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Cities and Green Growth: Issues Paper for the 3rd Annual Meeting of the OECD Urban Roundtable of Mayors and Ministers, 25 May 2010, Paris

8-9 June 2010
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Cities and Green Growth

ISSUES PAPER FOR THE 3RD ANNUAL MEETING OF THE OECD URBAN ROUNDTABLE OF MAYORS AND MINISTERS

25 May 2010, OECD Conference Centre, Paris

C40 CITIES
CLIMATE LEADERSHIP GROUP

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This report has been prepared by the Regional Policy Development Division of the OECD for the 2010 OECD Roundtable of Mayors and Ministers on Cities and Green Growth, Paris, 25 May 2010, *www.oecd.org/urban/2010roundtable*

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Executive Summary

Cities' growth impacts both environmental quality and national competitiveness.

- Cities are high drivers of national GDP and main centres of innovation and typically feature higher levels of productivity than their country's average thanks to specialization
- Cities are also major energy and resource consumers. In a predominately urban world, cities consume 60-80% of energy worldwide and therefore are responsible for large shares of GHG emissions.
- The urban form matters: the lower the urban density, the more energy is consumed for electricity and transportation. CO_2 emissions per capita drop significantly as urban areas densify.
- Cities provide the right scale for markets of eco-products and for large-scale green infrastructure investment.
- Short-term costs of urban environmental policies are lower than at the national level because of the effects of stronger synergies. Local policies to reduce pollution increase attractiveness – a main factor of city competitiveness, especially in economies that are higher up the value chain.

Cities have a pivotal role in national and global green growth strategies .

- Cities and regions are promoting green growth through an arsenal of innovative tools, which need to be pursued simultaneously to unlock policy complementarities:
    - Greening public investment and purchasing – in infrastructure, building, transport, communication networks and utilities.
    - Supporting greener local industries by improving the eco-efficiency of production, easing the way for green start-ups and training local workers.
    - Raising consumer awareness through consumer education and lowering the cost of green technology purchases.
    - Catalysing research and the development of the green-tech clusters that will become the engines of cities' green economic growth over the long term.
- Compact cities policies can contribute to green growth and significantly reduce energy consumption. Successful "compact cities" rely on transportation linkages, mixed land uses, and high-quality urban services. Applying densification policies or congestion charges can have long-term positive effects on the economy due to technological innovation: *e.g.* high-quality, more-efficient public transport that responds to economic needs and better connects labour with employment, thus increasing firms' productivity.

Moving towards a low-carbon, more sustainable society will require significant up-front investments.

- Acting on green growth in cities requires new financial instruments, such as urban use of carbon markets, local cap-and-trade systems and grants that take environmental sustainability into account.

- Existing urban revenue sources could be "greened": congestion charges and road taxes can reduce car travel and fund green infrastructure; local energy fees that put a price on wasteful energy use can increase efficiency; and property taxes can stop favouring urban sprawl and start encouraging development in the urban core and around transportation linkages.

- Private financing will be important: public-private partnerships could bolster urban green growth goals but must be transparent and clearly accounted for.

National governments have a key role to play in enhancing cities' capacity to act on green growth.

- There is a need to bridge the gap between national and local approaches to green growth. National plans do not account for the spatial elements of green growth, nor for cities' existing contribution to green growth. Urban green growth strategies tend be stand-alone, "flagship" green projects that are dependent on short-term political cycles, but long-term sustainable economic growth calls for a systematic, citywide, multi-sectoral approach.
- National governments could green urban finance by re-designing taxes and grants to sub-national governments to correct incentives for unsustainable behaviour and reward cities that create environmental benefits beyond their borders.
- Technical assistance, funding and knowledge-sharing is needed for large-scale infrastructure projects – such as smart grids, high-speed trains, and green R&D – and to help cities measure the economic and environmental impact of green growth initiatives.
- Strong national and international environmental targets and baseline standards are needed to remove policy obstacles, prevent harmful competition among regions and promote incentives for a "race to the top". Cities also need flexibility to innovate urban-level policy responses that can then be scaled up.
- Green growth is impacted by the way carbon emissions and environmental quality are valued. Urban green growth policies would benefit from national price signals and standards – *e.g.* through carbon taxes or other pricing mechanisms.

Better monitoring of policy impact is needed.

- A common set of urban environmental and economic indicators are needed to compare best practices and measure green jobs and growth. Inconsistent methodologies across cities counteract any attempt to monitor and evaluate progress on green growth.
- An urban green growth strategy should include data generation, market information and analysis of the local economy to better understand how local energy use and emissions relate to economic activity. Access to this information by national governments could inform both urban and national strategies.

CITIES AND GREEN GROWTH

ISSUES PAPER FOR THE 2010 OECD URBAN ROUNDTABLE OF MAYORS AND MINISTERS

As cities emerge from the crisis, there is a need to find means of economic growth that help cities reduce their contributions to climate change and resource use.

City and national leaders are beginning to understand green growth as a means of creating jobs and growth while reducing costs and environmental impact over the long run. The global recession and continued concern over climate change have called into question the ability of the current model for economic growth to foster long-term prosperity. Green growth has emerged as a new paradigm that promotes economic development while reducing greenhouse emissions and pollution, minimising waste and inefficient use of natural resources and maintaining biodiversity. As key engines of economic growth, job creation and innovation, but also as major contributors to global warming and environmental problems, cities play an increasingly important role in meeting this challenge.

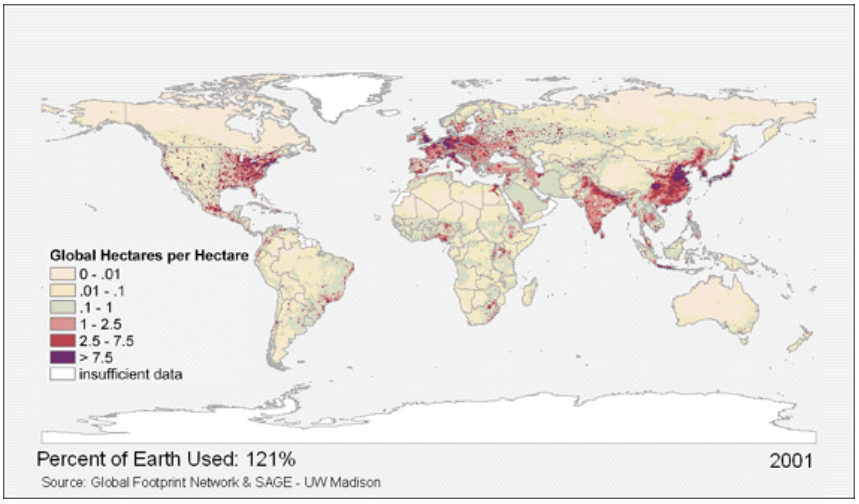
A green growth agenda reflects an urgency to confront climate change and out-of-control resource use, which are disproportionately affected by urban development.

More than half of the world's population now lives in cities, a share that is expected to grow to two-thirds by 2050 (UNFPA, 2007; UNHABITAT 2009). As key centres of economic activity and production, cities are also the primary consumers of energy worldwide, (OECD, 2006; OECD, 2008a), consuming an estimated 60-80% of the world's total energy output (IEA, 2008a). All projections indicate that this trend will continue as urban populations grow, especially as cities in the developing world switch from low-carbon to high-carbon sources of energy. If we continue on the present trajectory, global greenhouse gas emissions will increase by more than 50% by mid-century, causing world temperatures to rise from 1.7 to 2.4 degrees Celsius above pre-industrial levels by 2050, and from 4 to 6 degrees Celsius or more in the long-term (OECD, 2008b).

Cities often have large ecological footprints, which place pressure on surrounding ecosystems and contribute to the export of waste by-products to non-urban areas.

