efficiency (such as the recently upgraded EU Directive on the Energy Performance of Buildings 2002/91/EC). Examples of case-studies that have been established to achieve national objectives include the Dutch *Climate Covenant*, and *SwissEnergy* in Switzerland.
2. **Economic development.** Many programmes such as the EU-funded *Local and Regional Energy Agencies* are established to “promote social and economic cohesion and promote the creation of small and medium enterprises”. The *Covenant of Mayors*, for instance, aims to “create stable local jobs”.
3. **Co-operation in federal countries.** Three case-studies were established in Federal countries with the aim of achieving greater cooperation between different levels of government. For example, in Belgium, motivations for the *CONCERE-ENOVER* forum stemmed from entangled jurisdictions over energy efficiency. In Canada, the *Assistant Deputy Minister*

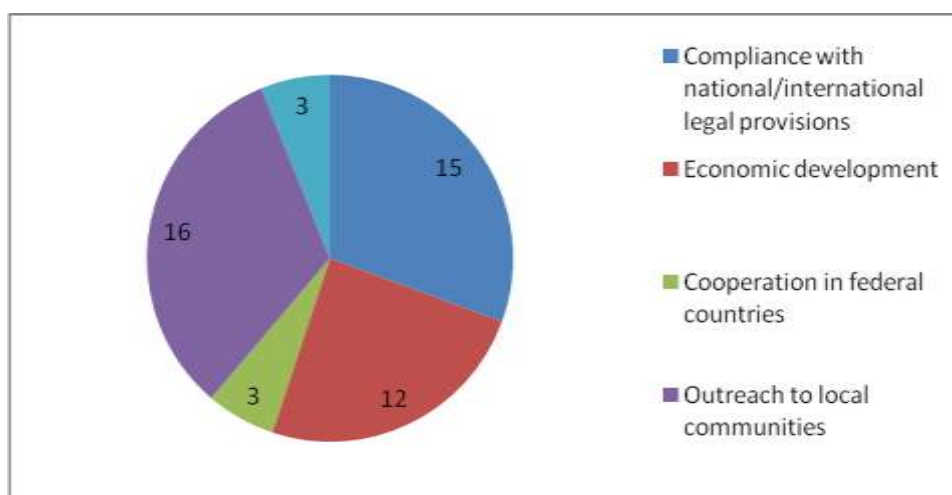
#### **Motivations and objectives: key points**

- We can identify five motivation themes;
- All case-study set clear objectives;
- Too many objectives can be challenging;
- One way to deal with multiple objectives is to prioritise objectives over time;
- MLGEE managers need to understand the full range of (stated and implicit) objectives.

*Steering Committee for Energy Efficiency* aims to remedy potential programme duplication in the various Provinces (regions). In Switzerland, *SwissEnergy* contributes funding to Cantonal energy policies in exchange for matched levels of funding from the Cantons.

4. **National government outreach to local communities.** National governments often use MLG as a means of promoting national policies and targets in local communities. For example, in France, the underlying motivation for opening *Espaces Info Energie (Energy Advice Centres)* lies in the perception that sub-levels of government are much better connected to individuals.
5. **Fuel poverty reduction.** Programmes specifically targeting fuel poverty account for three of the case-studies featured in this analysis (the *Low-Income Retrofitting Project* in Greece, *WarmZones* in the United-Kingdom and the *Weatherization Assistance Program* in the United States).

**Figure 5. Primary motivation for creating the MLG arrangement**



### Scope and structure

The scope and structure of a MLGEE programme, *i.e.* the range of MLG activities and the elements that define how levels of government interact, is important.

#### Scope

Two important issues to consider regarding the scope of an MLGEE include how many government players are involved (level of inclusion) and the type of measures promoted.

### *The level of inclusion*

Most case-studies covered in this report involve two levels of government (bilateral). Although cases involve all kinds of government, few target the county level (one notable exception is the *Energy Efficiency and Conservation Block Grant* in the United States).

Examples of bilateral arrangements include *CONCERE-ENOVER* in Belgium, a forum where the federal government and the regions discuss the potential for cooperation in energy efficiency, and *Eco-Model Cities* in Japan, where the national government organises a competition for cities.

Multilateral arrangements usually include representatives from the international, national, regional and municipal levels, as well as of the civil society. The *European Energy Award* scheme and the *Local and Regional Energy Agencies* are examples of multilateral programmes, where the international, national, regional and local levels contribute to the arrangements in one way or another.

### *Types of energy efficiency measures promoted*

Evidence shows that MLGEE can be used to promote and implement energy efficiency using a range of measures.

Certain programmes such as *WarmZones* in the United Kingdom effect energy efficiency directly, by gathering funding and human resources necessary to implement insulation solutions. Conversely, other programmes revolve around indirect measures such as dissemination of energy advice to individuals (the *Espaces Info Energie* network in France) or capacity-building within municipalities (e.g. *ECO-Buy* in Australia educates relevant staff in local councils on how to set up a “green procurement” policy at the local level).

Some MLGEE promote measures that fall between direct and indirect action. For example, *Paranácidade* in Brazil provides for a financial building capacity tool (indirect). However, this tool is also a key element needed to enable direct action.

### *Structure*

In addition to defining the scope of an MLGEE, policy-makers must pay attention to the structure of the arrangement. Important considerations in the structure of MLG are the initiation in decision-making process, nature of participation, the formality of administrative structures and levels of accountability.

#### ***The level of inclusion: key points***

- *Most MLGEE are bilateral agreements;*
- *Few MLGEE target county-level government;*
- *The question of which, and how many, levels of government to include is a critical issue for policy-makers*

#### ***Types of measures promoted: key points***

- *MLGEE can be used to promote and implement energy efficiency using a range of measures.*
- *Selecting the type of measure a MLGEE should promote, at what time, is important.*

### *Initiation and decision-making process*

The majority of case-studies investigated in this report have strong top-down characteristics – both in their initiation and decision-making processes. An example of an MLGEE initiated and managed by top levels of government is the *KLIMP* programme, which was conceived by then Ministers of Sweden and the decisions of which were made at the national level as well.

An interesting finding in this analysis is that top-down MLGEE tend to be associated with two characteristics. They tend to be heavily asymmetric in their funding.. That is, top-down MLGEE tend to rely heavily on the majority of funding coming from central government. Second, all top-down case-studies used to dominant modes of governance: governance by provision and governance by enabling. No case-studies were associated with governing by authority where central government forces participation without providing resources or enabling conditions.

Another interesting feature of the majority of the case-studies is that the decision-making and ownership approach changed over time. The analysis shows that regardless of the initiation process, it is common that decision making is eventually transferred/delegated to bottom levels of government.

### *Nature of participation*

The great majority of MLGEE case-studies were of a voluntary nature. That is, participation in the MLGEE was not mandatory or required by legislation.

In some instances, participation in MLGEE has been required by law. In Turkey for instance, membership in the Association of Turkish Municipalities (TBB) is mandatory for all 3,000 municipalities of Turkey. The TBB was in turn included in the national *Energy Efficiency Coordination Board* by a law of 2007. The establishment of *Paraná* in the Brazilian State of Paraná also reflected a legal obligation: municipalities borrowing money from upper levels of government are required by law to have their requests for finance supervised by Brazil's Central Bank.

### *Governance mode*

Governance by provision is most common in grant-oriented programmes such as the Dutch *Klimaatconvenant* or the *State Energy Program* in the United States: the government offers funding in return for energy efficiency action at lower levels of governance. Governing *through enabling* often focuses on information distribution such as the *Assistant Deputy Minister Steering Committee on Energy Efficiency* in Canada (seeking to avoid programme duplication by sharing information) or France's *Espaces Info Energie* (via dissemination of information to the general public and small businesses).

#### ***Initiation and decision-making process: key points***

- *The majority of case-studies have strong top-down characteristics.*
- *Case-studies characterised as top-down have heavily asymmetric funding and use governance by provision and enabling.*
- *Decision-making and ownership changes over time towards more bottom-up processes.*

#### ***Nature of participation: key points***

- *The majority of case-studies are voluntary arrangements.*
- *The decision as to whether the MLGEE is mandatory or voluntary will influence the level of participation.*
- *Voluntary arrangements can lead to low participation but can encourage greater efforts by participants.*
- *Even voluntary arrangements have formal supporting structures.*
- *Voluntary arrangements can deliver a range of energy efficiency measures.*

The closest arrangement to an “authoritative” type of governance is the Turkish *Energy Efficiency Coordination Board*, in that adherence to the TBB is mandatory; yet, the *Energy Efficiency Coordination Board* itself only provides advice to the government and does not impose policies to municipalities directly.

Most case-studies actually utilise several types of governance. For example, the *Low Income Retrofitting Project* in Greece involves ‘governance *by provision*’ (budget to reinforce energy efficiency in houses) and ‘governance *through enabling*’ (local information centres inform households on the project). The same pattern is noticeable in another programme targeting fuel poverty: *WarmZones* in the United Kingdom. This pattern might be explained by the need to inform the population in situation of fuel poverty about the very existence of programmes they are entitled to. Also, for the *Energy Efficient Cities of Ukraine* association, the Ukrainian government *enabled* the creation of this association with a law of 1997 which allowed for formal cooperation between municipalities on certain subjects; international organisations have provided the association with most of its funding (governing *by provision*); the network, however, is entirely *self-governed*.

#### *Formality of administrative structures*

The degree of formality of administrative structures of MLGEE is manifested in various ways:

- Sometimes, the MLGEE required the creation of **dedicated physical entities** (the *Low-Income Retrofitting Project* in Greece, formal). Other times, the MLGEE is run through pre-existing, non-dedicated entities (the *Crown Energy Efficiency Loan* in New Zealand, informal)
- In some case-studies, objectives and regulations are defined in **documents** (ranging from very formal documents such as the Constitution in Belgium to less formal such as “milestones” in the *Cities for Climate Protection* campaign),
- The **types of decision-making process** within the arrangements range from formal authoritative decisions (for example, the *European Energy Award* certification scheme, where selection criteria to award municipalities the different levels of award are clearly stated and where rules of governance are detailed and include thresholds for financial participation in the supporting entity) to less formal (for example, with the *Local Promotion Program* in New South Wales, Australia, the contents of actions led by local councils in exchange for regional funds are left to the local councils’ appreciation. Only a few requirements on promotion of the regional rebates on energy efficiency must be met, but the form of the promotional events is completely unregulated by the programme<sup>2</sup>) and consensus (in *CONCERE-ENOVER* in Belgium, no decisions are made by vote. Discussions between the parties last until a compromise is reached, or no decision is made)
- The **channels of communication** sometimes take an unstructured form (for example, in the *Energy Efficiency Agreements* in Finland or *CONCERE-ENOVER* in Belgium, much communication between the parties takes place informally). Other arrangements are sometimes more restricted to official channels only. These later cases are harder to identify, as informal communication might take place which was not reported; however, French

#### ***Formality of administrative structures: key points***

- *The degree of formality differs among all case-studies.*
- *Formal administrative structures can be achieved through dedicated physical entities, formal documentation of objectives and regulations and clear decision-making processes.*



“energy efficiency advisors” in *Espaces Info Energie* must fill a debriefing report on every single intervention they have completed.

Clearly defined working relationships are essential for MLGEE since they can often involve levels of government that are not accustomed to cooperating with each other. This perhaps explains part of the reason why negotiating Finland’s *Energy Efficiency Agreement* took so long. In this case, municipalities were reluctant to conclude negotiations until each party had a full understanding of its role.

The degree of formality is important because it can impact on the degree of resilience of the MLGEE. A high degree of formality can provide robust structures that can withstand changes in political will. This is particularly the case if the formal establishing documents enshrine the MLGEE in law. However, formal structures can also be disadvantageous. They can be relatively bureaucratic and lack the flexibility needed to change with circumstances. In this instance, a low degree of formality can offer less bureaucracy, more flexibility and therefore increased resilience.

#### *Level of accountability*

A high degree of accountability is essential in MLGEE for several reasons. Because these arrangements often use significant amounts of public finance, it is important to ensure that those managing MLGEE are accountable for the use of that money. Good accountability in MLGEE can help to ensure that investments are effective and delivering value for money. Accountability can also ensure financial sustainability of an arrangement by keeping stakeholders informed of the financial situation. This information in turn enables better financial planning. Finally, accountability in an MLGEE can help to build trusting relationships between the various levels of government involved.

<p><b><i>Accountability: key points</i></b></p> <ul style="list-style-type: none"><li>• <i>Accountability is important in MLGEE.</i></li><li>• <i>Most MLGEE have some form of accountability arrangements.</i></li><li>• <i>In many instances, efforts devoted to accountability wane over time.</i></li></ul>
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We evaluated the level of accountability in case-studies by identifying which case-studies had the following elements:

- Political monitoring (by an elected body);
- Ex-post evaluation (both process and outcome evaluations);
- Regular external monitoring;
- Regular internal monitoring and reporting;
- Pre-screening of projects.

Many MLGEE case-studies have some form of accountability mechanisms. In some of the case-studies it appeared that the accountability mechanisms were inadequate. For example, several of the case-studies rely heavily on trust and self reporting. During interviews, several respondents claimed that the issue of accountability is culturally dependent. For example, the Netherlands has a long history of relying on voluntary approaches to energy efficiency. In this context, Dutch interviewees identified that relying on trust and self reporting was appropriate. This may not be the case in other countries.

## Funding provisions

Along with the motivations, the scope and the structure, funding provisions are critical in determining the shape of an MLG arrangement.

The case-studies reviewed in this report cover a huge range of budgets. The smallest budget accounted in the case-studies is Canada's *Assistant Deputy Minister Steering Committee for Energy Efficiency* with approximately CAD 15,000 (EUR 10,000) per year, which corresponds to the costs of organising meetings three to four times per year. The largest programmes featured in the case-studies are the American programmes linked to the USD billions in the *American Recovery and Reinvestment Act* of 2009. The *EU Covenant of Mayors*, while budgeted with approximately EUR 15 million (for its facilitation structure "ELENA"), has enabled several cities to apply for hundreds of million Euros of loans from the European Investment Bank.

Not surprisingly, the level of funding determines the scale of an MLGEE. During the course of the interviews several programme managers reported that more municipalities would have taken part in the programmes if more funding was available (for example, this was noted with respect to *Eco-Model cities* in Japan and *SwissEnergy*).

Of particular interest at the moment is the economic crisis. In an attempt to respond to the crisis and the ensuing economic downturn, IEA countries are implementing stimulus packages (International Energy Agency 2009). For example, the stimulus packages in Canada, France, Germany, etc., provide funding for energy efficiency.

The impact of the crisis on municipalities and local levels of government was brought up in several interviews. **Stimulus funds increased the budgets of many of the case-studies highlighted in this report.**

In addition, large stimulus packages are refocusing MLGEE on direct measures. This trend was actually acknowledged by the European Commission in the case of the *Covenant of Mayors* when the Covenant was granted an initial EUR 15 million by the European Investment Bank, followed by grants of EUR 160 million to the City of Barcelona and plans for a EUR 500 million loan to the Province of Milan. At the same time, EU officials interviewed have stated that the *Covenant of Mayors* was established in an attempt to stimulate further direct action.

A key question for policy-makers is how to design MLG arrangements that are independent of external funding. As an example, certain energy efficiency programmes involving MLG mechanisms were stopped in the past for lack of funding (e.g. NU-Spaarpas in the Netherlands<sup>3</sup>).

The use of innovative mechanisms is needed for reducing dependence on external funding. In this regard, such initiatives as ECO-Buy in Australia or the market for third-party financing in Upper Austria provide useful examples. These programmes seek to build sustainable links between suppliers (ESCOs in Upper Austria, producers of green goods in Victoria) and consumers (local authorities).

### **Funding provisions: key points**

- *There is a huge range in the sizes of budgets for MLGEE.*
- *The economic crisis means that many MLGEE are redirecting their efforts towards direct energy efficiency measures.*
- *Several MLGEE have investigated innovative mechanisms to reduce dependence on external funding.*
- *MLGEE with large budgets do not necessarily have robust accountability systems.*
- *The higher the number of participants the higher the budget and funding symmetry.*

National and regional governments act here as barriers-lifters, by providing the infrastructures of self-sustaining markets. However, these programmes have required long periods of preparation and training among the receivers.

The timing of funding can become a source of concern. Lags in central/federal funding create delays in programme implementation. On the other hand, large amounts of funding in a space of time can also stretch a programmes' capacity to implement effectively in the short term – because of time delays in recruitment etc. This issue of timing of funding was recognised as a challenge and is currently being explored by the European Commission regarding the *Local and Regional Energy Agencies*.

Surprisingly, programmes relying on considerable budgets do not necessarily have the most robust accountability systems. Indeed, this appears to be the case of recently launched programmes such as the EU *Covenant of Mayors* or the three US cases established under the ARRA. In this context, we define lack of accountability systems to mean that the goals of the MLGEE were not binding. For example, a key goal of the Covenant of Mayors is to get cities to benchmark their energy performance against one another, although there is no formal obligation for cities to do this. . The lack of accountability mechanisms raises the concern that the States (regions) might not use the funds in the way originally intended for (*i.e.* fostering self-sustaining investments instead of mere hardware investments).

Older programmes such as the *Green Municipal Fund* in Canada or *KLIMP* in Sweden do succeed in combining high levels of accountability with large amounts of funding.

Reviewed case-studies also differ greatly in the symmetry of funding. That is, how evenly funding is divided between levels of government. Symmetrical arrangements include European *Local and Regional Energy Agencies*. These agencies receive EU funding for up to 50% of the costs necessary to their establishment; local governments or the private sector, depending on the country, contribute their own funds to cover the rest of the costs.

Based on the case-studies, it is possible to make two tentative observations relating to funding. First, it appears that symmetry of funding is loosely related to the number of actors involved. That is, the higher the number of participants (higher score on the y-axis), the greater the funding symmetry (lower score on the x-axis). Second, it appears that the greater the degree of multilateralism (higher score on the x-axis), the higher the MLGEE budgets (higher score on the y-axis).

### **Last thoughts**

Taken together, the observations offered in this paper identify that cooperation across levels of government is a feature of many countries' strategies to enhance energy efficiency. Countries have shown remarkable creativity in their design of MLGEE – as evidenced by the diversity of the group of case- studies covered in this report. However, there are some areas that require more attention. For one, attention needs to be given to ensuring all MLGEE have adequate accountability mechanisms and are regularly externally evaluated. Second, it appears that combining or bridging complementary programmes and approaches can improve their effectiveness. Third, the level capacity (both financial and human skill level) of participants – particularly local-government, appears to influence the effectiveness of MLGEE. Finally, individuals play a key role in a successful MLGEE. Political leaders and other advocates who champion MLGEE are often key to the success and continued support of a programme.

It is hoped that these and the other observations offered in this information paper will go some way to assisting countries to take advantage of the opportunities that MLGEE offer to improve energy efficiency around the world.

### Notes

1. The concept of MLG used in this study most closely follows that of the Organisation for Economic Cooperation and Development (OECD 2009). In this report, MLG can be understood as the complex system of interactions between actors at all levels of government, engaged in the exercise of authority.
2. This does not mean the promotional events are not regulated in themselves at the local council's level, but the programme does not tackle it, and foresees explicitly that local councils are free to design their own rules.
3. The NU-Spaarpas programme was a central state and provincially-sponsored scheme in the city of Rotterdam, aiming at inducing consumers to buy green by means of a points-based mechanism. The scheme stopped operating at the end of 2003, despite being successful, when no more funding was available.

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## CLIMATE LA – LOS ANGELES’ MUNICIPAL CLIMATE CHANGE PROGRAMME<sup>1</sup>

*By Beth Jines*

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*In the last four years, we quadrupled our renewable energy portfolio. We’ve removed 4 500 dirty diesel trucks from the Port and sent them to the junkyard, and we’ve left much of the world in the dust by beating the Kyoto targets four years ahead of schedule. It’s now time to meet the carbon challenge.*

*Our second goal for the next four years is to put LA on a path to permanently break our addiction to coal. Moving forward, we’re aiming to get 40% of our power from renewable sources by 2020 and 60% carbon-free by the end of the next decade.*

Mayor Antonio Villaraigosa

Los Angeles is home to more than 4 million people in diverse communities, covering 470 square miles. In economic terms, the city is far more than an iconic entertainment capital. It is a major global trade hub, taking in 43% of all US imports and powering much of the Southern California economy, the fourteenth largest in the world.

Yet economic success has not prepared Los Angeles for the biggest environmental challenge. In fact, Los Angeles’ progress has contributed to global climate change, one of history’s greatest crises. Leading scientists predict that climate change will have major impacts on the environment, economies, and public health around the world. In Los Angeles, this means summers could be even hotter and longer, with double the number of heat-wave days per year. The city could see 75% to 85% more days with poor air quality and high ground-level ozone, which could cause more heat-related deaths and strain on those with respiratory and cardiovascular disease. Rainfall patterns could change, increasing the number of severe droughts and decreasing the snow melt that is our primary source of drinking water. Sea-level rise could impact coastal neighbourhoods and increase saltwater intrusion into drinking water supplies. In the worst-case scenario, rising seas flood the Port of Los Angeles and sever the city’s connection to international trade. To protect the climate and safeguard our future, every city must take responsibility for its contributions to climate change. Los Angeles emitted more than 50 million metric tons of carbon dioxide (CO<sub>2</sub>), in 2004 – about the same amount as the entire country of Sweden. Mayor Antonio Villaraigosa and the city of Los Angeles have developed a bold response to the climate challenge, promising to reduce emissions of CO<sub>2</sub>, the most common greenhouse gas (GHG), to 40% below 1990 levels by 2030.

In May 2007, the city published “*Green LA: An Action Plan to Lead the Nation in Fighting Global Warming*”. This climate action plan includes more than 50 actions to reduce GHG emissions, as well as measures to adapt to the effects of climate change. The plan directs city departments, led by EnvironmentLA (ELA), to compile a set of actions that will meet Los Angeles’ GHG reduction goals. The departments have been working hard to respond to the challenge ever since. The result is *ClimateLA*, a programme that will carry out the implementation of the 50 actions outlined in the *Green*

*LA Plan.* The *Green LA Plan* and the detailed inventory of mitigation actions to be taken by city departments as part of the implementation of *ClimateLA* can be found at: [www.environmentla.org](http://www.environmentla.org).

While the risks associated with climate change are high, the benefits of acting today are also high – and achievable. Reducing carbon emissions will improve air quality, create a more liveable city, and promote cutting-edge green technology that can be marketed around the world. The threat of climate change is actually an opportunity to transform Los Angeles into the greenest big city in the United States – a model of sustainability for the 21st century.

## **ClimateLA**

### ***Implementation of the Green LA Plan***

The *Green LA Climate Action Plan* identifies over 50 individual action items – some new, many on-going – that will lead Los Angeles to lower GHG emission levels. These actions form the core of the city's programme and include measures over which the city has a great deal of control. They include changes to city operations, goals for changing city employee behaviour, further encouraging sustainable practices for the private sector and residents, and greening city facilities of regional importance.

*ClimateLA*, as the implementation programme for the *Green LA Plan*, describes each of these action items, providing context, lead departments, and importantly, a timeline for completion of each measure. Where possible, the potential CO<sub>2</sub> emission reductions from full implementation of the measures have been calculated. The city will continue to add calculations as more information is obtained about the specific GHG benefits of the measures. In a reporting sense, many of the emission reductions achieved will be attributed to the municipality of Los Angeles. For example, as the city uses less diesel and gasoline fuels in fleet vehicles, emission reductions will accrue to the city's emissions reporting. On the other hand, increased residential recycling rates due to expanded curbside recycling programmes can be attributed to the community of Los Angeles. No matter what the source, all of these emission reductions are necessary to meet the combined, community-wide goal of reducing GHG emissions to 40% below 1990 levels.

While *ClimateLA* 2008 primarily addresses the implementation of measures from the Green LA Plan, the *ClimateLA* programme will continue to grow. As noted later in this report, the city is pursuing a public engagement strategy with residents and businesses on climate change and is soliciting input on the existing measures and new measures to add to the programme. The *ClimateLA* implementation programme will be expanded to incorporate new ideas, fill in gaps and address strategies that are outside the city's direct control. Some of these new measures may require legislative action by the city to ensure implementation; the city may also consider incentive programmes or other ways of encouraging private actions to reduce GHG emissions. The actions in *ClimateLA* set Los Angeles on a solid path toward meeting GHG reduction goals. However, continued expansion of the programme is needed to become more comprehensive and to ensure continued progress and participation by all sectors in the community.

### ***Priority actions***

The actions in this document are categorised by the focus areas of the *Green LA Plan*: energy, water, transportation, land use, waste, open space and greening, green economy and proprietary departments (proprietary departments are the Los Angeles Department of Water and Power (LADWP), the Port of Los Angeles and the Los Angeles World Airports.) Much of the plan focuses on energy, including **greening the power from the largest municipal utility in the United States, helping**



**Angeles save energy, and making Los Angeles a world leader in green buildings.** To achieve these ambitious goals, the LADWP will increase its renewable fuel sources to 20% by the end of 2010 and to 40% by 2020. LADWP will develop new renewable energy projects in Southern California and the transmission lines needed to bring the power to Los Angeles. While greening the power supply, the city will help residents conserve energy in homes and offices. LADWP will distribute two compact fluorescent light bulbs (CFLs) to each of the 1.4 million households in the city and offer even more customer rebates for energy-efficient appliances, windows, lighting and heating and cooling systems. Further, the city has adopted comprehensive green building policies to support private sector development. Projects of 50 000 square feet or more and residential projects with 50 units or more, must meet the intent of the US Green Building Council's Leadership in Energy and Environmental Design.

### *Design-certified standard*

Transportation is another important focus of *ClimateLA*, owing to its large contribution to harmful air pollution and GHG emissions. The city will **cut the environmental impact and carbon intensity of transportation** by requiring **85% of the city fleet to be powered by alternative fuels**. The city will also convert its Commuter Express diesel buses to alternative fuel and continue cutting emissions from the DASH shuttle bus fleet. The alternative-fuel fleet has already grown by more than 20% per year on average since the city adopted its Clean Fuel Policy in 2000.

Limiting per capita water use will reduce the amount of electricity used for pumping and treating water, thus leading to reduced GHG emissions from fossil-fuelled electric power plants. Recycling is a reliable, economically feasible and environmentally sensitive way to augment the city's water supply. The city will use water conservation and recycling to meet all additional demand for water resulting from population and business growth and reduce per capita water consumption by 20%. LADWP and the Bureau of Sanitation will also implement an integrated resources plan for water and wastewater that includes capture and re-use of stormwater.

One of the region's largest sources of air pollution is the Port of Los Angeles. With adoption of the *Strategic Plan for the Port of Los Angeles* in 2007, however, the Port aims to become the world's greenest by raising environmental standards and further protecting public health. The Port and LADWP will complete a strategic growth plan, featuring sustainable and green-growth options. Environmental initiatives in the 2007 plan include implementing the San Pedro Bay Ports Clean Air Action Plan (CAAP), incorporating a sustainability ethic into all Port activities, and protecting the water, soil and local habitat.

The long-range goal of the *Green LA Plan* is to **create a more liveable city** that offers a healthy environment and strong economy for all Angelenos. Transit-oriented development (TOD) is a land use strategy to accommodate new growth efficiently and to strengthen neighbourhoods by allowing people to work, shop and recreate near home. Promoting TOD will create cohesive, vibrant, walkable communities where fragmented, automobile-dependent corridors now exist.

### *Summary of implementation actions*

#### *Energy*

- Green the power from the Los Angeles Department of Water and Power (LADWP), the largest municipal utility in the United States.
- Increase use of renewable energy (solar, wind, biomass, geothermal, etc.) to 20% by 2010.

- Increase use of renewable energy to 60% by 2020.
- Los Angeles will be coal-free by 2020.
- Increase the efficiency of natural gas-fired power plants.
- Increase biogas co-firing of natural gas-fired power plants.
- Wider use of solar, wind and geothermal technology will reduce LADWP's carbon-emissions by 60% below 1990 emissions.
- Increase the Small Business Direct Install Programme – offering up to USD 2 500 in free energy- efficient lighting equipment to those businesses that would be financially challenged to upgrade their inefficient equipment.

#### Make Los Angeles a world-wide leader in green buildings

- Improve the city's comprehensive green building policies to support and increase green private sector development.
- Retrofit a portion of city-owned buildings and public spaces to meet Leadership in Energy and Environmental Design (LEED) standards; and,
- Create new green jobs in Los Angeles to perform the retrofitting work.

#### Transform Los Angeles into the model of an energy-efficient city

- Reduce energy use by all city departments to the maximum extent feasible.
- Perform energy-efficient retrofits on 500 city buildings to continually reduce energy consumption.
- Install the equivalent of 50 "cool roofs" on new or remodelled city buildings.
- Improve energy efficiency at drinking water treatment and distribution facilities.
- Maximise energy efficiency of wastewater treatment equipment.

#### Help Angelenos save energy

- Distribute two CFLs to each of the 1.4 million households in Los Angeles.
- Increase the levels and types of customer rebates for energy-efficient appliances, windows, lighting and heating and cooling systems.
- Increase distribution of energy-efficient refrigerators to qualified customers.
- Create a fund to "acquire" energy savings as a resource from LADWP customers.

## *Water*

### Decrease per capita water use

- Meet all additional demand for water resulting from growth through water conservation and recycling.
- Reduce per capita water consumption by 20%.
- Implement the city's innovative water and wastewater integrated resources plan, which will increase conservation and maximise use of recycled water, including capture and re-use of stormwater.
- Initiate new rebate programmes for drought-resistant landscaping.
- Increase the use and availability of recycled water from 9 200 to 22 000 acre feet by 2014. To supply this recycled water, we will add 20 miles of "purple pipe" infrastructure by 2013.

## *Transportation*

### Lower the environmental impact and carbon intensity of transportation

- Require 85% of the city fleet to be powered by alternative fuels.
- Convert 100% of city refuse collection trucks and street sweepers to alternative fuels.
- Convert 100% of Metropolitan Transportation Authority buses to alternative fuels.
- Convert Commuter Express diesel buses to alternative fuels and CityRide diesel vehicles to ultra- low-emission gasoline.

### Focus on mobility for people, not cars

- Complete the Automated Traffic Surveillance and Control System (ATSAC).
- Expand FlyAway shuttles serving Los Angeles world airports, including Los Angeles International Airport, and convert existing FlyAway buses to alternative fuels.
- Make transit information easily available, understandable and translated into multiple languages.
- Increase city employee participation in the rideshare programme and increase subsidies for mass transit.
- Promote walking and biking to work, within neighbourhoods and to large events and venues.
- Expand the regional rail network.

### *Land use*

#### Create a more liveable city

- Promote high-density housing close to major transportation arteries.
- Promote and implement Transit Oriented Districts.
- Make underutilised city land, especially near transit, available for housing and mixed-use development.
- Make underutilised city land available for parks and open space.
- Clean up brownfields for community economic revitalisation and open space.

### *Waste*

- Switch from waste disposal to resource recovery
- Reduce or recycle 70% of trash by 2015.

### *Open Space and Greening*

#### Unpave paradise/create new paradises

- Create 35 new parks.
- Revitalise the Los Angeles River to create open space opportunities along the 32-mile corridor within the city.
- Plant 1 million trees throughout Los Angeles.
- Identify opportunities to “daylight” streams.
- Identify and develop promising locations for stormwater infiltration to recharge groundwater aquifers.
- Partner with schools to create more parks in neighbourhoods.

### *Green economy*

#### Create demand and catalyse growth of the green economic sector

- Leverage city policy, purchasing and regulation, and deepen local university partnerships, to promote local research, development and production of green technology and products.
- Strengthen global economic relationships to promote investment in Los Angeles’s green sector and help local, environment-focused companies penetrate local, national and foreign markets.
- Identify and promote locations for green businesses.

- Develop programmes to train residents of low and middle-income communities for jobs in the green economy.
- Work with the private sector to offer effective incentives for the growth of local green businesses.
- Work with local educational institutions such as universities, community colleges and adult education programmes to provide city residents the skills needed to work for green businesses.

#### *Green the Port*

- Fully implement the San Pedro Bay Ports Clean Air Action Plan.
- Meet aggressive clean air standards of a 45% reduction in particulate matter; 47% reduction of NO<sub>x</sub>; 52% reduction of SO<sub>x</sub> and significant reduction of carbon emissions.
- Aggressively replace diesel trucks and equipment inside the Port area with electric-powered machinery.
- Complete a strategic plan for the Port of Los Angeles, including sustainable and green-growth options.
- Complete economic development plan for the Port, identifying ways to link its investment in green growth to new economic opportunities in the green sector and to the development of green jobs.

#### *Green airports*

- Fully employ the Sustainability Performance Improvement Management System to track and improve sustainability initiatives.
- Develop and implement comprehensive policies to help Los Angeles World Airports meet green building specifications, improve recycling, use alternate fuels, use recycled water and other water conservation methods, reduce energy requirements and reduce GHG emissions.
- Evaluate options to reduce aircraft-related GHG emissions.

### **Ensuring progress toward our goal**

Completing the carbon reduction programmes described in *ClimateLA* will take co-ordination across city agencies and the ability to act quickly while maintaining a long-term vision. It will require a partnership with Los Angeles communities, universities, environmental organisations and local governments to encourage regional co-ordinated climate change action and regional and individual solutions. The partnership will involve outreach, education and public input into city programmes and policies. Many of the programmes identified in *ClimateLA* are well under way, such as purchasing alternative-fuel vehicles for the city's fleets and greening LADWP's power portfolio.

More than half the programmes and projects in this document are expected to reach their targets over the next five years. As the city moves forward, new ideas, technologies and discoveries that will help reduce GHG emissions from municipal operations and community programmes must be

researched and developed. The city may modify some programmes as a result of new information and public input, and occasionally may need to jettison actions that cannot be funded or do not reduce emissions as expected. *ClimateLA* will be updated regularly to reflect any such changes. Thus *ClimateLA* is a living document that will be modified to reflect the city's GHG emissions reduction programme as it changes over time.

### **Public engagement**

The Green LA Climate Action Plan calls for an aggressive public participation and outreach effort to solicit public input to the Climate Programme and to challenge all Angelenos to reduce their individual carbon footprint. To that end, working with the Los Angeles Environmental Affairs Commission (EAC), the ELA contracted with academic and environmental organisations to develop an outreach and public participation strategy for the city's Climate Programme. The resulting report, *Engaging the Public in the Fight Against Global Warming*, provides a series of key findings and recommendations for a Climate Action Campaign. The report was developed after substantial research into other municipal outreach efforts, and a lengthy series of interviews (over 150) with representatives of various sectors, including environmental organisations, financial institutions, business interests, media and movie industries, and youth groups. These interviews represent the beginning of public engagement on climate issues. ELA, in partnership with the EAC and other city departments, will implement many of the recommendations in the report in the coming months. The public engagement report is available at [www.EnvironmentLA.org](http://www.EnvironmentLA.org).

### **Tracking progress**

A significant component of *ClimateLA* is tracking the city's progress in implementing the actions described in this document, and in achieving the GHG emission reductions called for in the *Green LA Plan*. There are two primary methods of tracking the city's progress: action item monitoring and annual GHG emissions inventories. These tracking methods are informed and supported by interaction with City departments and the public.

### **Action item monitoring programme**

ELA is developing a comprehensive monitoring programme to help track the progress made by city departments. Each action item in this document, along with its milestone dates, will be tracked in a computer application held at ELA. Departments will submit regular progress reports to ELA, detailing any changes in milestone dates or scopes of action and comparing the progress to that proposed in *ClimateLA*. ELA will review the reports and contact management of the lead department if a significant milestone has been missed or progress is otherwise not made. The goal of this tracking is to get programmes back on track by bringing attention to funding or staffing needs and improving co-ordination and/or policy direction. Information from the progress reports will also be used to calculate GHG emission reductions from each programme, based on progress to date or future projections. Progress on *ClimateLA* will be described in regular reports to the Mayor and City Council, and made available on [www.EnvironmentLA.org](http://www.EnvironmentLA.org).

### **Annual GHG emissions inventories**

ELA will continue to work with city departments to prepare annual inventories of GHG emissions from municipal operations. The city has completed its inventories and verification of CO<sub>2</sub> emissions from calendar years 2004, 2005, 2006, and 2007 and have submitted the inventories to the California Climate Action Registry (CCAR) for posting on their website and at [www.EnvironmentLA.org](http://www.EnvironmentLA.org). The municipal inventories help track emissions reductions from all city

operations, but do not necessarily break out emissions by department or programme. The upcoming 2008 inventory, being prepared now, will include emissions from all six gases tracked by CCAR.

As noted in the *Green LA Plan*, the city also has prepared a preliminary community GHG emissions inventory that includes emissions from municipal operations as well as from residents and businesses. The city, in partnership with other local governments, will conduct a more comprehensive inventory in the coming year, once the community emissions protocol is complete. The *Green LA* goal of reducing GHG emissions to 40% below 1990 levels is set at the community level. However, the municipal inventory will be used to track progress toward this goal until the community inventory is prepared.

### ***Year one***

#### *Progress report*

Preliminary calculations (awaiting verification) indicate that Los Angeles has reduced CO<sub>2</sub> emissions by more than 7% by 2008. The single largest factor in meeting this goal is LADWP's move toward renewable sources of electricity. LADWP increased its percentage of renewable power by 3% between 2004 and 2008, reducing CO<sub>2</sub> by an estimated 524 000 metric tons. LADWP also has tangible commitments to four additional renewable energy projects, some of which are expected to be on-line by 2010. Conversion of 900 traffic signals to energy-efficient LED lights has cut some 6 200 metric tons of CO<sub>2</sub>. The city's conversion of 140 000 street lights to LED over the next couple of years will also provide significant reductions. Installation of ATSC at 43 intersections has reduced CO<sub>2</sub> emissions from vehicles by an estimated 9 826 metric tons, and the continued conversion of city fleet vehicles to alternative fuels reduced CO<sub>2</sub> emissions by 2 477 metric tons in the last year alone. Upgrades at 18 city buildings have contributed another 60 metric tons of CO<sub>2</sub> reductions. Those measures that are quantifiable will provide an estimated 5.7% decrease in community-wide emissions compared to 1990.