With economic growth and the generation of wealth, direct and indirect consumption of energy and materials increase, adding to pressure on water resources, waste disposal, energy and transport (OECD, 2008b), and straining local and national budgets. The growing number of urban pockets with very high population densities and compact centres of leisure and economic activities rely on distant resources to remain sustainable. The ecological footprint – the total area required to provide environmental goods and services for a specific region – is particularly severe in cities (Figure 1). For example, London's footprint was found to be 125 times the size of the city and twice the land size of Great Britain (Wackernagel, 2006; London Remade, 2007). Urbanisation is associated with higher ecological footprints per capita, primarily because of the high levels of industrial commodity production and the concentration of key consumer markets in urban regions (Jorgenson, 2003).

Figure 1. The ecological footprint is highest in urban areas



Source: www.footprintstandards.org

Cities, especially those located on the coast or near rivers, are especially vulnerable to water-related calamities and the effects of climate change.

An OECD study on 136 port cities shows that 40 million people today are exposed to rising sea levels. The total value of assets exposed in 2005 was estimated at USD 3 000 billion, which corresponded to around 5% of global GDP in 2005. By the 2070s, in a scenario involving higher seal levels and increased storm activity, land subsidence, population growth and urbanisation, the total population exposed could grow over three times, to around 150 million people, and the total asset exposure could reach as much as USD 35 trillion, more than ten times the 2005 figure. This is projected to amount to roughly 9% of projected annual GDP at that time. Abating climate change not only reduces the risk of catastrophic impacts on cities, but also addresses local environmental problems such as poor air and water quality (Nicholls *et al.*, 2008).

A new approach is warranted: mayors and national government officials must find ways to successfully leverage green growth in the face of tremendous economic change and growing environmental pressures. Four questions have emerged for national and urban policy makers interested in making the transition to a greener economy

1. How can a green growth strategy contribute to a stronger economy and job creation while reducing greenhouse gas emissions and other environmental impacts?
2. Why should cities have a key role in the new green growth model?
3. How can local governments integrate green growth principles into the web of existing policies on transportation, building, land use, and energy?
4. What financing and coordination mechanisms do cities need to successfully implement green growth policies?

1. How can a green growth strategy contribute to a stronger economy and job creation while reducing cities' impact on climate change and the environment?

Following the recession, a window of opportunity has opened to reconsider sources of long-term, sustainable growth.

The traditional efficiency paradigm is giving way to a richer definition of societal progress, where efficiency, equity and environmental sustainability are closely interrelated. Traditionally, economic efficiency was seen as a goal separate from equity and environmental objectives. Economic policy was basically assigned the role of reaching the efficiency frontier or maximising growth rates. Governmental action addressing equity and environmental objectives was often designed to avoid interference with the search for efficiency. There has been, however, a growing uneasiness with this vision. Driven by the climate change debate, public opinion is increasingly questioning the sustainability of our development model and its replication in the developing world. The persistent and growing development gaps, both across and within nations, also lead to questions about the assumed separation between efficiency and equity objectives, notably in the context of a globalised world (OECD, 2008c; OECD, 2009a).

Green growth aims to become a pillar of short–term economic recovery and a catalyst for sustainable long-term growth.

The economic crisis has provided the opportunity for structuring economic recovery in ways that are more environmentally and socially sustainable. Green growth implies increases in public and private investments and consumption leading to sustainable resource use, lower greenhouse gas emissions, and reduced vulnerability to climate change. Many countries have included an emphasis on green growth in their stimulus packages, putting in place a structure to evaluate policies from an economic efficiency, environmental quality and social equity perspective (OECD, 2010a). The OECD has been mandated by 34 countries to develop a global Green Growth Strategy that defines green growth and the policy responses it offers (Box 1).

Box 1. Launching of the OECD Green Growth Strategy

In June 2009, Ministers of Economy, Finance, Trade and Foreign Affairs from 34 countries, including both OECD and non-OECD members, met at the OECD to adopt a Declaration on Green Growth. They agreed to develop frameworks for economic growth that would minimise environmental deterioration and enhance quality of life, and mandated the OECD to develop a Green Growth Strategy, which will be presented in June 2012.

The aim of the Strategy is to provide clear recommendations for how countries can achieve economic growth and development while at the same time moving towards a low-carbon economy, reducing pollution, minimising waste and inefficient use of natural resources and maintaining biodiversity. This entails developing specific tools and policy recommendations across a range of relevant areas from investment and taxes to innovation, trade and employment. The OECD Green Growth Strategy is being prepared through a multi-disciplinary inter-governmental process and is based on the work of the 25 OECD Committees engaged in its development. It will be a fundamental contribution from the OECD to support countries' transition to greener growth in the coming years.

Further information on the Green Growth Strategy is available at: *www.oecd.org/greengrowth*.

By linking environmental quality to economic growth, green growth represents a generational shift in urban sustainability policies.

The first generation of environmental policies focused on modifying urban activities to reduce their impact on the environment: reducing energy required for moving around the city, and heating and cooling buildings; reducing waste and increasing recycling; reducing water consumption and preserving open space. The second generation of policies, as synthesised in green growth, recognises that environmental policies that do not also support economic growth are not sustainable in the long term. As countries grow richer there is a legitimate aspiration for higher quality and high status goods. Up to now, these goods have tended to have a higher environmental footprint (*e.g*. bigger cars, larger houses). The great challenge for green growth is precisely how to reconcile individual material welfare and environmental sustainability. Thus, transportation and land-use policies that aim to reduce greenhouse gas emissions and air pollution must also increase the efficiency of movement of labour and goods – connect employees with jobs, manufacturers with retailers, and residents with commercial and leisure activities. Building policies that seek to increase energy efficiency and the use of renewable energies need also to broaden their scope to support the development of local businesses in green technologies and energy services, and the transition to new skills to multiply the effect of green job creation to the wider economy. Policies to reduce and recycle waste have to see non-recyclable waste as a source of energy.

There is certainly a potential for job creation associated with green growth, provided that new labour market opportunities are well understood and more thoroughly monitored.

More analysis is needed to enable local policy makers to assess their development plans based on the triple metric of job-creation effects, impact on the local environment, and the distribution of benefits. While most of the local investments in the domains of energy provision, transportation and the built environment are likely to yield efficiency gains and multiplier effects in the medium-term to long-term, their effect on net employment in the short run is not straightforward. Capacity building and information sharing on local green policies is thus of critical importance. Policy-specific estimates of approximate costs and time-horizons of the investments are also needed. The knowledge gap on labour effects and investment costs vs. benefits limits the capacity of sub-national governments to prioritise their interventions and generates uncertainty, slowing down urgent policies and investments.

2. Why should cities have a key role in the new green growth model?

National economies are today largely metropolitan and the health and vitality of cities are drivers for any long-term, sustainable economic model.

- **Cities are the primary consumers of energy worldwide**, so an increase in urban energy efficiency and renewable energy use will have far-reaching impact on the switch to green energy.
- **How cities develop affects national environmental targets**. The energy efficiency of urban activities and urban spatial form has an impact on the success of local and national climate change and sustainability goals.
- **When designed at the urban level, policies to reduce greenhouse gas emissions, resource use and waste are more effective and cost-efficient**. Complementarities between environmental and economic growth policies are stronger at the local level, where addressing the negative impacts of urban concentration (e.g. congestion, pollution) can both reduce environmental impacts and increase economic efficiency. Urban policies that reduce energy consumption can be applied without harming economic growth in the long-term, when innovation is taken into account.
- **Cities foster innovation, which will be crucial for the success of green growth strategies**. As drivers of innovation and entrepreneurship, cities account for a disproportionately strong share of a country's GDP per capita.

Cities are the primary consumers of energy worldwide.

Cities are major contributors to CO_2 emissions.