Many other measures in *ClimateLA* cannot yet be quantified, including:

- climate change education benefits
- city department best energy-reduction practices
- promotion of high-density housing and TOD
- expanded recycling awareness and practices among the public and city staff
- increases in trees and parkland
- green product purchases
- promotion of green businesses

### **Looking ahead**

Confronting climate change will re-order city priorities for decades to come. It will require a long-term vision and the discipline to make and catalyse public and private investments in renewable energy, infrastructure and environmental technology. It is changing the way Los Angeles does business. Through direct municipal action, and through partnerships with the public and private

sectors, Los Angeles can and will cut its GHG emissions by the targeted 40%. Reducing the city's carbon footprint will bring multiple environmental benefits, with cleaner air, better public health, and more open space. It will stimulate an important new high-tech sector – the green economy – with opportunities for well-paying jobs for all Angelenos. Mayor Villaraigosa and the city have dared to imagine Los Angeles as the greenest big city in the nation, and are working to achieve this vision by leading the fight against climate change.

### **Notes**

1. This document draws upon sources from the City of Los Angeles and EnvironmentLA.



## **GREEN GOVERNMENT: WHY CO-OPERATION ACROSS LEVELS OF GOVERNMENTS IS ESSENTIAL**

*By Juan Carlos Zentella Gomez  
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### **Introduction**

As noted in the 2<sup>nd</sup> Annual Meeting of the OECD Round Table for Urban Development, “Competitive Cities and Climate Change” held in Milan in 2008, urban competitiveness is in many ways the outcome of the adoption of environmental practices and climate change policies and strategies.

In Mexico, as in many other countries, the use of Clean Development Mechanisms to mitigate greenhouse gas (GHG) emissions under the Kyoto Protocol is likely to become a demand of social, public and private players. Climate change policies must therefore be aligned with economic development policies as well as urban development policy.

Mexico has a population of 106 million inhabitants, 76.4% of whom live in urban areas of more than 15 000 people, and 23.6% in rural areas.<sup>1</sup> Just nine metropolitan areas account for 35% of the total population: Valle de México (19.2 million people), Guadalajara (4.1 million), Monterrey (3.7 million), Puebla (2.5 million), Toluca (1.6 million), Tijuana (1.6 million), León (1.4 million), Juárez (1.3 million) and La Laguna (1.1 million). However, megacities are not growing as fast as medium-size cities of between 100 000 and less than one million inhabitants. For example, the population growth rate of Valle de México is 0.8%, Guadalajara 1.8%, Monterrey 1.9% and Puebla 2.0%.

In the last decade, social housing policy has been very active, due to the easy availability of home credits. Unfortunately, one of the consequences is that urban growth has increased by about 17 000 hectares per year because of a lack of co-ordination between social housing policy and the cities’ urban development programmes.

As far as GHG emissions are concerned, in 2006 (INEGI, 2006), Mexico, which is responsible for 1.6% of global emissions, accounted for 715 million tons<sup>2</sup> of CO<sub>2</sub> equivalent, an approximately 30% increase over 1990.<sup>3</sup> The distribution of GHG emissions produced mainly in the urban environment is as follows:<sup>4</sup>

- 24% from energy generation and use;
- 18% from motor, aerial, train and sea transportation;
- 16% from manufacture and the construction industry, as well as other industrial processes;
- 14% from change of land use and residual water;
- 7% from agriculture;
- 11% from fugitive emissions and other consumption.

On the other hand, Mexico is one of the countries most vulnerable to the phenomena caused by climate change, given that 87.7 million of its inhabitants live in high-risk areas. Again, 70% are urban dwellers;<sup>5</sup> 34.4% of its inhabitants are exposed to hurricanes, and about 33.2% are settled in flood plains.<sup>6</sup> Informal human settlements are still ongoing: about 90 000 poor households live in irregular settlements<sup>7</sup> and many of them are located in vulnerable areas. This, of course, has resulted in chaotic and sprawling urban growth that poses a challenge to local governments.

The Mexican government's strategy for climate change was outlined in the *Special Programme for Climate Change 2009-2012*, which was approved and announced on 28 August 2009.

The programme establishes a compromise for stabilising GHG emissions before 2012 and reducing them 50% by 2050. The goal is ambitious and inspirational, and its accomplishment depends first on a series of factors, such as a multi-lateral regimen that will make financial and technological support possible, and secondly on the capacity and innovation helping sub-national governments and cities to converge through mechanisms of inter-governmental co-operation, involving the assumption of commitments and responsibilities. This is crucial, since 50% of the world's population, or 3 300 million people in 2008 (United Nations), lives in cities and is responsible for 80% of total global energy consumption, according to the International Council for Local Environment Initiatives (ICLEI). It follows that the preponderance of global energy consumption occurs in cities.

### **Co-operation across levels of government to deal with climate change in Mexico**

#### ***Inter-ministerial Commission for Climate Change***

The most important effort the federal government has undertaken to establish co-operation mechanisms with state governments is the creation of the *Inter-ministerial Commission for Climate Change*, created on 25 April 2005, as the leading authority in this field. Under the umbrella of this Inter-ministerial Commission are several ministries that promote adaptation and mitigation actions within their specific national programmes. For example, the Ministry of Social Development (*Secretaría de Desarrollo Social, SEDESOL*), as a federal ministry responsible (among others) for conducting urban and regional planning policy, gives training and technical assistance to local governments to promote a compact model for urban growth, integrated with the existing urban fabric, with mixed uses allowing short distances between major activities, to discourage the consumption of fossil fuels and encourage walking or the use of non-motorised transportation.

#### ***Urban design guidelines and the Special Climate Change Programme for Sustainable Housing Development***

One of the most important powers of SEDESOL as the federal authority governing urban planning is the issuance of guidelines for urban development. To this end, Urban Design and Integration with the Urban Environment Guidelines from Article 73 of the Housing Law were developed in order to guarantee mixed land uses, privilege public transportation and non-motorised mobility, as well as efficient consumption of energy in all new housing developments built with federal funds. These guidelines are very important, given that in 2006, the housing sector consumed between 17% and 19% of the energy produced in the country,<sup>8</sup> which prompted the incorporation of strategies for increasing energy efficiency in housing construction. To this end, the National Housing Commission published the *Special Climate Change Programme for Sustainable Housing Development*, whose methodology is being considered to qualify as a Clean Development Mechanism (CDM). This methodology is intended to reduce GHG derived from normal housing practices in order to secure CO<sub>2</sub> savings that could be sold on the international carbon markets. The methodology includes three guidelines for construction processes:

- *Reduction in electricity consumption:* Through bio-climatic design, such as the incorporation of window wings, cross-ventilation, heat chimneys, thermic aisles and a focus on conserving energy.
- *Alternative sources of electricity production:* Through introduction of photovoltaic systems.
- *Reduction in gas consumption:* Through using solar-powered rather than natural gas boilers.

No matter which methodology is used, it must be approved by the CDM Directives and it is important to bear in mind that it will not necessarily comply with regional processes and territorial management. This may reduce the condition of additionality, but being contrary to the urban structure, especially due to its localisation. Indeed, the most important elements of the methodology are technological and construction issues which do not consider urban and regional context, especially the location of the buildings, their density, social equipment and the existence of employment and the particular effects of GHG on all these considerations.

Housing located far from the urban system makes it difficult for residents to obtain education and health services, entertainment, employment and chances of obtaining income, resulting in more motor vehicles and GHG emissions. Mono-functional space (*i.e.* housing without other uses) is not favourable to the urban environment: residents tend to favour motor vehicles over bicycles, usually resulting in security problems.

These guidelines should become mandatory on 1 January 2010, for housing developers financed with federal funds. This may be the most important concrete action concerning housing and climate change policy, even though it was not expressly designed for that purpose.

A *Green Mortgage Programme* is also implemented by different social housing organisations under which monthly loan fees are reduced for those who purchase homes equipped with eco-technologies for heating water, producing renewable electricity, water conservation systems, and so on.

### ***Transportation, public spaces and use of methane gas***

The National Infrastructure Foundation (*Fondo Nacional de Infraestructura, FONADIN*) has given support to 18 cities and metropolitan areas with more than 500 000 inhabitants (the metropolitan zones of Valle de México, Guadalajara, Monterrey, León, Veracruz-Boca del Río, Oaxaca, Chihuahua, Mexicali, Apizaco-Tlaxcala-Puebla, Aguascalientes, Tampico-Ciudad Madero, Villahermosa, Acapulco, Tijuana, Culiacán, Ciudad Juárez, Reynosa y Cancún) by preparing feasibility studies and projects. These activities made possible the financing of the supported cities through the Federal Support Programme for Mass Transit (*Programa de Apoyo Federal al Transporte Masivo, PROTRAM*) of the FONADIN. SEDESOL is a member of its Consultative Working Group.

At the same time, technical assistance was provided to studies on transport and urban mobility in 46 cities of more than 100 000 inhabitants, including Durango, Matamoros, Tlaxcala, Pachuca, Tepic, Irapuato, Mazatlán, Coatzacoalcos, Celaya, Puerto Vallarta, Colima, Tehuacán, Ciudad Victoria, Ensenada, Zacatecas, Los Mochis, Zamora, Campeche, Tulancingo, Tapachula, Chilpancingo, Salamanca, Cozumel, Manzanillo, Guanajuato and Chetumal, among others.

Public space and green areas have a fundamental role to play in generating microclimates and mitigating the urban heat island effect. Mexico's government, through the Ministry of Social Development, is implementing a nationwide *Public Space Improvement Programme* that made possible the renovation of

1 855 public spaces in 287 cities of more than 50 000 inhabitants between 2007 and 2008; the goal is to improve 1 000 spaces in 275 cities in 2009.

As part of the mitigation actions, methane gas at waste dumps should be used to produce electricity. This strategy has the advantage of reducing atmospheric emissions and of generating additional funds by selling these credits in the carbon trading market.

In Mexico, solid waste dumps have a high content of organic material (more than half), which leaves considerable potential for the reduction of emissions, an estimated 16.6 to 18.7 million tons of CO<sub>2</sub> equivalent, for the year 2020.<sup>9</sup>

### ***Risk maps***

Reduction of catastrophic risk is a priority in Mexico, and the *National Development Plan* establishes some attributions for SEDESOL and a strategy called “Prevention and anticipation of natural disasters”.

A document entitled “Manual for incorporation in the Atlas of Hazards and Risks in urban development planning” was drawn up to promote the incorporation of disaster risk criteria and risk mitigation in the *Atlas of Hazards and/or Dangers* for local urban development planning, to promote these instruments of disaster prevention. Furthermore, in 2009, a specific item in the *Habitat Programme* allocated federal funds to support the incorporation of prevention criteria in urban development programmes.

A total of 700 projects were undertaken in the past two years, with the support of 218 municipalities that drew up *Atlases of Risks* at different levels: metropolitan area, city and municipality. With this planning instrument, local authorities will be able to identify risk areas and execute actions to reduce vulnerability like retaining walls, sewage, roads, dams or hydraulic control, slope stabilisation or reforestation, rechanneling of riverbeds, and so on. As a result of the change to a prevention culture, education courses have been developed for officials and for the public on the topic “Integrated Management of Risk”.

Furthermore, some positive activities for improving the environment, such as reforestation, cleaning gullies and environmental education, have been carried out.

Under the *Habitat Programme (Programa Habitat)*, residents may be relocated if they live in vulnerable areas, if they demand relocation and the local authorities deem it necessary.

In order to increase awareness of prevention and mitigation, some publications on flood protection were reprinted, and a brochure about maintaining water channels was shared with the municipalities of the National Urban System. A video, “Atlas of Natural Hazards and the Importance of Their Management in Cities, Municipalities and Metropolitan Zones” was distributed to 425 municipalities in the National Urban System.

Finally, two international seminars were held to share experiences and best practices, and case studies for reducing the vulnerability of human settlements and adaptation to climate change.

### **Co-operation across levels of governments, and the challenges for cities in confronting climate change**

In Mexico, the institutional model for local/national co-operation on climate change is a “top down” model. Each ministry devises a strategy for its own sector (natural resources management, national water

management, energy supply, education, rural development, transport and roads, and so on) to cope with the causes and consequences of climate change at a national level.

The most important effort in establishing mechanisms of co-operation across levels of government has been undertaken by the Ecology National Institute (INE) of the Ministry of the Environment and Natural Resources (SEMARNAT). The INE has published methodological guides so that every state government can adopt the same methodological framework in constructing an inventory of its GHG emissions and design its own strategies of mitigation and adaptation.

The only climate action plan for a city is the *Mexico City Action Plan 2008-2012*, as well as the edition of the *Inventory of Gas Emissions of Winter 2006* by Mexico City and its metropolitan zone. There are several State Action Plans concluded or in process for the following states: Veracruz in the Gulf of México, Michoacán, Nuevo León San Luis Potosí, Tamaulipas, Campeche, Tabasco, Yucatán and Quintana Roo. Guanajuato, Tabasco and Guerrero that created a State Commission of Climate Change.

We believe that the most important challenges for city governments in Mexico, including the federal government, are issues concerning the distribution of authority between the three levels of government. We are aware of the need to strengthen co-ordination between municipal, state and national governments. In any case, political and institutional co-operation is required, and urban governance will be one of the most important challenges for the world: by 2030, 5 000 million people will live in urban areas, equivalent to the world's total population in 1987 (United Nations, *World Population Prospects*, 2008).

According to the workshop that followed the conference “Climate Change: Meeting the Challenge Together”, held in Berlin some years ago, urban governance entails public responsibility and citizen participation. “If local government does not act, sustainability will not be reached,” was how Beate Weber, the Mayor of Heidelberg, began her presentation on “Sustainable Development at the Local Level – the City of Heidelberg.” Local government is both a source of problems and a possible solution: the local level can be the starting point for unsustainability, but it can also be a forum for action. To underline that approach, the Mayor outlined the strategy that secured Heidelberg the prestigious European Sustainable City Award. Guided by the kind of agenda for local and global responsibility developed at the International Council for Local Environment Initiatives (ICLEI) summit (held alongside the World Summit on Sustainable Development at Johannesburg in 2002), it was focused on implementing international commitments at the civic level.

As the federal government in Mexico concerning national urban policy described before, at the core of the Heidelberg approach was an integrated *City Development Plan* dealing with all elements of sustainability, from waste management to atmospheric pollution to domestic energy use. One of the most significant measures was a complete spatial policy to create hard edges to the urban boundary, redevelop brownfield sites rather than greenfield sprawl, and retain available open spaces for the city population. Thanks to this planning approach, some 75% of all new dwellings were built on previously developed land. The transport and mobility management programme had delivered a marked reduction in the use of private cars, a growth in public transport usage, and an extended network of bicycle and pedestrian lanes. The council also led the way in curbing energy use in public buildings. While the local authority had delivered a 25% cut in CO<sub>2</sub> emissions over a 15-year period, the same could not yet be said of local 16 universities and hospitals. However, the council had worked effectively with small and medium-sized enterprises to curb greenhouse gas emissions and deliver cuts in energy costs.

The Heidelberg experience showed the benefit of longer periods of political office (eight-year terms in this case) for the delivery of sustainable policies. But it also showed the merits of a programmatic-based approach that took citizens into account and involved them at every step. “We need to make use of the unlimited capacity of our brains, rather than our limited resources”, Weber concluded.

Taking into account Heidelberg's example, several immediate actions could be taken to foster co-operation between levels of government in Mexico:

- Generate information on emissions and the potential to reduce them in the urban environment.
- Sensitise local authorities to adopt compact urban models and to include risk-prevention criteria and civil protection programmes in their planning policies and procedures.
- Broaden local government knowledge on the national and international financial mechanisms for carbon bonuses.
- Associate research and development strategies with the need to generate information regarding climate change. To achieve this, strategic alliances will be required between entrepreneurs, the academic sector and government.
- Align efforts and generate consensus in developing an agenda to integrate the climate change challenge and economic development policies. In this process, local authorities will have to be involved, as well as social leaders and entrepreneurs for the surveillance of the follow-up of agreements and commitments; members of the academic sector must play a special role in generating information and monitoring achievements; legislators will have to team up to build a legally sound and institutionally appropriate framework, to promote and finance adaptation and mitigation policies.
- Local governments should implement an explicit policy of tax incentives, financing instruments, dissemination of the theme, and technical assistance to specific areas such as energy supply, transport, civil protection and land use planning, among other issues, as well as establishing public-private partnerships to help each other achieve climate change mitigation and adaptation.
- The private sector already plays a major role in the development in Mexico of Clean Development Mechanisms (CDM) under the Kyoto Protocol. Since the creation of the Inter-Ministerial Commission for Climate Change on 25 April 2005, Mexico has established over 292 CDM projects (117 reiterated by the Communications Co-ordination Committee for the United Nations, or CCCUN) located in 317 localities in 146 municipalities in 29 of 32 states in Mexico, with a potential mitigation of emissions of approximately 7.4 million tons of CO<sub>2</sub> equivalent per year.<sup>10</sup> Most of these projects are located in rural areas, with the exception of waste management projects to reduce methane emissions. Also, some projects in urban areas take place in the transport sector in such cities as Mexico City, León and Monterrey.
- The entities with a major number of localities with CDM projects are: Jalisco (36), Veracruz (28), Puebla (27), Sonora (25), Coahuila (25), Yucatán (23) and Michoacán (21).

## Notes

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3. SEMARNAT, INE, (2006), *Tercera Comunicación Nacional ante la Convención Marco de las Naciones Unidas sobre Cambio Climático*, México.
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6. Mancilla, Elizabeth (1996), “Prevención y atención de desastres en México” in Allan Lavel, *et. al.*, *Estado, Sociedad y Gestión de Desastres en América Latina*, La Red. Mexico.
7. Comisión para la Regularización de la Tenencia de la Tierra (CORETT) (forthcoming), quoted by SEDESOL (2008), *Programa Nacional de Desarrollo Urbano 2008-2012*, México.
8. Along with the commercial and public sectors, they accumulate 23% of energy consumption in Mexico. Of this 23%, the housing sector alone consumes up to 83%. CONAFOVI (2006), *Uso eficiente de la energía en la vivienda*, Col. Guía CONAFOVI, México.
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**SESSION 2-B**  
**FINANCING CLIMATE FRIENDLY INITIATIVES**

## FINANCING CLIMATE-FRIENDLY INITIATIVES: THE ROLE OF THE EUROPEAN INVESTMENT BANK

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### Preamble

Climate change has become a key area of concern for public policy makers, and cities are increasingly recognised as the key delivery vehicles for the implementation of any significant mitigation measures. The financing of climate-friendly initiatives is therefore a topic of growing importance, as traditional financial products are adapted and new financial products are developed to exploit what is fast becoming an enormous market with significant commercial opportunities. But there are also areas where market failure is limiting investment and where public intervention and/or the deployment of more innovative financial instruments are required. In this regard, the role of the European Investment Bank is worthy of note, and to this end, this paper simply outlines what that role is, how it has developed over time and how it might evolve in the near future in response to a rapidly changing global agenda.

### The European Investment Bank

The European Investment Bank (EIB) is the European Union's long-term lending institution, established in 1958 under the Treaty of Rome, which supports the EU's objectives by lending money to both the public and private sectors for projects of European interest. As an international financial institution (IFI), the Bank is active not only in the EU but also in more than 140 other countries worldwide with which the EU has co-operation agreements.

The EIB is a not-for-profit, policy-driven bank that in general makes long-term loans for capital investment projects (mainly fixed assets), although its portfolio of intervention possibilities is becoming increasingly diversified. It does not, however, give grants. The Bank's owners are the member states of the European Union, which subscribe jointly to its capital, each country's contribution reflecting, in large measure, its economic weight within the EU. The total subscribed capital at the end of 2008 was EUR 164.2 billion, of which EUR 8.2 billion had been paid in. Because the Bank extends more than EUR 50 billion per year in the form of its various loan products, it uses its AAA credit rating, and funds itself by raising equivalent amounts on the capital markets. The Bank does not use any funds from the EU budget.

Not all projects are eligible for EIB support, but those that are carefully selected according to the following criteria:

- They must help to achieve EU policy objectives, reflecting EIB's *raison d'être* as a policy bank.
- They must be economically, financially, technically and environmentally sound, satisfactory environmental performance becoming an increasingly important component of the Bank's project appraisal process.

- They should help attract other sources of funding. As a rule of thumb, EIB funding is normally limited to a maximum of 50% of a project's total cost.

## **Cities and energy**

In addressing the climate change agenda and developing policies to mitigate global warming, there are compelling reasons why cities should be the focus of attention. In 2008, more than 50% of the world's population lived in urban settlements. By 2030, this figure will have risen to 60%, equivalent to the total global population in 1987. Meanwhile, patterns of urbanisation are also changing. Whilst the first half of the twentieth century was dominated by European cities, with urbanisation levels reaching an impressive 80%, currently most urban population resides on the Asian continent, where urbanisation rates are fast approaching European thresholds, and some of the world's fastest-growing cities are now to be found Africa. The geography of cities is changing, and as cities grow, so too does their impact on the environment.

- As major centres for the transformation of primary resources and intermediate goods, cities are the most important engines of economic growth and therefore the places with the highest levels of energy consumption. Given current rates and patterns of urbanisation, cities will account for an increasingly large proportion of global energy use and CO<sub>2</sub> emissions. The inevitable and significant impact on global warming provides an obvious rationale for focusing on cities in energy management and climate change mitigation.
- Given their concentrations of population and very high rates of economic activity, cities are also the most significant source of contamination/pollution and waste. Unless the pace and patterns of urbanisation are controlled, cities also pose a significant environmental threat under this generalised pollution umbrella, providing a second rationale for focusing on cities in waste management and pollution control.

In summary, in addressing the interrelated environmental problems of global warming, pollution and the increasingly politically sensitive issue of energy dependence, cities must necessarily be the principal focus for public policy makers.

## **The European Union's urban policy agenda**

The European Union has been relatively slow in bringing the urban dimension into the policy mainstream. In the recent past, the argument that urban issues are intrinsically domestic, and therefore better dealt with through national institutions, was often invoked by EU policy makers to limit intervention in the urban sector under subsidiarity<sup>2</sup> considerations. However, given the emerging consensus among the European Union institutions, and indeed of industrialised countries generally, over the need to pay increasing attention to the urban environment, and the consequences that localised deprivation and social exclusion may have on the quality of life and economic performance of urban areas, it is hardly surprising that the urban theme should have become part of the EU agenda. Due to the commonality of a wide range of problems, challenges and opportunities throughout Europe, and the fact that cities are pivotal delivery points for many strands of EU policy (not least the need for more concerted effort to mitigate the negative impacts of climate change), the promotion of more sustainable cities and communities has become one of the priorities of European action.

Over the years, a number of milestones can be identified in the progressive consolidation of a European urban policy agenda. An urban dimension has been implicitly present in European policy delivery at least since the establishment of the Structural Funds.<sup>3</sup> The problems of urban industrial decline were a key concern for DG-Regio<sup>4</sup> in the 1980s, and played a central role for the definition of Objective 2<sup>5</sup>

priorities for the 1994-99 programming cycle. The policy relevance of cities was made explicit in a more decisive way in the late 1990s, with the European Commission documents “*Towards an Urban Agenda in the EU*” (1997), and “*Sustainable Urban Development in the EU: A Framework for Action*” (1998), where key components of a European urban policy were outlined and then discussed in the October 1998 Vienna Forum. In 2000, the *Lille Action Programme*<sup>6</sup> consolidated this process. These events were important in determining the reinforcement of the urban dimension in the 2000-2006 programming cycle through specific priority axes and measures in Operational Programmes, and through community initiatives like *Urban II*<sup>7</sup> and *URBACT*.<sup>8</sup> The Rotterdam ministerial meeting on Urban Policy in 2004 acknowledged that the experiences of different European countries in the previous decade generated a set of common principles that underpin successful policies, which was termed the *Urban Acquis*. In October 2005, by adopting an own-initiative report on the urban dimension, the European Parliament recognised that cities and urban agglomerations have a central role to play in achieving the revised Lisbon<sup>9</sup> and Gothenburg<sup>10</sup> objectives. The competitiveness and employment objectives were thus added to the more traditional arguments focused on the environment and on physical infrastructure. Following in the steps of the *Urban Acquis*, the *Bristol Accord*<sup>11</sup> agreed by EU ministers in December 2005 established the principles of a common EU urban agenda stressing the importance of developing sustainable communities.

The 2007-13 programming cycle has thus brought the urban dimension into the structural policy mainstream. Community Strategic Guidelines recognise the importance of developing an integrated approach to territorial cohesion, while the EU Structural Fund regulations now explicitly incorporate sustainable urban development. This is in line with the current EU *Cohesion Policy* which, while refocusing on growth and jobs in accordance with the Lisbon Agenda, places a strong emphasis on sustainable urban development as a means of boosting regional competitiveness and fully realising the economic potential of member states. Policies at both the European and national levels are expected to incorporate an urban dimension to address the market failures that exacerbate joblessness and social exclusion in the urban context. The need for a more integrated approach when addressing urban problems and issues requires a range of actions across different fields, a clear long-term vision and, critically, significant funding. Given the consensus among policy makers over the need to develop more sustainable approaches to urban regeneration, and the significant funding gap occasioned by the traditional market failures that characterise the urban sector, the EU launched the *JESSICA*<sup>12</sup> initiative in February 2006.

The importance of integrated urban development as a prerequisite for successful urban sustainability was consolidated in the *Leipzig Charter on Sustainable European Cities*, which was signed in May 2007 by all the Ministers responsible for urban development in their respective countries, in which they commit themselves to:

- initiate debate in their respective constituencies on how to integrate the principles and strategies of the Charter into national, regional and local development policies;
- use the tool of integrated urban development and the related governance for its implementation and, to this end, establish any necessary framework at national level; and
- promote the establishment of balanced territorial organisation based on a European polycentric urban structure.

In summary, EU intervention in the urban sector has evolved over time from early support for a series of relatively modest *ad hoc* initiatives to far more substantive intervention and associated financial support, with the urban agenda now formally embraced within the policy mainstream. Against this backdrop, and in pursuit of the headline policy goal of developing more sustainable cities and communities, the Union’s urban policy is informed by both the economic imperatives of the *Lisbon Agenda* and the need for a more integrated approach to urban planning and development as emphasised in the *Leipzig Charter*. As the

lending arm of the EU, the EIB has responded accordingly, formally supporting the EU's sustainability objectives and developing a range of financial products to meet the resulting funding challenge. In doing so, the Bank has developed what might be termed an implicit action plan for cities, comprising three elements:

- extending its traditional lending operations in the urban sector by increasing its lending volume and customising its lending products to more appropriately meet the needs of cities and municipalities;
- extending the scope of its structured finance facility (SFF), where the Bank takes on more risk than normal, including possible equity investment, to include urban projects; and
- promoting financial engineering and, in particular, supporting the EU in the promotion and implementation of the *JESSICA* instrument.

For environmental projects *per se* and in pursuit of sustainability objectives, the Bank has:

- embraced support for climate-friendly initiatives, sustainable development and social welfare in its corporate operation plan;
- strengthened its internal procedures when appraising projects seeking EIB funding and/or support to ensure minimal adverse environmental impact; and
- increased its lending in this sector. In 2007, of a total loan volume in excess of EUR 50 billion, there were direct loans of some EUR 13 billion for:
  - mitigating the adverse consequences of climate change,
  - promoting waste management and the sustainable use of natural resources,
  - improving the urban environment,
  - reducing pollution, and
  - protecting biodiversity.

A plethora of policy options and potential projects can be identified in pursuit of sustainability objectives, and to avoid the obvious threat of fragmentation, *Leipzig* has highlighted the need for a more integrated approach to urban planning and development. The EIB has therefore explicitly embraced the need for more holistic evaluation of individual initiatives to ensure consistency between apparently disconnected projects and to exploit any obvious and positive synergies in development programmes. Within the urban sector, it is a requirement that almost all projects seeking Bank finance, by way of loans or equity, must form part of an integrated urban development plan for the localities in question. What this actually means in practice is open to interpretation, but there is now a clear requirement that any project seeking EIB support must be “planning led”.

It is beyond the scope of such a short paper to detail the full extent of the Bank's activities in support of more sustainable cities and communities, but the following paragraphs briefly outline EU policy and the EIB's response to energy and the environment.

## Energy and environment

According to the European Environment Agency, energy accounts for 80% of greenhouse gas emissions (GHG) within the EU. Meanwhile, the EU is committed to reducing GHG emissions by 20% by 2020, compared to the 1990 level. At the same time, the EU's target is for renewable energy sources to account for at least 20% of the energy mix by 2020 (as recently as 2005, the figure was only 5%). Since urban areas account for approximately 70% of the total primary energy demand of the EU, and urban energy consumption is projected to increase at twice the rate of the EU as a whole,<sup>13</sup> it is self-evident that cities must play the pivotal role in achieving EU energy efficiency and climate change objectives.

The main ways to achieve EU energy and climate change objectives is by improving energy efficiency (EE) and exploiting the potential of renewable energy sources (RES), and as already noted, the scope for significant gains is most pronounced in cities, especially in buildings and urban transport. Accordingly, substantial investment is planned:

- approximately EUR 700 billion in the period 2005-20 in RES; and
- substantial investment in EE, at levels much higher than for RES.

The EIB's response has been timely, measured and flexible. Energy became a priority objective in the Bank's Corporate Plan in 2006, with significant funds set aside to support the Bank's energy strategy in 2007:

- energy lending in 2007 was EUR 6.8 billion (EUR 4.4 billion in the EU and EUR 1.4 billion outside); and
- lending to RES in 2007 was EUR 2 billion (EUR 1.5 billion in the EU and EUR 0.5 billion outside).

The instruments deployed to disburse the funds include individual loans to finance large projects; instruments to finance small investments via financial intermediaries through global or framework loans; a broad range of more complex products from senior loans to quasi-equity finance; and credit lines combining loans with grants (where grants have been awarded to help develop bankable projects, for energy audits and to cover transaction costs for financial intermediaries, but where supplementary loans are needed to facilitate the implementation of the project).

## Conclusions

The numbers demonstrate that there are numerous and significant investment opportunities in the urban environment to tackle climate change. However, to develop and exploit this potential commercially, it is still necessary to address substantial barriers, such as limited information, and to reduce transaction costs. This is one of the reasons why so many commentators place such emphasis on the need to develop bankable projects. Without the latter, access to equity and credit markets is necessarily limited. This is why the EIB's role is so important, not only as a conduit to promote best practice through its funding protocols, but also to reduce barriers by supporting city initiatives with adapted and flexible financial instruments. In this regard, the bank's support for the *Covenant of Mayors*<sup>14</sup> initiative is particularly instructive.

## Notes

1. Brian Field is a Senior Economist at the European Investment Bank, where he is also the bank's Special Managerial Adviser in Urban Planning and Development. The usual disclaimers apply..
2. The principle of subsidiarity is defined in Article 5 of the Treaty establishing the European Community, whereby the Union does not take action (except in areas that fall within its exclusive competence) unless it is more effective than action taken at national, regional or local level. It is linked very closely with the principles of proportionality and necessity, which require that any action by the Union should not go beyond what is necessary to achieve the objectives of the Treaty.
3. Structural and Cohesion Funds are monies allocated by the EU for two related purposes: to support the poorer regions within the Union, and support for integrating European infrastructure, especially in the transport sector. In the current programme period, 1 January, 2006 to 31 December, 2013, the budget for Structural Funds is EUR 277 billion, and for Cohesion Funds the figure is EUR 70 billion.
4. The Commission of the European Communities, or European Commission (EC) for short, is the executive branch of the EU and is responsible for proposing legislation, implementing decisions, upholding the Union's treaties, and the general day-to-day running of the Union. The Commission is divided into departments known as Directorates Generale (DGs), each of which covers a specific policy area or service. The Directorate General for Regional Policy, or DG Regio, is responsible for strengthening economic, social and territorial cohesion, by co-financing eligible infrastructure projects aimed at reducing disparities between the levels of development of regions and countries within the Union.
5. Objective 2 of the Structural Funds aimed to support the economic and social conversion of areas facing structural difficulties, including urban deprivation and decay.
6. The *Lille Action Programme* was a proposal for a multi-annual programme of co-operation in urban affairs in the European Union. It was adopted at the informal meeting of ministers dealing with urban affairs in Lille on 3 November, 2000, and was based on a report prepared by the Committee on Spatial Development in the autumn of that year. The main aim of the action was to help member states of the EU, the Commission and cities to give more tangible form to the policy objectives defined at the European level to the challenges facing cities.
7. The *URBAN II* initiative, covering the programming period 2000-2006, was designed to promote the implementation of innovative strategies for economic and social regeneration in small and medium-sized towns and declining areas in major conurbations.
8. The EU launched *URBACT* to bring together different groups of EU cities through a number of thematic networks (such as one on Sustainable Communities) to exchange ideas on best practices and to review lessons learned from various EU Urban Agenda initiatives.
9. The Lisbon Agenda, also known as the Lisbon Strategy, was set out by the European Council in Lisbon in March 2000, and comprises an action and development plan for the European Union that aimed to make the EU "the most dynamic and competitive knowledge-based economy in the world" capable of sustainable economic growth with more and better jobs and greater social cohesion, and respect for the environment by 2010.
10. The Gothenburg European Council in June 2001 completed the Lisbon strategy by adding an environmental dimension. It emphasised the need to protect the environment and achieve a more sustainable pattern of development.

11. The *Bristol Accord* marked the conclusion of the British Presidency of the EU. Ministers involved in urban policy in their respective countries agreed upon a common goal of creating more sustainable communities in Europe. The Accord's ambition was to provide a new framework for EU governments to create jobs, economic prosperity, social justice and improved quality of life for all citizens through more integrated planning and development of urban settlements.
12. *JESSICA* stands for *Joint European Support for Sustainable Investment in City Areas*. Under new procedures, member states are being given the option of using some of their EU grant funding for Structural Funds to make repayable investments in projects forming part of an integrated plan for sustainable urban development. These investments, which may take the form of equity, loans and/or guarantees, are delivered to projects via Urban Development Funds and, if required, Holding Funds.
13. It is worth noting that cities consume a higher share of gas, electricity and heat than the EU average, and a lower share of coal, oil and biomass.
14. The *Covenant of Mayors* is an ambitious European Commission-led project that was launched in January 2008. It is a commitment by signatory towns and cities to go beyond the objectives of EU energy policy in terms of reduction in CO<sub>2</sub> emissions through enhanced energy efficiency and cleaner energy production and use. At the time of writing, the number of signatories is fast approaching 400.



## CLIMATE INVESTMENT PROGRAMMES IN SWEDEN

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Climate investment programmes, by which state funds have been transferred to municipalities, organisations and the private sector for climate action through a competitive selection process, have made a significant contribution to Swedish environmental and climate performance in the last ten years. In addition, the programmes have had a broad range of other positive effects. This paper describes the climate investment programme known as “Klimp”, which has been in effect since 2002. It also introduces the recent support programme “Sustainable cities”, which was put into effect this year.

First, however, a few words should be mentioned about general policy measures that have been central to Swedish development, and which form a basis and precondition for the positive effects of the investment programmes.

Concern for the environment and thorough environmental legislation has a long history in Sweden. Sweden was one of the first countries to establish a national environmental protection agency, in the 1960s, and environmental legislation has proliferated since. In 1999, the different parts of the environmental legislation were assembled into a comprehensive law, with the over-arching aim of achieving sustainable development.

At the same time, the Environmental Objectives, a comprehensive national system for measuring and managing environmental performance, was introduced. Sixteen overall environmental quality objectives were adopted by the Swedish Parliament in 1999 and again in 2005. These goals describe what quality and state of the environment are sustainable in the long term. They form an important part of the process of achieving sustainable development, along with social and economic dimensions. A monitoring and management system for the objectives has been set up.

Along with legislation, economic policy measures are fundamental for establishing incentives for better environmental performance. Chief among the national Swedish measures regarding climate is the energy and carbon tax. Levied since 1991 on energy used for heat and transport, the tax rate has increased from an initial 25 öre (SEK 0,25) per kilo of CO<sub>2</sub>, to approximately SEK 1 per kilo of CO<sub>2</sub> today. The tax has made a broad range of energy efficiency and conversion measures profitable for individuals and private and public actors, including municipalities.

### **Klimp**

The Swedish government’s support for Climate Investment Programmes, “Klimp”, is a tool for attaining Sweden’s climate objectives, as formulated in the Swedish climate strategy in 2002. Klimp has enabled municipalities and other local actors to receive grants for long-term investments that reduce greenhouse gas emissions. The grants were distributed five times by the Swedish Environmental Protection Agency between 2003 and 2008. The investments are estimated to have reduced emissions by 1.1 million tons of carbon dioxide per year. Klimp is helping Sweden to achieve its climate objectives in three ways:

- The investments lead to reduced emissions of greenhouse gases.
- The work on a climate investment programme strengthens local climate work and co-operation between various actors.
- Collecting and disseminating knowledge and experience of climate investment encourages climate work in other parts of the country.

Between 2003 and 2008, Klimp funding of SEK 1.8 billion was granted for 126 climate investment programmes, as well as 23 special projects known as *guldklimpar* (“gold nuggets”). The grants have been invested in 67 municipalities, seven municipal associations, five county councils and four companies in every county in Sweden. *Guldklimpar* are particularly effective measures that have been granted funding within programmes that have not been granted other funding. Together, the programmes comprise about 900 measures and an investment volume of just over SEK 8 billion.

The measures that were granted funding between 2003 and 2008 are estimated to reduce emissions of greenhouse gases by 1.1 million tons of carbon dioxide equivalents per year. This corresponds to about a third of the Swedish climate objective, which is to cut the level of greenhouse gas emissions by 4% over the period 2008-12 compared to 1990 levels. The programmes are also estimated to save 1.2 terawatt/hours of energy per year. The largest reductions are expected within the categories Energy (production and distribution), by almost 344 000 megawatt/hours per year, and transport (road), by almost 293 000 megawatt/hours per year.