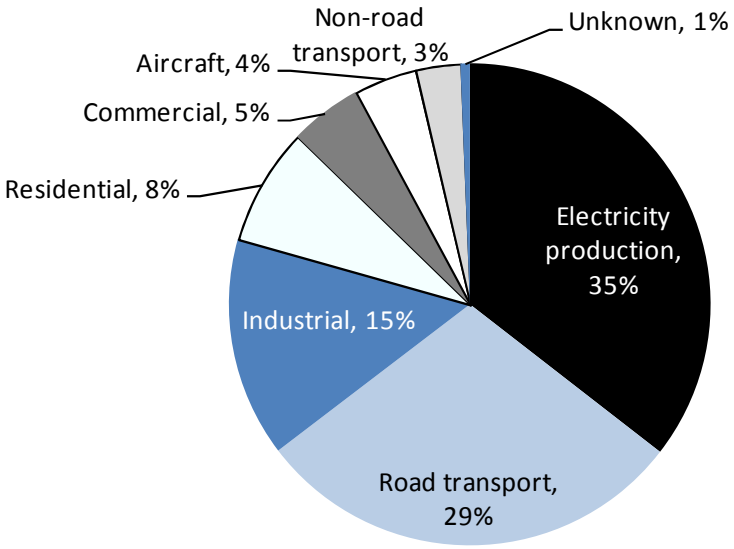
Within the next decade, there will be nearly 500 cities of more than a million people, including several 'megacities' with populations exceeding 20 million. Cities consume a great majority – between 60 to 80% – of energy production worldwide and account for a roughly equal share of global CO_2 emissions (IEA, 2008a). Growing urbanisation will lead to a significant increase in energy use and CO_2 emissions, particularly in non-OECD countries in Asia and Africa where urban energy use is likely to shift from CO_2-neutral energy sources (biomass and waste) to CO_2-intensive energy sources (Jollands in OECD, 2008a).

Energy consumption accounts for the bulk of cities' climate impact in OECD countries.

Greenhouse gas emissions in OECD cities are increasingly driven by the energy services required for lighting, heating and cooling, appliance use, electronics use, and mobility (Figure 2 presents an example from the U.S). The impact of energy consumption on greenhouse gas emissions depends not just on the amount consumed, but also on the greenhouse gas emissions generated by the energy source, which in turn depend on the mode of energy production. For example, Cape Town has comparatively lower per capita electricity consumption than Geneva, but its consumption has a higher greenhouse gas emissions factor, due to South Africa's use of coal for 92% of its electricity generation whilst Geneva relies on hydropower. Technology also matters: urban areas relying on inefficient or wasteful energy sources contribute more greenhouse gas emissions than those that consume the same amount from more efficient sources (Kennedy *et al*., 2009).

Figure 2. Cities' energy sources matter

Carbon emissions produced in predominantly urban areas in the United States by type of activity (2002)



Source: OECD calculations based on data from the Vulcan Project (2009). The Vulcan Project is a NASA/DOE funded effort under the North American Carbon Program (NACP) to quantify North American fossil fuel carbon dioxide (CO_2) emissions at space and time scales much finer than has been achieved in the past.

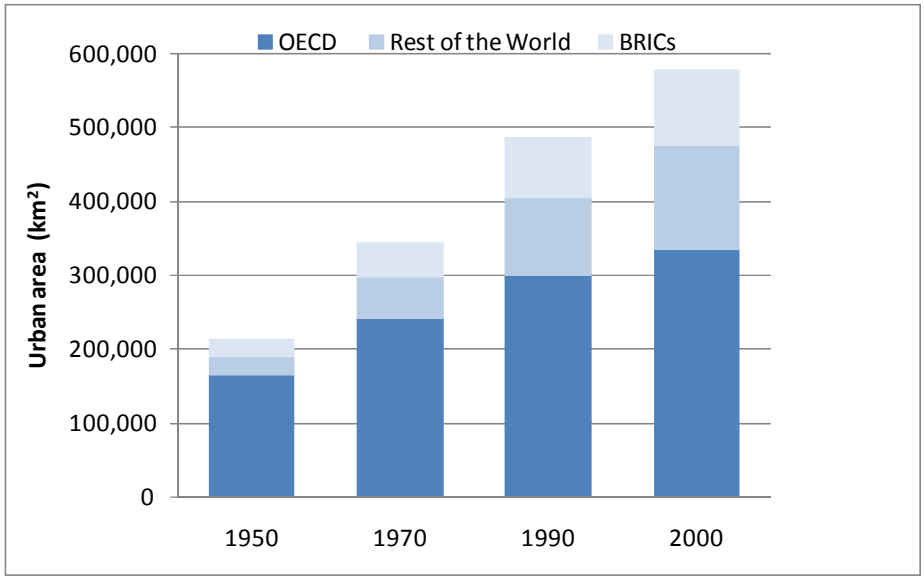
How cities develop affects their national environmental targets.

How cities grow and operate matters for energy and resource demand.

It is not cities, or urbanisation per se, that contribute to greenhouse gas emissions and resource demand, but rather the way in which people move around the city, the sprawling spatial patterns they produce, the way in which people use energy at home, and how buildings are heated that make cities great consumers of energy and polluters. The acceleration of urbanisation since the mid-half of the last century has been accompanied by urban sprawl, with urban land area doubling in the OECD and growing by a factor of five in the rest of the world (Figure 3). In fact, in the vast majority of OECD metro-regions, the suburban belt grows faster than the core – 66 out of the 78 largest OECD cities experienced a faster growth of their suburban belt than their urban core over 1995-2005 (Kamal-Chaoui & Robert (eds.), 2009).

Figure 3. Urban sprawl on the rise

Trends in urban land expansion in the world and the OECD



Note: BRIC countries refers to Brazil, Russia, India and China.

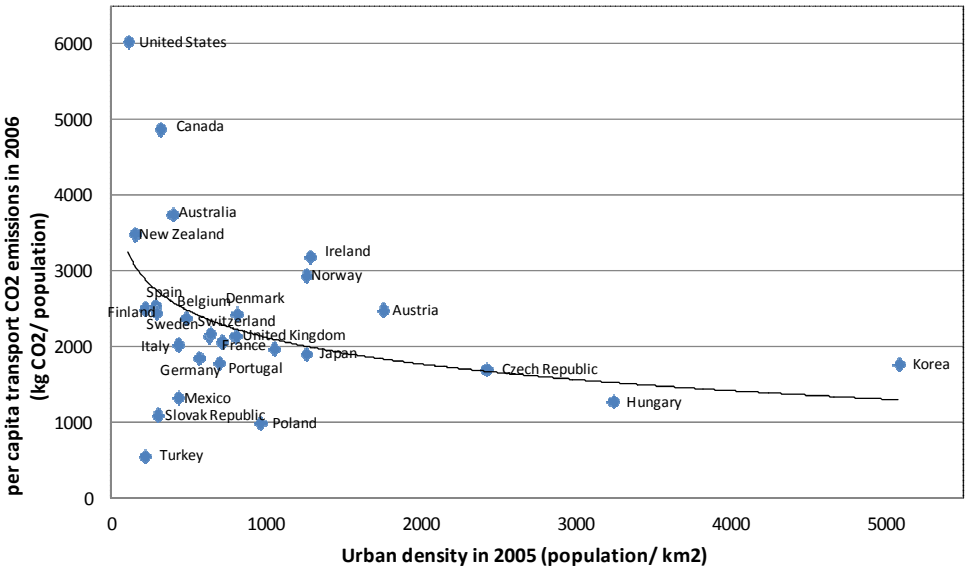
Source: OECD (2008b), Environmental Outlook to 2030, OECD, Paris.

Efforts to reduce energy use and greenhouse emissions benefit from sustainable urban form, especially density.

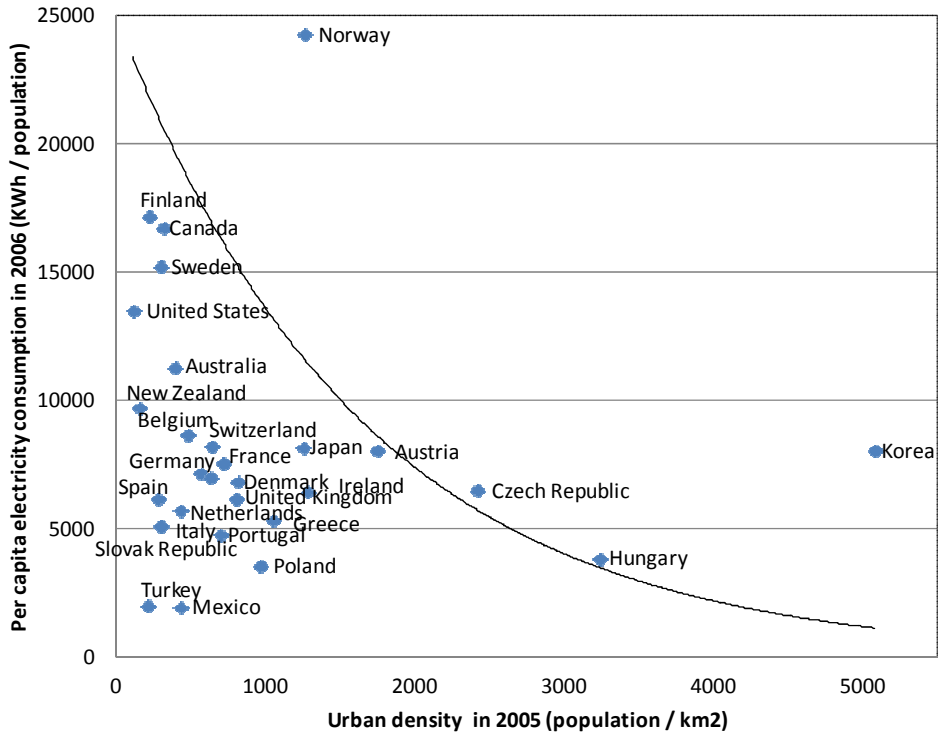
While urbanisation is linked to increased carbon emissions, not all urban areas contribute to emissions equally. Urban density and spatial organisation are key factors that influence energy consumption, especially in the transportation and building sectors (Figure 4). As density increases, CO_2 emissions from transport go down. Austria's urban areas are more than four times denser than Australia's, and generate only 60% of the amount of CO_2 emissions per capita that Australia's urban areas generate. Therefore, while urbanisation levels might bring about an expansion in carbon emissions, these are reduced with higher density. As density increases in urban areas, per capita electricity demand also decreases. For instance, Japan's urban areas are around five times denser than Canada's, and the consumption of electricity per person in the former is around 40% that of the latter. If we take countries in the same geographical context with similar heating needs such as Denmark and Finland, the proportions are quite similar. Denmark's urban areas are denser than Finland's by a factor of four, and people there only consume around 40% of the electricity consumed by the Finns. Similarly, not all cities in the same country have the same lifestyles nor do they contribute to carbon emissions in the same way. Although the USA is the OECD country with the most flows of carbon emissions, internally cities like Los Angeles are noticeable for the concentration of CO_2 emissions (Figure 5). Even smaller cities like Houston produce much more CO_2 than New York –the largest city in the country.

Figure 4. High density in cities is associated with lower CO_2 emissions

High density in cities is associated with lower per capita carbon emissions produced by transport activities



High density in cities is associated with lower electricity consumption



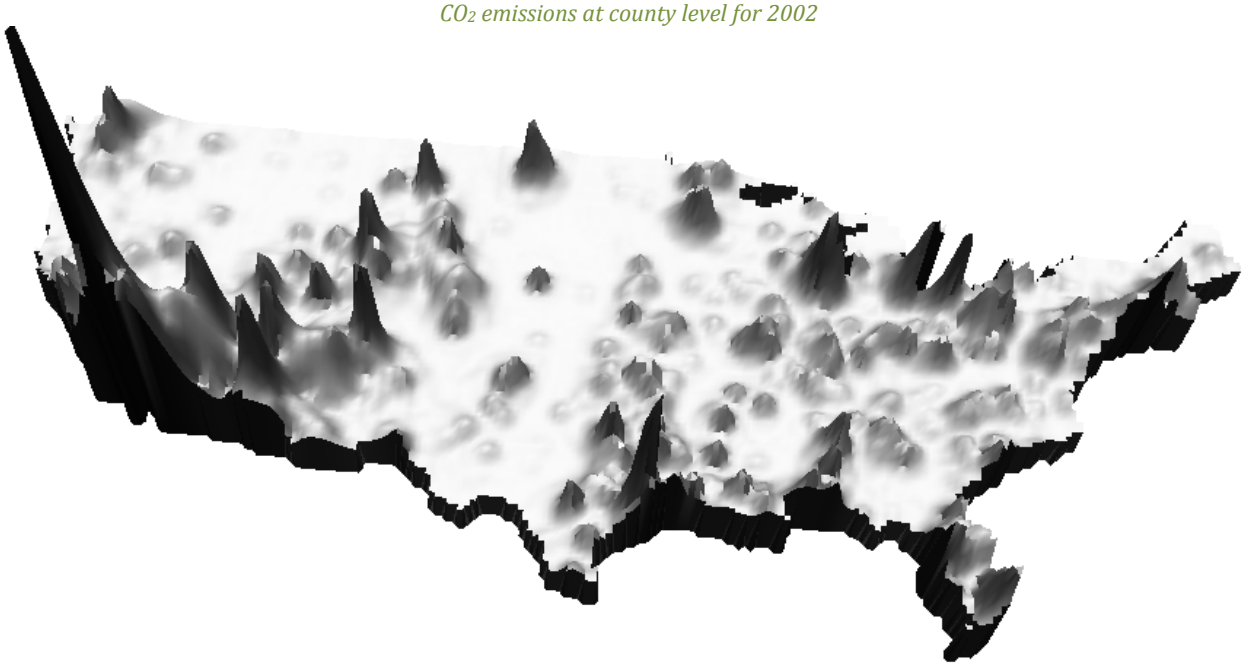
Notes: Urban density is calculated based on the OECD definition of "predominantly urban" areas.

Iceland and Luxemburg were not included in the sample as the OECD Regional Database identifies no predominantly urban (PU) regions in those countries.

Source: Calculations based on data from the OECD Regional Database; IEA (2008b) CO2 Emissions from Fuel Combustion, OECD/IEA, Paris; and IEA (2009a) Energy Balances in OECD Countries, OECD/IEA, Paris.

Figure 5. Concentration of carbon emissions in the USA

CO_2 emissions at county level for 2002



Source: Own calculations based on data from the Vulcan Project (2009) and the OECD typology of regions. The Vulcan Project is a NASA/DOE funded effort under the North American Carbon Program (NACP) to quantify North American fossil fuel carbon dioxide (CO_2) emissions at space and time scales much finer than has been achieved in the past.

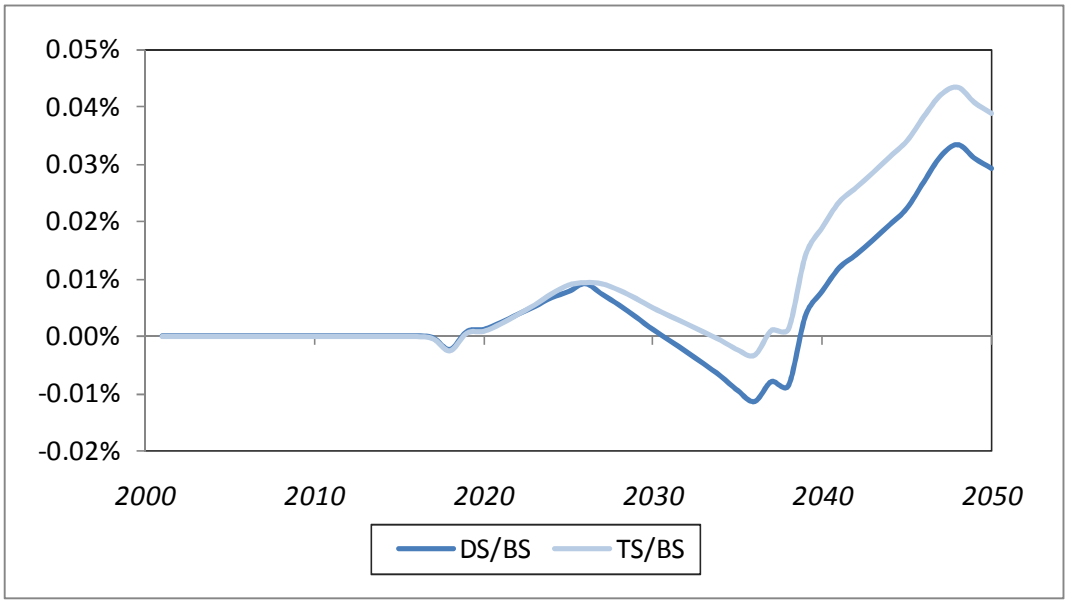
When urban policies are integrated into national environmental and economic policy goals, the costs of environmental abatement are reduced

Increasing urban density and setting congestion charges can reduce energy and resource use without reducing economic growth.