The investments are made in the sectors that have the largest impact on climate. This applies above all to measures in the transport and energy sectors. They include expansion of district heating, transition to biofuels, measures to boost energy efficiency and local information about the climate issue and the ongoing projects. Almost one-third of the Klimp grants have been invested in biogas measures.

Only the best measures in the best climate investment programmes have received funding. The Swedish EPA and the sector agencies, the Swedish Road Administration, the National Board of Housing, Building and Planning and the Swedish Energy Agency have thoroughly assessed the applications received by the EPA. The programmes have been awarded points depending on how well they demonstrate good climate strategies, overall perspectives, collaboration, efficient use of funding and environmental effects.

The climate investment programmes normally run for four years, after which a final report is submitted to the EPA. By 2012, all programmes will have been concluded.

### **Sustainable cities**

In 2009, Klimp was superseded by the Support Programme for Sustainable Cities. The sustainable cities programme is more specifically dedicated to support integrated urban development projects with a climate focus. Over two years, SEK 340 million will be made available for support to urban initiatives. The support is intended to be awarded to a limited number of projects through a two-stage competitive process similar to the Klimp procedure. The aim of the programme is to enable urban development projects that can produce significant climate effects and simultaneously provide good examples of integrated urban development initiatives that can facilitate national and international co-operation and trade. The support programme is managed by the new *Delegation for Sustainable Cities*, an urban task force, or national platform, with a broad task of facilitating and stimulating integrated sustainable urban development overall.

## A COMMUNITY TAKES CHARGE: THE EVOLUTION OF BOULDER'S CARBON TAX

*By Jonathan Koehn  
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This paper discusses the development and implementation of Boulder's carbon charge and offers a brief history of Boulder's climate protection program. The city of Boulder needed a long-term revenue source to fund its climate protection program and meet City Council's Kyoto Goal. In 2003, growing momentum for city action on energy issues led to the dedication of USD 100 000 from the city's General Fund for limited analysis and programs in 2004. A two-year increase in the city's Trash Tax provided an annual budget of USD 258 000 for energy and greenhouse gas programs. The short-term and limited nature of the Trash Tax, as well as public concern over the tax increase, meant that a new, long-term revenue stream would be needed to continue the greenhouse gas programs beyond 2006. Staff hired a consultant team to complete a report on potential long-term funding options.

The public and city staff process surrounding the report highlighted limitations of the options and resulted in the city aggressively pursuing the carbon charge concept. Xcel Energy, the investor-owned utility serving Boulder, agreed to collect the charge on Boulder's behalf on the condition that it was passed by the voters. On 7 November 2006, Boulder voters approved Initiative 202, the Climate Action Plan Tax, marking the first time in the nation that a municipal government imposed an energy tax on its residents to directly combat climate change.

In June 2009, Boulder City Council voted unanimously to increase the tax to the maximum level approved by voters, essentially doubling the annual revenue generated to USD 1.6 million.

### **Introduction**

Unlike many cities with community energy and greenhouse gas (GHG) programs, Boulder does not have a municipal utility or a state-wide system benefit or public goods charge to provide program funding. Like many cities, Boulder has faced declining revenues and the need to make significant budget cuts, forcing City Council to make difficult decisions about scaling back levels of services and staffing. As such, there were no substantial and unrestricted internal sources of funding that could be diverted to fully fund the climate change program at approximately USD 1 million per year through 2012. In order to fund the climate program and meet City Council's Kyoto Goal, the city would need a source of new, long term revenue.

This paper discusses the development and implementation of Boulder's carbon charge and offers a brief history of Boulder's climate protection program. Relevant City Council meeting documents and the Climate Action Plan are available on the Community Relations page within the Energy and Climate section at [www.environmentalaffairs.com](http://www.environmentalaffairs.com).

### **Background**

Boulder is a college town in Northern Colorado known for its beautiful mountain landscapes. Boulder has approximately 100 000 residents, including resident students at the University of Colorado. Boulder is

also home to many federal laboratories, such as the National Centre for Atmospheric Research (NCAR) and the National Oceanic and Atmospheric Administration (NOAA), high-tech companies, energy and environmental consultants and natural lifestyle companies. The community has a strong and long-lived interest in environmental protection, as is shown by its commitment to preserving open space, recycling and waste diversion, promoting the natural and organic products industry, and maintaining a high quality of life.

The Office of Environmental Affairs (OEA) at the city of Boulder is responsible for implementing many of the city's environmental policies and programs. The OEA works in the following program areas: waste reduction, green building, integrated pest management, pollution prevention, and energy and GHG emissions reduction. As of December 2006, there were seven full time employees, with each employee generally dedicated to a specific work area or program. The OEA reports directly to the City Manager's Office and works closely with City Council and its advisory board.

### **The Kyoto Resolution and the BREEE Report**

In 2002, the Boulder City Council formally recognised the need to take action on climate change and passed a resolution committing the city to an initial goal of reducing greenhouse gas (GHG) emissions to 7% reduction below 1990 levels by 2012. The resolution, referred to as the Kyoto Resolution, directed staff to develop a local action plan outlining cost-effective actions to reduce emissions in all sectors. The resolution also prompted the creation of a volunteer working group—the Boulder Renewable Energy and Energy Efficiency working group (BREEE)—comprised of local energy experts, students, interested residents and city staff. Initially, BREEE intended to develop a preliminary energy efficiency and renewable energy roadmap for the city. However, a local carbon expert suggested that efficiency and renewable energy be addressed within the context of a comprehensive GHG mitigation plan.

BREEE met bi-monthly over the course of several months and developed a report including a preliminary greenhouse gas emissions inventory, policy and program recommendations to reduce emissions, an estimate of the emissions reductions of existing city programs and potential long term funding sources. The report was an important first attempt at defining the scale of the challenge and highlighting potential opportunities to save energy and reduce emissions. It also was successful in helping to catalyse city action and commitment to developing a comprehensive emissions reduction program. Much of staff's early work, particularly reports to City Council, was made possible by the efforts of the dedicated individuals engaged in BREEE.

The BREEE report was completed in early 2003 and the group continued to meet to discuss strategies for reducing emissions in Boulder. The growing momentum inspired staff to launch its first formal energy efficiency program in the fall of 2003. Through participation in Xcel Energy's Custom Efficiency rebate program, the city could offer Xcel rebates to Boulder businesses that completed efficiency projects, particularly lighting retrofits<sup>1</sup>. Staff also placed more emphasis on raising awareness of energy issues through water bill inserts and increased visibility of energy in its pollution prevention program, Partners for A Clean Environment (PACE).

### **2004: the energy builds**

As part of the 2004 budget process, City Council made a one-time appropriation of USD 100 000 from the City Manager's contingency fund for greenhouse gas and energy programs. Specifically, the funds were to be used to hire a consulting company, Econergy, to begin quantifying and analysing the emissions reductions needed to meet the goal and to hire a fixed term, full time employee to work on energy programs and assist with the development of the action plan.

The 2004 budget allocation allowed staff to dedicate time and resources towards research, planning and analysis, outreach and limited programs, and to cultivating relationships with community stakeholders, other Front Range cities and national programs, such as ENERGY STAR and the Chicago Climate Exchange. Highlights from the 2004 Progress Report include:

- finalised GHG Emissions Inventory;
- completed commercial buildings analysis and report;
- analysed environmental and economic impacts of various packages of energy efficiency measures;
- created a preliminary residential buildings analysis;
- USD 55 000 in lighting rebates provided to 13 local businesses, saving a combined USD 104 000 a year in energy costs;
- distribution of over 2 100 energy-efficient light bulbs and related educational material;
- replacement of 250 halogen floor lamps with energy efficient models, as part of a community halogen lamp swap; and
- a small (under 1 000 mtCO<sub>2</sub>e) but significant start in reducing GHG emissions toward the Council's Kyoto Protocol goal.

The decision to hire a consulting firm, Econergy, to complete the emissions inventory was partly a result of concerns by some BREEE members and energy experts about available software.

Specifically, they found that it was not transparent, making it difficult to judge if it was consistent with the WRI Protocol. Additionally, the inventory in the BREEE report was based on data from three or four years. Econergy refined the inventory using data from each year back to 1990 and developed an Inventory Maintenance System to track annual emissions. The updated inventory improved confidence in the 2012 forecast. A valuable outcome of developing the inventory was strengthened communication and relationships with Xcel Energy and other city departments, on which staff was dependent for data. Econergy's commercial buildings analysis was also useful in understanding the magnitude of the challenge and for providing data for future analyses.

### **The Trash Tax**

As 2004 drew to a close, it was necessary to secure funding if work was to continue in 2005. Staff did not seriously begin looking at potential long term funding options in 2004, because they wanted to complete more planning and analysis to determine how much funding would be required to meet the Goal. In short, without a completed inventory and analysis and relatively little community engagement, it seemed premature to spend a significant portion of the limited budget on developing a long term funding source. Moreover, it was unlikely that City Council would be comfortable making a decision on a funding source without a clear understanding of how the funds would be used.

The city's Trash Tax was highlighted as a source of two year bridge funding. The Trash Tax is an occupation tax on the trash haulers in Boulder, based on the amount of trash they collect in the city limits. This tax is passed on to customers based on the customer's level of trash service. Though not technically

earmarked, Trash Tax revenues historically had been used for waste reduction programs and related personnel expenses. City Council has the authority to increase the tax up to the voter-approved cap.

In order to provide funds for the GHG program, the Trash Tax would have to be increased. This increase would be in addition to a USD 210 000 increase proposed by waste reduction staff for more waste reduction programs. GHG staff initially requested an annual budget of USD 440 000 to complete the planning and analysis, increase program offerings and add another full time employee. Feedback from the City Manager's Office and City Council instructed staff to re-evaluate its budget needs, *i.e.* scale back its request. Staff developed an alternate and lower budget of USD 258 000 per year. The lesser amount reflected the elimination of .5 FTE and cuts in programs. At the October 2004 Study Session, Council also directed staff to focus on limited commercial and residential energy programs and not on analysis of other sectors, particularly analysis by private consultants.

Consideration of the Trash Tax evoked lively debate on whether it was an appropriate source of funds for energy and greenhouse gas programs and ultimately required Council to either reaffirm or reject its commitment to meeting the Kyoto Goal. This was a significant issue as many of the Council members that voted for the resolution were no longer on the Council and some of the new members had serious concerns over whether climate protection was a legitimate role for city government. Specific to the Trash Tax, some Council and community members questioned the strength of the nexus between the funding source and work to be funded. The situation was intensified due to a perceived lack of notice, specifically to the business community, of the tax increase. Several members of the community felt like the tax was being pushed through "under the radar," which naturally prompted public resentment. In retrospect, staff made the mistake of relying on the media to cover the Study Sessions and city conversations about the tax increase.

The media did not cover the story until it was a controversy, for which the media found willing and vocal opponents. For example, the media focused on the percent increase rather than the actual dollar increase, which was as much as USD 1.30 per month per household depending on trash subscription level. It is likely that part, if not most of the controversy could have been avoided with more concerted and timely effort to explain the tax increase to the public. Ultimately, Council decided to raise the Trash Tax, providing an annual budget of USD 258 000 for the GHG Program. A hotline received complaints for approximately a month and then the calls ended. As promised, the GHG portion of the Trash Tax was sunset at the end of 2006.

### **The search for long-term funding**

Along with limited commercial and residential energy efficiency programs, Council directed staff to concentrate on developing options for long term funding of the GHG Program. In March 2005, staff released an RFP seeking a consultant(s) to complete an analysis of potential funding options to generate long-term revenue for the implementation of the city of Boulder's Greenhouse Gas Emissions Management Plan. The RFP stated that the funding source should be capable of generating one to three million general fund dollars annually for greenhouse gas programs and related personnel expenses. The funding source should be able to be implemented by January 1, 2007 and generate revenue for at least six years. The funding source should also be within the city's legal ability to implement, have a logical relationship to the work being funded, and not involve a sales tax increase. Staff had approximately USD 40 000 to dedicate to the funding analysis.

It is instructive to note that though staff had ideas on potential funding sources, they did not have the time or legal or financial expertise to adequately analyse and determine the feasibility of the options. Staff sought consultants that could contribute that expertise, as well as provide an independent analysis for staff and Council's consideration. It is also instructive to note that in early 2005 a local energy efficiency

advocacy organisation had written a bill that was debated in Colorado's House and Senate authorising natural gas demand side management (DSM) programs and creating a state-wide system benefit charge. Xcel Energy supported the natural gas DSM programs, but did not support the system benefit charge citing administrative burdens. The bill was vetoed by the Governor, leaving the impression that Xcel would fight a local system benefit charge. At that time, it was not known whether a local system benefit charge would require changes to the city's franchise agreement with Xcel or the city charter. The decision was made to pursue other funding options given the apparent likelihood that Xcel would not collect a charge on Boulder's behalf.

The funding RFP was reissued in April, as the quantity and quality of responses were low from the first round. It is assumed that part of the reason for the low response was a short turnaround time and conflicts with Spring Break. It wasn't until mid May 2005 that staff hired a consultant team headed by Heidi VanGenderen, the University of Colorado's Wirth Chair. To assist with this project, the Chair assembled a multi-disciplinary team (Team) with state-of-the-industry experience in identifying, securing and financing new revenue streams to fund sustainability and other governmental initiatives. In addition to the Chair, the Team was comprised of Shaw Environmental and Infrastructure, Inc. (Shaw), Scott Balice Strategies, Policy Solutions Ltd. and Natural Capitalism Solutions (NCS).

As part of the funding analysis, the Team completed a resource inventory cataloguing city taxes, fees, and bonds, as well as applicable grants and programs that could potentially provide funds for GHG mitigation. The goal of the inventory was to highlight existing revenue sources or fund balances that could potentially be directed to the GHG Program as one-time seed funding or for on-going support. When this idea and the possible options were vetted with other city directors, it was found that many funding pools could not legally be diverted to other purposes and even if they could, it would shift the burden to other departments to raise replacement funds. Many of the fund balances were being held in reserve for future purposes or as a safety net.

The Team also thoroughly reviewed Boulder's 2004 Comprehensive Annual Financial Report (CAFR) and 2005 Budget to understand the structure of City finances and to identify potential revenues and existing, available funding sources to support the Plan. They also identified existing practices used by other local governments to fund emission reduction strategies.

The consultants' research culminated in a report containing thirteen potential revenue sources that met the criteria outlined in the RFP. The thirteen options could be used in isolation or as part of a package. The options included:

- establish a Boulder Energy Enterprise and Fee
- create an annual Vehicle Sticker Fee
- extend the Trash Tax
- create a Renewable Energy Mitigation Program/Renewable Energy Mitigation Fund
- increase the Development Excise Tax
- create a stand-alone Development Fee
- increase certain Planning and Development Services fines
- utilise Special Purpose Districts

- increase the Admissions Tax
- levy an Occupational Privilege (“Head”) Tax on employees and employers who work in Boulder
- increase the Public Accommodations Tax
- increase parking fines
- grants and Intergovernmental Revenue Sources

Staff and the consultants reviewed these options with the Deputy City Manager and Department directors. The group had the following concerns: competition for funds, particularly with the Transportation Master Plan; some options had a weak nexus between funding source and work to be funded, which would be problematic for a fee; some options were politically challenging and undesirable; and there had been no public process up to this point. As a result, the group recommended that some of the options be removed from consideration and that staff should present only the most feasible and desirable options to City Council. The city’s Finance Director resurrected the idea of an energy consumption tax to fund the Energy Efficiency and Renewable Energy (EERE) enterprise based on the direct nexus. Staff took note, but proceeded with the consultants’ work so as to present to Council a variety of possible options.

Of the 13 options in the report, staff identified five as having the greatest potential for successful implementation. The five options included the following:

- establish an Energy Efficiency and Renewable Energy (EERE) enterprise and fee;
- create an annual Vehicle Sticker Fee;
- extend the Trash Tax;
- create a Renewable Energy Mitigation Program/Renewable Energy Mitigation Fund; and
- increase the Development Excise Tax.

In December 2005, City Council directed staff to continue research on the five options and review them with a variety of committees and stakeholders and return to them in April 2006 with more detailed analysis and recommendations in preparation for a final decision in June. They also requested that the funding sources be accompanied by a final Climate Action Plan. Throughout the first and second quarter of 2006, staff reviewed and discussed the funding options and draft Plan with the newly-formed Climate Action Plan Committee (CAPC) and other groups. The CAPC was created to provide input on the funding options and the draft Climate Action Plan. Participants were selected based on an expressed interest in the program, previous involvement with the program, policy knowledge in the field, the time and ability to serve, or by recommendation from other invitees. The members represented a variety of viewpoints and levels of knowledge about climate change and mitigation strategies.

The discussions with city staff and the CAPC highlighted the limitations of the options included in the report. For example, many people had a difficult time understanding the EERE Enterprise and the associated fee or tax. The City Attorney’s Office cautioned that there would be state pre-emption issues with the vehicle sticker fee and it could be problematic to fund building efficiency and other climate programs with a transportation-based fee. Generating sufficient revenue through the Trash Tax would necessitate a dramatic rate increase and again raise nexus concerns. People were generally supportive of the Aspen-style Renewable Energy Mitigation Program, but were concerned that it would be too unstable,



narrowly-focused and limited to generate the necessary revenue. It was also mentioned that the option would be best implemented on a county-wide level; Boulder County is exploring the option as a way to address the surge in large homes. Similar problems were raised about increasing the Development Excise Tax to fund the Plan.

In part due to the limitations of the proposed options, two CAPC members introduced other funding proposals. One of the proposals echoed earlier ideas of a local energy consumption or system benefit charge, which became the foundation of the carbon tax. The other proposal was a fee based on a building's square footage, using square footage as a proxy for energy consumption. Of the two options, the CAPC favoured the carbon charge option due to the strong nexus to the work being funded. Staff worked with the City Attorney's Office to submit an informal request to Xcel Energy asking for initial feedback on collecting the charge on the city's behalf. Preliminary conversations with Xcel proved more promising than anticipated, prompting staff to aggressively pursue the option. It is important to note that this conversation happened in parallel with the city's investigation of forming a municipal electric utility. It is unknown how much the municipalisation discussion influenced Xcel's position on collecting a Boulder-specific charge on their customers' bills.

There was considerable discussion among the Committee about whether the charge should be a fee or a tax. The primary distinctions are that fees are enacted by City Council and require a demonstrable nexus between the fee and the benefit; Taxes require voter approval and have greater flexibility in terms of the nexus. A voter-approved tax was selected because of potential legal difficulties associated with a fee and the desire to have clear public support. Having public support was also important to Xcel, as they recognised that they would receive the majority of complaints since the charge would appear on their bills.

Even though none of the options from the consultants' report were selected for implementation, the process was valuable. The process helped develop credibility and importance for the climate program within other city departments and provided a framework to have serious discussions with city and community leaders. The process also yielded a few options that could potentially have been used if the carbon tax failed, which was always a possibility.

### **The Climate Action Plan Tax**

At an April 2006 Study Session, staff presented three options to City Council and requested direction on which option or options, if any, to include in the 2007 budget process. The three options, in order of staff recommendation, were the energy tax collected on Xcel bills, square footage fee collected on city water bills or a new fee collection system, and Trash Tax increase. City Council directed the City Attorney's Office to submit a formal letter to Xcel Energy asking them to collect the charge.

Council also directed staff to develop rate structures that varied how much each sector contributed to the total collected revenue. The following table summarises information that was used to develop rate structures. For example, the table shows that the residential sector contributes 27% of total emissions, is expected to contribute 31% of the total estimated reductions by 2012, is expected to pay 19% of total private investment in energy efficiency and renewable energy, and receive 58% of total city funds through programs, services and education.

	Residential	Commercial	Industrial
Percent of Total Emissions (2005)*	27	53	19
Percent of Total Reductions	31	41	22
Percent of Total Private Investment	19	76	5
Percent of Total Public Investment	58	39	3

\*Other contributing sectors include transportation and solid waste. These emissions were distributed equally among the residential, commercial and industrial sectors.

Other considerations included:

- Some industrial users are addressing emissions and have set targets at a corporate level.
- Increased energy use and emissions are a by-product of increased production and growth, for which industrial users should not be punished.
- The residential sector will not have access to the level of utility efficiency rebates available to the commercial and industrial sectors. The commercial sector is expected to receive 92% of the anticipated rebates flowing into Boulder.
- Tenants in all sectors may have limited potential for reducing consumption and therefore reducing the charge.
- The charge will represent a higher percentage of monthly income for low-income residents.
- Low income residents are likely renters in older homes with limited potential for reducing charge.
- Customers subscribing to Xcel's wind power program, Windsource, should not pay the charge for that portion of their electricity use, since their electricity is carbon-neutral.
- Customers of other REC marketers cannot be exempt through Xcel bill for logistical reasons.

Given these considerations, the following rate structures were developed and based on:

- *Emissions allocation model*: Sector contribution to total GHG emissions, such that the percent contribution to total emissions is equal to the percent contributed to total revenue.
- *City funding allocation or "revenue recycling" model*: Proposed allocation of city funds to each sector, such that the amount that each sector pays is equal to what they will receive in city funds through programs and services.
- *Uniform rate model*: Uniform rate for all sectors, such that every household and business pays the same rate.

Each option had advantages and disadvantages. Notably, the Industrial sector had concerns that under the emissions allocation model they would contribute approximately 20% of the revenue but receive only 3% of city expenditures. The charge could exceed USD 20 000 per industrial sector company. Under the city funding allocation model, the residential sector rate is higher and better matches the efforts and funding dedicated to the sector. A drawback of the city allocation model is that the rates could potentially widely vary from year to year. However, under all models the rate would change from year to year. The ability to annually adjust the rate is a key safeguard to optimise the rates in light of the design constraints and achieved outcomes.

City Council decided to set the rate based on the estimated allocation of city funds. This option seemed to balance industrial sector concerns and increase the amount that households would pay, while not being overly burdensome. To address the problem of increasing costs for low income households and renters, staff developed additional programs to help them reduce their electricity consumption.

It should be noted that the limited scale and timeframe of the tax did not demand as rigorous analysis and considerations as if the tax was considered for state-wide or national implementation. Notably, the tax is not designed to influence company investments or consumer decisions, as the tax does not reflect the social cost of carbon or marginal damage associated with increased GHG emissions. To set the rate to better reflect carbon's true cost on a city-wide level would have disadvantaged Boulder companies and increased the already high cost of living in Boulder. It also would have generated a budget in excess of what the city had the capacity and perhaps the political and legal authority to spend. Another limitation is that as electricity consumption increases, the rate actually decreases to maintain desired revenue levels, creating a perverse incentive. However, if emissions are steadily increasing the city has the flexibility to propose a larger budget and consequently higher rates to achieve additional and perhaps harder-to-reach reductions. The city could also pursue regulatory strategies, which are currently not included in the Implementation Plan section of the Climate Action Plan.

Similarly, the city entertained the idea of establishing a Boulder-specific cap and trade program, but staff determined that it was infeasible given the lack of accounting and tracking infrastructure, low potential for flexibility, absence of a long-term goal and high transaction costs. Additionally, to generate public revenue the city government would have to sell emission allowances, which could create a contentious political situation.

### **Setting the rate**

The first step in establishing the rate was to finalise budget estimates for 2007 to 2012. Staff used a bottom-up approach to estimate the budget. The budget is based on projected expenses for the identified programs, services and related expenses, such as salaries, administrative costs and direct renewable energy purchases, as outlined in the Implementation Section of the Climate Action Plan. These cost estimates were derived from the city's pilot programs, as well as other programs around the state and country and input from technical groups. Additionally, it reflects participation rates and results that are believed to be reasonable, achievable, and slightly conservative, so as not to overestimate results or underestimate the necessary budget.

The estimated budget was used to determine minimum and maximum rates for inclusion in the ballot measure. The Implementation Plan section of the Climate Action Plan outlined detailed activities for each year. Staff used information from existing programs and reasonable assumptions to estimate the necessary budget. The budget ranges from USD 860 265 in 2007 to USD 1 342 000 in 2012. The recent economic downturn has resulted in a slight reduction of revenue; the 2009 projected collection is USD 839 000. The annual budget increases reflect larger renewable energy purchases for city operations, annual salary increases, and consumer price index.

The budget estimates were broken down by sector expenditures, such that the residential sector contributes 58%, the commercial sector contributes 39% and the industrial sector contributes 3%. Staff used 2005 electricity consumption data as the basis of forecasting future consumption. Staff developed a variety of scenarios to ensure that the requisite budget would be generated each year.

During this process, there were a few key factors affecting revenue levels to consider, including:

- As electricity consumption increases, the rate per kilowatt-hour (kWh) will decrease.
- As electricity consumption decreases, the rate per kWh will increase.

- As Windsource subscription increases, it will have the effect of decreasing electricity consumption that is taxed and will increase the rate per kWh. However, the impact on the rate will be related to the level of increase or decrease in consumption of traditional electricity.
- The rate is based on assumptions of electricity consumption for the upcoming year (*e.g.* 2007), using the past year's data (*e.g.* 2005).
- Xcel Energy assumes electricity demand will increase by 1.8% annually, but Boulder has experienced greater increases in the past.
- If the energy efficiency measures outlined in the Plan are successfully implemented, it would result in approximately a 10% reduction in projected 2012 consumption, compared to business-as-usual.
- Each sector's rate could change with changes in the allocation of city funds, the budget and above or below average changes in sector consumption.
- To keep administration costs low and the tax simple, only electricity consumption is covered.

As currently designed, the tax will generate about USD 1 million annually through 2012 when the tax is set to expire. The City Council set the first year tax at a maximum rate of USD 0.0022 per kWh for residential customers; USD 0.0004 per kWh for commercial customers; USD 0.0002 per kWh for industrial customers. The average household will pay USD 1.33 per month and an average business will pay USD 3.80 per month.

In subsequent years, the City Council has the authority to increase the rates as needed to fund the Plan, as it may be amended, to a maximum rate of USD 0.0049 per kWh for residential customers; USD 0.0009 per kWh for commercial customers; USD 0.0003 per kWh for industrial customers. These maximum tax rates are estimated to support a maximum USD 1 342 000 program budget.

## **Climate Action Plan**

In June 2006, City Council approved the Climate Action Plan (CAP). The plan outlines baseline information, including the emissions inventory, and establishes the context for the GHG work. It also presents emissions reduction strategies for each sector. The primary strategies for reaching the emission reduction goal are to increase energy efficiency (*i.e.* reduce use), shift to renewable fuel sources for electricity and vehicle fuel, and reduce vehicle miles travelled. The specific strategies are based on programs and policies in other communities, utility energy efficiency programs, staff research, and input from the CAPC. The CAP is continuously evolving in response to new information, legislation and opportunities.

Section VI of the CAP—The Implementation Plan—outlines the specific programs and actions that are proposed for 2007 to 2012, with service levels and programmatic details subject to change in response to new circumstances and as targets are achieved. Because energy efficiency is the most cost-effective strategy for reducing emissions, the majority of the annual budget will be directed toward energy efficiency programs, services and outreach.

## **The election**

In August, 2006 City Council took great care in drafting the ballot language and unanimously approved the Climate Action Plan Tax for inclusion on the November ballot. City Council's leadership was very important in gaining public support for the ballot measure. Legally, the city is not allowed to use

public funds to advocate for ballot measures. To promote the measure, a group of local supporters, including the mayor, came together to solicit campaign donations, write letters to the editor, hand out yard signs, hold rallies and generally build support for the initiative. Many of the people had been involved in BREEE, consulted with about the Plan or participated in the city's activities and programs. Others were simply interested residents. It is reasonable to assume that staff's outreach and communication efforts and community activities and programs helped familiarise the community with energy and climate change issues and demonstrate the corollary benefits associated with reducing emissions. Staff's efforts in 2004 through 2006 helped build the awareness and confidence needed to pass the measure. At the time of the election, there was no formal opposition to the measure.

It is important to note that despite the Chamber of Commerce's involvement on the CAPC and concerted staff effort to address their concerns, the Chamber initially opposed the ballot measure. Their opposition included the assertions that companies are already taking cost-effective measures to reduce emissions and hiring additional city staff to encourage people to do what they should already be doing or are doing is unnecessary. They also had concerns about the rates for the industrial sector and larger companies. However, after additional internal discussions and a letter from Hunter Lovins (co-founder of the Rocky Mountain Institute and founder of Natural Capitalism Solutions) highlighting the merits and economic benefits of the Plan, the Chamber of Commerce announced support for the measure.

On November 7, 2006, Boulder voters approved Initiative 202, the Climate Action Plan Tax, marking the first time in the nation that a municipal government will impose an energy tax on its residents to directly combat global warming. The Initiative passed with 60% of voters for the measure.

## **Conclusion**

Prior to the November election, staff implemented programs and outreach activities and developed a detailed action plan to demonstrate the city's commitment and competence and to build support for the city's greenhouse gas emissions reduction program. The Emissions Inventory and the Inventory Maintenance System for annual updates were also very important for being able to confidently measure progress. Having two full time employees dedicated to the GHG program also made much of the progress possible. It is difficult to imagine completing the necessary scope of work with less than two dedicated people. Additional staff time, when it was available, noticeably increased the work that could be accomplished. Furthermore, the relatively small budgets enabled staff to complete a range of activities, while requiring that staff be as efficient as possible. The pilot projects were of critical importance in understanding the types of services that are useful to the community and in building relationships. It is reasonable to assume that without staff's efforts to engage the community and demonstrate the economic benefits of saving energy and reducing emissions that it would have been harder to pass the ballot measure authorising the tax. Additionally, City Council's support was crucial; without it the program would not have been successful.

With passage of the CAP tax, 2007 represents the first year in which funding and staff levels for the city's climate protection efforts will be aligned with the comprehensive actions and programs necessary to make significant progress in reducing emissions. Staff will continue to engage members of the community on suggestions for improving programs and developing new strategies for the Climate Action Plan. Staff will also seek out new partners, such as other cities, counties and non-profit organisations, to leverage resources and share best practices. With this cooperation and the dedicated funding, Boulder is well-equipped to tackle its Kyoto Goal.

As previously mentioned, City Council approved a revision to the tax rates that effectively doubles the revenue generated by residential, commercial and industrial customers. The tax increase accompanies a new strategy for the Climate Action Plan to meet the City's Kyoto target, and provide the necessary momentum to move beyond Kyoto in the foreseeable future.

### **Notes**

1. For more information on the city's participation in Xcel's rebate program, see "Lightening the Load: Promoting Utility Rebates to Boulder Businesses" at [www.environmentalaffairs.com](http://www.environmentalaffairs.com)

## INPUT AND EXPERIENCES FROM THE WORLD BANK

### URBAN FINANCE AND CLIMATE CHANGE: FINANCING CLIMATE-FRIENDLY INITIATIVES AT CITY LEVEL

*By Mila Freire  
Senior Advisor, World Bank*

Cities have a key role to play in dealing with climate change. Not only are they major contributors of carbon emissions, but they are also powerful vehicles for promoting behavioural changes and implementing the necessary adaptation in the physical attributes of human settlements. However, while the urgency of adopting mitigation and adaptation strategies are well accepted at city level, there is little research on the best fiscal instruments that could be used to finance the necessary investments.

This paper reviews the nature of climate change as a global good and suggests that a mixture of financing instruments is required. While carbon trade is well accepted to sell the right to emit among polluters, the associated resources are generally used to finance such investments as landfills. New lines of resources need to be identified to finance the massive costs associated with climate change. For example, controlling CO<sub>2</sub> below 450 parts per million will cost about 3% of world GDP in 2030 and 5.5% in 2050.

This paper analyses the role of the carbon trade in financing climate change measures at city level in several developing countries. It also presents programs launched in both developed and developing countries to increase knowledge, awareness and to develop benchmarks that could be used to promote energy efficiency in buildings, urban form and transportation schemes.

#### **Introduction**

The world of public goods has changed radically in the past quarter century (G. Heal, 1999). Not only are public goods increasingly produced by the private sector, either because of privatisation or because of externalities (often negative), but the market has gained a very important role in the provision of public goods. The traditional idea that public goods need to be produced and delivered by the public sector has been replaced by the consensus that there are many providers of public goods, which minimises the emergence of natural monopolies in the provision of global goods.

Take the case of carbon dioxide, the principal gas responsible for climate change. It is stable, remains in the atmosphere for 60 years; it mixes easily, and CO<sub>2</sub> emitted in New York or Beijing will be diffused around the globe in a matter of months. CO<sub>2</sub> in the atmosphere is uniform around the world, and its atmospheric concentration is a global public good (or bad, as the case may be). Production of CO<sub>2</sub> comes from billions of private households and firms for their needs, all outside the government's sphere. The government can influence these decisions, but only indirectly, through regulations and incentives.

The investment requirements associated with climate change are estimated at above 5% of a country's GDP. The latest Intergovernment Panel on Climate Change report estimates the cost of keeping CO<sub>2</sub> equivalent concentrations below about 450 parts per million (ppm) at less than 3% of world GDP by 2030 and less than 5.5% by 2050. Most of the integrated assessment models suggest that the costs of climate

change are on the order of 1% to 2% of national income, although *Stern* suggests a larger number, at least 5% and possibly as much as 20% for a business-as-usual scenario.

To reach a target level of GHG emissions, policy makers can use either command-and-control tools – take the total GHG to be abated, divide by the producers, and require that each reduce emissions by  $x\%$  – or market-based mechanisms: a pollution tax that would bring about the desired pollution level (depending on how elastic the output) or the allocation and trade of pollution rights. There is a consensus that the market-based mechanisms are more effective than command-and-control approaches in terms of effective emission reduction. A limit of total emissions is established, and the authority with oversight responsibility allocates the rights to pollute according to the trade that took place. The incentive to cut back on pollution is provided by the fact that an unused permit can be sold or that the price (and cost) is too high to be borne by the producer. The higher the market price, the stronger the incentive.

To introduce a regime of tradable emission quotas, property rights have to be created where none previously existed. These property rights must be allocated to countries participating in the carbon dioxide abatement programs, in the form of quotas. Such quotas are assigned a market value. Thus the creation of quotas leads to the potential evening of the playing field for countries that are not major producers – in many developing countries because they have not achieved a sufficient level of industrialisation. How to distribute quotas has an enormous importance. It is also important because any reduction of GHG emissions will be reflected in reduced output and energy consumption. Without a parallel change in technology, these cuts will lead to reduced output and income.

The financing of green investments is related to carbon trade but is not identical to it. Carbon trade will generate funds, particularly in low- and middle-income developing countries, to finance the urgent investments that are required to make possible changes in technology that allow production and consumption with much less environmental impact, to abate emissions, to enable adaptation, and to share knowledge and change behaviour.

This paper analyses the role of the carbon trade in financing climate change projects in developing countries, the steps to encourage and improve its functioning, and the complementary programs that are required to address the fundamental lack of knowledge and awareness in developing countries and their cities. We make use of some of the projects financed within the World Bank Group.

## **The city perspective**

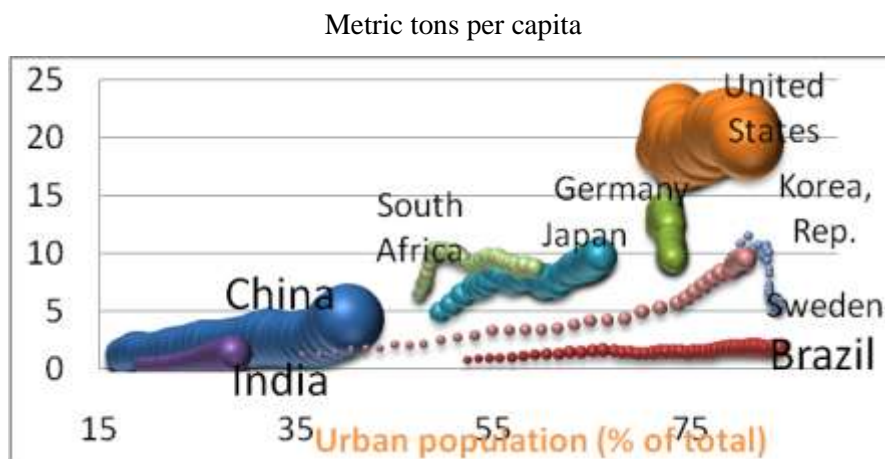
Cities are, and should be, at the core of the climate change debate. Cities are not only major consumers of energy but also vehicles for rapidly improving energy efficiency. “Sustainable cities are the best option to reduce the pollution that comes with much of today’s consumption, such as GHG emissions, air pollution, wastewater and solid waste” (Hoornweg *et al.*, 2009). Glaser calculated that in 48 major metropolitan areas, an “average household” generates up to 35% less GHG emissions if it is located in the city centre rather than in the corresponding suburb. In his paper, he concludes: “To save the planet, build more skyscrapers”.<sup>1</sup>

Major economies – and thus sources of emissions – are under the areas of influence of city governments – 37 of the world’s largest economies are cities (Hoornweg and Bhada, 2008). In 2006, cities emitted 19.8 gigatons of CO<sub>2</sub> from energy use (71% of global energy-related CO<sub>2</sub> emissions). Cities are expected to emit 30.8 gigatons of CO<sub>2</sub> from energy use in 2030 (76% of global energy-related emissions). Today, Chinese cities represent 75% of the energy demand in the country – this percentage will increase to 83%, by 2020. GHG emissions are unevenly distributed. In general, rich cities generate more GHG, and denser cities generate less GHG. The variation in per capita emissions results from variations in wealth, sector specialisation, climate, the urban form, energy sources, buildings and transport infrastructure.



The potential for cities to have an active participation in the climate change agenda is visible throughout the world. In the United States, more than 900 cities have signed on to meet or exceed Kyoto Protocol targets to reduce GHG emissions, and examples abound of cities that have set specific targets to reduce emissions and improve sustainable ways to produce and consume. The demand for increased participation and for an opportunity to be heard will be among the messages that city governments will bring to Copenhagen this fall.