Findings from a general equilibrium model of OECD metropolitan regions demonstrate that urban density policies and congestion charges can reduce the overall cost to the economy of meeting greenhouse gas emissions reduction targets, compared to applying economy-wide policies, such as a carbon tax, alone.[1] In this model, carbon emissions are reduced relative to the baseline following the implementation of densification policies[2] and congestion charges, a form of road toll of the type already implemented in some metro-regions (London and Stockholm among others).[3] This is in line with previous evidence that urban form affects individuals' travel behaviour and consequently global environmental quality (Grazi *et al.*, 2008). While densification and congestion charges are not the only effective tools to reduce energy demand and carbon emissions, they are important as they do not have a detrimental effect on long-term economic growth, when innovation is taken into account (Figure 6).

Figure 6. Densification and congestion charges can generate the conditions for economic growth

Changes in GDP comparing densification and congestion charges vis-à-vis baseline scenario



Note: DS refers to Densification Scenario; BS refers to Baseline Scenario; TS refers to Tax Scenario (in turn refer to the application of congestion charges).

Source: Simulations from IMACLIM-R model based on the OECD Metropolitan Database.

Technological innovation can reduce and even offset the economic cost of urban policies to curb carbon emissions.

The discussion on how to address climate change has mainly focused on the economic impact of carbon abatement, which has been evaluated at 1-3% (depending on the discount rate used) of reduction in world GDP (compare Stern, 2007 and OECD, 2009b). However, the OECD (2009b) acknowledges that the perceived trade-off between economic growth and mitigation policies is lower if technology-support policies are considered: first because technology-support policies may help address innovation failures and boost economic growth; second because these policies postpone emission cuts until technologies become available and therefore reduce the impact on economic growth (OECD, 2009b). In other words, the prospects of economic growth can actually be improved by providing incentives to innovation and growth.

Sustainable and equitable spatial growth relies on robust transportation linkages.

With limited budgets, cities now face the challenge of providing transportation infrastructure that meets the needs of a growing economy while reducing pollution, congestion and greenhouse gas emissions, and the challenge of providing land and services to expand their tax base while avoiding the negative economic, environmental and social impacts of sprawl. To meet this challenge, many urban areas are putting the priority on orienting development around public transportation and public services delivery (*e.g.* Copenhagen's Finger Plan). In some cases, this takes the form of spatial plans in which cities aim to direct growth around an urban core or a polycentric system of urban core areas. In other cases cities have focused primarily on promoting development that extends outward around public transportation networks, public services and urban amenities,. What these strategies have in common is their goal of support economic growth through means that also reduce consumption of energy and other resources. They can also address social equity concerns, as in seeking to concentrate development around areas of public services and in seeking to better connect existing areas to public transportation, they serve as a way of integrating urban populations at risk of being isolated from local employment and economic activities (Jenks *et al.*, 2008).

Improving environmental quality in cities can strengthen their economic attractiveness.

Low pollution levels will increasingly be a factor driving the attractiveness and efficiency of urban areas. In the next two decades, cities that could become more attractive will do so while also curbing local pollution. According to the results of an OECD projection model, and if current trends are sustained, cities can combine higher environmental quality and economic attractiveness. Cities like Ankara, Auckland, Barcelona, Krakow, Lille, Melbourne, Montreal, Monterrey, and Toronto will experience improvements in attractiveness by 2030 while also reducing local pollution. Underlying these results is the fact that technology-support policies can reduce and even offset the economic cost of curbing carbon emissions. Conversely, metro-regions could lose attractiveness if they continue to pollute along current trends, as in the cases of Chicago, Los Angeles, New York, Osaka, Paris, Philadelphia, Seoul and Tokyo. As local pollution is related to attractiveness, and the latter associated to population and firm creation, higher incomes, productivity and wages, then an environmental policy at the local level generates economic growth. In particular, policies to respond to climate change can take the form of removing tax and development disincentives in the urban core, actively pursuing compact spatial form, and increasing mass transit networks and urban amenities in areas targeted for higher-density growth. These issues should be at the heart of the ongoing debate about a green growth strategy.

3. How can governments integrate green growth principles into the web of existing policies?

Synergy between environmental and economic policies emerges at the urban level, particularly in the sectors of transportation, building and energy.

City policies that respond to the negative effects of urban agglomeration address both environmental and economic growth priorities. Congestion, pollution and public services constraints affect not just environmental quality but also the efficiency of cities' economic activities and their ability to attract firms and skilled workers. Policies that reduce energy and resource consumption and waste, and increase the attractiveness of the urban environment can thus also support urban economic growth. Some urban climate policies should be considered as no-regret policies as they can provide additional co-benefits. These include public health improvements, cost savings and increased efficiency, energy security and infrastructure improvements, and improved urban quality of life. Cities and metropolitan regions are well positioned to develop policy and programmatic solutions that best meet specific geographic, climatic, economic, and cultural conditions. They are equally well placed to develop innovative policy solutions that can be scaled up into regional or national programmes, or to provide a laboratory for national pilot programmes on the urban level.

Effective urban green growth and sustainability policies reinforce one another.

For example, land-use zoning policies that allow for higher densities and greater mixing of residential and commercial uses can enhance transportation climate goals by reducing trip distances and frequency while strategic mass transit linkages can attract development and thus promote compact growth (Table 1). Long-term growth plans in a number of OECD metropolitan areas aim to maximise these complementarities (*e.g.* Paris, New York, London). Within the transportation sector, policies to increase the quality and availability of public transportation, bicycle, and foot travel make policies to discourage or restrict vehicle travel and circulation more politically feasible. For example, congestion fees for driving during peak hours worked well in London because they were combined with improvements in management of the road network and substantial enhancements in bus service. Energy efficiency standards for new buildings are well complemented by projects to retrofit existing buildings with energy efficiency technologies. Waste policies to promote waste-to-energy incineration need to be combined with robust support for recycling programmes to enhance the economic viability of recycling programmes to divert waste from landfills.

Table 1. Synergy in urban policy

Impact →	Transportation	Renewable energy	Waste and water
Land-use Zoning *Land-use zoning determines the density, height of buildings, and proportion of undeveloped land on each property.*	Segregation of land uses impacts travel distances and frequency; transit-oriented development zones encourage use of mass transportation.	Zoning density can constrain on-site renewable energy production but can also increase efficiency of service delivery.	Zoning density can determine the efficacy of delivery of waste, recycling and composting services; and the energy required and efficacy of delivery of water services
Natural Resources *Natural resource policies determine which areas are preserved from development and what uses are acceptable on them.*	Natural resource policies affect the placement of road and mass transportation infrastructure.	Natural resources endowment makes certain renewable energies possible	
Building *Building policies, including building codes, affect building materials, construction types, and other physical conditions*		Building codes can require the on-site generation of renewable energy.	Building codes can require design and building materials that produce less construction waste.

Note: Policy sectors with no shading demonstrate highest impact. Policy sectors with shading demonstrate lower impact. Policy sectors with diagonal lines demonstrate no impact.

Urban "green growth" strategies hold the promise of a new development path where economic growth and higher environmental quality are complementary.

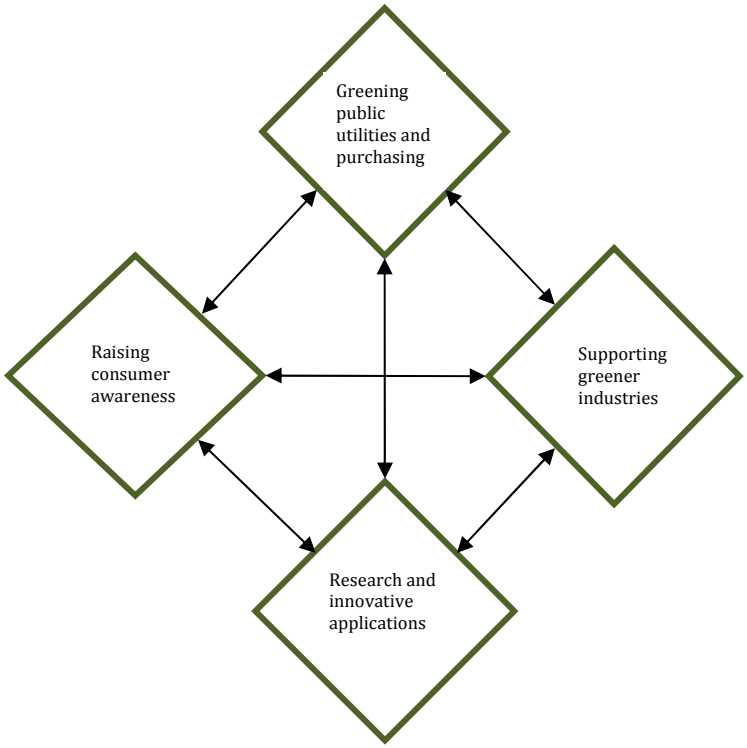
Multiple policy instruments need to be combined to achieve the ambitious goal of higher growth at lower carbon intensity. The complementarities among these policy instruments demand a dramatic shift towards more integrated policy making at the urban level. More sustained municipal investments in infrastructure that is less carbon-intensive are already in the pipeline and represent a necessary first step. However, supply-side measures alone will not be enough and are unlikely to be sustainable at the current state of prices of green technologies and market demand for low-carbon goods and services. Thus, urban policy makers should pursue an integrated policy package that takes into account how firms adjust to new business opportunities and adjustments in the price of energy, how individuals change their preferences, and how green technologies are developed and diffused in the market.

The pillars of urban green growth policies

Urban green growth strategies are more likely to succeed if they account for policy interventions in each four pillars (Figure 7):

- Greener public services and purchasing behaviour;
- Support for increasing the eco-efficiency of industrial production;
- Raising value and consumption of green products and technologies;
- Support for research and innovative applications of green technologies.

Figure 7. How to Localise Green Growth: The Green Growth Diamond for Cities



The Green Growth diamond presents conditions of environmentally responsible, economically rewarding and socially responsible urban development plans.

Prioritisation among the different interventions needs to be based on an accurate screening of possible complementarities among the four pillars. In other words, within a well developed strategy, interventions in one domain unlock positive developments in other domains. For example, a large retrofit program for public buildings can be a powerful boost to skilled and semi-skilled employment generation. However, the impact of the program on local employment can be maximised only if well trained workers are locally available. Higher competition among suppliers of retrofit services, as well as innovations that could reduce the cost and the carbon-intensity of these materials is also needed to improve the cost-efficiency of the public retrofit investment. Synergies and possibilities for leverage do exist, and urban policymakers should develop capacities

to spot and use them. More knowledge of how the local economy works and a strong capacity to pursue interdepartmental programs are essential prerequisite to seize the employment and growth potentials of the low-carbon transition.

First pillar: Greening public utilities and public purchasing

Cities can directly promote the demand for green products and services through their purchasing choices and their management of existing and new infrastructure.

Over 2008-1010, the stimulus packages in several OECD countries have injected resources that could drive higher investments to reduce the carbon footprint of cities. Examples of employment-intensive investments include: pipeline support infrastructure to transport natural gas or biofuels, promotion of grid interconnection schemes that support renewable power generation and modal shifts to public transportation in urban areas. These initiatives generate employment and improve the overall efficiency of the urban system, yielding further economic gains in the medium-long term. Whether these investments will have a tangible effect on the carbon footprint of cities depends on the political willingness and technical capacity to attribute more weight to green considerations in project selection.

City governments can use their large purchasing power and market engagement to bring new technologies on the market.

Several experiences show that sustainability concerns can be successfully integrated in urban procurement practices through innovative tools evaluating the environmental impacts of the products or services delivered (*e.g.* life cycle costing[4]), and through institutional solutions. The city of Helsinki established a Procurement Centre, charged with developing operational models for managing markets through systematic dialogue with businesses. The centre is defining environmental criteria for different product groups and coordinating training programs to raise awareness among procurers. In recent years, several local governments in OECD and non-OECD countries have already invested in renewable energy, resource-saving, recycling activities and green area management in order to spur job creation (IEA, 2009b). Within the variety of these public investments for green growth, four essential areas can be identified: housing and construction sector; transportation and information and communication technology (ICT); renewable energy; and recycling and pollution control.

Lowering the carbon footprint of the building sector

Large-scale building retrofit programs represent the most obvious option for a shovel-ready, green investment to re-employ displaced workers or create new jobs.

Jobs can be created immediately, with no new plans, environmental impact statements, or land acquisition, to repair or replace deteriorated assets. Further, the technology to reduce energy consumption in buildings already exists and simply needs to be deployed. While regional and city governments may be tempted to focus on standards for new construction projects as the primary means for reducing energy demand from buildings, retrofitting the existing stock is a more labour-intensive activity with greater short-term impact on building energy demand. Current practice in retrofit programs makes possible a considerable reduction in building maintenance costs and in the repair and replacement of worn-out elements. Finally, retrofitting public-owned residential complexes has the important complementary benefit of increasing the market value of dwellings, making residential areas more attractive.

Cities can deploy building retrofit programmes directly on publicly-owned building stock or facilitate them in privately-owned buildings.

New York City's "Greener, Greater Buildings Plan" is expected to create 17,800 construction-related jobs in energy auditing, retro-commissioning, upgrading lighting, and maintaining equipment (City of New York, 2009). The city of Freiburg, Germany, allocated a budget of EUR 2M to the renovation of the city's old and historical buildings. This includes the non-intrusive, strategic installation of 180 solar PV panels on the tiled roof of the old City Hall. Berlin pioneered a model of enabling retrofitting of privately owned buildings by energy system companies (ESCOs), whose energy efficiency investments are gradually paid back by the building owners

through the reduction in energy costs they realise. The Berlin Energy Agency provides technical assistance to local building owners who form "Energy Savings Partnerships" to issue tenders to the ESCOs, with the goal of achieving annual 26% savings in energy costs (C40 Climate Leadership Group, 2007). Cape Town launched an ambitious programme, the Kuyasa Energy Efficiency Project, in which the city retrofits existing houses in low-income neighbourhoods with solar water heaters, insulates ceilings and supplies energy-efficient light bulbs (OECD, 2008d).

How to capitalise on investments in transportation and ICT for green growth

Cities can improve their environmental effectiveness and attract new firms and jobs through combined investments in transportation networks and ICT.

Efficient intra-urban mobility is crucial to realising the economic advantages of agglomeration - that is, cities that are more connected and more compact. There are important complementarities between ICT and transportation investments. Both respond to the need of improving connections between people and businesses, reducing costs of commuting and information transfers. ICT innovations, when applied to public transportation systems, can improve service quality and thus ridership more cost-effectively than large-scale capital investments.

Siting development around public transportation and public services delivery responds to sustainability and job growth priorities.