### Carbon dioxide emissions per capita, 1967-2005



Most developing cities are overwhelmed by the magnitude of the service delivery requirements. More than half of the urban population in sub-Saharan Africa and 40% of the urban population in South Asia lack access to basic sanitation (Satterwaite, *et al.*, 2008). The prospects of developing in a carbon-constrained world and uncertain climate add to this problem. About 360 million urban residents live in coastal areas less than 10 meters above sea level and are vulnerable to flooding and storm surges. In most developing countries, more than 1 billion urban residents now live in slums. The impending threat of climate change only increases the urgency of financing these adaptation-related investments

Cities face two types of climate change challenges: mitigation – *i.e.* trying to reduce GHG emissions – and adaptation – *i.e.* trying to prepare for probable disasters, rising sea levels, and increased weather variability. In mitigation, the major policy instrument at the city level is the shaping of the urban form. Density is clearly associated (in a negative way) with GHG emission, so that local policies can potentially have a significant role in reducing emissions. Through retrofitting of city buildings and infrastructure, coupled with the design of future city expansion to ensure greater density, efficient cities can take steps today that could greatly reduce emissions from their current trajectories, especially in rapidly urbanising countries.

Mitigation investment is particularly important in rapidly urbanising middle-income countries, as established long-lived capital stock can lock in emissions for long periods, of up to 100 years. Carbon markets are not enough. They provide a mechanism to allocate the allowed emissions in an efficient way and will provide the incentive to innovate technologically once the pricing of carbon emission reductions, (ER), are high enough. Even when potential ER revenues are sufficiently high, a need for up-front financing remains to reflect potential long-term carbon revenues that may accrue.

A critical requirement for cities is to prioritise their needs as they move towards sustainable development. For example, high-income cities with high levels of emission (*e.g.* Denver, Los Angeles, Cape Town, Tokyo and Hong Kong) prioritise the mitigation aspect of climate change policies. Cities in developing countries (*e.g.* Dhaka, Hanoi and Jakarta) will focus on the challenges of adapting their

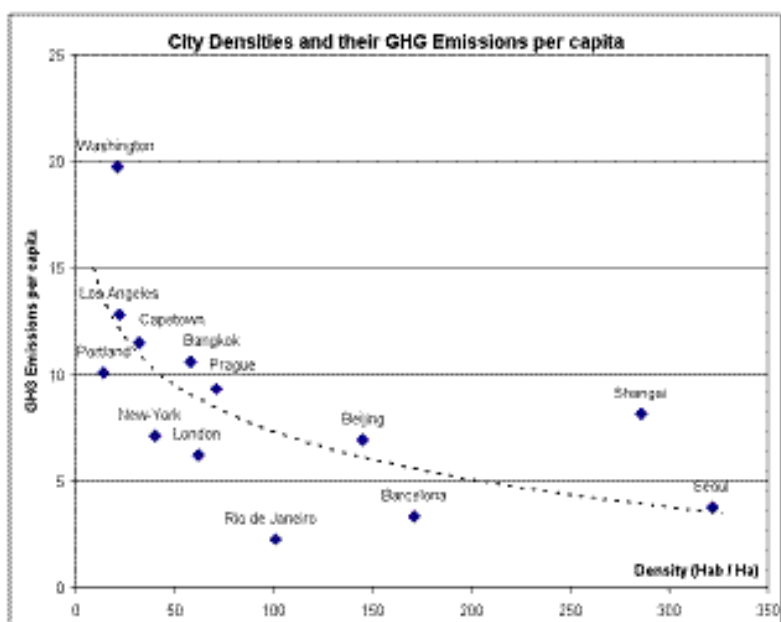
infrastructure to the vagaries of weather and climate uncertainties. Energy-efficient cities such as Hong Kong and Tokyo adopted policies that discouraged individual car use and urban sprawl early on. What is important to underscore here is that a city's built form and the nature of its urban transportation system are key determinants in the emissions produced, and that good policies can have important impacts.

### Environment policies and finance

From the economic literature, we have a good grasp of the main instruments to control climate change of GHG emissions:

1. regulations
2. taxes and fees (*e.g.* fuel tax)
3. carbon trade (distribution of quotas and rights to pollute)
4. non-environmental specific, *e.g.*, management, planning.

Figure 1.

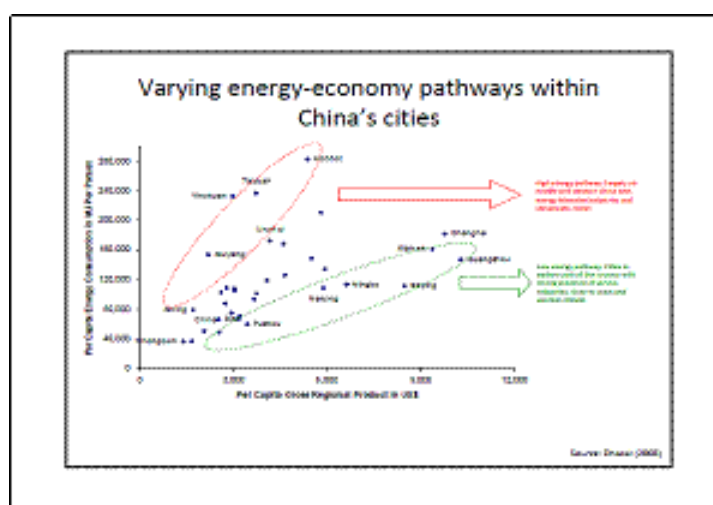


At the city level, in developing countries, the most important tools for addressing GHG emissions are planning, management and knowledge. As cities are growing rapidly, urban form can be an important instrument for slowing down emissions and producing a more efficient city. It is clear that density is one of the most important factors for cutting back emissions, together with energy-efficiency materials and transport. There are also concrete examples of cities that are tapping into concessional finance opportunities offered by the carbon finance system and are positioning themselves to play a more active role.

## Carbon-emissions trading scheme

Climate change is considered a new form of externality, which differs from traditional externalities in the sense that is global – both its causes and consequences have global impacts (*International Human Dimensions Program* meeting, 2009). Policies and measures devised to control pollution are applicable to governments to limit or reduce GHG emissions. These include regulations and standards (command and control), as well as market-based instruments such as taxes and charges, tradable permits, voluntary agreements, subsidies and financial incentives. Information programs and development efforts complement these instruments.

Figure 2.



Market-based instruments, such as pollution charges, subsidies and tradable permits, encourage firms and individuals to undertake pollution control efforts that are in their own interests and that collectively meet policy goals. Carbon-trading schemes are one form of limiting access to a common property resource by issuing usage rights. They are particularly suited to instances where a large number of emission sources are covered and the pollutant is spread evenly in the environment, as it is the case of CO<sub>2</sub>.

## Carbon financing makes green initiatives attractive to cities

Global public goods, such as a clean environment, are by their very nature difficult to tackle on the development agenda, because they involve benefits and costs that cannot be easily assigned to and addressed by individual actors or entities. Most cities in the developing world today face severe financial constraints, compounded most recently by the global economic and financial crisis, and, consequently, any investment that might help mitigate GHG emissions has to be coupled with the appropriate incentives.

In light of these challenges, the *Clean Development Mechanism* (CDM) provides an important linkage between reducing a city's carbon footprint and the changes in behaviour needed to affect such change. This is achieved through incentives in the form of carbon credits provided to national governments as well as cities to reduce their GHG emissions. Earning such carbon credits needs to be verified against standard indicators referred to as certified *Carbon Emission Reductions* (CER), but the potential rewards in terms of revenue streams that can offset initial capital outlays for transfer stations and landfill development can make the prospect of a "green investment" attractive. Some examples of how World Bank-financed projects have helped four cities to improve their delivery system and increase awareness for environmental issues are included below.

### ***Amman, Jordan***

The Amman Solid Waste Management Project is a case in point. With a flow of 2 400 tons of waste per day, the Greater Amman Municipality handles half of the entire solid waste generated in Jordan. With USD 25 million in World Bank financing, the city of Amman aims to expand and upgrade existing transfer sites and develop its existing landfill site. The design of the landfill site includes provisions for recycling of recoverable materials and landfill gas (LFG) recovery. The latter will be captured to generate “green” electricity expected to amount to 160 000 MWh, which will be channelled to the national electricity grid. The sale of this electricity is expected to generate an estimated USD 25 million by 2019. In addition, the projected certified emissions reductions resulting from the project are estimated at 0.9 to 0.95 million tons of CO<sub>2</sub> equivalent during the period 2009-14, and this is expected to generate a further USD 15 million in CER revenue by 2014, while the electricity sale will generate revenues estimated at USD 25 million through 2019. In sum, the city will be able to recover a significant share of its initial investment outlay to improve solid waste management through the combined revenues of “green” electricity revenue and CER revenue. The economic analysis of the project indicates an Economic Internal Rate of Return of 37% and a benefit/cost ratio of 1.63.

### ***Morocco***

In 2006, Morocco enacted its first law on solid waste management. In 2007, it launched a 15-year municipal solid waste program to establish service and disposal standards for urban areas. The goals included 90% of coverage by 2021; sanitary landfills in all urban areas; the closure and rehabilitation of 300 existing open dumps; and the promotion of solid waste reduction and recovery. In March 2009, the World Bank approved the first Development Policy Loan (DPL) in the amount of USD 132.7 million to support that program. The program benefitted from years of analytical work, which included the finding that poor solid waste management practices in Morocco were contributing to environmental degradation at an equivalent of 0.5% of GDP per year (compared to 0.2% in Egypt and 0.1% in Algeria, Lebanon, Syria and Tunisia). The government has so far enacted two decrees establishing the process for public consultation during the Environmental Impact Assessments, and national and regional commissions for their review and approval. Gas capture projects will also capture and flare methane from landfill sites, thus reducing emissions by 0.7 to 1.0 million tons of CO<sub>2</sub> equivalent per year, and earning Morocco revenue from CERs sold under the Clean Development Mechanism. Generating revenues to the sector through carbon trading is an added incentive for municipalities to tackle solid waste problems while contributing to international efforts in mitigating climate change.

### ***Santa Cruz, Bolivia***

Santa Cruz de la Sierra in Bolivia has a population of about 1.3 million and is growing by 6% each year. Sanitation services are well provided by ten co-operatives, but coverage is limited to 32%, which threatens to contaminate the city’s main aquifer. The World Bank has helped Santa Cruz increase the capacity of four waste water treatment plants. These plants will use a lagoon treatment system, which uses anaerobic bacteria to break down organic matter. Unfortunately, this process produces methane. The second project covers the four large anaerobic treatment lagoons with high-density polyethylene “geomembrane” sheeting, supported by a system of floats and tubes. Those tubes capture gas from the lagoons, estimated at more than 44 000 tons of CO<sub>2</sub> per year, which is then transported to a flare. This project is funded by an emission reduction purchase of USD 2.09 million by the Community Development Carbon Fund (CDCF) and the Bio Carbon Fund. The local co-operative SAGUAPAC receives the proceeds and is responsible for implementing the project, which is estimated to cost USD 1.48 million to install and USD 24 000 a year to operate and maintain.

## ***Karnataka State, India***

The 18 million urban dwellers in the state have water coverage, but only for less than four hours a day. To improve the efficiency of water provision, the government is launching a comprehensive program that includes improvements in energy efficiency and reduction of GHG emissions. Energy represents more than half of the water costs, since the municipal water pumps are powered by fossil-fuel electricity from the national grid. The program is implemented in six cities: Belgaum, Gulbarga, Hubli/Dharwad, Mangalore, Bellary and Mysore. Total energy savings are estimated at 16 023 696 kilowatt/hours. Total emissions reductions are estimated to be 13 620 tons of CO<sub>2</sub>. Capital investments will cost USD 4.5 million. The resulting emissions reductions – about 60 000 ER units – will be purchased by the Community Development Carbon Fund (CDCF). Depending on the certified emissions reductions price, the gross revenue will amount to between USD 600 000 and USD 900 000, which will be shared amongst participating municipalities.

### **Helping cities play a larger role in carbon trade finance**

Improving knowledge and methodologies to standardise a GHG emission baseline at city level is needed to help cities to benefit from the system. Cities are often as large and as capable as many countries and, like them, need verifiable and regular reporting of GHG emissions. These baselines should build on the considerable experience of ICLEI and other partners and be consistent with each country's national inventory, as directed by the UN Framework Convention on Climate Change (UNFCCC). Building on agreed-to emissions baselines, cities need new methodologies to facilitate emissions trading and carbon finance for aggregated approaches to emissions mitigation. Unlike large companies with one or two discrete processes, cities oversee thousands of smaller initiatives that when aggregated, can have an enormous impact. Cities, for example, could provide significant GHG mitigation by implementing aggressive building code modifications or changes to urban mobility and driving practices. In the current CDM process, these efforts are almost impossible to adequately capture. New methodologies are being developed and should be piloted in 2009.<sup>2</sup>

**Knowledge sharing:** Local governments need comprehensive and ongoing access to global experience. There are several programs being developed to respond to these needs and better connect municipal staff across cities. MetroMatch is one such program. Originated by King County in Washington State in the United States, MetroMatch is a program that enables municipal employees across the globe to share data, benchmark performance and seek advice and guidance from peers in comparable cities in various areas of city management, including environmental management.

**Other critical tools** that cities need are: comprehensive standardised building codes; good examples of land development regulations and policies; a renewed emphasis on preventative city planning (designing to reduce disasters); innovative financing plans; methodologies for partnering with the private sector; programs to strengthen public communications and awareness locally and globally; energy efficiency programs; and localised application of climate models.

**What are the impacts of emissions trading at the city-level?** How emissions trading works at the city-level is being studied in Helsinki.<sup>3</sup> The planned impact assessment takes a wide perspective on environmental issues that can be dealt with at the city level. The focus is on issues affected by the requirements set by an international treaty on GHG emission reduction and its regional operationalisation. It aims to offer information and guidance to the political process for developing a new international treaty at the UN climate change meeting in Copenhagen (COP-15), December 2009.

The question unfolds into three other questions: (a) How does the composition of an emissions trading system influence city-level decisions upon activities causing significant GHG emissions? (b) How do those

city-level decisions affect the decision making of individual citizens regarding those activities? (c) how do these city-level and individual decisions together result in changes in behaviours and activities, and consequently their impacts? The model takes into account three levels of decision makers – the international community deciding upon international climate agreements; political leaders of EU deciding upon the EU-ETS; and local society, in particular the Helsinki Metropolitan Area Council, as the decision maker for inter-municipality decisions such as public transport and random citizens living in the area (as residents or passengers).

### **The World Bank – nationwide experiences that can be useful at city level**

On 28 May, 2009, the World Bank approved a USD 600 million loan to fund energy efficiency and renewable energy in Turkey. The financing includes USD 100 million from the Clean Technology Fund (CTF), a new USD 5.2 billion multilateral fund managed by the World Bank. This will provide low-interest financing to scale up low-carbon technologies to reduce GHG emissions until a new global climate change agreement is negotiated and becomes effective. The loans will be channelled towards two Turkish development banks for credit-line financing of renewable energy and energy efficiency investments. The project aims to increase privately owned and operated energy production from local renewable sources within the market-based framework of the *Turkish Electricity Market Law*, thereby helping to enhance energy efficiency and curb greenhouse gas emissions.

### **International Finance Corporation**

Meeting the challenge of climate change requires the involvement of the private sector to develop and introduce new technologies, as well as to create supportive business models and marketing practices. The International Finance Co-operation (IFC), the World Bank arm that works with the private sector, is calling on banks in developing countries to increase their lending to companies wishing to invest in climate-friendly technologies. The role of the IFC supporting private companies is particularly important, as these companies have no obligation under the Kyoto Protocol to reduce CO<sub>2</sub> emissions. Through its Sustainability Energy Program, IFC has played a pioneering role in helping remove barriers for clean energy technologies and services in emerging markets. Between June 2005 and June 2006, IFC leveraged more than USD 1.5 billion in sustainable energy investment through 21 projects, ranging from biomass co-generation facilities in sugar refineries and waste heat recovery in steel mills, to run-of-river hydro and wind power projects. Together with the government of the Netherlands, IFC is managing USD 175 million to purchase emission-reduction credits from projects eligible under the Kyoto Protocol's *Clean Development Mechanism* and *Joint Implementation Mechanism*.

Specific successful programs include:

1. Affordable lighting in **Africa**, a project aiming to bring affordable and alternative sources of lighting to low-income people through development of the light-emitting diodes (LED) market;
2. Pilot projects in **Ghana and Kenya** to identify market forces and technological changes that yield affordable commercial solutions with high developmental impact;
3. **China**. IFC has brought together for the first time a gas company, a supplier of clean energy equipment and a commercial bank to create a new financing model. The bank provides commercial credit to the customers of the Xinao Gas company to finance clean energy projects. Xinao Gas offers advice on reducing energy consumption and pollution. It also provides boilers and heating systems and partners with Industrial Bank to provide loans for the equipment. The result will be USD 150 million worth of clean energy projects over six years, and a total carbon dioxide reduction of 5-10 million tons.

4. **Carbon Finance Assistance:** the World Bank is also working to help developing countries to participate in the global carbon market. Links between carbon finance-climate change and air quality have been developed in at least three programs:

- the **Cambodia** program on biomass energy
- the **China** program on tax on carbon revenues
- work in **Bangladesh** under the UNFCCC Programmatic CDM, *Carbon Finance Assist for a Low-Carbon World*.

In China, the program aims to shift the paradigm in urban transport policies and investment. The *China-GEF-World Bank Urban Transport Partnership Program* aims to achieve a paradigm shift in China's urban transport policies and investments toward the promotion of public and non-motorised transport, modes that are less energy intensive and polluting, and to slow the growth of GHG emissions in China's cities. The total project cost is USD 27 million, of which USD 21 million is a GEF grant for a four-year program.

- **Indonesia:** The World Bank has initiated a partnership with the government of Indonesia to provide inputs for the country's low-carbon growth strategy. Key sectors of relevance to urban air quality include transportation, energy efficiency and the power sector, where opportunities to reduce emissions intensity are being sought.

5. **Climate-Resilient Cities**,<sup>4</sup> a World Bank publication, presents a tool for city governments to better understand how to plan for climate change impacts and impending natural disasters. It gives local governments information to engage actively in training, capacity building and capital investment programs. It also presents case studies of 13 cities that have begun to address climate change impacts: Albuquerque, Dongtan, Hanoi, Jakarta, London, Makati, Milan, New York City, Rockville, Seattle, Singapore, Tokyo and Venice. These case studies lead to eight strands of sound practice: information, ownership, preparation of climate change strategy, development markets and management systems. These strands are complemented by a further eight strands of mitigation and adaptation practices, concerning the energy sector, transport sector, built environment and densification, forestry and urban greenery, finance and financial mechanisms, infrastructure, water conservation and flooding, and public health.

6. *ESMAP, the Energy Efficient Cities Initiative*, aims to mainstream and scale up sustainable energy actions and climate change mitigation in the urban context. It draws from the work that the World Bank and partners are doing through broad consultation and leverage sustainable energy investments. The program focuses on five activities:

- Development of an *Analytical Framework for Energy-Efficient Cities*, a rapid assessment framework (RAF) for the retrofitting of existing city systems, including six sectors (transport, buildings, water, public lighting, power/ heating, solid waste);
- A Small Grants Program to encourage more initiatives from cities on energy efficiency, ESMAP would provide small grants for cities to test new and innovative pilots without extensive upfront analytical requirements;
- Good Practice Awards;

- Project Development Support. ESMAP would set aside some funds and staff time, supporting perhaps three to five urban lending projects for up to USD 300 000 per fiscal year in cash and staff time; and
  - Outreach and Dissemination.
7. **“Eco<sup>2</sup> Cities: Ecological Cities as Economic Cities.”** The objective of the Eco<sup>2</sup> Cities Program is to help cities in developing countries achieve greater ecological and economic sustainability. Innovative cities from across the world have demonstrated that efforts in pursuing ecological and economic sustainability can significantly reinforce each other. By doing so, such cities have improved their citizens’ quality of life, enhanced their economic competitiveness and resilience, and strengthened their fiscal capacity. The Eco<sup>2</sup> Cities Program has developed an analytical and operational framework that can be adapted by cities in all regions to systematically work toward the positive accomplishments mentioned above.

### **Cities in developed countries**

Innovation can happen and spread in developed country cities for several reasons. First, these cities have access to deep capital markets and turn to bond issuing to encourage the population to participate in the greening of their own city. One example is Albuquerque, New Mexico, which used its domestic capital market for financing its environment and GHG programs, as well as to complement its budget derived from taxes, user fees and national and state grants for targeted projects. This provides the opportunity for local government to better plan and implement, because it can count on a reliable and consistent revenue stream.

Local governments should learn more about municipal finance and develop the capacity to prepare and implement “commercially viable” climate change and hazard management capital projects. In introducing the 2007 General Obligation Bond Program and the 2007-16 Decade Plan, Albuquerque goes to great lengths to educate its population as to what a bond is, why it is useful, and the purposes to which it will be applied. The financial incentives in the form of rebates encourage the public to “Go Green” in Albuquerque. Water rebates for water efficiency, as well as facilitated building permits for green building projects, are attractive to developers. Water rebates, given for converting to modern, efficient appliances and fixtures, cover low-flow toilets, low-water use washing machines, hot water re-circulating systems, rainwater harvesting barrels and multi-setting sprinkler timers.

### **Conclusion**

Cities in developing countries are facing rapid growth, increasing needs for expanded service coverage and the challenge to go green. The success of any program will depend on the existence of technological solutions that will enable developing cities to provide the services to their population with low GHG emissions. Given their limited resources for funding R&D, international co-operation and help from developed cities are essential. Use of carbon trade finance has produced very clear results in many projects, especially those with clear outputs that can be assigned values. The experience needs to be expanded and cities encouraged to develop GHG emission baselines that they could use to promote energy efficiency in buildings, urban form and transportation schemes.

This paper does not address the costs and needs of adaptation. The needs faced by Third World cities to prepare for increased variability of world climate are considerable, and only slowly will countries be able to upgrade their infrastructure and increase their resilience. Fortunately, the stock of positive experiences is increasing and through learning and sharing, many cities will be able to maximise the resources they have at their disposal.



**Table 1.**

City	GHG emissions per capita (t CO <sub>2</sub> e)
Ankara	3.6
Bangkok	10.7
Barcelona	4.2
Beijing	6.9
Bologna	5.7
Cape Town	11.5
Copenhagen	7.5
Miami, Dade County	11.6
Washington, DC	19.7
Denver	19.4
Glasgow	8.4
Hanover	10.6
Heidelberg	7.9
Helsinki	8.3
London	9.6
Los Angeles	13.0
Minneapolis	17.5
New York	10.5
Portland	10.1
Prague	9.3
Rio de Janeiro	2.3
San Jose	8.8
São Paulo	1.4
Seoul	4.1
Shanghai	11.7
Tokyo	4.9
Toronto	11.6

Source: Kennedy C., J. Steinberger, B. Gasson, Y. Hansen, T. Hillman, M. Havránek, D. Pataki, A. Phdungsilp, A. Ramaswami, and G. Villalba Mendez (2009), *Greenhouse Gas Emission Baselines for Global Cities and Metropolitan Regions*, 5<sup>th</sup> Urban Research Symposium, Marseille, June 2009.

### Notes

1. Glaser, Edward L. (2009), "Green Cities, Brown Suburbs", *City Journal*, Vol. 19, No. 1, pp 50-55.
2. World Bank, Carbon Finance Unit – Carbon EXPO, Barcelona, May 2009.
3. Purpose (opas net) [http://en.opasnet.org/w/Assessment\\_on\\_impacts\\_of\\_emission\\_trading\\_on\\_city-level\\_\(ET-CL\)](http://en.opasnet.org/w/Assessment_on_impacts_of_emission_trading_on_city-level_(ET-CL))
4. World Bank (2008), *Climate Resilient Cities: A Primer on Reducing Vulnerabilities to Disasters*, World Bank, Washington DC, [www.worldbank.org/eap/climatecities](http://www.worldbank.org/eap/climatecities)



**SESSION 3-A**  
**BLUE IS THE NEW GREEN:**  
**EMERGING TRENDS IN WATER MANAGEMENT**

## FLOOD RISK ASSESSMENT AND POLICY IN THE NETHERLANDS

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This paper introduces water safety policy in the Netherlands. Water safety considerations are important for water investments, spatial planning and insurance. In order to prevent floods, investments in flood prevention present opportunities that can benefit society by lowering the expected damage of relevant flood scenarios. From an economic perspective, flood damage includes physical damage, production loss, and economic loss resulting from the interruption of communication, infrastructure and trade relations.

The Dutch Ministry of Transport, Public Works and Water Management estimates the number of victims, physical damage and production loss of relevant flood scenarios using a comprehensive flood damage model. However, floods tend to have long-term, indirect effects on labour, housing and product markets as well. The resulting problems in these markets can decrease welfare. The assessment of indirect economic effects of floods appears to deserve improvement.

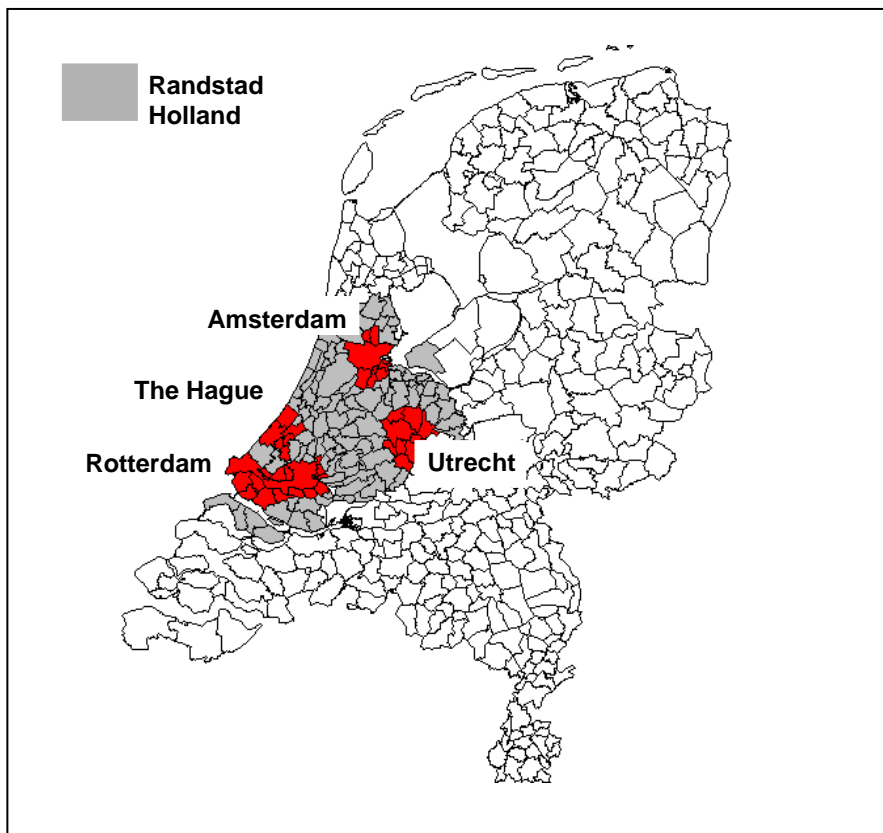
A case study investigates the Greater Rotterdam area. A spatial computable general equilibrium (SCGE) model for the Netherlands, known as RAEM (for Ruimtelijk Algemeen Evenwichts Model or Regional Applied General Equilibrium Model), is applied to assess both physical and indirect effects of relevant flood scenarios in the Rotterdam region. Indirect effects of floods on housing, labour and capital markets can account for about 15% to 55% of total flood damage. These gradually decrease after a flood has occurred, and the detrimental effects subsequently disperse throughout the country. Regions whose economic sectors are comparable to those of the flooded region appear to experience slight economic benefits, because they take over the production loss in the affected region's specialised sectors.

### Introduction

The Netherlands comprises about 40 000 square kilometres of surface area, two-thirds of which is located below sea level. This area comprises the largest four Dutch cities: Amsterdam, Rotterdam, The Hague and Utrecht. These cities (collectively named Randstad Holland) represent the spatial core of the Dutch economy and feature the country's so-called main ports: Schiphol Airport and the Rotterdam harbour. These ports are considered of vital importance to the economy. About 6.7 million people live in the economic core, earning over EUR 250 billion (EUR 38 700 per capita) in 2007 (Manshanden *et al.*, 2009; OECD, 2007). The total capital stock below sea level is roughly estimated at EUR 1 800 billion (Deltacommissie, 2008).

The Netherlands has experienced numerous major floods. The last major flood occurred in 1953, causing 1 853 fatalities and about EUR 0.7 billion of direct physical damage (Botzen and Van den Bergh, 2008). In 1993 and 1995, the areas around the Rhine and Meuse rivers were nearly flooded. Recently, the so-called Delta Commission (Deltacommissie) published policy recommendations for flood protection in the twenty-first century in the face of climate change and its possible consequences for the Netherlands (Deltacommissie, 2008).

**Figure 1. Location of Randstad Holland and its core cities within the Netherlands**



Source: TNO.

This paper deals with flood-risk assessment and policy in the Netherlands. In Section 2, current policy in the Netherlands is discussed, stressing the importance of indirect effects of floods in *ex ante* policy making. Section 3 discusses how economic effects of floods can be estimated. Section 4 describes a case study of the Greater Rotterdam region. Section 5 concludes.

### ***Policy background***

Climate change is commonly divided into two research and policy fields, the first being mitigation and the second adaptation. The first discipline deals with strategies for reducing the pace of climate change by reducing carbon emissions. Adaptation deals with ways to adapt to the effects of climate change and is of central interest to the Dutch authorities. The Netherlands has a long tradition of protecting its land area from the sea and rivers, its water management boards (*Waterschappen*) being the oldest governing bodies in the country.

In the context of adaptation, climate change involves two types of cost that are expected to decrease societal welfare: the costs associated with damage resulting from climate change and the costs associated with preventing the consequences of climate change. One of the decisive elements in the latter cost category in the Netherlands is the increased probability of floods, especially in urban areas with low elevation levels. Optimal water safety policy minimises the sum of the two associated cost categories: the cost associated with preventing floods and the cost resulting from floods (Eijgenraam, 2005).

The following subsections describe water safety policy, spatial policy and insurance issues from a flood risk perspective. A common factor in these three policy fields is a strong tendency to focus on limiting probabilities of flooding while relying on innovative yet expensive technical solutions, as well as limited integration of water safety within other policy disciplines. The attention for cost-benefit considerations, the potential contribution of private insurance to efficient reduction of flood risk as well as *ex post* evacuation and recovery policy is relatively limited.

### ***Water safety policy***

The damage associated with floods is expected to increase due to climate change as well as (predominantly) future economic growth. Flood risk can be described as the annual flood probability multiplied by the expected damage floods will cause in the inundated region. Flood probabilities are used to define the legal minimum safety standards of dikes. Water management authorities (mainly the water management boards and national government organisations) are assigned the task of keeping the protection levels above these minimum requirements. A relatively new phenomenon is managed re-alignment. This entails providing rivers with more space to retain water, thereby lowering the likelihood of floods in times of high water discharge. These policies, dating back to the high waters of 1993 and 1995, are believed, together with traditional dike construction, to offer the best way of dealing with the expected increase in flood probability due to climate change. The main objectives of managed re-alignment initiatives were greater water system resilience, improved coherence between water policy, nature conservation and spatial planning, and the involvement of relevant stakeholders.

Flood risks differ among so-called dike rings (comprehensive protection system areas), according to population density and capital stock. The Netherlands consists of 53 dike rings. Flood probabilities per dike ring were first identified by the Delta Commission in 1960. This commission was installed to evaluate flood policy as a response to the catastrophic flood of 1953. The resulting flood probability norms were between 5 and 100 times stricter than those prevailing before the flood of 1953, with return periods between 500 and 10 000 years. By international comparison, these norms can be considered relatively strict. For example, in the United Kingdom, return periods of 1/100 are applied (Pearce and Smale, 2005).

**Table 1. Flood risk norms and estimated actual flood risk 2005 and 2020 (dike rings not matching the norm in bold), risk = 1/estimate**

	Dike ring	Legal norm	Actual estimated probability 2005	Current policy estimate 2020
1	Schiermonnikoog	2 000	5 000	5 000
2	Ameland	2 000	5 000	5 000
3	Terschelling	2 000	5 000	5 000
4	Vlieland	2 000	5 000	5 000
5	Texel	4 000	10 000	10 000
6	Friesland en Groningen	4 000	10 000	10 000
7	Noordoostpolder	4 000	5 000	10 000
8	Flevoland	4 000	5 000	10 000
9	Vollenhove	1 250	<b>1 000</b>	2 000
10	Mastenbroek	2 000	2 000	5 000
11	IJsseldelta	2 000	2 000	5 000
12	Wieringen	4 000	10 000	10 000
13	Noord-Holland	10 000	10 000	20 000
14	Zuid-Holland	10 000	100 000	20 000
15	Lopiker- en Krimpenerwaard	2 000	<b>1 000</b>	5 000
16	Alblasserwaard en Vijfheerenlanden	2 000	<b>500</b>	5 000
17	IJsselmonde	4 000	100 000	20 000
18	Pernis	10 000	20 000	20 000
19	Rozenburg	10 000	20 000	20 000
20	Voorne-Putten	4 000	<b>500</b>	10 000
21	Hoeksche Waard	2 000	20 000	5 000
22	Eiland van Dordrecht	2 000	2 000	5 000
23	Biesbosch	2 000	<b>200</b>	n/a
24	Land van Altena	2 000	<b>1 000</b>	5 000
25	Goeree-Overflakkee	4 000	10 000	10 000
26	Schouwen Duivenland	4 000	10 000	10 000
27	Tholen en St. Philipsland	4 000	10 000	10 000
28	Noord Beveland	4 000	10 000	10 000
29	Walcheren	4 000	10 000	10 000
30	Zuid Beveland west	4 000	10 000	10 000
31	Zuid Beveland oost	4 000	10 000	10 000
32	Zeeuwsch Vlaanderen	4 000	10 000	10 000
34	West-Brabant	2 000	5 000	5 000
34a	Geertruidenberg	2 000	5 000	5 000
35	Donge	2 000	5 000	5 000
36	Land van Heusden/de Maaskant	1 250	<b>1 000</b>	2000
37	Nederhemert	1 250	<b>1 000</b>	n/a
38	Bommelerwaard	1 250	5 000	2 000
39	Alem	1 250	<b>1 000</b>	n/a
40	Heerewaarden	500	500	n/a
41	Land van Maas en Waal	1 250	<b>500</b>	2 000
42	Ooij en Millingen	1 250	5 000	5 000
43	Betuwe, Tieler-en Culemborgerwaarden	1 250	<b>500</b>	2 000
44	Kromme Rijn	1 250	100 000	50 000
45	Gelderse Vallei	1 250	100 000	100 000

**Table 1. Flood risk norms and estimated actual flood risk 2005 and 2020 (dike rings not matching the norm in bold), risk = 1/estimate (continued)**

	Dike ring	Legal norm	Actual estimated probability 2005	Current policy estimate 2020
46	Eempolder	1 250	2 000	2 000
47	Arnhemse-en Velpsebroek	1 250	50 000	50 000
48	Rijn en IJssel	1 250	10 000	5 000
49	IJsselland	1 250	500	5 000
50	Zutphen	1 250	1 000	5 000
51	Gorssel	1 250	500	5 000
52	Oost Veluwe	1 250	2 000	2 000
53	Salland	1 250	1 000	2 000

Source: Deltares

In a 2005 inspection, a number of dike rings could not be proven to fulfil the legal safety requirements (about 25% of the water defence system was judged to have insufficient or uncertain safety levels in terms of return periods). Extensive maintenance and improvement is planned for the period until 2020. Many dike rings are therefore expected to show improvement with respect to their respective safety levels. Still, the effects for Dike Rings 23 (Biesbosch), 37 (Nederhemert), 39 (Alem) and 40 (Heerwaarden) remain unknown.

In 2008, a new Delta Commission identified policy options for the twenty-first century in response to expected climate change, advocating a tenfold increase in return period criteria for dikes, as well as the use of 1.3 metres expected sea-level rise as a reference for the year 2100 (Deltacommissie, 2008). An agreement was signed between the central government and water boards to improve the protection level so as to meet safety requirements by 2015.

Multiplying flood probabilities by expected flood damage results in estimations of flood risks. Expected flood damage is based on current practice in cost-benefit analysis, for which a comprehensive standard is used in the Netherlands. Evaluation of costs and benefits according to this standard is compulsory for national transport investments (Ministry of Transport, Public Works and Water Management, 2000). Economic effects of flooding are divided in a manner similar to the standard for cost-benefit analysis, featuring direct physical effects, direct production effects and indirect effects, respectively.

Direct effects are the first-order effects of floods. Direct effects of flooding scenarios are physical damages based on replacement costs. Direct production effects concern loss of value added due to flooding. Indirect effects are second-order effects due to flooding on product, labour and housing markets. These effects only affect societal welfare if a flood results in a change in market imperfections, *e.g.* when a housing market in a neighbouring region of the inundated area clears because of a flood.

### ***Spatial policy***

Flood risk depends on spatial planning in various ways. First, the way river water discharge is accommodated is important for flood probability and damage. The high waters of 1993 and 1995 showed that the approach until then was not sufficient to deal with extreme water discharges. A different approach was chosen, mainly entailing that rivers should be provided space. Moreover, anticipation of risks should govern policy instead of having policy react to water problems as they occur (Brouwer and Kind, 2005).



This has led many water boards to identify water retention areas, mainly in agricultural environments. Generally, identifying these areas has not caused major spatial problems. However, in urban areas like Rotterdam and Dordrecht, it is not always easy to deal with flood risk while simultaneously preserving urban and heritage space, as in the case of the old centre of Dordrecht next to the mouth of the Hollandsch Diep. Furthermore, spatial planning by the central government has not integrally incorporated future climate change, identifying local bodies of government as the main stakeholders in urban planning. It is not clear whether this rather dispersed way of governing urban policy takes sufficient account of the risk of floods. For example, new built-up areas have been constructed in areas located six metres below sea level, such as the Zuidplaspolder area east of Rotterdam.