The "New Mobility" models of transportation, which cities have experimented with in both developed (*e.g.* Toronto, San Francisco, London) and developing countries (*e.g.* Cape Town, Chennai, Bangalore), search for better integration of multiple transport modes around hubs that are dynamic centres for service provision. The synergy between transportation and economic activities generates new employment opportunities in entertainment, recreation, dining, banking, commerce, and community services. Integrated urban strategies for sustainable transportation can serve as incubators for green technology innovations, providing a good framework for evaluating the cost and benefits of new technologies with wide industrial applications, such as hybrid engines, hydrogen fuels and sensor networks. For example, the City of Hamburg has sought to support the development of hydrogen-fuel buses by combining its purchasing power with other cities, Barcelona, Berlin, Cologne and London, with the goal of creating demand for 100-150 hydrogen buses (EurActiv, 2009).

Investments in ICT can attract new firms and jobs while contributing to green technological innovation.

The introduction of enabling technologies (ICT and nanotechnologies) can significantly decrease the cost and increase the environmental efficiency of new infrastructure and network investments (OECD, 2009c). There is increasing evidence of the positive effects of ICT on productivity growth (OECD, 2003, Crandall *et al*., 2006). Regulatory reforms, reducing barriers to entry and investment by new service providers are critical to sustain private investment in broadband and other ICT networks. First-movers in ICT network investments seem to enjoy significant benefits. The Paris suburb of Issy-les-Moulineaux, by providing superior broadband infrastructure, a business-friendly climate and innovative e-services, has managed in less than a decade to radically change its industrial structure, reducing local unemployment to virtually zero (European Commission, 2010).[5] Korean municipalities are particularly active in the deployment of ICT technologies as a mean of enhancing energy efficiency of urban infrastructure. The Gangnam-gu district of Seoul, home to corporate headquarters, multinationals and IT venture firms, had adopted a carbon mileage system and is now pioneering innovative service provision via wireless (OECD, forthcoming).

Powering cities with renewable energy

Raising the share of renewable energy can lead to job creation.

New investments in renewable technologies are generally more labour-intensive than investments to expand fossil fuel-based energy generation. A distinction here is needed between large scale, centralised renewable energy utilities, and small scale, decentralised utilities. The latter, distributed solar Photo-voltaic (PV) in

particular, have higher labour intensity as a result of the fragmentation (number of systems required to achieve the needed capacity) and of the labour-intensive installations. Installing a large 100 MW solar PV array in the desert requires significantly less labour than installing 100 MW of 4 kW residential rooftop PV systems (*i.e.*, 25 000 systems). There are also significant differences across renewable technologies, in particular concerning labour demands for maintenance and operation of the facilities. Kammen *et al*. (2006) estimate that installing 1 MWa of wind turbine capacity creates an estimated 0.7-2.9 times as much permanent employment *vis-à-vis* a comparable natural gas combined cycle (NGCC) power plant; installing 1 MWa of rooftop solar PV creates an estimated 7.8 times more employment than a NGCC power plant.

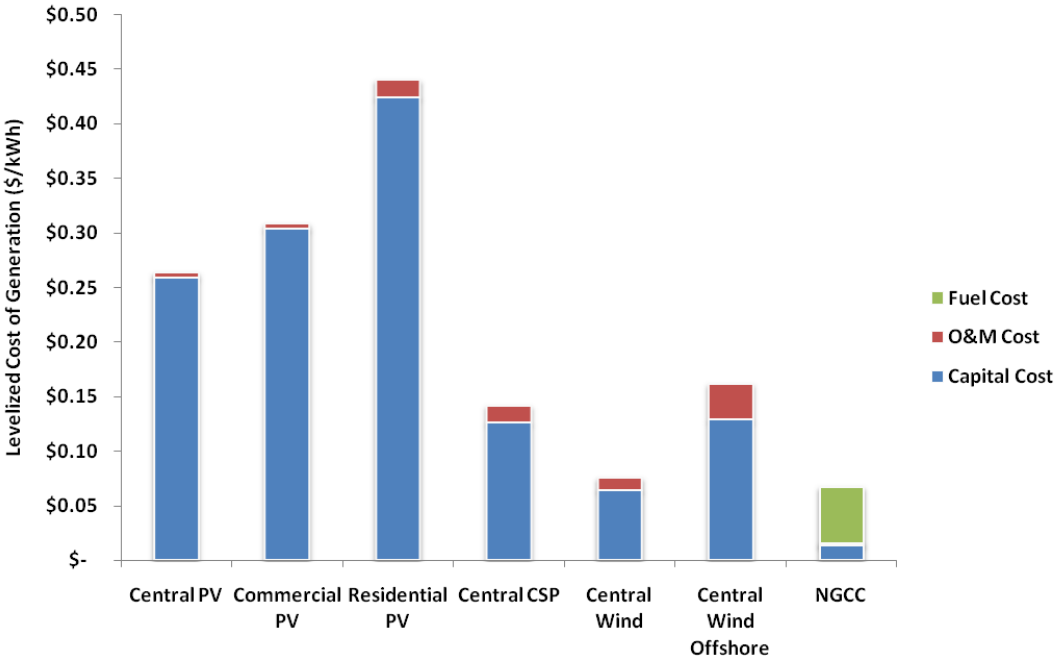
Local governments that generate energy or electricity through public power utilities can increase the share of renewable energy they produce.

For example, Los Angeles' *GreenLA Climate Action Plan* sets targets for the Los Angeles Department of Water and Power (LADWP) to increase its renewable fuel sources to 20% by the end of 2010 and to 35% by 2020, in part by developing four new renewable energy projects. In Venice, the Port Marghera Fusina power station, opened in 2009, becoming the world's first industrial-scale, 16 megawatt, hydrogen-fuelled power station. It generates enough electricity to meet the needs of 20 000 households each year and avoids the emissions equivalent of 17 000 tons of carbon dioxide that are typically emitted when using coal-fired plants (OECD, 2010b). Cities and regions that are not municipal power producers can still use their regulatory authority to remove obstacles to local renewable energy production and district heating, and their self-governing authority to purchase renewable energy for city or regional operations (IEA, 2009b). Copenhagen's exemplary use of district heating, which provides 97% of the city's total heating needs, is supported by regulations requiring connections in areas served by the system (OECD, 2009d). The City of Toronto, Canada, has enabled the creation of a district cooling system by establishing a corporation that has connected most of the major downtown office buildings to a deep lake water cooling system and which has resulted in a significant decrease in electricity demand for air conditioning (OECD, 2009e).

The renewable energy industry has already reached a noteworthy size and is growing. In 2003, there were approximately 200 000 renewable energy jobs in the EU (European Commission, 2004).

Worldwide, 600 000 people are employed in the solar thermal industry, 300 000 in the wind power industry, and 170 000 in the solar photovoltaic sector, with half of these jobs located in emerging and developing economies (UNEP, 2008). While the majority of jobs in the fossil fuel industry are in fuel processing, a relatively capital intensive activity, the majority of jobs created in the renewable energy industry are in manufacturing and construction. In all renewable energy sectors, costs have fallen dramatically due to improved technologies. However, renewables are not yet cost-effective compared to conventional energy sources, as they require more inputs – both in terms of capital and labour – for a given amount of output. Renewable installations are in fact more short-lived (on average 25 years versus 40 years for coal and gas), and have a lower capacity factor (operating on average 25% of the time, with respect to about 80% of fossil fuel plants). Again, there are large differences in costs across technologies. To summarise: distributed generation is currently more expensive than centralised generation, residential PV is more expensive than commercial PV, PV is more expensive than solar thermal, solar is more expensive than wind, and onshore wind can be cheaper than natural gas (Figure 8).

Figure 8. Renewable energy generation cost differences



Note: NGCC is combined cycle natural gas and central CSP is concentrating solar power.

Source: Levelised costs are early 2009 estimates based on Kahrl, F., W. Tao, and D. Roland-Holst (2009), "Municipal Climate Policies: Scope, Economics, and Institutions", Center for Energy, Resources, and Economic Sustainability, University of California at Berkeley.

Powerful policy tools can be created at the local level to promote renewable energy development.