Second, urban planning determines the amount of value that is protected by dikes. The Scientific Council for Government Policy (WRR) has indicated that economic growth is a central source of future flood damage for this reason (WRR, 2006). Future land use accommodation is highly determinative of damage in relevant flood scenarios. In economic and spatial scenario studies for the Netherlands (WLO, 2006) Geographical Information System (GIS)-based maps of future land use for 2040 are used for both a trend scenario and a high-growth scenario. This map system is called Ruimtescanner. In the trend scenario, the bulk of future urban development will occur in the flood-prone area of Randstad Holland. Some alternative development scenarios were identified. These entail mainly refraining from building new housing in dike rings with high flood probabilities, shifting investment to higher elevated areas in the Netherlands (predominantly to the east of the country), and offensive protection of the economic core in Randstad Holland by extending the coastline 5 kilometres westward (MNP, 2007). From an economic point of view, the third scenario appears the most promising, as economic cores appear geographically constant over time, implying that moving economic activity out of the core incurs high societal cost. Reducing flood probability appears preferable to decreasing potential flood damage below sea level.

Still in question, however, is what the relative influence of future climate change on flood damage will be. Water speed and maximum water depth in inundated areas are the principal determinants of damage. Sea and river level rise can be protected by higher and wider dikes, but the risk of floods will never be eliminated. Floods will eventually feature increased water speed and depth. Sea-level rise and river discharge are therefore important determinative factors for flood damage.

Other determinative factors include such considerations as land subsidence in the west of the country and dependence on water safety spatial policy in neighbouring countries, especially Germany. Land subsidence occurs in the north of the Netherlands because of gas drilling, and in the west of the country because of agricultural exploitation of peat soil. The subsidence can range up to 1 or 2 centimetres per year, which in the long term adds significantly to flood damage. A related problem is that subsidence necessitates improvement of dikes, which in itself causes subsidence.

Dutch water discharge norms are currently stricter than those in Germany. Given Germany's current water safety policy, extreme high water discharges will cause floods in the Ruhr area before they occur in the Netherlands, and all the water involved will be prevented from reaching the Netherlands. Increased severity of the norms in Germany would have consequences for discharge patterns in the Netherlands, encouraging the governments involved to co-ordinate relevant flood policies.

### ***Insurance***

Flood protection is considered a public good, since no individual can be excluded from enjoying its benefits. Moreover, flood protection is universally beneficial: up to a certain point, flood protection for one individual does not take away from its usefulness for others. Individuals are typically reluctant to pay for flood protection, making it difficult for private firms to provide it. Flood protection is completely provided by central government and water boards in the Netherlands. Flood risk cannot be privately insured, as the

central government compensates flood damage based on legislation, crowding out private market initiative (Botzen and Van den Bergh, 2008). Comparisons of protection options to insurance options present a rather new element in Dutch water safety evaluation. Comparing protection cost, expected flood damage and insurance premiums (should insurance be possible) can help to illuminate optimum policy choices.

The main reasons why private insurance companies avoid insuring flood damage appear to be incomplete measurement of expected damage (which insurance companies need to determine insurance premiums), the existence of a large number of dependent risks due to the spatial composition of the Netherlands, and the possibility of moral hazard (for example, new real estate in areas far below sea level) (Pearce and Smale, 2005). On the other hand, no realistic scenarios exist in which the whole of the Randstad Holland region floods, limiting the size of dependent risks. Moreover, insurance of flood damage can contribute to sharing risks among a multitude of policy holders and providing citizens with incentives to reduce losses of eventual floods. Insurance entails the contractual right to compensation, whereas current government compensation depends on public pressure and political preferences, which can be considered quite arbitrary (Botzen and Van den Bergh, 2008).

### **Assessing economic effects of floods**

Assessing the economic effects of floods has only been partly successful in forecasting potential flood damage. The range of future changes in flood risk caused by expected climate change, economic development and spatial planning appears large, indicating the existence of large knowledge gaps and uncertainty concerning the impact of relevant future trends. Despite the obvious importance of future economic growth (WRR, 2006), it remains unclear whether future climate change or economic growth will cause the largest increase in monetary flood risk (Koops *et al.*, 2008).

Whereas direct effects of floods are well documented and assessed, indirect effects are usually derived applying fixed coefficients to direct effects. Effects such as the aforementioned depression on real estate prices due to adaptive expectations, effects of government-initiated recovery plans and labour market effects are usually not explicitly and independently assessed, focusing the modelling exercise on interruption of supply and demand of intermediary goods in regions close to the flooded area. This appears strange, since indirect effects can have dramatic consequences at the regional and local level. Tentative studies also point to persistent decreases in real estate value in regions after floods (Daniels *et al.*, 2006). Secondly, expected indirect effects are important determinants of *ex ante* policy. For example, the indirect effect of interrupted transport and communication networks is important for determining evacuation and recovery plans. Moreover, recovery initiatives by the central or local government can exert a large influence on post-flood regional economic development.

For complete assessments of flood damage, multiple steps have to be taken. A first step involves assessing expected climate change for the Netherlands, including resulting weather patterns. Secondly, weather pattern forecasts will have to be translated into physical effects on dike-ring areas, resulting in changes in flood probabilities for areas on a regional scale. A third step deals with translating expected economic and spatial development into expected damage. Once these steps are taken, relevant flood scenarios (Ministry of Transport, Public Works and Water Management, 2006) can be modelled and run to calculate expected annual flood risk change. However, all these steps involve considerable uncertainty with regard to future development (Jonkhoff, 2008).

### ***Direct effects***

Direct effects are mainly the first-order effects of floods: victims and damage to property as production loss. Assessment of direct effects is based on the standard flooding information system used by Dutch water authorities, called *Hoogwater Informatie Systeem*. Its damage and victims module (*Schade en*

*Slachtoffer Module* or HIS-SSM) estimates the damage that might occur due to a flood with a variable rate of water flow and water depth based on flooding scenarios (Ministry of Transport, Public Works and Water Management, 2006). This system also shows the weakest links of a dike ring, as well as potential damages from flooding and the effects of different policy options. HIS-SSM takes into account all sorts of physical damages and fatalities, providing detailed and comprehensive overviews of direct effects of floods. However, the HIS-SSM system assumes a linear increase in indirect effects based on direct effects.

HIS-SSM has been applied to evaluate large national research projects. Water boards, provinces, ministries and economic policy boards like the Central Planning Bureau are frequent users of the information system, which is maintained by the directorate for roads and water constructions of the national infrastructure management institute Rijkswaterstaat (RWS-DWW).

HIS-SSM provides the user with approximations of damage of floods featuring different water depths, speeds of water flows and speeds of water level increases. The model uses 100 by 100 metre rasters to provide geographically detailed projections. For any given raster and economic item, a maximum damage amount is available. The damage function then calculates the percentage of maximum damage that will occur based on the relevant flood scenario. The model uses very detailed datasets as information sources with regard to land use, infrastructure, housing, employment and locations of firms by sector.

The flooding scenarios HIS-SSM uses consist of Geographical Information System (GIS) raster information. Types of flood damage are provided consistent with national cost-benefit practice, identifying the following types of damage:

- *Direct damage*: damage to economic objects, capital goods and moving goods because of contact with water;
- *Production loss*: direct damage due to business loss where production is interrupted;
- *Indirect damage due to production loss*: damages to companies involved in supply and demand outside the flooded dike-ring through loss of sales, plus damage due to loss of supply and demand infrastructure based on travel-time losses.

However, some damage categories are excluded from the HIS-SSM system. The main components are recovery cost, interruption of energy and communication, welfare loss in land, labour and housing markets, and numerous non-priced effects such as injuries, non-tangible damage, societal disruption, loss of environmental values, and environmental damage (Jonkhoff *et al.*, 2008). Recovery cost, energy and communication interruption and welfare loss in land, labour and housing markets are indirect effects, which can be assessed separately.

### ***Indirect effects***

Indirect effects concern second-order, rather long-term effects of floods. These effects include the effect on product, labour, housing and land markets, commuting, and public recovery initiatives. Spatial computable general equilibrium (SCGE) modelling can be used to assess the indirect effects such as supply chain changes outside the affected region, labour market adjustment, migration, real estate price changes, and the effects of government responses to floods.

SCGE models are typically comparative static equilibrium models of interregional trade rooted in micro-economic theory, using utility and production functions with substitution between inputs. These models are part of the New Economic Geography (NEG) school (Fujita, Krugman and Venables, 1999) and have been around for less than a decade.

The RAEM model is a spatial general equilibrium (SCGE) model for the Netherlands. It models the Dutch economy for 40 NUTS3 (Nomenclature of Territorial Units for Statistics, in French *nomenclature d'unités territoriales statistiques*) regions and 15 economic sectors. For all regions and sectors, the complete economic system is modelled with markets for production, labour, capital, consumption, investments, housing and trade. The circular flow of income results in interdependency of all markets. The model consists of a micro-economic basis where equilibrium demand meets supply under rational behaviour of economic agents. The RAEM model consists of three economic agents: households, firms and the government. Households and firms in each region and sector are modelled by a representative agent. For each region and sector, all individual agents act according to the representative agent. That means that for each region and sector, all firms and households are identical. The government is a special economic agent. Like other economic sectors, the government sector purchases goods and services from different economic sectors. But the government also collects taxes and pays benefits to the unemployed, and finances infrastructure projects. An extensive description of the technical details of the RAEM model is given in Ivanova *et al.* (2007).

**Figure 2. The Netherlands divided into 40 NUTS3-regions for assessment of indirect effects**



Source: TNO.

The RAEM model uses input from the HIS-SSM model to assess indirect effects of floods. The RAEM model has been designed and applied for policy evaluation of investments in infrastructure in the Dutch national cost-benefit analysis framework (see *e.g.* Snelder, Koops and Ivanova, 2008). Cost-benefit analysis following this framework is compulsory for evaluation of major investments in infrastructure (Ministry of Transport, Public Works and Water Management, 2000). An NEG model, such as the RAEM model, is recommended to calculate indirect effects in Dutch transport investments (Ministry of Transport, Public Works and Water Management, 2004). Indirect effects are additional costs and benefits for producers and consumers because of the direct benefit on the transport market. In order to qualify as an

additional indirect effect and not a passed-on direct effect, some kind of market imperfection or interaction with countries abroad should exist (Oosterhaven *et al.*, 2005). Examples of market imperfections are taxes and benefits, limited labour mobility, economies of scale, product differentiation and knowledge spillovers.

The RAEM model can be used to model floods as disinvestments in the economy, resulting in estimations for the total damage of floods as well as indirect effects: recovery cost, energy and communication interruption, and welfare losses on land, labour and housing markets. However, a distinction will have to be made between the short, intermediate and long term to obtain a full view of indirect effects.

The initial RAEM model calculates indirect effects concerning:

- supply and demand for firms outside the inundated area
- loss of transport connections
- loss of energy, water and communication networks
- feedback effects on labour and housing markets

However, to identify indirect effects in a comprehensive way, the model input can be expanded. First, since floods influence the availability of land to a large extent with only few substitutes, land should be explicitly added to the production process assessment, apart from labour and capital.

Secondly, capital can be subdivided in fixed and flexible capital. Firms' capital stocks comprise flexible capital, which can flow freely to alternative production locations, while part of the capital (mostly the physical capital stock) is fixed. Considerable differences exist between sectors in their relative shares of flexible and fixed capital, and some sectors are able to respond more smoothly to floods than others. The greater the adjustment capability of a sector, the lesser the extent of flood damage. In general, services sectors adjust more easily to floods than agriculture and manufacturing sectors. Tangible fixed assets as well as stocks are considered fixed capital, while intangible fixed assets, short- and long-term liabilities, shares and liquid assets are part of flexible capital.

Third, a housing market can be added to the model, assuming the housing stock to be exogenous. A flood constitutes a shock leading to an exogenous decrease of the housing stock in the affected region, negatively impacting household utility.

Fourth, a distinction can be made between short-, medium- and long-term equilibrium. RAEM enables calculation of effects in the short term (until one year after a flood), medium term (one to three years after the flood) and long term (over three years after the flood). In the short term, no adjustment mechanisms like the ones identified above occur. For example, households in the affected area lose their dwellings, and unemployment occurs due to production loss. In the medium term, labour and housing markets find new equilibriums due to adjustments in commuting and migration by affected households and firms. In the long term, (fixed) capital markets find new equilibriums as firms reconsider their investments.

The input for the RAEM model is derived from the following damage components in the HIS-SSM model:

- **Loss of capital:** direct damage to firms per sector is derived from HIS-SSM. Loss of capital as a production factor causes less production, as well as lower efficiency of production. However, in RAEM, firms can apply land and labour as substitute production factors.

- **Land use:** Based on the relevant flood scenario, the amount of land use per function that is lost is known. Subsequently all land with water depth over 1 metre is assumed to be lost for functional use. Similarly to capital loss, land use loss leads to decreased production as well as lower efficiency of production while substitution options for firms exist.
- **Housing:** HIS-SSM provides the loss in housing stock. Inundated dwellings were assumed to be permanently withdrawn from the total housing supply in RAEM.
- **Labour:** HIS-SSM calculates the number of victims floods incur. These are all assumed to be part of the labour force, reducing a region's labour force by equal numbers.

RAEM generates results in terms of total effects and indirect effects per region in Euros.

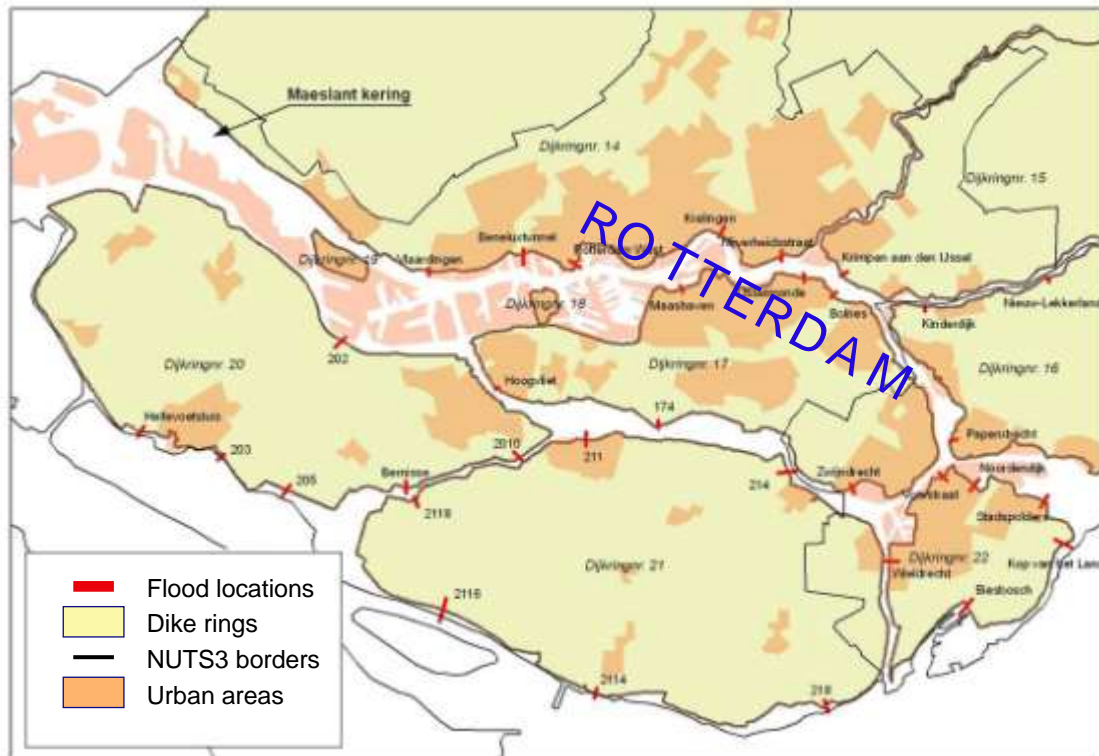
## **Case: Greater Rotterdam**

### *Case description*

The Greater Rotterdam area is located in the southwest of the Netherlands to the south of the urban Randstad Holland region. Greater Rotterdam comprises the city of Rotterdam (600 000 inhabitants) and its neighbouring communities (Vlaardingen, Schiedam, Capelle, Ridderkerk, Dordrecht, Barendrecht, Spijkenisse). Nearly 10% of the Dutch population (about 1.5 million people) live in the area. The region features some polders with elevations of as low as 6 metres below sea level, notably to the northeast of Rotterdam. The region also has the largest harbour in Europe. The urban areas are protected from the sea and rivers by major water defence works like the Maeslantkering – a removable dam in the mouth of the harbour. Normally, the dam is open, but in extreme weather, it can be closed. The Maeslantkering forms the finishing project of the Delta works (Deltawerken) initiated after the major flood disaster in 1953. So far, the dam has been closed only once.

To estimate the damage of floods with HIS-SSM and RAEM, about 25 floods in the Greater Rotterdam area (see the red bars in Figure 3) were simulated. The locations of the simulated floods are based on Ministry of Transport, Public Works and Water Management (2006). In this study, an inventory is made of the weak parts of dike rings in the Netherlands. At the weak points, the dikes were assumed to fail. The total damage, the number of victims and the flooded area for each flood were calculated applying HIS-SSM. For each dike ring, about six floods were simulated. For the estimation of the short-, intermediate- and long-run economic damage of the floods with the RAEM model, we assume an average flood for each dike ring based on the HIS-SSM results. Also, it was assumed that the flood took place in 2008 and a flood period of two months. The results concern a total of seven dike rings (Dike Rings 14, 15, 16, 17, 20, 21 and 22).

Figure 3. Overview of flood simulations in the Greater Rotterdam area



Source: TNO.

## Results

In this section, results are illustrated for Dike Ring 15 (Lopiker-en Krimpenerwaard) east of Rotterdam. We refer to the appendix for the results of the other dike rings. Based on HIS-SSM, the total damage of an average flood in Dike Ring 15 is EUR 3.2 billion. More than 95% of the damage in HIS-SSM is physical damage. Economic damage (production loss in the flooded area and indirect effects) is rather limited. The RAEM model calculates the economic damage during and after the flood. To avoid double counting of economic effects during the flood, we only take RAEM results for economic effects into account for the total flood damage. The addition of economic effects in the intermediate and long run leads to an increase of total flood damage by over 50% (to EUR 4.9 billion). A flood leads to permanent loss of production factors and a re-allocation of the production process, causing permanent loss of welfare.

**Table 2. Total damage of an average flood in Dike Ring 15 in 2008, in million euros**

Damage category	HIS-SSM	RAEM	Total (HIS-SSM+RAEM)
Physical damage	3.074	x	3.074
* housing	1.833	x	1.833
* infrastructure and public works	590	x	590
* business sites	652	x	652
Economic damage during flood period	133	163	163
Economic damage in intermediate and long run (years 2009-2100)	x	1.670	1.670
<b>Total damage</b>	<b>3.207</b>	<b>1.833</b>	<b>4.907</b>

Note: <sup>a</sup> x = not calculated.

Source: TNO.

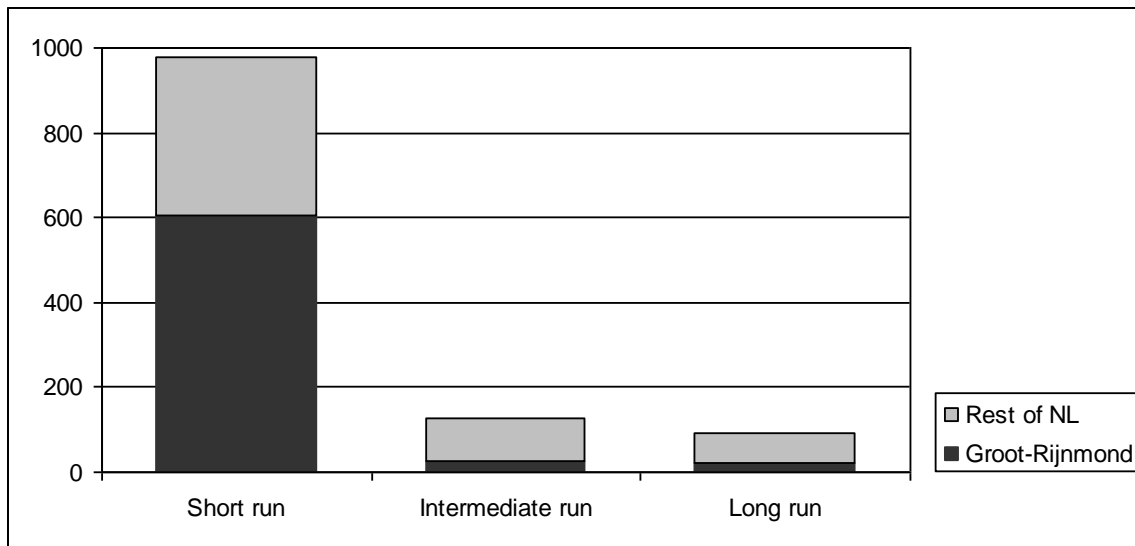
The economic damage in the intermediate and long run is calculated by the net present value of the estimated damage per year, applying an annual discount rate of 5.5%. The discount rate is based on the Dutch standard for cost-benefit analysis (Ministry of Transport, Public Works and Water Management, 2000), which is currently 2.5%, plus a risk premium of 3%. The intermediate run is assumed to last three years, in this case the years 2009, 2010 and 2011. The long run is assumed until 2100, so for the long run, we take the 2012-2100 period.

The direct effects of an average flood in Dike Ring 15 amount to EUR 3.2 billion, which is inclusive of economic damage (production loss) during the flood. Indirect effects add another EUR 163 million of economic damage during the flood (in the other Dutch regions), as well as nearly EUR 1.7 billion in the intermediate and long term, with total damage estimated EUR 4.9 billion. It should be emphasised that these results apply to an average flood scenario. Many differing flood scenarios exist (Ministry of Transport, Public Works and Water Management, 2006). The total damage of floods can amount up to tens of billions of Euros (Jonkhoff *et al.*, 2008).

In Figure 4, the distribution of economic damage between the flooded area (region Groot-Rijnmond) and the rest of the Netherlands is shown. The distribution is based on the welfare of households measured by equivalent variation. Equivalent variation is the monetised utility difference for households and is a commonly used welfare measure in a general equilibrium framework (Koops *et al.*, 2008). On the short run, 62% of the damage occurs in the flooded region Groot-Rijnmond. More than 35% of the damage ends up in the regions that did not directly suffer from the flood. Examples include residents of non-flooded regions who work in Groot-Rijnmond, or firms that buy or sell goods and products in Groot-Rijnmond. In the intermediate and long run, the regional distribution of the damage disperses over the Netherlands. Groot-Rijnmond has a share of about 20% to 25% of the total damage in the intermediate and long run.



**Figure 4. Annual economic damage of an average flood in Greater Rotterdam (Groot-Rijnmond) area in the short, intermediate, and long run; divided into flooded region and rest of the Netherlands, in million Euros**

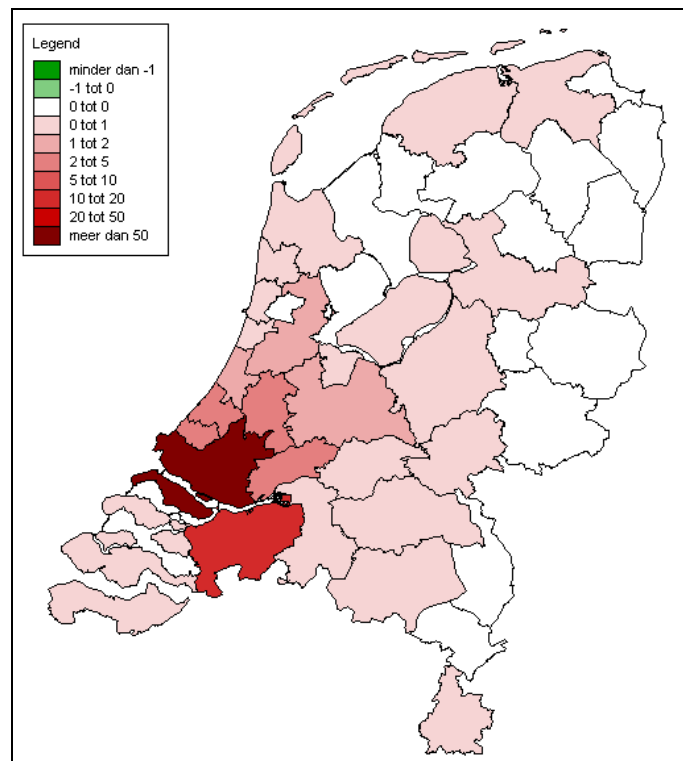


Source: TNO.

In the following figures, the regional distribution of flood damage is given for all regions. About 62% of total welfare loss is allocated in Groot-Rijnmond (Greater Rotterdam). Also West Noord-Brabant (12.8%) and other nearby regions like Delft and Westland (4.6%), Zuidoost Zuid-Holland (3.3%) and Oost Zuid-Holland (3.2%) experience welfare losses. A share of the inhabitants of these regions commute to the flooded area and are temporarily out of work. Trading partners of firms in the flooded area also face welfare loss because of loss of demand and/or intermediate inputs.

Figure 5A shows that adjustments in the labour and housing market result in a decrease of annual flood damage of 85% to 90%. Flood damage in the short run, *i.e.* the economic damage of a flood in Dike Ring 15 that would last for a whole year, is EUR 978 million. Adjustments in the capital market lead to an additional decrease of annual economic damage of about 15%.

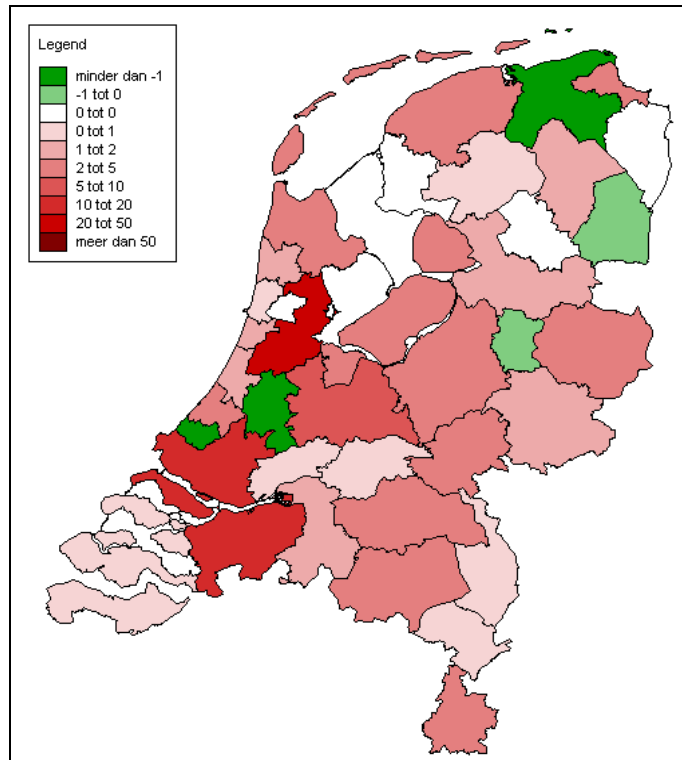
**Figure 5A. Percentage regional distribution of flood damage of a flood in Dike Ring 15 in the short run (Netherlands = 100%)**



Source: TNO.

In the intermediate run (figure 5B), some regions benefit from the flood because of distribution effects, albeit marginal. The regions of Delft and Westland and Oost Zuid-Holland, two small regions near Groot-Rijnmond, show the largest benefits (just over 1% of total national damage). In the intermediate run, the labour and housing market will be cleared. Production restarts in the flooded area (with loss of capital and land). People can decide to migrate or commute to other regions. The competitiveness of regions close to the flooded area increases and a demand shift takes place.

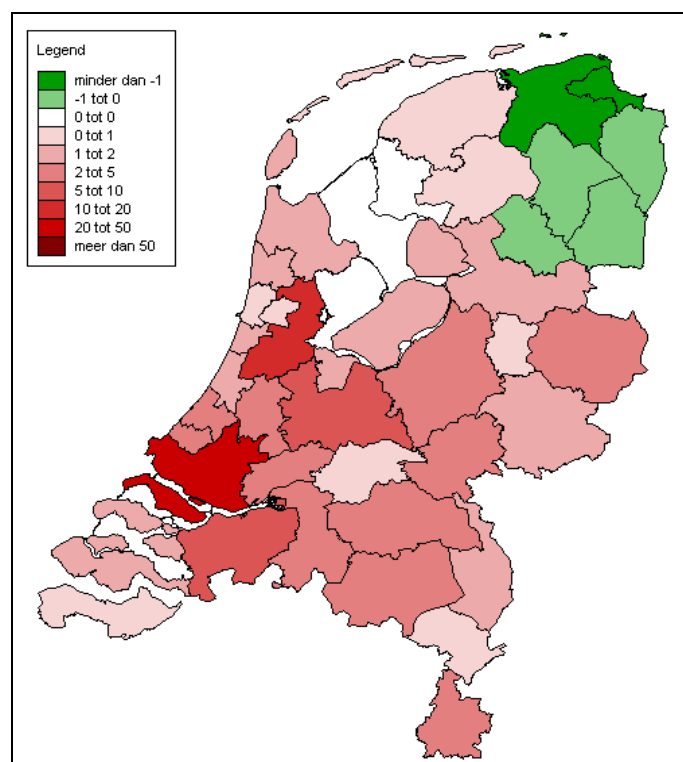
**Figure 5B. Percentage regional distribution of flood damage of a flood in Dike Ring 15 in the intermediate run (Netherlands = 100%)**



Source: TNO.

In the long run (after capital adjustments, figure 5C), all regions close to the Groot-Rijnmond region experience welfare loss. The northern part of the Netherlands benefits, albeit only slightly. The main reason for this is that chemical and harbour activities in Groot-Rijnmond move to the north of the country. Both the northern regions and Groot-Rijnmond have a large chemical cluster and sea harbours. The loss of production factors in Groot-Rijnmond leads to a lower return on investment of capital in this region. However, the size of the welfare gains in the benefiting regions remains small. About a quarter of total welfare loss in the long run takes place in the flooded region Groot-Rijnmond.

**Figure 5C. Percentage regional distribution of the flood damage of a flood in Dike Ring 15 in the long run (Netherlands = 100%)**



Source: TNO.

The results need a few qualifications, since two assumptions may lead to an over-estimation of total economic damage. First, it was assumed that all damage to production factors is permanent and irreversible. Input for the RAEM model consists of loss of capital, labour, land and dwellings. The loss of labour is based on the number of victims and can be considered irreversible. However, the loss of capital is over-estimated because we do not take the natural depreciation of capital into account. Second, we assume that all dwellings in the flooded area will be demolished. This appears unrealistic, because a share of the houses can probably be recovered.

Bearing these considerations in mind, the results show that taking explicit account of indirect economic damage after the flood may lead to a significant increase of the total damage estimate. The exercise shows that total damage of HIS-SSM increases by 15 to 55%, depending on the location and size of the flood. A larger size of the flood and/or an economically more important flooded area results in a larger increase of total damage.

### **Concluding remarks**

Climate change has uncertain consequences for countries of low elevation like the Netherlands. It is therefore imperative to gather as much reliable information on possible effects of phenomena like floods induced by climate change. Complete assessment of the effects of floods is beneficial for *ex ante* policy with regard to water safety, spatial planning, insurance, as well as *ex post* evacuation and recovery strategies. Focusing policy on *ex ante* flood probability reduction may ignore uncertainties inherent in future flood risk. Simultaneously, a focus on the physical damage of floods may lead to under-estimations

in total damage projections because intermediate and long-term economic damage after the flood period are not explicitly assessed.

We argue that due to loss of production factors, capital, land and labour and due to loss of dwellings, a permanent loss in welfare occurs that differs according to the way regionally interdependent markets function. Simulations for flood scenarios in the Greater Rotterdam area show that total damage estimated by the HIS-SSM model increases by 15% to 55%, depending on the location and size of the flood. For the Randstad Holland region, flood damage ranges from a few million to tens of billions of Euros. A flood can be regarded as a spatial disinvestment leading to regional re-allocation of economic activity. Households can choose to migrate or search for new job opportunities. Firms can choose to re-allocate capital investments. This way, the welfare effects of floods are tempered in the intermediate and long term, and the damage becomes increasingly regionally dispersed. Regions other than the affected area can even experience small positive welfare effects, depending on sector likeness with the inundated region.

The regional component in indirect effects estimation allows for improved spatial planning of built environments, for example when dealing with decisions to build in areas below sea level. Although policies to relocate economic activity to areas outside the Randstad Holland region do not appear economically sound, relocation of housing initiatives within the cities comprising Randstad Holland seems promising. In this respect, further integration of water policy and spatial policy is required.

Complete assessment of the damage inflicted by floods is also necessary for insurance purposes. Insurance can provide improved risk-sharing opportunities between those at risk, limiting moral hazard by offering citizens incentives to reduce their own flood risks. However, a full understanding of the damage associated with floods is necessary so that insurance companies can forecast their potential effects under worst-case scenarios. Insurance companies use worst-case damage assessments to evaluate the degree to which risks can be insured, and comprehensive assessment of potential flood damage contributes to better insurability of flood risk. Since it is currently not possible to insure flood risk in the Netherlands while government puts an emphasis on citizens' own responsibility, this topic deserves more policy attention.

Further research is needed on the time span of floods, the impact on real estate values, adjusted (migratory) behaviour of individual households and firms and the effect of public recovery plans. The adjustment behaviour of economic agents after a flood is highly uncertain. However, it has a large impact on the regional economic welfare effects of a flood and hence on *ex ante* policy evaluation. Further research should contribute to answering the following questions. Do households and firms change their attitude towards flood risks after a flood? How do they adjust their economic behaviour? What will firms do with long-term investments in vulnerable flood areas? And finally, what is the additional damage when government recovery investments do not take place or are delayed?

## APPENDIX A: RAEM SCGE RESULTS FOR ALL DIKE RINGS

In Table A1, the RAEM results are given for seven dike rings in the Greater Rotterdam area. The short-run results for RAEM are given in the first column. In the last column, the net present value of the short-, intermediate- and long-run results are presented. It is assumed that the flood takes place in 2008 and lasts two months. The intermediate run takes three years.

**Table A1: Total economic damage of an average flooding scenario for each dike ring in 2008, in million Euros**

Dike ring	Total economic damage during flood <sup>a</sup>	Total economic damage 2008-2100 <sup>b</sup>
Dike Ring 14	-73	-2 979
Dike Ring 15	-163	-1 833
Dike Ring 16	-118	-926
Dike Ring 17	-6	-72
Dike Ring 20	-2	-25
Dike Ring 21	-7	-54
Dike Ring 22	-36	-534

Notes: <sup>a</sup> Flood period is two months. <sup>b</sup> Based on the net present value of annual damage in the period 2008-2100 and a discount rate of 5.5%.

Source: TNO.

In Table A2, the annual damage is shown on the short, intermediate and long run for all dike rings. Based on the results of Table A2, the net present value of Table A1 is calculated.

Note that RAEM did not solve the long-run results for Dike Rings 14, 16, 20 and 21. For these dike rings, it is assumed that the long run damage of a flood is 85% of the intermediate run results of the same dike ring. This percentage is based on the results for Dike Rings 15, 17 and 22.

**Table A2: Yearly damage of an average flooding scenario for each dike ring in the short run, intermediate run and long run, in million Euros**

Dike ring	Short-run damage	Intermediate-run damage	Long-run damage <sup>a</sup>
Dike Ring 14	-440	-176	x
Dike Ring 15	-978	-107	-85
Dike Ring 16	-2.831	-195	x
Dike Ring 17	-36	-4	-3
Dike Ring 20	-11	-1	x
Dike Ring 21	-43	-3	x
Dike Ring 22	-859	-113	-104

Note: <sup>a</sup> x = RAEM did not solve.

Source: TNO.

### Notes

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**GREEN CITIES: NEW APPROACHES TO CONFRONTING CLIMATE CHANGE:  
THE VENICE EXPERIENCE**

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Coastal zone management has been a focal issue in Venice since its early days, and it continues to be relevant to the survival of the city in a period of climate change and sea-level rise. The historic centre of Venice and its lagoon would not exist if several man-made interventions had not modified and safeguarded its entire ecosystem over the centuries.

Venice and its lagoon can be considered a paradigmatic example of how governments and governance procedures can address the global challenge of maintaining the urban environment through sustainable development, particularly on the front lines of environmental management.

Several projects are in place in the Venice area to cope with the challenge of preparing the city for foreseeable climate change impacts, and to help avoid subsidence and exacerbation of flood risk. They include:

- the “Mose System”, to defend the city of Venice from high waters;
- the “Fusina Integrated Project”, a global approach to waste water treatment and re-use in the central area of the Venice lagoon; and
- the “Vallone Moranzani Project”, an integrated solution for the rehabilitation of a contaminated industrial estate area through the development of a new hydraulic network and urban landscaping.

A common feature of all the projects is that they are an integral part of a number of strictly inter-connected measures involving a complex web of different authorities and institutions. These measures are presently put into effect through “programme agreements” that enable a joint action plan to be identified. The agreements integrate the measures that will be carried out by the different bodies, and where necessary, a single implementing body is appointed.

Co-ordinated and unitary implementation of the various measures within a programme agreement has been shown to improve operational efficiency, optimise implementation times, reduce final costs and, last but not least, to mitigate any possible inconveniences for citizens during the required construction.

## Foreword

Venice, a city with a singular history, constitutes a precise reference point, almost a benchmark, for policies and measures designed to protect delicate coastal ecosystems.

The historic centre of Venice and its lagoon would not even exist as shown on the postcards that millions of tourists send around the world every year, if man-made interventions had not modified and safeguarded its entire ecosystem over the centuries. A complex and exhaustive set of measures are in place for safeguarding Venice and the lagoon.

### Measures for the safeguarding of Venice and its lagoon

The Venice lagoon ecosystem is made of three territorial units that are closely inter-connected: the lagoon itself, the drainage basin and the Northern Adriatic.

**The Lagoon**, with its 550 square kilometres of surface area, is the largest wetland of the Mediterranean Basin. It is divided from the sea by a strip of barrier islands, the littoral, that runs for about 60 kilometres from the mouth of the Adige River to the mouth of the Piave River, interrupted by the lagoon inlets of Lido (800 metres wide), Malamocco (400 metres wide) and Chioggia (380 metres wide). Inside the lagoon basin are Venice, Chioggia and more than 50 islands, including Murano, Burano and Torcello; about 70 square kilometres of salt marshes (low-lying areas covered with halophytic vegetation); and a 1 580-kilometre network of canals that ensures the propagation of the tidal currents up to the boundary with the mainland. In the northern and south-central lagoon, the lagoon boundary is defined by fish farms (areas covering about 90 square kilometres that are separated from the living lagoon and are equipped for fish farming). The average depth of the lagoon is 1.2 metres.

The drainage basin is the part of the mainland that channels fluvial waters and rainwater into the lagoon. It has a surface area of about 2 000 square kilometres, crossed by a hydraulic network of over 2 500 kilometres that pours about 2.8 million cubic metres of water a day and between 25 000 cubic metres and 50 000 cubic metres per year into the lagoon in 27 different places. Just over 60% of the area is used for agriculture. The drainage basin is divided among roughly a hundred local authority areas in the provinces of Venice, Padova and Treviso, with a total of nearly 1.5 million inhabitants.

The **northern Adriatic** governs the lagoon ecosystem, with tides that enter and exit the lagoon twice a day through the lagoon inlets, reaching two maximums and two minimums (semidiurnal tides). It has been calculated that the volume of water exchanged daily between the sea and the lagoon is about 400 million cubic metres. The average range of tidal levels in the lagoon is about 70 centimetres (between minus 20 cm and +50 cm). Nevertheless, the tidal level is subject to important variations, above all in relation to astronomical and meteorological factors. When the tide rises to the point where it floods the historic centres of the lagoon, the phenomenon of *acqua alta* (high water) is said to occur.

Over the last few centuries, a series of natural phenomena and factors due to man's intervention have profoundly altered the lagoon. In the course of time, eustasy and subsidence have drastically modified the relationship between land and water, with a loss of land level of more than 23 centimetres in the last 100 years alone. These few centimetres are significant for a city that rests on the surface of the water.

From the fourteenth to the nineteenth centuries, the interventions for the deviation of the rivers from the lagoon, undertaken to deal with the problem of sedimentation, almost completely eliminated the replenishment of sand and sediments from the hinterland. The construction of the outer breakwaters at the inlets between 1800 and 1900, which facilitated the passage of modern ships, also reduced the quantity of sediments brought in by the sea. Over the course of the twentieth century, the creation of the industrial estate of Porto Marghera and the excavation of deep navigation channels have in turn caused runoff into

the ecosystem of a sizeable quantity of pollutants deriving from industrial activity (as well as from agricultural and civil sources), as well as profound modifications to the hydrodynamics of the lagoon.

**Eustasy, subsidence, erosion, pollution and wakes** have produced the general crisis of the “lagoon system”.

The frequency and intensity of the floods have become progressively worse, so much so that today, in the autumn and winter, the lowest-lying zones of Venice undergo flooding almost daily, and the risk of a dramatic event like that on 4 November, 1966, in which Venice, Chioggia and the other historic centres were completely submerged by water, is ever-present.

The beaches of the littoral have drastically reduced in width or even disappeared, leaving the coastal areas even more exposed to the violence of sea storms.

Meanwhile, the strictly environmental characteristics of the ecosystem have undergone progressive impoverishment and deterioration, with the reduction of the surface area of the salt marshes, the deepening of the lagoon beds and the worsening of the water and sediment quality.

To confront all this, in 1973, the Italian government defined the problem of safeguarding Venice and its lagoon as one of “primary national importance” (Special Law no. 171/73). Contributing to safeguarding the lagoon are the Italian government, which is responsible for defending Venice, Chioggia and other urban areas from high waters (*difesa dalle acque alte*), protecting coastal areas from storms and restoring the environmental balance of the ecosystem; the Veneto Region, which is responsible for pollution abatement; and the local authorities of Venice and Chioggia, which are responsible for socio-economic development, maintenance and restoration of the architectural and built fabric.

A “General Plan of Interventions”, tied to the territory, is intended to defend the physical and environmental of Venice and its lagoon ecosystem from high tides. The plan outlines a series of measures for the resolution of critical elements, according to distinct but reciprocal and systematic lines of action: defence from high tides, defence from sea storms and environmental defence.

The “General Plan of Interventions”, developed in accordance with the “Special law 139/92” and updated and integrated over time, is managed and supervised by the “Committee of Policy, Co-ordination and Control” (the so-called “*Comitatone*”), under the “Special law 798/84”. It is chaired by the President of the Council of Ministers and consists of representatives of local and national authorities and institutions. The “*Comitatone*” is the main instrument for planning and financing the work of safeguarding the lagoon.

The activities already completed and currently under way constitute the most important programme of defence, rehabilitation and management of the environment that the state has ever carried out in Italy.

The work at the lagoon inlets, the so called “Mose System”, intended to safeguard Venice from high waters, is described below. This endeavour has been developed by the Ministry of Infrastructure and Transport-Venice Water Authority through its concessionaire, the *Consorzio Venezia Nuova*.

## **The “Mose System”**

### ***The problem: high water***

The Venice lagoon is regulated by the tides in the Adriatic Sea, the highest in the Mediterranean Basin. On average, the tidal variation in the lagoon is between -20 centimetres and +50 centimetres. There are, however, significant variations in relation to astronomical and meteorological factors.

When the tide rises higher than the level of the quaysides and paving in built-up areas in the lagoon, it causes a “high water” event.

Dramatic reports of high waters turn up with ever greater frequency in the chronicles of the various periods right up to our time. These include: *Diluvium aquarum maximum ecclesias et domos penetravit* (eighth century); great flood with storm and whirlwind (twelfth century); there was a flood of seawater never before seen (fifteenth century); the seawater was very high (eighteenth century); 24 apocalyptic hours for the people of the lagoon (1966); Venice submerged by water (2002). A problem that has always affected the lagoon area has now become a full-scale emergency.

Today, floods occur ever more often, and are becoming more intense than in the past. The most dramatic took place on 4 November, 1966. Submerged under more than a metre of water, Venice, Chioggia and other built-up areas in the lagoon experienced hours of major devastation. Numerous exceptional high waters have occurred since then, accompanied by an endless series of floods caused by lower tides that reach the oldest and lowest-lying areas of the historic city centres, such as the San Marco area of Venice.

All this causes repeated inconvenience for inhabitants and tourists, interruption of socio-economic and cultural activities, deterioration of the architectural heritage and built fabric and degradation of the whole area in terms of the environment, flora and fauna.

Since the beginning of the 1900s, high waters have become more frequent and intense, and, in the future, the phenomenon could worsen due to the predicted rise in sea level produced by the “greenhouse effect”.

The common image of Venice “sinking” reflects a real problem. The lagoon area floods ever more frequently because the relationship between water and land has been profoundly modified, particularly during the last one hundred years. This can be attributed to the combined effect of a rise in sea level (eustasy) and a drop in land level (subsidence). As a result, urban centres in the lagoon are an average of 23 centimetres lower today in relation to sea level than they were at the beginning of the twentieth century.

The problems caused by flooding for residents and for Venice’s architecture and buildings are becoming more serious, and reach an ever-greater area as water levels increase. This is a real and concrete threat. More than once, a similar or even more dramatic event than the 1966 flood could have occurred, but was avoided thanks to a fortuitous and unexpected improvement in weather conditions.

In recent years, successions of closely spaced high tides have increased in frequency, such as during the period between 15 November and 6 December, 2002, when 15 tides exceeded 100 centimetres, with nine above 110 centimetres, five above 120 centimetres and a peak of 147 centimetres.

Figure 1.



Note: a) The ten highest tides recorded in Venice between 1926 and today (values are expressed in centimetres); b) Increase in the frequency of high water events in Venice between 1926 and 2005 (a number of events equal to or higher than 110 centimetres, per decade).

### ***The solution: what the “Mose System” does and how it works***

The “Mose System” was designed to protect built-up areas in the lagoon and the entire ecosystem from high waters and to cope with a rise in sea level of at least 60 centimetres during the next hundred years.

In fact, the Mose was been designed as a precaution since it has become apparent that high waters could be further aggravated by the predicted rise in sea level produced by the “greenhouse effect”. In other words, it could be higher even than the latest estimates from the IPCC, which predicts a probable increase in sea level of between 18 and 59 centimetres in the next 100 years. Furthermore, the Mose management procedures are flexible enough to cope with high waters in various ways, depending on the scale of the tidal event. Defence strategies can involve simultaneous closure of all three inlets, closure of one inlet at a time, or partial closure of each inlet, since the gates are all independent.

The Mose is being built at the lagoon inlets of Lido, Malamocco and Chioggia, the three openings in the barrier island through which tides enter and leave the lagoon. It consists of a series of mobile barriers that allow the lagoon to be isolated from the sea during the most dangerous high tides and also includes new breakwaters outside the inlets to attenuate tidal currents entering the lagoon.

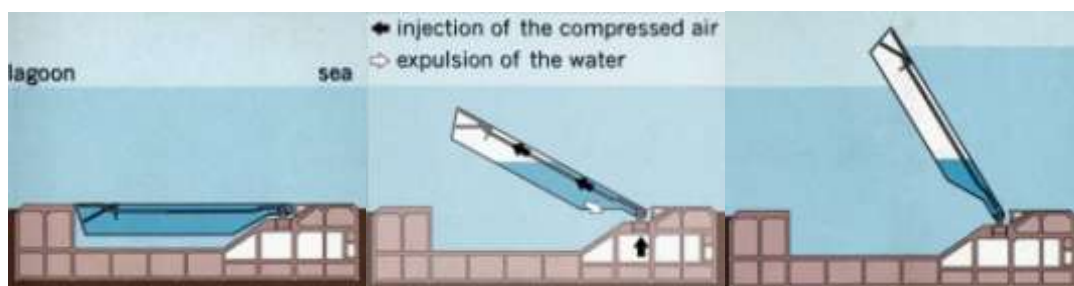
The Mose structures are integrated with raising of quaysides in historic city centres in the lagoon to help confront more frequent floods.

The mobile barriers consist of gates that are normally full of water, resting on the seabed and completely invisible. When a high water is forecast, compressed air is forced into the gates, expelling the water and causing the gates to emerge, so that they block the flow of the tide into the lagoon. The gates remain in operation for the duration of the high water only. When the tide drops, they are filled with water again and return to the neutral position within their foundation caissons. To guarantee the continuation of normal port activities while Mose is in operation, a large lock gate is being constructed at the Malamocco inlet to allow the passage of large ships. Similarly, at the Lido and Chioggia inlets, there will be lock gates for fishing boats, emergency vessels and pleasure craft. Mose represents an important opportunity to

improve and develop the littoral by integrating the structures into the architecture and landscape of the coast.

To this end, studies and analyses have been performed to identify possible alternative solutions, taking into consideration the formal and functional relationships between the new constructions and the specific environmental and urban context at each lagoon inlet.

**Figure 2. How the gates of Mose work**



### ***Construction in progress***

Construction of the Mose began in 2003, after it was authorised by the “Comitatone”, and is being carried out simultaneously at the three inlets.

To date, almost half the construction work has been completed, including almost 90% of the visible part above water. Currently, about 700 people are employed at the construction sites; this will increase to 1 500 as work proceeds. The sea sites extend over 15 kilometres and involve a fleet of about 100 boats.

The work is proceeding hand in hand with a programme to monitor the main environmental and economic parameters in play (water, air, land, important flora and fauna, port activities, fishing, etc.). Before work began, the seabed was cleared of devices left from World War II, and underwater surveys were carried out to identify and protect archaeological sites in the area.

Maintenance of Mose and management and monitoring of the ecosystem will be based in the north part of Venice’s ancient dockyard, the Arsenale. The Venice Water Authority has restored its sixteenth-century buildings to make them functional again and is also improving the area occupied by the twentieth-century dry docks.

In the near future, benefiting from the invaluable experience gained from the preservation and sustainable management of the Venetian ecosystem, the old Arsenale of Venice will be the site of a centre for research and technology dedicated to coastal zone management and issues associated with confronting global climate change in coastal cities.

This is one of the most significant consequences of the ongoing projects for the city of Venice. It is intended to have a real impact on the social and economic fabric of historical Venice by attracting new young and knowledgeable residents and by helping to mitigate the dominance of the tourism industry.

### **The Fusina Integrated Project**

Along with the Mose project, and as a substantial part of the measures to safeguard and protect the Venice lagoon and inland waters, the Veneto Region has approved and launched a public/private partnership project, the Fusina Integrated Project (FIP), to provide a comprehensive solution to the

municipal and industrial pollution that threatens the central area of the Venice lagoon and also to optimise water management both for drinking and non-drinking purposes.

The project is an important part of the Master Plan 2000, which governs the actions and interventions to reduce and control all sources and avenues of pollution in the Venice lagoon. The plan takes into account all the possible sources, generating points and means of diffusion of pollution, whether urban, agricultural, industrial or air-borne, and plans state-of-the-art measures to fight them.

This Master Plan is the first example in Italy of an integrated approach to an environmental problem, adopting a pro-active rather than a reactive approach.

The general strategy for surface waters focuses first on preventative action to reduce the potential loads, and next on measures to reduce or minimise pollution that has been released. Enhanced self-purification of the rivers discharging into the lagoon is the next step, and, as a last resort, diversion of the final flows from the lagoon may be considered if necessary.

The Fusina Integrated Project is particularly relevant because it aims not only to reduce pollution, but also to prevent pollution through re-use of the discharged water. A detailed Environmental Impact Assessment (EIA) has also been carried out to evaluate the best solution for the final discharge of the treated water.

### ***Regional and national planning to reduce pollution in the Venice lagoon***

The lagoon drainage basin has an extension of 2 038 square kilometres and a population of close to 1.5 million inhabitants.

The Master Plan 2000 aims to reduce the annual nutrient loads to prevent the proliferation of macro algae and the risk of environmental crisis. Italian law sets the acceptable load for nitrogen at 3 000 tons/year and for phosphorus at 300 tons/year. In the past ten years, nutrient loads have been reduced by anti-pollution measures and will be further decreased to satisfy the remediation targets.

The plan also aims to reduce the concentration of micro-pollutants in water and sediment to levels that protect humans from adverse effects associated with the consumption of fish and shellfish.

The Fusina Integrated Project deals with the most densely populated section of the lagoon basin. It is based on simple principles: use water twice, reduce sewage flow, treat all water to higher standards and disperse the residual outflow into the sea, away from the lagoon. The target is a dramatic reduction, with sustainable costs, of the mass discharge of micro pollutants and eutrophising nutrient compounds into the lagoon. The Master Plan 2000 considers:

- An extensive restoration of the old combined municipal sewage networks aimed at reducing the inflow of brackish groundwater by 50%.
- The separation of industrial waste water collection and treatment from municipal waste water sewage and treatment.
- The extension and renewal of the main municipal Waste Water Treatment Plant (WWTP) for greater reliability both in dry and wet seasons; most of the rainwater will be stored and treated partly by biological processes, partly by chemically enhanced primary treatments and wetlands.

- Purification of WWTP effluent by a huge constructed wetland, in order to produce a large amount of non-potable freshwater for re-use; this flow will replace the actual industrial withdrawal of drinking water from Sile River, which will be switched to the big water supply scheme of the Central Veneto.
- A new pipeline to supply low-cost non-potable water to the whole Marghera industrial zone (1 000 hectares, with four power plants that need large quantities of cooling water and many chemical industries that use water for processing and flushing).
- A new sewage system for collecting and transferring all the water that industry now discharges directly into the lagoon to a centralised post-treatment plant. Water used in industrial processing will be pre-treated by industry, then pumped to the central plant, and polluted rainwater from industrial areas will be stored locally, then gradually sent to the central plant. Polluted infiltration waters drained along the impermeable barriers that separate the industrial areas from the lagoon will be sent to a dedicated section of the central plant.
- A post-treatment plant to control and reduce the residual pollution of industrial sewage flows. Due to the great variability of the quality of the inflows and the high standards required, this plant will be composed of big storage tanks and multiple treatment devices (physical, chemical and biological). A complex pilot plant will assess the best technology and set-up.
- A long discharge pipe across the lagoon will disperse into the Adriatic the residual outflow, with its low chemical and organic residual pollution.

### *Global impact assessment*

The Environmental Impact Assessment (EIA) has been considered as a tool to improve the FIP's performance. The main items considered in the EIA were:

- reduction of sewage discharge by preventative action and by industrial re-use of treated water;
- centralised control and post-treatment of industrial flows, runoff and of seepage groundwater;
- low-cost treatment improvement by constructed wetlands.

The EIA developed in compliance with the requirements of the Veneto Region (Regional law 10/99) was carried out in parallel with the preliminary design of the works, enabling the optimisation of the design solutions not only in its technical and economical aspects, but also with respect to the preservation of the environment, the landscape and artistic/archaeological concerns. The main optimisation aspects concerned:

- analysis of the three alternative options for the location of the residual plant discharge already identified within the Master Plan 2000;
- identification and evaluation of the critical aspects concerning the areas located next to the lagoon border, where the wetlands for the refinement of the treatment plant outflow are to be constructed.

The main study guidelines were:

- developing environmental analysis, using parameters and models enabling the assessment and selection of the different strategies identified in the Master Plan 2000 for the management of residual discharge from the treatment plant;



- considering the Lagoon of Venice and the neighbouring marine coastal area as a whole when assessing the environmental impact of the residual plant outflow;
- taking account, among the different scenarios, of the realisation of the mobile barriers at the lagoon inlets;
- paying attention to the impacts generated by the laying of the discharge pipe on the lagoon ecosystem and on the archaeological sites along its track;
- paying attention to the programmatic, environmental and socio-economic aspects of supporting the design choices concerning the location of the areas where the treatment wetlands are to be constructed;
- paying attention to ecological considerations in designing the treatment wetlands.

Concerning the management and localisation of the treatment plant residual discharge, the EIA was developed for all the solutions presented for further evaluation in the Master Plan 2000. Three different locations of the discharge of the WWTP were studied.

The first option considered was to locate the final outflow discharge within the lagoon, at a point next to the Malamocco inlet, so that the treated waste water would quickly flow out to sea; the second option considered discharge of the residual outflow into the River Brenta, flowing into the Adriatic Sea just south of the lagoon; and the third option was to lay an underground pipe across the lagoon and discharge the residual outflow directly into the sea, about 10 kilometres offshore, meeting the quality limits imposed by law for the sea (Italian law 152/99) and ensuring no interference, also in critical environmental conditions, with the coastal and lagoon waters.

The analysis was performed using the CRUP model developed by the Venice Water Authority (consisting of a finite elements two-dimensional hydrodynamic model coupled to a dispersive model) to evaluate the impact on the lagoon waters, and the CORMIX model, developed by the EPA, to evaluate the impact on marine waters.

The Environmental Impact Assessment included extensive consultation of all different stakeholders and the final choice taken by the decision makers was to bring the residual outflow from the Fusina treatment plant directly offshore into the Adriatic Sea.

### ***Technical features***

The most important point pollution source that significantly affects the quality of the lagoon waters is Fusina WWTP discharge. Its sewage basin covers a wide part of the lagoon watershed, with 300 000 equivalent inhabitants (EI). The nitrogen load (361 tons of nitrogen/year) discharged by the plant equals 50% of the whole point pollution urban load of the basin and corresponds to one-third of the further target reduction expected by 2013. The key intervention of Master Plan 2000 deals with this plant, but regards it as an opportunity to build an integrated and reliable new generation sanitation system. The aims are:

- to achieve the full control of all the local sources of point pollution (urban, industrial, runoff) with high reliability systems and structures;
- to reduce dramatically the mass discharge of nutrients and micro pollutants, not only to reduce concentration, but mainly to save water;

- to optimise the fresh water management by extended re-use of treated water.

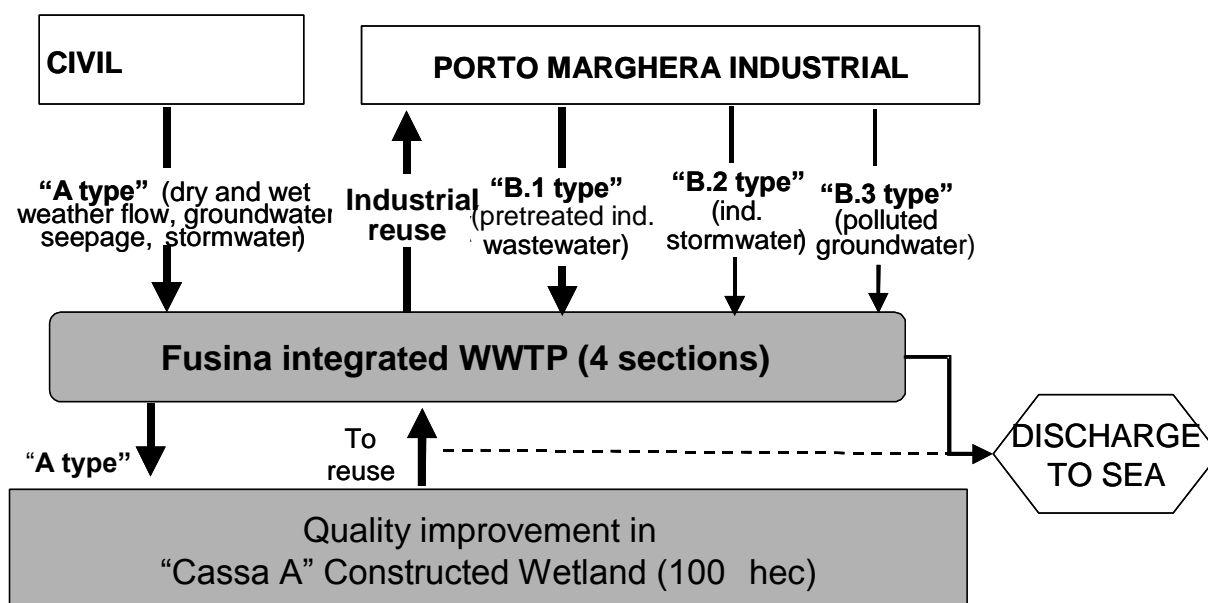
A water treatment and re-use general plan has been studied, based on the minimisation of the residual pollution discharge to the sea, the maximisation of the industrial re-use of treated water and the saving of fresh water withdrawal from the River Sile. This water will be used more properly for the drinking water supply.

### Components and fluxes

The scheme of the plant is quite simple (Figure 3): urban sewage flow (called “A type” flow) will be treated in a traditional enhanced biological plant, followed by a further polishing in a constructed free water surface (FWS) wetland. The treated water will be pumped to the industries of Porto Marghera, replacing the current supply from the River Sile. Then the industrial sewage water (“B type” flow) will be carried by dedicated pipes and conduits to Fusina to be controlled and further treated to comply with the sea discharge limits. This is a sort of “water use open cycle” that does not accumulate salts and pollutants in re-used waters and reduces the final discharge by 50%.

The “A type” flow (85 000 cubic metres per day in dry weather, up to 288 000 cubic metres per day in wet weather) comes from urban sites that are normally drained by combined sewers and also carry large quantities of groundwater seepage and stormwater.

Figure 3. Fusina waste water treatment, re-use and discharge



The “B type” flow is composed of three components: “B1 flow” (43 200 cubic metres per day in winter; 57 400 cubic metres/day in summer) is the pre-treated water from industrial processes; “B2 flow” (up to 17 200 cubic metres/day) is the runoff polluted water that will be gradually discharged by the first flush tanks to be built in the industrial sites (the maximum number of admitted sewage overflows is five times/year for industrial areas; so local storage tanks are necessary to limit rainwater treatment capacity in Fusina plant to a maximum of 30% of average daily B1 flow); “B3 flow” (from 3 000 to 5 500 cubic metres/day) is the polluted groundwater flow that will be drained behind the impermeable beltings of Porto Marghera industrial canals (under construction). The key aim is to centralise the control and the treatment of all polluted waters of the area in an integrated system.

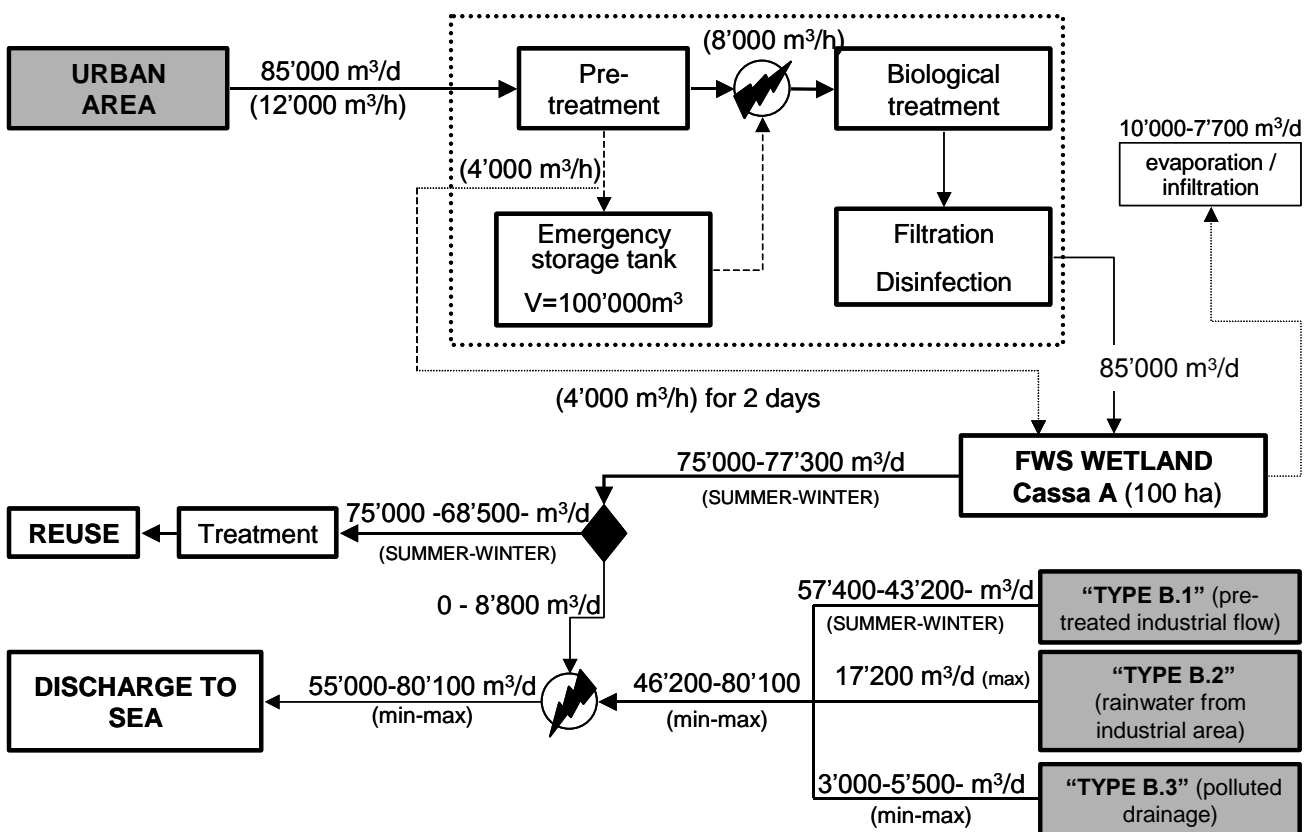
**The biological plant**

The biological plant for “A type” flows is based on a traditional biological reactor with high redundancy in the main components. The physical pre-treatment can manage up to 12 000 cubic metres/hour, and the biological reactor can treat for long periods up to 8 000 cubic metres/hour. It is composed of four plug flow reactors with variable nitrification/denitrification volume, with a total volume of 69 000 cubic metres. The final sedimentation tanks are built for an 8 000 cubic metres/hour continuous flow. It also has large storage and equalisation capacities (100 000 cubic metres, more than one day of average flow).

A Chemical Enhanced Primary Treatment (CEPT) section dedicated to stormwater pre-treatment (up to 4 000 cubic metres/hour) before overflowing in the wetland. It has also a filtration and UV disinfection treatment for wetland protection before sending treated water to the quality improvement wetland (a reclaimed site open to visitors).

The existing anaerobic digesters will be revised to treat sludge at a higher temperature (55°C thermophilic) to increase the biogas production.

**Figure 4. Medium-term Fusina plant flow chart**



**The constructed wetland**

The peculiarity of type “A” flow treatment is the large constructed wetland (100 hectares) which assures the re-use quality standards, with sustainable post-treatment costs. It will be built in a reclaimed area close to Fusina. Before re-use, further polishing treatments are provided anyway: chemical-physical corrective treatment (when necessary), sand filtration and UV disinfection.

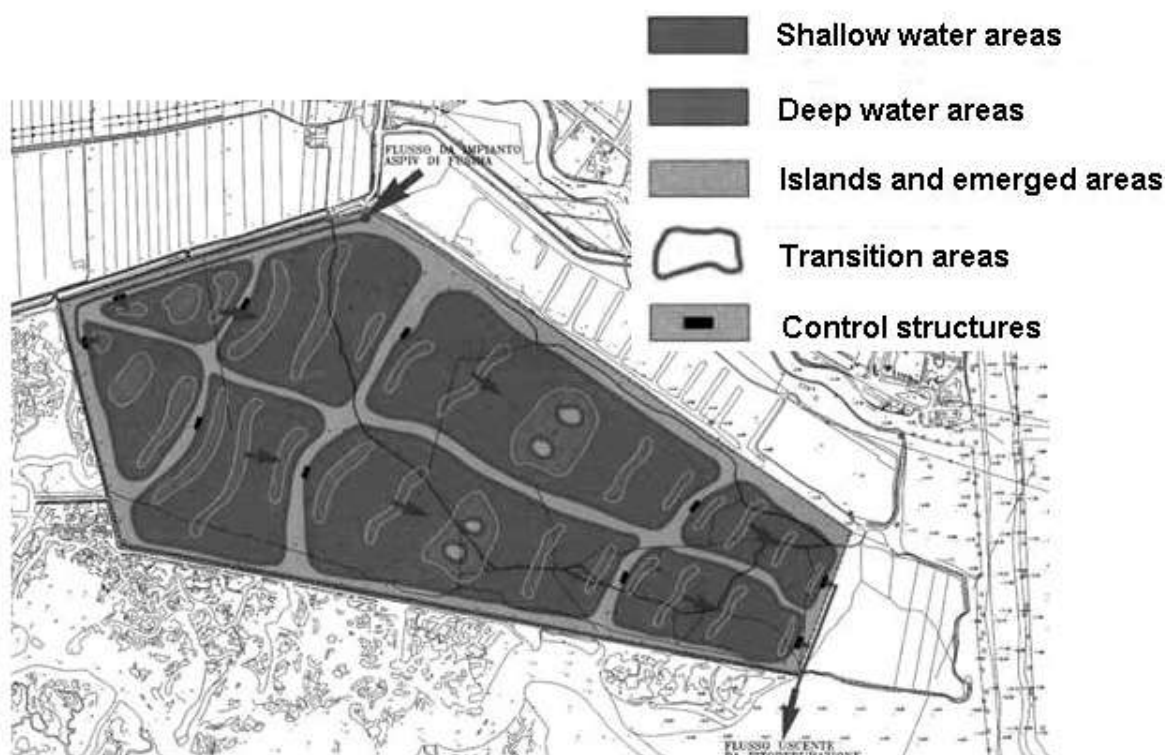
The area, extended over 120 hectares, was reclaimed in the 1960s using the mud resulting from the excavation of large navigation channels to cover the existing salt marshes. As time passed, it regained some of its original natural features. At present it is mostly covered with reeds and visited by valuable bird species, both nesting and wintering.

The treatment wetland will be fed by water that has already been treated and whose quality is therefore already largely compatible with the discharge limits of the most vulnerable bodies of water. It is designed to further refine the water and to create a constructed wetland of increased natural value that can also be enjoyed as an aquatic park and recreation area, following the example of many comparable projects around the world, some of which have been ongoing for over ten years.

The area was designed as a patchwork of free water surfaces and vegetated areas, taking into account of its natural and recreational value, as well as its efficiency and functionality for further treating the water.

The extensive free water surfaces, making up the treatment basins and the connected areas covered by hygrophilous vegetation, will enable many waterfowl species to rest and nest, and it will also attract other vertebrate species typical of wetlands, such as reptiles and amphibians.

**Figure 5. Cassa di Colmata A, preliminary design of the constructed wetland**



***Re-use treatments and pipes***

The treated water will be re-used mainly by power station cooling systems (48 840 cubic metres/day in summer) and by chemical industries of Porto Marghera (from 25 000 to 30 000 cubic metres/day) that now use good quality water from the River Sile carried by a dedicated water supply pipe. The withdrawal from the Sile will be reduced by up to 75 000 cubic metres/day. Very good quality standards are expected,

due to the wetland improvement; they are comparable with Sile river water quality but with lower suspended solids values and higher chloride concentrations (lower, at any rate, than the Environment Ministry limits for re-use).

### ***Industrial flows post-treatment***

The “B” flows post-treatments will be calibrated by complex process calibration devices. A large storage volume (75 000 cubic metres) will ensure an efficient quality control and mixing before treatment. The processes provided are:

- post de-nitrification (mainly for concentrated flows coming from cooling towers);
- flocculation/settlement;
- filtration/micro filtration (aimed at reaching a suspended solids (SS) concentration lower than 1 milligram/litre, which is necessary to fulfil the legal limits of most micro pollutants).

The process calibration device will be operated mainly for the treatment testing of polluted groundwater that contains iron (Fe), manganese (Mn), fluoride, hydrocarbons and chlorinated solvents (HCl).

### ***Sea-discharge pipe***

The selected option for the location of the final discharge of the treated plant effluent (direct discharge into the sea 10 kilometres from Lido shores, 2 kilometres beyond the lagoon water exchange zone) has positive impacts on the lagoon. Moreover, transferring the residual pollutant load to the Adriatic Sea proved compatible with the preservation of the coastal environment.

To evaluate the significance of such impact, a model analysis was expressly performed using the CORMIX model developed by EPA, focusing on the abatement of the pollutant concentrations along the main dispersion direction of the discharge plume.

Taking account of the seabed geometry, the climate of winds and currents, and the discharge location, the chief modelling aims were:

- identifying the area affected by significant increases in the pollutant concentration with respect to the present conditions, paying special attention to the possible impacts on the many offshore mussel farms located along the coast and on bathing;
- making sure that the discharge point is far enough from the lagoon inlets to prevent the discharged treated waste water from entering the lagoon.

Different model simulations were performed, replicating the most frequent wind and water stratification conditions, including extreme conditions.

All the simulations considered an average treated waste water discharge of 100 000 cubic metres/day, equal to the peak plant discharge (the medium-term average discharge ranges from a minimum of 55 000 cubic metres/day in dry winter weather to a maximum of 80 100 cubic metres/day in wet summer weather), and pollutant concentrations equal to the maximum admitted by Italian law. A pumping station located in the middle of the pipe at Malamocco can regulate the discharge to the sea.

The model simulations confirmed that:

- the distance of the discharge location from the coastline means that neither mussel farming nor bathing are appreciably affected and not even a small part of the discharged pollutant loads enters the lagoon;
- the concentration of the discharge pollutants in the sea waters is appreciable only in a limited area close to the discharge site, thanks to dilution processes that quickly abate the concentrations moving away from the discharge site.

### ***Operation and environmental quality management***

The Fusina Integrated Project (FIP) aims at the optimisation (in terms of safety, flexibility, reliability) of sanitation systems and water uses in the most complex and sensitive area of the lagoon basin by:

- centralised control of point pollution sources (urban, industrial, runoff);
- strong reduction of freshwater withdrawal through re-use of treated water of up to 75 000 cubic metres/day;
- dramatic reduction of macro- and micro-pollution, using advanced high-efficiency techniques supported by process calibration devices;
- minimum environmental impact of final discharge (large constructed wetland, residual outflow to the sea).

To achieve these goals, detailed modelling and monitoring of the residual pollution dispersion in Adriatic Sea are necessary.

The monitoring programme for the coastal waters is being set up to be performed before, during and after the new discharge pipe is put into operation.

A “routine” activity programme will be developed together with a special programme, to be activated when predefined threshold values (on water, sediment, biota) are exceeded and revealed by the routine monitoring.

The monitoring will be supported by a mathematical model specifically developed and calibrated according to the local conditions, able to simulate the dispersion of the treated outflow and its effects on the marine ecosystem in the different wind and current conditions.

The model will consist of a hydrodynamic-dispersive module; a re-suspension and sediment transport module; an eutrophication module; and an eco-toxicological module.

The use of such a model, constantly fed with field data, will enable to foresee and prevent the occurrence of situations potentially able to affect the trophic conditions of the recipient water body and to create an ecological risk for plant and animal communities and for human health, in case of fish or seafood consumption.

### **The Vallone Moranzani Project**

To conclude this brief overview of Venice’s experience in dealing with the preservation and maintenance of its delicate ecosystem, the so-called Vallone Moranzani Project should be mentioned.

Several objectives can be achieved through such a project:

- The clean-up and environmental reclamation of a number of dumping sites at the borders of the industrial estate area of Marghera, along the Moranzani site;
- The use of the site to develop a system of infrastructures to store, treat and re-use as landfill the material dredged from the industrial and port channels within the Lagoon. Approximately 6.4 million cubic metres of sediment, part of which is heavily contaminated, must be dredged for environmental and navigational purposes;
- The rehabilitation of the hydraulic network in the whole area;
- The development of new wetlands for the expansion of the run-off;
- The creation of a widespread green area to improve and make available for recreation a contaminated former industrial area;
- The shaping of a new urban park in the nearby historic village of Malcontenta;
- The burying of four 230-380 KV power lines, and finally;
- The re-location of a oil storage facility.

This project represents an articulated and ingenious response to a chronic environmental emergency. After many years of public debate, the only viable solution was to appoint a commissioner who, thanks to the special powers granted to him directly by the Premier, was able to launch a public/private partnership to fund the entire project through the re-use/landfill cost of the treated sediment.

As in the previous cases, the involvement of the various stakeholders has been crucial, and the benefits conferred on the local community are not only environmental but socio-economic.

## **Conclusions**

As the above project shows, strictly inter-connected measures involving a number of different authorities and institutions are under development in the Venice lagoon area.

These measures are implemented through programme agreements that enable a joint action plan to be identified, integrating the measures to be carried out by the different agencies and, if necessary, appointing a single implementing body.

Co-ordinated and unitary implementation of the various measures within a programme agreement has demonstrated that it improves operational efficiency, optimises implementation times, reduces costs and mitigates any inconvenience to citizens during construction activities.

### Venice and its lagoon high tide (*Acqua Alta*) in Venice



### Summary of the components and main characteristics of the Mose system

#### *Objectives*

To defend the cities of Venice and Chioggia, other urban areas in the lagoon and entire lagoon basin from the destructive effects of medium-high tides and the devastating effect of exceptional tides.



### *System adopted*

The solution chosen was a system of various types of structures with integration between mobile barriers (rows of gates) and fixed elements (“complementary measures”), and works together with local measures that raise banks and public walkways (up to 110 centimetres in Venice). This takes into account the architectural and socio-economic structure of the area and also includes extensive environmentally conscious morphological interventions.

#### *Mobile barriers*

##### Type of gate

Disappearing, oscillating, buoyancy flap gate.

##### Number of gates

78 in four rows (Lido-Treporti; 21; Lido-San Nicolò: 20; Malamocco: 19; Chioggia: 18).

##### Gate dimensions

Thicknesses vary from 3.6 metres (row at Lido-Treporti) to 5 metres (row at Chioggia); lengths vary from 18.5 metres (row at Lido-Treporti) to 29.6 metres (row at Malamocco); the width is 20 metres for all rows.

##### Average inlet closure time

Four to five hours (including gate opening and closure times)

##### Maximum difference in level between sea and lagoon

The gates are designed to withstand a difference of 2 metres between the sea and lagoon. They are therefore able to cope with the possibility of a considerable increase in sea level during the next 100 years.

#### *Complementary measures*

##### Breakwaters outside the lagoon inlets

The riprap and acropods breakwaters will have a length of 1 000 metres (Lido inlet), 1 280 metres (Malamocco inlet) and 520 metres (Chioggia inlet) respectively.

##### Raising of the bed at the Malamocco inlet

Raising of the bed from -16 metres to -14 metres is envisaged to reduce the volume of water exchanged between the sea and the lagoon, together with the breakwaters outside the inlets, contributing to attenuating water levels in the lagoon during the most frequent tides.

##### Lock at the Malamocco inlet

Useful length, 370 metres; width, 48 metres.

The lock is designed to accommodate both ships and tug boats and allow the transit of ships of up to 280 metres long, with a maximum width of 39 metres and a maximum draught of 12 metres.

The configurations of the lagoon inlets with the defence structures.

Lido Inlet



Malamocco inlet



Chioggia inlet



## ***A WATER COMPANY PERSPECTIVE***

***By Paul Hickey<sup>1</sup>***

***Head of Environmental Services, Anglian Water, United Kingdom***

Climate change and the pressures of a growing population are key challenges for the water sector. A key means of managing these issues is to integrate water and spatial planning. Anglian Water supplies some 18% of the land area of England and Wales and provides water to 4.2 million people and waste water services to 5.5 million people. The region is particularly vulnerable to the effects of a changing climate, being low-lying with an extensive coastline. It is also dry (receiving only two-thirds the national average rainfall) and has high biodiversity value. Set against this context is the need to plan for significant levels of population growth.

Managing climate change and growth are features of our strategy to deliver sustainable and efficient service over the long term.

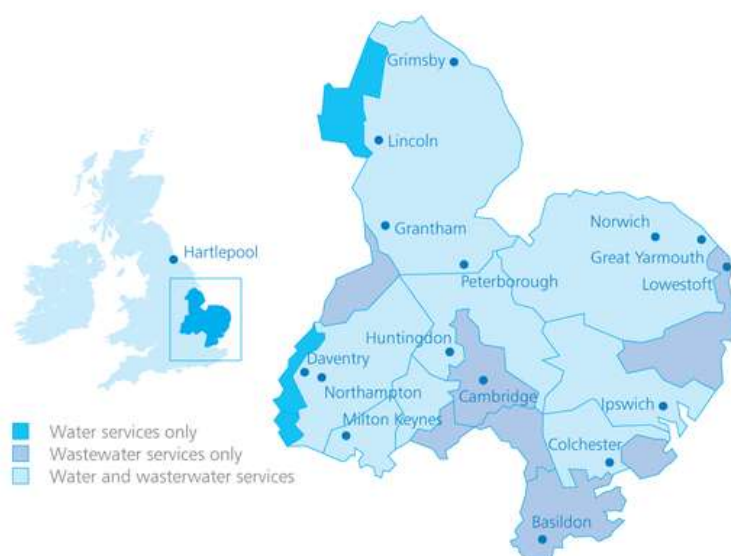
This paper discusses a central means of managing these by integrating water and spatial planning both at regional and local levels. One effective tool to achieve this, “water cycle studies”, is detailed. As well as yielding long-term infrastructure strategies, water cycle studies allow us to promote two specific issues that we see as particularly important in the context of climate change and population growth: water efficiency and sustainable drainage systems.

Developing effective cross-organisational co-operation supported by top team leadership is also vital, and some examples of good practice are also discussed.

### **About Anglian Water and the water industry in England and Wales**

Anglian Water is one of ten companies in England and Wales that provides both water and waste water services to their customers. There are a further 16 companies that provide water services only.

Figure 1.



### Summary of operations

- Serves 18% of the land area of England and Wales
- Provides water services to 4.2 million people via:
  - A network of 36 800 kilometres of water mains
  - Supplies direct from rivers (5%), groundwater (50%) and reservoirs (45%)
- Provides waste water services to 5.5 million peoples via:
  - 1,083 waste water treatment works (17% of all those in England and Wales)
  - 43,400 kilometres of sewers
  - 4,333 pumping stations (22% of the industry total)
- 42% of customers live in rural areas
- 65% of households are metered

Anglian Water is the principal subsidiary of Anglian Water Group Limited (AWG), which is owned by a consortium of investors; Osprey Acquisitions. Anglian Water Plc was first listed on the London Stock Exchange in 1989, when the water industry in England and Wales was privatised. Its parent company, AWG Plc, was subsequently de-listed from the London Stock Exchange in December 2006, after its acquisition.

The UK water industry is highly regulated. In England and Wales, the quality of customer service and the charges made to customers are regulated by the Water Services Regulation Authority, or Ofwat, as it is more commonly known. The water industry operates on five-yearly cycles known as Asset Management Plan periods. Prices are set by Ofwat at the beginning of each period following submissions from each company. These submissions detail the costs of maintaining existing service levels, dealing with changing customer expectations and demanding or achieving higher-quality standards (generally driven by new legal requirements).

Other government agencies regulate different aspects of our operations. For example, the Drinking Water Inspectorate is responsible for ensuring compliance with the drinking water quality regulations, whilst the Environment Agency controls the amount of water we are allowed to abstract from the environment and the quality of the water that we return to it.

The industry structure is similar for Scotland and Northern Ireland but there are separate operators and regulatory bodies.

Further information about Anglian Water can be found at our website, [www.anglianwater.co.uk](http://www.anglianwater.co.uk). More general information on the structure of the water industry in England and Wales can be found on the Ofwat website, [www.ofwat.gov.uk](http://www.ofwat.gov.uk).

### Key challenges of climate change and population growth

Anglian Water's role is to deliver a reliable supply of clean, safe drinking water and effective waste water services at an affordable price.

In 2008, we published our strategic direction statement, which sets out our long-term strategy to keep us delivering this goal ([www.anglianwater.co.uk/\\_assets/media/strategic-direction-statement.pdf](http://www.anglianwater.co.uk/_assets/media/strategic-direction-statement.pdf)). This places the current discussions with our economic regulator, Ofwat, on the priorities for the period 2010 to 2015 within a 25-year context. Our business is long-term, and we must plan over such time scales.

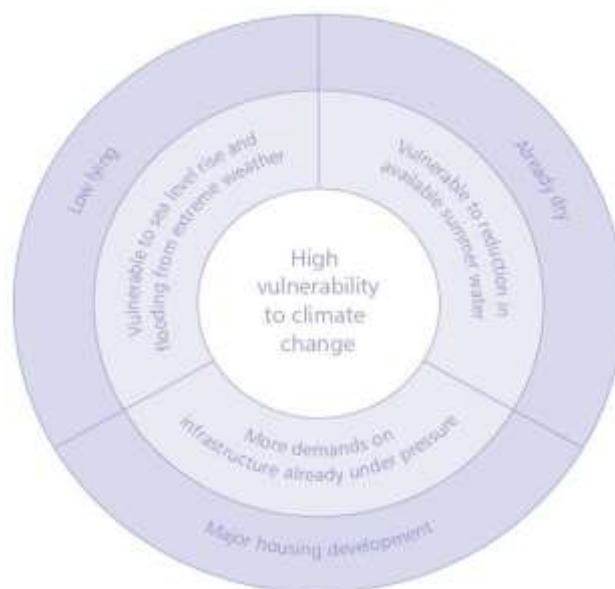
In shaping our long-term strategy, we identified a number of challenges. The two most significant are:

- servicing a growing population
- the need to adapt to the impacts of climate change

While these are important issues for all in our sector, the characteristics of our region make them particularly vital for our business.

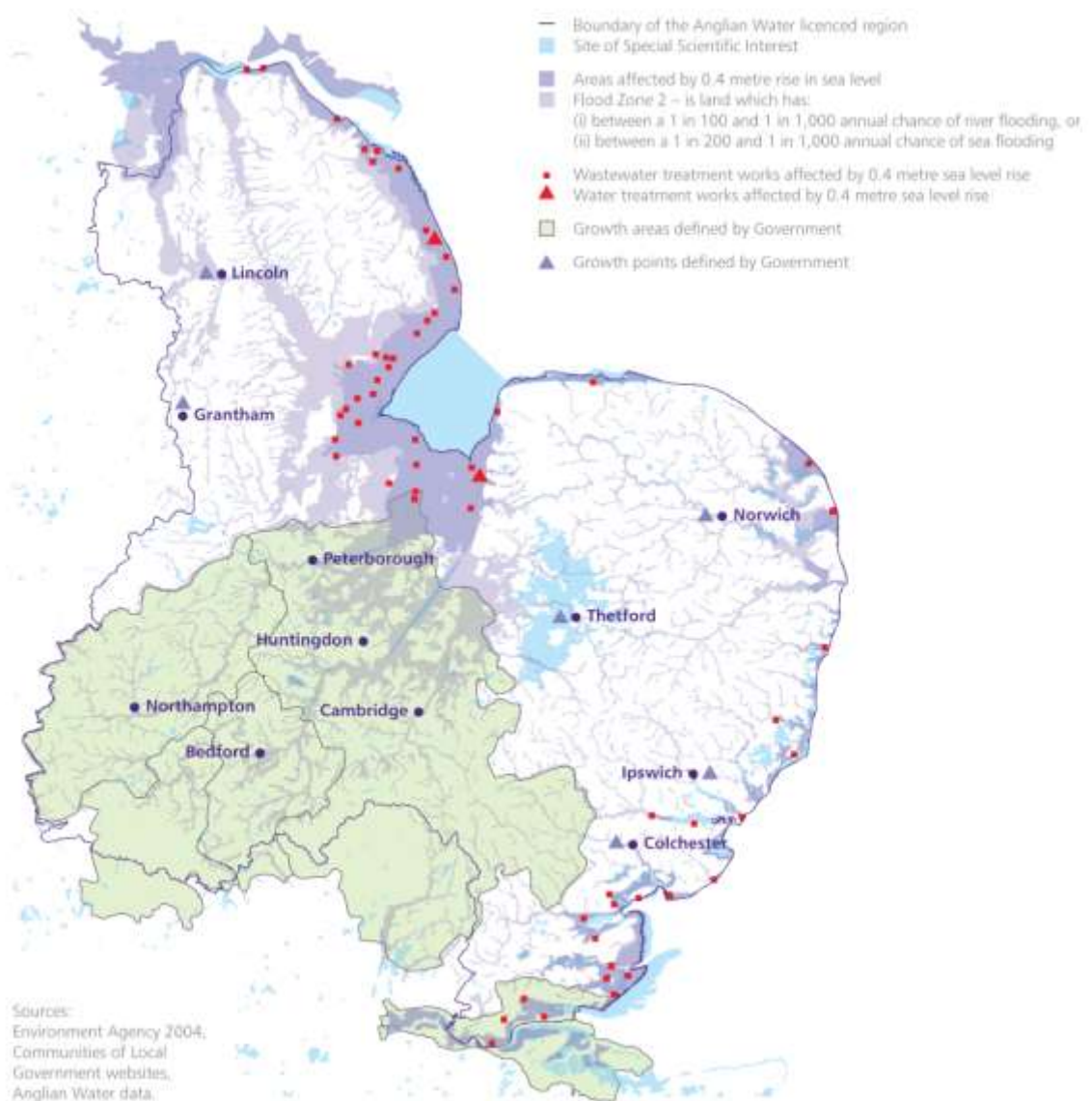
- The region is the *driest region in the UK*, receiving only two-thirds of the total national average annual rainfall (approximately 600 millimetres). Higher temperatures and changing patterns of rainfall, together with increased demand from customers because of substantial planned growth, will affect the region’s water resources, water quality and biodiversity. Much of the region is already classified as “high water stress” by the Environment Agency.
- The population of the region is predicted to continue to grow rapidly. Together with a continuing trend towards fewer occupants per household, there will be increasing demand for new homes. To meet this demand, government targets are for *greater levels of housing across the region* to meet pressing social as well as economic needs. The current downturn is significantly affecting house building, which will exacerbate the underlying demand. Thus, these targets are likely to be subject to increasing and upward pressure over the medium and long-term.
- The region is one of *high environmental sensitivity*. Water demands present an additional pressure. For example, over half the region’s 750 Sites of Special Scientific Interest (SSSIs) are important wetland habitats that are already sensitive to warmer, drier conditions. Proportionately more wetland SSSIs are in an unfavourable condition.

**Figure 2. Regional vulnerability to climate change**



- The region's *low-lying nature and long coastline* make it vulnerable to flooding from storm surges and the impacts of rising sea levels. More intense storms and floods will test the capacity of drainage systems and flood defences.
- *Agriculture* is a key influence in the region; culturally, socially and economically. It is also a key water user at some 10% of resource use against a national average of 1%. Furthermore, agricultural demand for water is concentrated in the driest two to three months of the year. The agricultural sector is already changing, particularly in high commodity markets such as arable, horticulture and biofuels. This may result in increased tension between water users.

**Figure 3. Regional impacts of climate change and population growth**



## Linking spatial and water planning

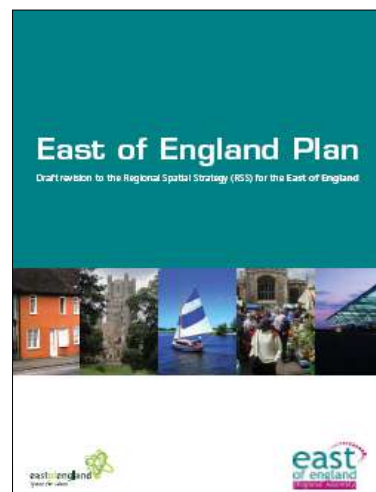
Thus we must plan to provide our core service against a background of population growth with consequent development pressures, the ecological sensitivity of the region and the potentially large and uncertain impacts of climate change.

We see as a key means of managing this balance to more fully integrate spatial and water planning processes to promote sustainable growth from a water perspective and also embed climate change adaptation strategies.

In recent years, there has been a major change in the way spatial planning is carried out in England, and this process of reform is continuing. There is now a greater emphasis on “strategic” spatial planning.

Under the new planning system, there is a policy cascade from national planning policies to Regional Spatial Strategies to Local Development Frameworks.

The national policies set the over-arching framework. Beneath this, Regional Spatial Strategies form the top tier of the statutory development plan. There are nine such strategies for each of the regions of England. They provide a regional framework to inform local development documents and other plans relating to land use. The purpose of the Regional Spatial Strategy is to promote sustainable development by addressing housing shortages and supporting economic growth, while minimising the impact on the environment. Regional Spatial Strategies are formulated by the regional planning body, which currently is the Regional Assembly (a partnership body of elected members and representatives from private, voluntary and community sectors).



The Local Development Framework is a suite of documents that translate the Regional Spatial Strategy into the local context; setting out growth targets culminating in site-specific allocations. The Core Strategy provides detail on the strategic location of development within a district or borough. The Site Specific Document then sets out where development will occur in accordance with the Core Strategy. The Local Development Framework must be in conformity with the Regional Spatial Strategy and demonstrate a 15-year supply of deliverable housing from the date of adoption.

We see that the Regional Spatial Strategies and Local Development Frameworks offer important opportunities to consider water management. In this we define water in the broadest sense; water resources, treatment and supply, waste water collection, treatment and disposal as well as flood risk management and the receiving watercourse.

## Influencing regional planning decisions

At the Regional Spatial Strategy level, the location of proposed development is only broadly defined.

Our water and waste water infrastructure base are quite different. In contrast to our largely integrated water network, our waste water service is provided by 1 083 individual systems. Understanding the location of new development is key to effective waste water infrastructure planning, because the separated nature of the drainage catchments means that these plans are much more sensitive to the location and

timing of development than for water services. For water service, we have regional modelling tools that link available water resources and infrastructure capacity. For waste water, we have numerous localised catchment models.

We have a formal and well-tried process for developing a long-term water resources management plan alongside our business plan in close liaison with the Environment Agency and Ofwat and in consultation with a wide range of stakeholders. These plans are ultimately reviewed and approved by government. In developing our statutory plans, we account for the population and household projections as set out at the Regional Spatial Strategy level. We also model the potential changes in demand arising from climate change together with the implications this and environmental legislation may have on water resource availability.

In conjunction with the Environment Agency, we provide evidence at the formation of a Regional Spatial Strategy and at the subsequent cycles of review. The test is to ensure that growth forecasts and strategic development proposals can be met while maintaining sufficient resilience of our water supply infrastructure and without compromising the environment. This assessment is made using the regional modelling tools used to develop our water resource management plan.

Our strategy is based on the “twin-track” approach of managing demand through a combination of promoting household metering, controlling leakage and promoting the efficient use of water alongside developing additional supplies where required, to meet local growth in demand. Our current plans describe how we propose to maximise the use of existing licences and to develop our capacity to transfer water. We also plan to re-use the increased waste water discharges that we have treated and returned to the environment. In the longer term, we continue to plan to import water from the Lower Trent catchment and to develop a large winter storage reservoir in the Lincolnshire Fens to facilitate transfers to the east of our region.

Such thinking at a regional level is more recent for waste water. This is partially because it is more difficult to make such an assessment without a detailed understanding of location of proposed development; *i.e.* at a lower level in the planning hierarchy. It is also due to a difference in approach. Historically, there has not been a long-term planning process for waste water, as there has been for water resource management. To overcome this and to form the basis of our forward-looking waste water strategy, we developed a screening tool to assess the environmental capacity of watercourses across the region. This exercise was carried out in partnership with the Environment Agency.

Environmental capacity has two themes; first, to dynamically assess the performance of waste water infrastructure to maintain the environmental quality of the receiving watercourses. Since the privatisation of the water sector, there have been major investment programmes to improve watercourses, and it is important that these gains are not compromised. However, as standards tighten and demand increases, development constraints could occur as treatment levels reach technical limits. The second aspect is discharge volume. The nature of our river systems means that there is also potential constraint in terms of the amount of additional waste water discharges that can be received from a flood-risk perspective. This links to the need to consider the way surface water from storms is managed. More innovative ways of dealing with surface water are discussed later in this paper.

Using this screening tool, we assess plans at a Regional Spatial Strategy level to understand whether these can be accommodated from an environmental capacity perspective and where further work is required at a more local level.

Considering water and waste water at the regional planning stage provides a number of outcomes; *i*) there is confidence that the plans can be serviced within environmental limits, *ii*) areas where further work



are identified early to prevent later conflict and *iii*) infrastructure planning can advance in parallel with spatial planning processes. We see that the characteristics of our region make it critical to consider water management as an intrinsic part of the regional spatial planning process, so as to achieve sustainable development.

Further, clear policy guidance on water planning is incorporated at the regional level to inform the next stage of the spatial planning hierarchy; the Local Development Framework. Extracts from the East of England plan are set out below as an illustration.

#### **Box 1. East of England Plan**

##### **Policy WAT2: water efficiency**

The government will work with the Environment Agency, water companies, Ofwat and regional stakeholders to ensure that development in the spatial strategy is matched with improvements in water efficiency delivered through a progressive, year-on-year reduction in per capita consumption rates. Savings will be monitored against the per capita per day consumption target set out in the Regional Assembly's monitoring framework [105 litres/head/day].

##### **Policy WAT2: water infrastructure**

“The Environment Agency and water companies should work with Ofwat, EERA [the regional planning body] and the neighbouring regional assemblies, local authorities, delivery agencies and others to ensure timely provision of appropriate additional infrastructure for water supply and waste water treatment to cater for the levels of development provided through this plan, whilst meeting surface and groundwater quality standards and avoiding adverse impact on sites of European or international importance for wildlife.”

“A co-ordinated approach to plan making should be development through a programme of water cycle and river cycle studies to address issues of water supply, water quality, waste water treatment and flood risk in receiving watercourses relating to the development proposed in this RSS.”

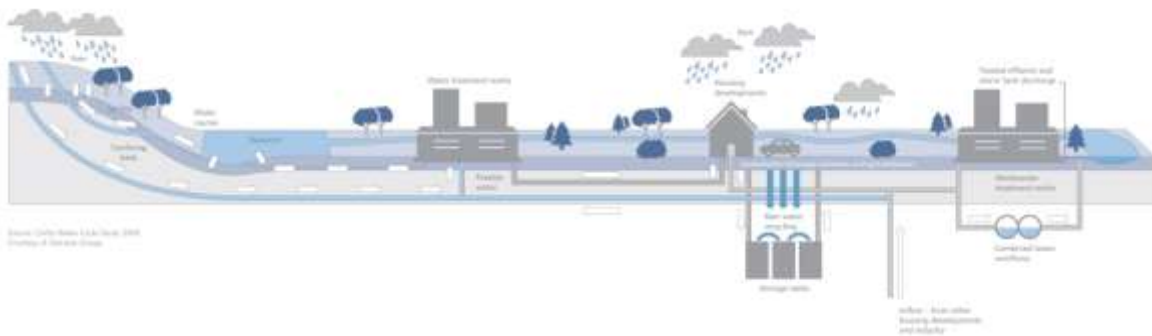
“Complementing this approach, Local Development Documents should plan to site new development so as to maximise the potential of existing water/waste water treatment infrastructure and minimise the need for new/improve infrastructure.”

#### **Supporting planning at a local level**

In partnership with the Environment Agency, we have championed the concept of “water cycle studies” as a key part of the Local Development Framework suite of documents to help to sustainably translate growth aspirations set out in Regional Spatial Strategies into the local context.

A water cycle study considers the implications of development on the whole water cycle at the settlement level; water resources, treatment and supply, waste water collection, treatment and disposal and the receiving watercourse. The issues around drainage particularly benefit from this holistic approach. Effective flood-risk management requires consideration of land drainage, surface water and sewerage systems as well as receiving watercourses – the operation of these are inter-related, so devising enhancements to cater for new development requires integrated thinking. Piecemeal approaches considering just an element of these connected systems will lead to less effective flood-risk mitigation measures, which are less flexible in the long term; particularly in terms of their adaptability for climate change.

**Figure 4. The local water cycle**



A water cycle study aims to provide a staged assessment of the capacity of the environment and infrastructure linked to the phases in the formulation of a Local Development Framework. It also identifies the roles and responsibilities of relevant stakeholders and ensures a partnership approach to agreeing funding mechanisms to facilitate fair distribution of infrastructure costs.

The three stages of a water cycle study are as follows:

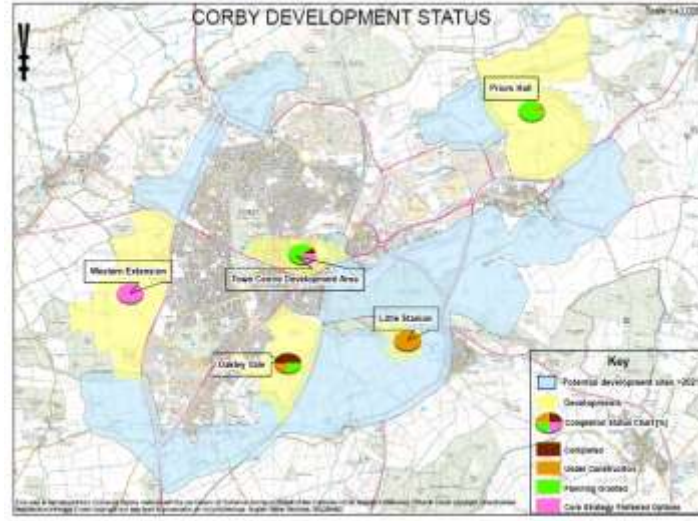
- Scoping stage – existing sources of data are identified and used to identify constraints in terms of the water environment and associated infrastructure. Information needs are also established for later stages of the investigation. It is critical that an effective partnership of relevant organisations is formed to drive the study forward.
- Outline stage – this stage of the study needs to satisfy stakeholders that there is a practical means to accommodate development proposals within the recognised environment constraints. This does not preclude further investigation or optimising of infrastructure solutions, nor does it follow that a detailed study will necessarily be required. The key test at this stage is to provide the evidence base for the local planning authority’s Core Spatial Strategy. It may identify the need to carry out more detailed assessment before approval can be given to specific sites either in terms of planning applications outside the Local Development Framework, or within the Site Allocations development plan document.
- Detailed stage – this is undertaken if a need is identified, and should address the recommendations of the outline study. It follows the latter stages of the planning process and yields a strategy to implement the water infrastructure and associated policies needed to support specific development in a sustainable, strategic manner. It also sets out who is responsible for provision of these and in what timeframe.

We have been successful in initiating water cycle studies with all the 65 local planning authorities across the region we serve. A completed, robust water cycle study provides an infrastructure strategy that caters for and is embedded within local planning policies. The process of developing this strategy means that the Local Development Framework has been devised on the basis of robust evidence from a water perspective, in line with the intent of the Regional Spatial Strategy. This approach is also allowing us to build a robust forward-looking waste water strategy akin to the framework in place for water resource planning.

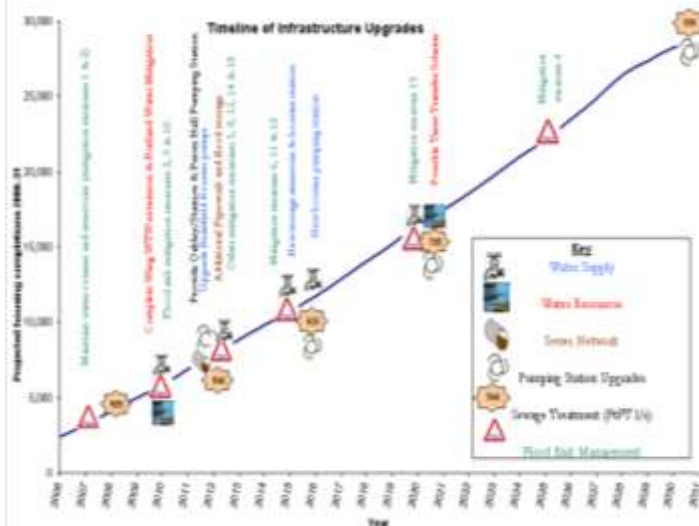
We have worked with the Environment Agency on national guidance to promote best practice on water cycle studies, recognising the importance these will play into the future. <http://publications.environment-agency.gov.uk/pdf/GEHO0109BPFF-e-e.pdf>.

### Box 2. Case Study: The Corby Water Cycle Study

The value of water cycle studies was proven to us at Corby, Northamptonshire. There are plans for major regeneration for this town, which will lead to it almost doubling in size. At the outset, the Environment Agency was concerned that the future volumes of waste water to be discharged from our treatment works could exacerbate existing flooding problems in urban areas.



Avoiding an increase in this discharge would require us to split the sewerage catchment and pump away to a new treatment works for discharge to an alternative river many miles away, with high cost and carbon implications. Instead a water cycle study was promoted to investigate this alongside land drainage and water supply, which was taken forward by the Local Development Vehicle. This study brought together the range of organisations involved in managing water infrastructure, and a waste water solution was devised for the existing treatment works that incorporated land drainage and river improvement measures to mitigate potential flood risk. The result was a jointly agreed water cycle strategy that supports economic development in a timely and more environmentally sustainable manner, and that is tied into local spatial planning policies. We believe this is a model to follow in other areas planning



significant levels of housing growth.

As part of devising effective local spatial plans and policies we also promote two specific issues that we see as particularly important in context of climate change and population growth:

- water efficiency
- sustainable drainage systems

In our region a web-based information tool has been established to help develop appropriate planning policy at a local level and to support decisions on specific developments. This has been produced in partnership with regional and local planners, the Environment Agency and ourselves [www.water-efficient-buildings.org.uk/?page\\_id=144](http://www.water-efficient-buildings.org.uk/?page_id=144). It provides technical and practical advice on water efficiency and sustainable drainage as well as more general supporting information from a water perspective.

### ***Water efficiency***

As previously discussed, we incorporate predicted forecast population trends into our future planning for new water supplies, to make sure that we are able to meet future needs. Yet this is only one element of our twin track approach of managing our region's valuable water resources. We believe that it is essential to manage demand through influencing existing domestic and industrial customers' behaviour and through tighter regulation of the way we build new homes and improve the existing housing stock.

As a sector, we promote water-efficient behaviours through the national "Waterwise" campaign ([www.waterwise.org.uk/](http://www.waterwise.org.uk/)). This primarily targets domestic customers and helps us make the most of existing water resources and manage our environmental impact in delivering this service. We also actively promote water metering and have achieved 65% penetration, the highest level for a large water company in the UK. Metered use of water further incentivises water-efficient behaviours. Our forward plan is to reach full metering. We also actively engage our industrial customers to tailor solutions for them that meet their business need and also use water more economically; this often means innovative thinking by all parties.

In terms of demand management, however, we believe that more could be done to drive better environmental performance in new housing. We champion the view that water efficiency should be of equal priority to energy efficiency. These agendas are linked through the use of energy to heat water within homes.

Water efficiency standards are set within a government *Code for Sustainable Homes*, relating to the measures required in the design and construction of new homes. It also considers the type of water using appliances that should be fitted into existing housing stock (for example, low-flow showers and taps, low-flush water use toilets) and water, as well as energy-efficient white goods. However, these are at present voluntary and we promote them becoming mandatory. Meanwhile, we are acting regionally to support water efficiency targets set at the Regional Spatial Strategy level. Resources such as the planning guidance detailed above helps this to be delivered on the ground.

We recognise the potential and the benefits for retrofitting more water-efficient appliances to existing homes. However this raises issues of funding and whether it is appropriate for customers to finance widespread improvements to the housing stock through water charges. We are engaged in policy development on this issue.

We see that more innovative ways of making new housing water efficient can also have a place. An example of this is rainwater harvesting and grey-water re-use. We understand the benefits of such systems but also see the potential risk to public health and security of supplies if these systems are not well

designed and maintained. We thus work closely with developers to promote best practice when such initiatives are advocated, focusing on the benefits of scale and community management.

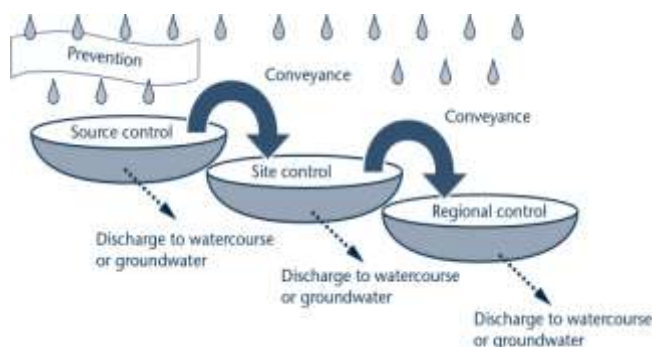
### *Sustainable drainage*

Urbanisation reduces the amount of rainfall that can soak away into the ground and means that it has to be managed to prevent flooding. Traditionally this surface water has been combined with the foul sewerage system. More recent developments have separate surface water sewers that discharge direct to local watercourses. Whilst this has advantages to combined sewers, there are environmental risks if misconnections occur between the two systems.

As towns have spread and density has increased, so too has the volume of the surface water that these piped systems must cope with. Looking forwards, the pressure on urban drainage systems will increase, both due to further development to meet the needs of our growing population and also as a result of a changing climate.

We believe that this means that a different approach to surface water management is needed and a particular priority for the region. This view is supported by regional planning policy, and such approaches are often mandated in new development.

As an alternative to conventional piped means of managing surface water, we promote the use of sustainable drainage systems (SUDS). SUDS aim to mimic within urban areas the way rainfall drains in natural systems.



The prime function of SUDS, as with conventional drainage, is to provide effective flood-risk protection over the long term both within and downstream of the development. However, SUDS approaches can bring wider benefits too:

- integrating with the landscape design to add amenity for the community as well as bringing biodiversity value;
- providing environmental protection by treating the quality as well as the quantity of surface water run-off.

Although there are many practical benefits to SUDS, there are a number of barriers that have caused problems implementing schemes in the UK, for example:

- Who takes responsibility for SUDS once they are built?
- How can past practices and regulation be changed to facilitate the use of SUDS?
- Who is checking that SUDS proposals are technically robust?
- How should SUDS be regulated over the lifetime of their operation?

Some of these issues are matters of national policy, and work is being done at this level currently. However, we also believe that solutions can be found at a local level through effective joint working between developers, planners and the Environment Agency.

We see playing an active role in promoting SUDS solutions as an important part of sustainable development.

#### *Making it happen*

Much of the paper thus far has concentrated on technical issues. However, equally important are the behavioural aspects. At each of the tiers of the planning hierarchy are a range of organisations that need to work together to deliver sustainable planning and development. Attributes sought are:

- top team-inspired leadership and drive
- role-modelling of the behaviours and actions sought in others to foster change
- partnership working – trust, openness and effective communications

Two regional partnerships are established to promote the behaviours needed to drive the studies and thinking set out within this paper. These are detailed below. Further, numerous local partnerships are in place to drive forward the water cycle studies across the region.

#### **Box 3. Water Partnership for the east of England**

The central aim of the Water Partnership is to join together spatial and water planning processes both at a regional and local level, to facilitate sustainable growth and adaptation to climate change. Key objectives are to:

- Support the development of the evidence base for the review of the East of England Regional Spatial Strategy;
- Ensure that water-thinking is embedded into the Local Development Frameworks. In particular, the Partnership will manage potential “water cycle strategies” across the region and facilitate their integration into local planning policies.
- Inform water infrastructure funding processes – for example, by providing growth forecasts for water industry planning purposes and informing Environment Agency flood defence programme priorities;
- Promote and encourage implementation of integrated urban drainage and sustainable drainage systems (SUDs) at a strategic planning level;

### **Box 3. Water Partnership for the east of England (cont.)**

- Ensure holistic water infrastructure planning by creating supplementary water-based planning guidance;
- Support the East of England Climate Change Partnership and ensure wider water policy thinking encourages and stimulates the region's efforts to mitigate and adapt to climate change;
- Provide the strategic direction and drive for the Water Partnership Delivery Group and other joint working groups that arise;
- Influence the national policy agenda, especially regarding climate change adaptation, by demonstrating regional successes.

### **Box 4. Climate Change Partnership**

The East of England Climate Change Partnership aims to help the East of England to develop sustainably in a continually changing climate and become the regional focus and provide leadership for joint activity on mitigating and adapting to climate change.

Members of the Partnership include the key regional organisations (EERA, EEDA, GO-East), local authorities, government agencies (Environment Agency, Natural England, etc.), water companies including Anglian Water, NGOs, business representative organisations and businesses, consultants and academics.

The focus of the work of the Partnership is on adaptation to the changing climate. The Partnership will also work on reducing greenhouse gas emissions where it considers that issues are not adequately addressed by other organisations. The East of England Climate Change Partnership is currently developing a Climate Change Action Plan. The overall aim of the Action Plan is an East of England successfully tackling climate change, by:

- reducing greenhouse gas emissions
- adapting to its changing climate
- taking advantage of opportunities offered by climate change

## **Notes**

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## BUILDING RESILIENCE TO SEA-LEVEL RISE IN NORTHERN VIRGINIA

*By Laura Grape<sup>1</sup>  
Senior Environmental Planner  
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### Introduction

A climate-resilient community is one that takes pro-active steps to prepare for climate change impacts.

In the United States, wide-scale planning for climate change adaptation greatly lags behind the effort to mitigate greenhouse gas emissions and improve energy efficiency. However, global climate change is well-documented, and qualitative analyses of current and near-term impacts from rising temperatures and rising seas are widely available. Northern Virginia is one of a few early leaders in the United States taking on the challenge of working with a diverse group of stakeholders to quantitatively determine the range of local impacts from sea-level rise inundation and storm-surge flooding and to incorporate adaptation strategies into local planning documents.

Communities within Northern Virginia are prone to significant inundation from the Potomac River, due to watershed run-off and from surge created by hurricanes and large storm events. Since 1933, the top five inundation events recorded at the Washington DC National Oceanic and Atmospheric Administration (NOAA) Tides and Currents gauge, occurring along the Potomac River, elevated the water level 1.4 metres to 2.4 metres above the mean sea level. Table 1 shows the water levels for the top five inundation events along the Potomac River, corrected for water-level elevations observed in calendar year 2003 and projected for calendar year 2100.

**Table 1. Summary water levels for the top five inundation events recorded at the Washington DC tide gauge, corrected for relative sea-level rise**

Absolute water level			Corrected for sea-level rise to 2003		
Event	Date	Elevation (metres)	Event	Date	Elevation (metres)
Flood	Oct. 1942	2.40	Flood	Oct. 1942	2.59
Flood	Mar. 1936	2.25	Flood	Mar. 1936	2.46
Hurricane Isabel	Sept. 2003	2.19	Hurricane	Aug. 1933	2.35
Hurricane	Aug. 1933	2.13	Hurricane Isabel	Sept. 2003	2.19
Flood	Apr. 1937	1.70	Flood	Apr. 1937	1.91

Source: U.S. Climate Change Science Program, 2009.

While there may be similar approaches to addressing inundation in the future, there is a vast difference in the duration of the event, as well as the impacts that may occur due to storm-surge flooding or sea-level rise.

With over 100 miles of heavily populated shoreline along the tidal Potomac River, the Northern Virginia Regional Commission (NVRC), through the *Sustainable Shorelines and Community Management* project, assesses areas most vulnerable to long-term and episodic sea-level rise and quantifies impacts to the natural and built environments. The development of adaptation strategies, which may lead to policy



creation and/or amendments, is currently under way. NVRC has a long history of working collaboratively with European countries to put into practice lessons learned and integrate innovative thinking into the Northern Virginia region, particularly for greenhouse gas reduction and other climate change mitigation efforts. The same approach applies to the development of adaptation strategies for sea-level rise in the region.

The impacts of climate change are not influenced by political boundaries. However, a local response strategy may be. With support from existing sea-level response strategies accepted in other parts of the United States and countries abroad, the Northern Virginia local governments can confidently work toward responding to how best to prepare their communities for sea-level rise and other aspects of climate change.

### **About Northern Virginia and the Northern Virginia Regional Commission**

Located across the Potomac River from Washington DC, Northern Virginia is one of the fastest-growing regions in the United States. The region earned the nickname “Silicon Valley of the East” because of the strong influence of its technology-focused businesses and companies that support the federal government.

**Figure 1. Map of Northern Virginia**



The region includes the counties of Arlington, Fairfax, Loudoun and Prince William; the cities of Alexandria, Fairfax, Falls Church, Manassas and Manassas Park, and the towns of Dumfries, Herndon, Leesburg, Occoquan, Purcellville and Vienna. With a population exceeding 2 million residents and projected growth of an additional 500 000 residents by 2030, the 337 734-hectare (1 304 square miles) geographic area is subject to increasing pressure on existing infrastructure and the environment.

The Northern Virginia Regional Commission (NVRC) is a regional council of 14 member local governments in the Northern Virginia suburbs of Washington DC. NVRC is a political subdivision (a government agency) within the Commonwealth.

Each member jurisdiction appoints one or more representatives from its governing body to serve on NVRC’s board of 25 commissioners. Only elected officials may be appointed, and the number of representatives per jurisdiction is population-based. The Commission is served by a highly trained staff, including a demographer and research analyst, regional planners, a civil engineer, human services professionals, technicians and administrative support personnel.

With a rich history spanning 60 years, NVRC’s chief roles and functions have focused on providing information, performing professional and technical services for its members, and serving as a mechanism for regional co-ordination. Current programs and projects address a wide array of local government interests.

As the “Voice of Northern Virginia”, NVRC is the primary representative of the Northern Virginia perspective, relating the region's interests to state government, to other geographic areas of Virginia and to the metropolitan area. The work of the commission is supported by annual contributions from its member local governments, by appropriations of the Virginia General Assembly, and by a variety of grants, contracts and fees from both governmental and private sector sources.

The localities in Northern Virginia have shown leadership in making commitments toward reducing greenhouse gas emissions and improving energy efficiency of public facilities. In particular, Arlington and Fairfax Counties stand beside King County, Washington and Nassau County, New York as pioneers in a national effort by counties to reduce global warming emissions 80% by 2050, an achievable average annual reduction of 2%. The city of Alexandria signed onto the *Cool Cities* initiative, making formal commitments to reduce greenhouse gas emissions. Additionally, Alexandria voluntarily initiated its *Eco-city* programme, which sets out an action plan for future development within the city’s boundaries. NVRC plays an instrumental role as the region moves forward with planning for climate change impacts and implementing efforts to mitigate greenhouse gas emissions, while adapting to the changes expected over the next century.

**Adaptation planning – Sustainable Shorelines and Community Management Project**

To support the development of a regional climate change adaptation toolbox for Northern Virginia, NVRC embarked on a three-year long effort to develop a plan for sustainable shoreline and near-shore community development, restoration, protection and revitalisation along Northern Virginia’s tidal waters. Through the *Sustainable Shoreline Community Management in Northern Virginia* project, the local governments in Northern Virginia are able to address coastal hazards and sea-level rise preparation in a collaborative manner. This plan focuses specifically on impacts due to sea-level rise and storm surge and is funded in part by the *Virginia Coastal Zone Management Programme* through a grant sponsored by the NOAA.

Phase I of this three-year, three-phase project includes an inventory of existing data resources and policies to determine the natural and man-made resources at risk, identify data gaps and understand current local shoreline management regulations.

A workgroup consisting of representatives from local, state and federal governments, colleges and universities, and other stakeholders assists in highlighting and collecting relevant data, including policies, land use and natural resource information (Figure 2).

Phase II will focus on filling data gaps identified through Phase I of this project and producing a report and maps of areas at risk for impacts due to sea-level rise and other climate change influences.

Additionally, two economic evaluations will be conducted to better understand the financial implications of sea-level rise and storm surge. Workgroup members will provide insight on aspects that are of utmost importance for this analysis. The analysis will include impacts to market costs (change in anything physically located on the ground: roads, houses, infrastructure, etc.) and impacts on non-market costs (the change in environmental services, including changes in water quality and habitat).

- Arlington County
- City of Alexandria
- Fairfax County
- Prince William County
- Town of Quantico
- Town of Occoquan
- George Mason University
- Virginia Tech
- National Park Service
  - Center for Urban Ecology
  - George Washington Memorial Parkway
- Fort Belvoir Army Base
- Quantico Marine Corps Base
- Virginia Department of Conservation and Recreation
- U.S. Fish and Wildlife Service
- Virginia Department of Transportation

**Figure 2. Organisations participating as workgroup members for the Sustainable Shoreline and Community Management in Northern Virginia project.**

Phase III will capitalise on the knowledge developed through Phases I and II to craft amendments to existing policies and codes or identify and pursue new policies as they relate to sustainable shoreline management and coastal community planning. Recommendations might include integration of areas at greatest risk for inundation from sea-level rise into comprehensive plans. Areas could also include migration zones for tidal freshwater marsh. In these areas, the use of living shoreline techniques or other best management practices will be encouraged.

***Adaptation planning – vulnerability assessment***

Vulnerability is defined as the susceptibility of a system to harm from climate change. It is a function of a system’s sensitivity to climate and the capacity of that system to adapt to climate changes.

Global sea-level rise is defined as the average increase in the level of the world’s oceans that occurs due to a variety of factors, the most significant being thermal expansion of the oceans and the addition of water by melting of land-based ice sheets, ice caps and glaciers.

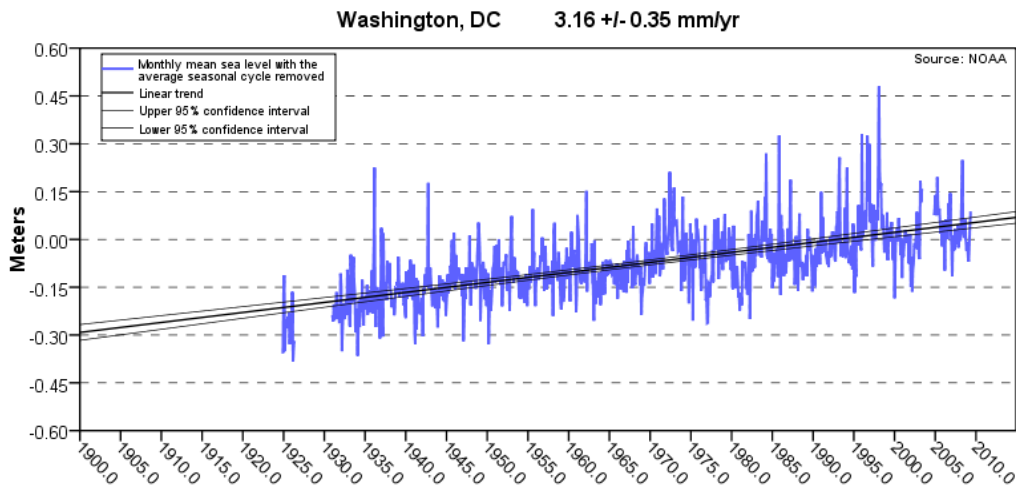
Relative sea-level rise refers to the change in sea level relative to the elevation of the adjacent land, which can also subside or rise due to natural and human-induced factors. Relative sea-level changes include both global sea-level rise and changes in the vertical elevation of the land surface. The scenarios selected for the *Sustainable Shoreline and Community Management Project* represent the historic trend based on the Washington DC gauge, the average rate of sea-level rise projected for the Chesapeake Bay region, and the highest rate projected for the region, based on global sea-level rise (Table 2).

**Table 2. Relative sea-level rise scenarios used for the *Sustainable Shorelines and Community Management Project***

Relative sea-level rise scenario	Definition
Steady state	The observed historic trend relative rate at Washington DC gauge (3.16 millimetres/year).
Average accelerated	The average relative sea-level rise rate projected for the Chesapeake Bay region.
Worst case	The highest relative rate projected for the mid-Atlantic and Chesapeake Bay regions.

The scenarios will be modelled over four planning horizons – 10 years, 30 years, 50 years and 100 years. These represent impacts in the near-term, impacts over the life span of a common home mortgage, and impacts projected at the middle of the century and at the end of the century.

**Figure 3. Record of mean sea level at Washington DC tide gauge**



Note: Monthly mean sea level at Washington DC tide gauge from 1924 to 2006. The blue line represents observed data (NOAA, 2009). The relative sea-level rate in Washington DC is nearly double that of the global (or Eustatic) sea-level rate, due to land subsidence.

However, to generally understand the areas along the Northern Virginia tidal shoreline that are most vulnerable to sea-level rise and storm surge impacts, NVRC and its partners broadly modelled two scenarios (a 1-foot rise and a 3-foot rise) against LiDAR topographic data. This modelling identifies “hot spots” or areas most susceptible to harm from inundation and flooding. Based on these rates, the results from an initial broad analysis of projected impacts to properties and tidal freshwater wetlands indicate 1 869 to 2 678 properties and 90% to 94% of tidal freshwater marsh could be affected by a 1-foot or 3-foot rise in sea level respectively (Table 3).

**Table 3. Impacts to property and tidal freshwater marsh in the Northern Virginia region from a 1-foot and 3-foot rise in sea level**

	1 foot	3 feet
Total number of properties affected*	1 869	2 678
Acres of tidal freshwater marsh** inundated	1 959 (90%)	2 031 (94%)

Notes:

\*This number does not represent any impacts to structures on affected properties.

\*\*Total acreage of tidal freshwater marsh in the Northern Virginia region = 2 168 acres.

Relative sea-level rates along the mid-Atlantic coast of the United States are measured at specific locations and vary from 1.75 millimetres to as much as 4.42 millimetres per year (Zervas, 2001). In the Chesapeake Bay, 12 tide and current gauges maintained by the NOAA capture this data. The closest gauge to the Northern Virginia area is located in Washington DC (Station 8594900) and has recorded data since 1924.

The average accelerated and worst-case scenarios represent the enhanced rate of sea-level rise in the Chesapeake Bay. The Virginia Governor’s Commission on Climate Change’s Adaptation and Sequestration Workgroup recommends that, at a minimum, Virginia should plan for a 3.6°F increase in air and water temperatures, and at least a 2.3-foot rise in sea level. The full range of sea-level rise expected across the Bay region is estimated to be between 2.3 feet to 5.2 feet, with great local variability as a result

of subsidence (GCCC, 2008). This range is based on the Chesapeake Bay Program’s Scientific and Technical Advisory Committee’s (STAC) September 2008 report.

The basis of the STAC report’s projections is a study conducted by Stefan Rahmstorf of the Potsdam Institute for Climate Impact Research in Germany in 2007. In this study, Rahmstorf uses a semi-empirical sea-level rise model that relates global sea-level rise to global mean surface temperature. When applied to the IPCC future warming scenarios (Nakicenovic and Swart, 2000), Rahmstorf’s model projects a rise of 700 to 1 400 millimetres by 2100. When added to the Chesapeake Bay local component that includes subsidence, the region may experience sea-level increases of 700 to 1 600 millimetres by 2100 (Pyke, 2008). Since 1924, the NOAA tide gauge located along the Potomac River has collected mean relative sea-level measurements.

Additionally, the *Sustainable Shorelines and Community Management Project* will include an analysis of storm surge impacts in the Northern Virginia region, particularly as it relates to accelerated rates of sea-level rise. Storm-surge strengths are based on historical influences from the unnamed hurricane of 1936 and Hurricane Isabel, which had observed surges of 2.13 and 2.19 metres, respectively (Table 4).

**Table 4. Observed water levels for two storm surge events created by two hurricanes that impacted the Northern Virginia region, corrected for sea-level rise projections**

Event	Absolute water level		Water level corrected for relative sea-level rise	
	Date	Observed elevation (metres)	2003 elevation (metres)	2100 elevation (metres)*
Unnamed hurricane	August 1933	2.13	2.35	3.51
Hurricane Isabel	September 2003	2.19	2.19	3.35

Note: \*1.16 metres by 2100.

The next step of the vulnerability assessment includes an inventory of impacts to other features of the built and natural environments. A refinement of the storm surge data, using existing Sea, Lake, and Overland Surge from Hurricanes (SLOSH) model results, will provide a more realistic understanding of impacts in the region from storm-surge flooding.

#### ***Adaptation planning – strategy development***

In December 2008, the Virginia Governor’s Commission on Climate Change released its *Climate Change Action Plan* for the state of Virginia. The plan:

1. inventories the amount of and contributors to Virginia’s greenhouse gas emissions, and projections through 2025;
2. evaluates expected impacts of climate change on Virginia’s natural resources, the health of its citizens, and the economy, including the agriculture, forestry, tourism and insurance industries;
3. identifies what Virginia needs to do to prepare for the likely consequences of climate change;
4. identifies the actions (beyond those identified in the Energy Plan) that need to be taken to achieve the 30% reduction goal; and
5. identifies climate change approaches being pursued by other states, regions, and the federal government.

The *Northern Virginia Sustainable Shorelines and Community Management Project* seeks to regionalise efforts that address sea-level rise and storm surge along the tidal Potomac River in Northern Virginia. Currently, there are no policies or tools in place that directly incorporate adaptation strategies in any of the jurisdictions that may be influenced by projected sea-level rise and storm surge.

The Policy Inventory report provides examples of planning efforts in the United States and abroad that incorporate sea-level rise and storm-surge response strategies into local policies and planning documents. The report also includes an inventory of policies in Northern Virginia's localities and recommends strategies for potential integration into other planning tools.

At the international level, a number of countries have commissioned studies and adopted adaptation strategies to address project sea-level rise and storm surge. Australia has completed a national assessment and provided recommendations for local governments; the Australian state of New South Wales has incorporated practices that address sustainable development and adapt to changing sea levels, while the State of Victoria has factored sea-level rise into its coastal management strategy. Canada also performed a national assessment and is in the process of assisting coastal jurisdictions in preparing for sea-level rise and storm surge. Canada conducted an impact study for Prince Edward Island and New Brunswick and provided adaptation strategies that both provinces have begun to incorporate. On a local level, the city of Vancouver has focused planning efforts on mitigating impacts to critical infrastructure.

Several US states, cities and counties, are incorporating adaptation strategies into their planning tools. King County, Washington, for example, has integrated a climate change plan and sea-level rise adaptation strategy into its comprehensive plan. The San Francisco Bay Area has factored sea-level rise and storm surge into the design of its shoreline structures since 1988. More recently, the Bay Area completed an assessment of potential impacts due to sea-level rise and storm surge and made recommendations regarding land use and the protection of critical infrastructure and ecosystems. New York City has started to adapt its water supply, drainage and waste water systems to account for climate change and sea-level rise. Currently, Delaware is assessing potential impacts on its coastal communities. Maryland has assisted Somerset, Dorchester and Worcester Counties by mapping inundation areas, identifying potential impacts and recommending adaptation strategies. The city of Crisfield, Maryland, has incorporated sea level-rise and storm surge into its comprehensive plan and is using land elevation to guide future land use planning.

Although Northern Virginia's communities do not have policies that directly address sea-level rise and storm surge, there are a number of existing policies that relate indirectly. The following section addresses consistencies and differences among local policies.

State-mandated policies have fostered the development of similar planning efforts among Virginia's jurisdictions, including:

- comprehensive plans
- Chesapeake Bay preservation
- erosion and sediment control
- stormwater management
- flood-plain management
- water quality management

In addition, several localities have developed watershed management plans and open space plans that contain environmental restoration and conservation goals and recommend land use strategies. However, a number of policies are unique to specific jurisdictions; a discussion of the policies distinct to each Northern Virginia jurisdiction is included in the paragraphs below.

Through its *Eco-City Environmental Action Plan: EPC Draft: April 2009*, the city of Alexandria intends to address sea-level rise and storm intensity changes as part of its long-term planning. Also, the city has a *Waterfront Master Plan* and *Waterfront Parks and Recreation Zone*.

Fairfax County has created a number of distinct policies as well, such as the *Environmental Quality Corridors* (EQC), which require an additional 50-foot protected buffer around designated critical areas. Furthermore, Fairfax County also enforces the *Tidal Shoreline Erosion Control Measures Ordinance*, *Environmental Hazards Ordinance*, *Water Supply Protection Overlay District*, *Natural Resource Overlay District*, *Residential Preservation District*, *Residential Conservation District*, *Parks and Recreation Plan*, and general land regulations on drainage, flood plains, wetlands and Resource Protection Areas.

The Prince William County Design and Construction Standards Manual covers flood-plain management, Chesapeake Bay Preservation and Resource Protection Areas. Prince William County also designated a *Flood Hazard Overlay District*.

The towns of Dumfries and Occoquan have designated *Chesapeake Preservation Overlay Districts* that meet the compliance with the *Chesapeake Bay Act*. Additionally, each jurisdiction has a designated Flood Plain District.

The state of Virginia is a low-water state, meaning that the rights of waterfront property owners extend to the low tide marker. Property rights for landowners are very strong in Virginia.

As Northern Virginia's jurisdictions move forward in the development of regional adaptation strategies, they can build upon the lessons learned from leading US and international cities, as well as the solid foundation of existing land use and environmental policies.

Indirectly, the project will develop a sense of pride in Northern Virginia's shorelines and the natural resources it contains and supports locally and downstream. Through thoughtful and collaborative data collection, policy review and product development the *Sustainable Shoreline Community Management in Northern Virginia* project will help planners, decision makers and individual residents living along the shoreline to adapt to the changing climate in a manner that limits human health risk and sustains the environment.

## Notes

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**SESSION 3-B**  
**MANAGING PORT CITIES**

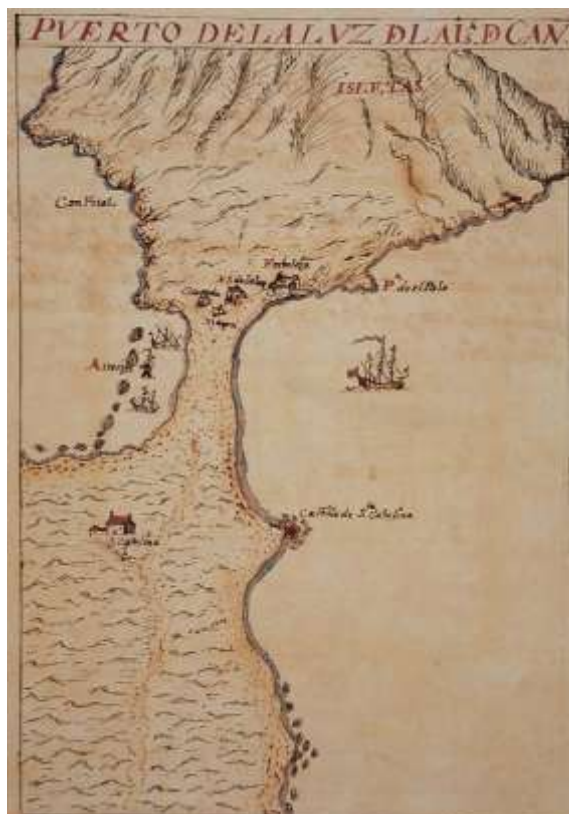
## LAS PALMAS PORT AS AN URBAN TOOL

*By Javier Sánchez-Simón Muños  
President of the Port Authority of Las Palmas, Spain*

The historical memory of the origins of Las Palmas Port goes as far back as the time of the journeys of discovery of Christopher Columbus, which shaped the destiny of the port.

At that time, its waters were known as “Las Ysletas”, a name that referred to the sheltering effect that three headlands provided to its eastern bay against the prevailing winds, and which was due to the geomorphologic quasi-island shape of the three headlands, joined to the rest of Gran Canaria by the then uninhabited isthmus of Guanarteme, which was barely perceptible at high tide.

### **Puerto de la Luz in Gran Canaria by Pedro Agustín del Castillo, 1686**



A number of episodes throughout the history of the island provide a wealth of data, though with a fair number of exaggerations, that illustrate the sociological parameters of the port that arose between the end of the sixteenth and the middle of the nineteenth century. However, the fact is that for this lengthy period, the port's infrastructure, far from being a catalyst for economic, social, political and/or cultural changes, was almost exclusively limited to its use as a site of natural anchorage, with the construction of fledgling wharfs or jetties (often made of wood), primary attention being given to the undertaking of civil defence works to protect the population against invaders or pirate attacks.

As in other Spanish port systems, the pioneering city quay, San Telmo quay, was not felt to be a necessity by the inhabitants of the island until towards the end of the eighteenth century (1785), when the local authorities, principally in recognition of the social demand for a safe and comfortable place for passengers to board and disembark, arranged for Rafael Clavijo, a military engineer, to draw up a project for an ashlar masonry dock. Plans were finalised four years later, in 1789.

From the moment the first stone was put into position in 1811, until its completion in the second half of the nineteenth century, the project was beset by an extensive variety of problems. These included economic and technical issues, but the main difficulties were due to the location that had been chosen, because the persistent action of the sea and frequent storms caused continual setbacks to an endeavour that was costing substantial money and effort.

The work came to a halt until, in 1827, the influential Gremio de Mareantes took over responsibility for it. A Board of Public Works was set up in 1831 and entrusted with its execution.

Given the relatively frequent damage that the dock suffered, it was decided in the latter half of the nineteenth century to build a perpendicular sea wall at its eastern end in a hammer-head shape, to offer greater protection and facilitate operations in the quay. This finally became inoperative when, some years later, the new work on the construction of Puerto de Refugio, or Puerto de la Luz, was undertaken.

#### **Las Palmas quay and the area of San Telmo**



Northwards, sand flats and dunes comprised a small desert-like area that extended up to the beaches of La Luz. Here, a few fishermen's homes, the "Señá Rosarito" inn and a small barracks for border police were the only places of interest to the travellers and sailors who found themselves there, generally looking for shelter from the bad weather.

When it was impossible to approach San Telmo, the more knowledgeable sailors would make their way to one of the three anchorages that existed at the time ("Las Comedurías", "El Marisco" and "Los Plátanos"), or they would seek shelter in the quiet waters of Las Isletas Bay.

If anything, Las Palmas' quay was a hindrance to economic growth. Sailors, ship-owners and traders all suffered the ordeal of a port that was not always accessible for the loading and unloading of local produce and goods for local consumption, and this entailed significant commercial losses.

However, the extensive bay located to the north of Las Palmas city was ideally situated to become an excellent maritime port. It was protected by the headlands of La Isleta, which sheltered it from the prevailing winds, and had a sandy and gently inclining seabed highly suitable for vessel anchorage and other maritime operations. In fact, the inlet of La Luz had always been used as a natural sheltering area by conquistadors, seafarers and local fishermen.

It was no real surprise that the commercial sectors of Las Palmas city should turn their attention to La Luz as a potential remedy for the obstacles that had hindered economic growth, nor that they should desire to see the city's future port constructed there.

The debate centred on whether to use the natural shelter afforded by the by now established natural anchorage area of Las Isletas bay (La Luz) as an auxiliary and complementary refuge to the city quay, or to build new infrastructure to provide the island with a port more befitting of the new sea-faring and trading conditions. It was felt to be a necessity that could no longer be postponed and an indispensable means for the future survival of the city. The formulation and reformulation of this idea and project remains a work in progress even today, and one that is continually being adapted to the requirements of times yet to come.

Practically all the options were debated, but the idea of constructing the quay in Puerto de la Luz gradually won favour as the preferred option of the city's inhabitants.

The Royal Act on Free Ports, dated July 13, 1852, signed by Juan Bravo Murillo, the Minister for Finance, served to establish the relief from customs duties characteristic of the idiosyncratic nature of trade in an archipelago, and this was indeed clearly stated in the Act itself:

*“Whichever economic system an individual might prefer, nobody can deny that the trading conditions in the Canary Islands are essentially different from those that exist in mainland Spain. [...] For this reason “the ports of Santa Cruz de Tenerife, Orotava, Ciudad-Real de Las Palmas, Santa Cruz de La Palma, Arrecife de Lanzarote, Puerto de Cabras and San Sebastián are designated as ‘free ports’ through which trade can only be undertaken with those of mainland Spain, with the corresponding records that serve to avoid misuse of this condition.”*

Echoing these aspirations, on 6 October 1856, the Governor of the Canary Islands made an official presentation to the Ministry of Public Works requesting an auxiliary quay in La Luz bay. The request came with favourable reports prepared by the Public Works Engineer, the Navy Command, the Board of Commerce and the Board of Agriculture; all spoke of the future economic benefits that the construction of a new quay would provide.

The result was the first works project drawn up by the engineer Clavijo y Pló for La Luz in 1857. Its aim was to build a small jetty or wharf that would serve as an auxiliary point for Las Palmas quay.

**General project for a quay in La Luz port harbour, 1857, by Francisco Clavijo**



Though it was only conceived as an auxiliary jetty or wharf, the cost of the work was estimated at around three million *reales de vellón* (the currency of the time), an astronomical figure for the period. The project was approved in 1858, but was never undertaken because of a lack of applicants for the tender.

In 1861, the Las Palmas local authorities took up the initiative from the central powers. This time a leap was taken in the direction of more extensive formulations than that of a simple “auxiliary wharf”. The presentation made by the local authorities stated that:

*“..... the importance of the Province’s trade with mainland Spain and foreign countries, and the importance that Spanish possessions in Africa and the Americas have acquired and will continue to acquire, will mean that, in the not too distant future, the Province must, for convenience’s sake and out of absolute necessity, have suitable port facilities, such as those that could be offered by La Luz.”*

This prophetic vision of the port was unlikely to have been the factor that moved the government to action. It was more probably the undertaking of the local authorities to pay 50% of the cost of the works. Whichever was the case, the order was given to start work on a study for the project on 27 August 1861.

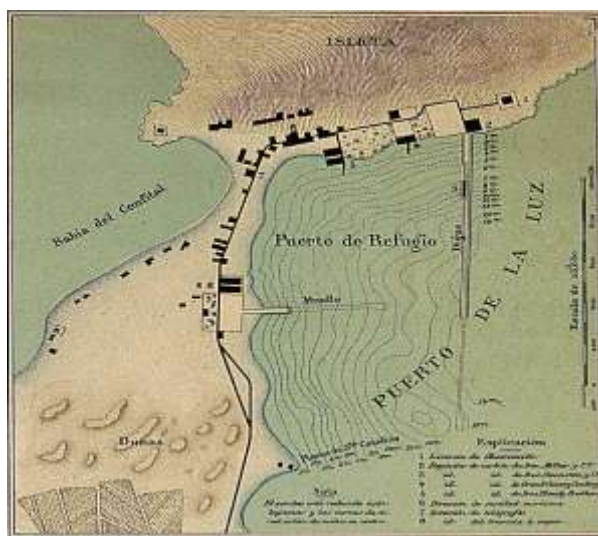
The vigour and desire displayed on all economic and social fronts was insufficient to prevent discontent and despondency from making its mark throughout the island. It was in fact not until the magical year of 1881 that the port infrastructure projects came to a successful conclusion. Indeed, in the Spanish port system, Las Palmas port had been pushed into the background and recently ratified by the innovative Port Law of 7 May 1880, as belonging to the category of “*port of local interest of secondary order*”. Such a categorisation meant that for all practical purposes, it had little hope of acquiring state funding for its projects.

However, on 27 April 1882, a law was passed that declared La Luz a “Port of Refuge of General Interest”, and the project work was begun in 1883. The project was subjected to a number of modifications and reforms, and work was finally concluded in 1903, three years having been added to the initial completion deadline of 17 years.

The port project essentially contemplated the construction of two major units:

1) The external sea wall or *La Luz Quay*, which started at the old landing stage whose construction had been abandoned in 1871 and which extended out to 1 240 meters. Its purpose was to provide an extensive sheltered area for the undertaking of maritime operations.

2) *Santa Catalina Quay*, located transverse to the aforementioned quay. This extended some 600 metres from the beach, very close to the old Santa Catalina Castle. This was the quay to be used for passenger boarding and disembarking, as well as for the loading and unloading of goods.



The slowness with which the work progressed was the greatest obstacle the new port had to face. But in 1900, before the construction work was over, proposals were already afoot to deal with the fact that more extensive work would be required.

Even, as mentioned, before the conclusion of the original project, it was becoming clear that the work being undertaken would not be of sufficient magnitude, and on several occasions the need to widen the scope of the work was raised (in 1910 a figure of around 4 500 steam ships was reached), so as to finally construct the long dreamed-about “port of the future”. This need led to the study and drawing up of several projects.

With the conclusion of these works, Puerto de la Luz became one of the most important ports along the eastern Atlantic, conceived as an obligatory port of call in the international flow of trade and navigation. Of vital importance was its role as a storage port for the loading and unloading of goods, for both export and import, as well as its use as an inter-island point of transfer. As a consequence primarily of its geographical location and the rapid intervention of its employees, the port soon became a well-known, efficient bunkering station for coal and vessel provisioning point, acquiring in addition a growing reputation in the ship repair sector.

In the 1920s, as the economic recovery grew and the number of vessels that wanted to use the port facilities increased, it became clear that the need for more extensive construction work could no longer be put off, particularly if the port wished to maintain its supremacy over competing African ports.

The definitive solution did not arrive until 1927, with the modified project of a new sea wall drawn up by Julio Rodríguez Rodas. This project also included urban modelling of the city district of La Isleta. Thus,

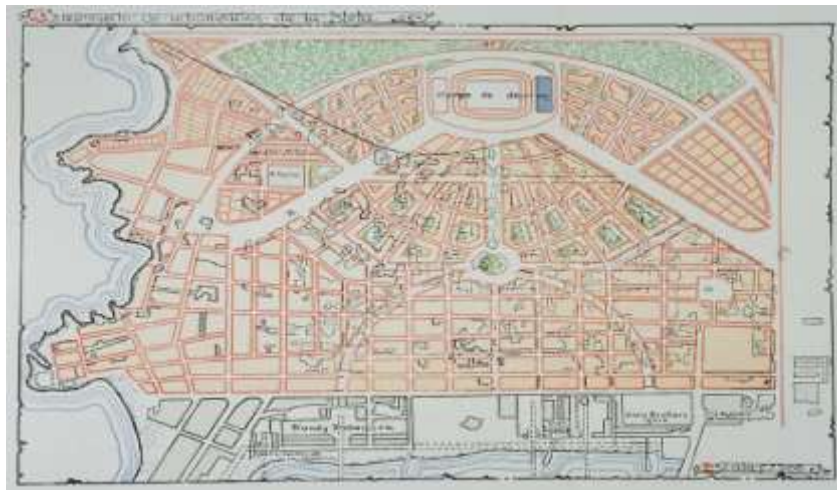


the Great Quay came into being (renamed “*Dique del Generalísimo*” or the “Great General’s Dock” during Franco’s dictatorship), constructed between 1927 and 1935 and signalling the start of a new age in the history of the port of Las Palmas.

**Preliminary plan for enlargement of the port area, by Julio Rodríguez Rodas, 1928**



**Preliminary plan for urban modelling of La Isleta, by Julio Rodríguez Rodas, 1928**



Work began in 1935 on the fruit quay Nuestra Señora del Pino (today a naval base), based on a project drawn up in 1932 by the engineer Antonio Artiles Gutiérrez. This work, which was concluded in 1937, aimed to improve the export service for the island's horticultural products at an ideally located site. Unfortunately, its launch did not coincide with the most favourable of situations and, particularly because of the outbreak of World War II and the consequent considerable restrictions to exports, in 1940 it was transformed into a military platform.



When World War II was finally over, a new chapter began for Puerto de la Luz, with the consolidation of new elements amongst its functions. Its use as a coal bunkering station port of call was transformed into that of a oil bunkering station; there was a marked increase in the type and range of goods that the port dealt with, and its use to the fishing industry became more clearly defined. Development in this sector was strengthened thanks to the project drawn up by the engineer Rafael Picó Cañeda in 1954 for the Castillo dock (the current fishing quay) and finished between 1954 and 1959, and to the widening and sectioning of the tip of La Luz dock.



Puerto de la Luz now had an infrastructure base and services with sufficient capacity to deal with the emergence of new and powerful maritime traffic.

All the work that had been undertaken at the opportune moment was to be used to the maximum during the 1950s and 1960s, until in 1967, with the close of the Suez Canal, an infrastructure crisis arose.

In 1964, the chief engineer, Modesto Viguera González, submitted to the approval of the authorities a new General Public Works Plan for the port. Generally speaking, this project followed the ideas of the Picó Plan, based essentially on the concept of a quay-breakwater for Las Palmas city and a new outer harbour for oil tankers and deep-draught vessels.

Work on the new sea wall for the outer harbour began in 1966, and three years later, on two shoreline quays in the same harbour. The first stage of the sea wall was completed in 1971.



As a result of the second closure of the Suez Canal, the port saw a rapid rise in traffic, reaching a historical maximum in 1970 not surpassed until the end of the century. This rapid rise in traffic led to heavy congestion in the port.

The full-blown crisis that the port was facing coincided with the presentation in 1971 of the Public Works Plan for the port as well as a draft plan for the new outer harbour, drawn up by the Chief Engineer, Juan Argenti Ulloa.

This plan, which undoubtedly comprised a radically different conception in the face of the new requirements that the port was clearly going to have to deal with, represented a major step forward in the evolution of the creation of the port infrastructure.



In the 1980s, the projects of the engineer Fernando Navarro Miñón were drawn up to deal with the need to create new infrastructure.



As a consequence of substantial developments that had occurred in the fields of communication and maritime transport, as well as in container transport, the port found itself obliged once again in the 1990s to adapt and modernise its facilities, its technological capacity and its mooring and operational areas. During this period, work was begun on the creation of large esplanades to make possible the transformation of Las Palmas Port into the main Hub Port of the mid-east Atlantic.

**PROYECTOS DE: TERMINALES DE CONTENEDORES DARSENA EXTERIOR 1997**

Proyectado por Ing. José M. Pintado Joga  
 1999-2004 : 1ª y 2ª Fases Muelle Virgen del Pino  
 1999-2003 : León y Castillo lado Este y Muelle de Cambulloneros



Today, in its desire to keep pace with its competitors in infrastructure and space and to ensure that the port will continue to attract clients and offer the best service possible, the port authorities are working on new plans for the port, opening it up to another outer harbour, following the criteria of expansion that have served it so well in the past.

**PROYECTO DE: DIQUE DE LA ESFINGE 2001**

Proyectado por Ings. José Miguel Pintado Joga, José Daniel Lopez Lopez y Salvador Capella Hierro  
 2002-2004 -Península del Nido - Baja del Palo y 2004-06 extensión  
 2003 - 2009... Esplanadas y rellenos.  
 2007 - 2010 Dique de La Esfinge



Functionally speaking, a port is essentially an intermodal connection hub in the logistics chain of maritime transport, which can also act as the connection point for the land to which it is attached (a “hinge function” or “transport modal interchanger”).

All the developments undertaken in the port have brought growth for the city itself, which has gradually helped to shape the city as it stands today.













The port has had a progressive influence on the social and environmental aspects of Las Palmas city, requiring a delicate balance between the needs of the city and those of the services the port offers.

Any planning process that involves the port must necessarily be complex and time-consuming, involving the reconciliation of the responsibilities of different local, regional and state authorities, with the consequent variations in legal and procedural questions.

The different points of view of the intervening administrations must somehow be brought together by concerted dialogue into a viable framework that can best serve the society as a whole. In the search for consensus, the principles of inter-institutional loyalty and co-operation have to be called upon, based on mutual respect for the obligations and responsibilities of all parties involved.

The challenge lies in conscientiously creating and making available the port infrastructure that its users demand with a reasonable and sustainable consumption of natural, territorial and financial resources. The appropriate allocation of physical space of the port hub will require the adoption of socio-environmentally balanced solutions that have sufficient versatility to provide flexible responses to new situations as they arise.

With such co-operation, planning becomes a process in which a desirable future is modelled. Objectives, resources and actions to be undertaken are prioritised and programmed over time, and milestones are set and reached. When correctly employed, planning enables mature and responsible societies to anticipate the scenario they are aiming for. It allows them to participate as protagonists in the planning of their own future, and to fully commit themselves to the goals that have been set.

In cognisance of this fact, the European Union in its 2003 guidelines developed one of the main proposals of the Aarhus Convention: the right of citizens to environmental information so that they can enjoy the right to a healthy environment and meet the obligation of respecting and protecting that environment. To ensure that this objective is met, citizens should have the right to participate in the decisions that concern the environment.

Planning must be a rational, systematic and anticipatory process, but above all it must be social, participative and multifaceted. Once competing authorities and limited sector-based points of view enter the equation, there can be no prevailing or single plan, only different plans that depend solely on a previously adopted *a priori* approach. As a result, differing sensitivities, values and objectives, not to mention a multiplicity of regulations and procedures, come into play.

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