Fixed price systems ("feed-in tariffs") have played a decisive role in attracting wind energy investment in European regions. Through feed-in tariffs, producers of renewable energy feed solar electricity into the public grid, receiving a premium tariff per generated kWh reflecting the benefits of renewable electricity compared to electricity generated from fossil fuels or nuclear power. A provision for a "feed-in tariff" is included in the ambitious Los Angeles' plan to move the city's energy grid toward renewable energy sources. The feed-in tariff encourages residents to install solar energy systems that are connected to the city's power grid, so that they sell solar energy to public utility suppliers. The overall plan would require ratepayers to pay 2.7 cents more per kilowatt hour of electricity consumed, with 0.7 cents of that — a so-called carbon surcharge — going to the city's Renewable Energy and Efficiency Trust. Feed-in-tariffs operates over a fixed period of time, reducing uncertainty in anticipated revenues.[6]

Utility green pricing programs, relying on voluntary contributions from customers are another instrument to support higher levels of local investment in renewable energy.

Participating customers in green pricing programs typically agree to pay a premium on their electric bill to cover the incremental cost, for the utility, of providing additional renewable energy. The number of these programs has increased steadily in recent years: to date, more than 750 utilities in the US offer a green pricing option. Green pricing programs involving voluntary contributions from private citizens and from corporations are proliferating in many other OECD countries. In Europe, green power purchasing and utility green pricing have existed since the late 1990s, and have achieved good results in particular in the Netherlands, Finland, Germany, Switzerland, and the United Kingdom. In Japan, there were an estimated 60 000 green power consumer-participants by early 2005. Green power in Japan initially developed through voluntary community organisations, like the Seikatsu Club Hokkaido.

Employment losses in the energy transition are a policy concern with the implementation of feed-in tariff or renewable energy standards.

Jobs can be lost in carbon-intensive sectors directly affected by regulations and standards (*e.g.*, in decommissioned fuel and coal power plants) or in other sectors along the value chain. For example, contraction in demands for coal-fired power generation will lead to upstream job losses in the mining industry. But perhaps even greater are the fears that energy price increases might lead to *i*) industry downsizing due to adjustment costs, and *ii*) relocation of foot-loose industries. The evidence of sizable negative effects associated to both mechanisms is however weak. Recent research by Mansur and Kahn (forthcoming) shows that rising energy prices will not play an important role in shifting the geographic patterns of where manufacturing clusters.

Investments in recycling can have important impacts on job creation and urban redevelopment

Recycling drives environmental friendly employment creation in cities.[7]

In the recycling sector, private companies are taking the lead in launching new investments and up-scaling existing ones, the role of city governments being more one of improving the business environment (through public procurement schemes, initial grants for factory facilities, collection schemes for recycled materials, deposit-refund systems and land-use regulations). The example of Kitakyushu City is illustrative of the tremendous employment opportunities that strategic waste management and recycling can open in a globalised economy (Box 2).

Box 2. Strategic urban economic policy in the recycling sector, Kitakyushu City's example

The recycling sector yields great potentials of employment creation and re-employment of displaced workers, in particular in cities with an industrial history. Kitakyushu City, Japan, once the capital of steel and chemical industries, overcame severe pollution and sought out the growth potential in the recycling sector. Kitakyushu City has now many recycling companies, which handle sludge and waste materials produced as by-products of industrial production processes. Kitakyushu City launched the Eco-Town project in 1997. In attracting recycling companies, local government emphasised the cheap and vast land available away from residential districts, abundant industrial water from the ocean, subsidies for factory facilities, accumulated human capitals and manufacturing sectors, and clustering of related recycling companies. Local government also facilitated companies' establishment in Eco-town through one-stop support services. As of 2008, 26 companies and 17 research institutions were in operation, employing 1 352 people (see the graph for Japan below).

According to the public opinion survey of 2007, an increasing number of citizens at Kitakyushu city recognise the recycling sector as one that contributes to environment, partly due to the government's effort for public involvement. Residents' support of the recycling industry is a big attraction for a sector that is often exposed to an attitude of "not in my back yard".

Globalisation is opening new windows of opportunity for Kitakyushu City. For example, China has gradually increased the need for recycling due to serious water contamination and inappropriate waste disposal. Kitakyushu City has begun environmental co-operation with Chinese cities, including Dalian City since the 1990s, Quingtao City since 2007 and Tianjin City since 2008. Kitakyushu International Technology Cooperation Association (KITA), a public training institution for environment policies and technologies, has taught over 5 000 people from 130 countries from 1980-2008. The City aims to link environmental co-operation with development of environmental business. In this way, Kitakyushu city's environment strategy is deeply embedded in the economic growth strategy.

Source: Kamal-Chaoui in (2008a) Competitive Cities and Climate Change: OECD Conference Proceedings, Milan, Italy, October 9-10, 2008, OECD, Paris; Bank of Japan, Kitakyushu subsidiary (2008), "Recycling Industry in Kitakyushu City", http://www3.boj.or.jp/kitakyushu/sonota/kitarecycle.pdf, accessed 2 October, 2009; OECD (2009f), OECD Territorial Reviews: Trans-border Urban Cooperation in the Pan Yellow Sea Region, OECD, Paris.

Enabling investments in energy recycling can expedite the regeneration of brownfields

Eco-industrial parks are a notable example of how innovative industrial land-use planning can create synergies between employment and environmental outcomes. At the heart of these eco-park initiatives is the argument that local industrial network can mimic natural ecosystems, shifting from the current wasteful linear model of production to a circular model, where wastes are converted into new inputs and energy cascaded through the local industrial network (Gibbs, 2008). Kalundborg in Denmark is the most well known example of the economic gains that can be achieved by connecting waste and energy exchanges in an eco-industrial park. The diverse firms in the eco-park of Kalundborg utilise each other's surplus heat and waste products, with annual estimated savings of USD 12-15 million. Several other eco-industrial parks have followed this successful model (*e.g.* Styrian recycling network in Austria, Rotterdam Harbour and Industrial Complex in the Netherlands, Londonderry industrial park in New Hampshire, and Guigang Eco-Industrial Park in China). Japan's Eco-Town program is an example of a large-scale public program to seeking to maximise business and resource-savings opportunities generated by the proximity of industrial and urban areas. It launched 61 innovative recycling projects, which successfully contributed to raising industrial productivity and generating employment, both to improve environmental amenities (Van Berkel *et al*, 2008). Among the instruments used to nurture the eco-parks are tax exemptions, offered to companies locating on land owned by or near a power plant that pursue activities of energy cascading, co-generation and utilisation of plant by-products for energy generation.

Second Pillar: Supporting greener industries

Making industrial production more environmentally sensitive and more efficient is a three-tiered effort.

First, it involves the application of economic and regulatory instruments to reduce resource use and waste per unit of output and to widen the application of greener technologies. Second, skill shortages and local skills transitions need to be addressed. Third, it requires the stimulation of markets for new, emerging "green industries", leading to the creation of more and more "green jobs". Local governments can be very effective in greening production by developing one-stop business services to enable businesses to reach conservation goals, support green industry start-ups and facilitate training tailored to local labour market needs.

Local or regional one-stop-shop agencies for business support should acquire specialised skills in order to advise firms on the most cost-effective ways of reducing emissions.

Their role would consist mainly in enabling businesses to reach conservation goals at lower costs, for example through sustainability audits. They might also engage in demonstration projects for new equipment, in partnerships with manufacturers and academia (OECD, 2009g). In Canada, programmes such as the Eco-Efficiency Partnership in British Columbia, the Eco-Efficiency Centre in Nova Scotia and the EnviroClub of Quebec are good examples of approaches to improving simultaneously the environmental performance and the competitiveness of local Small and Medium Enterprises (SMEs). The "Chicago Industrial Rebuild Program" assists facilities in securing financing to implement recommended improvements. An interest free loan is available to participants who purchase "green" or renewable power. Nearly half of the metal casting industry in Chicago participated in the city-funded assessments. If all recommendations are implemented, it is estimated to generate over USD 5 million in cost savings, 10-25% in energy savings and reduce air pollution by 1 000 US tons per year.[8]

Fledgling green industry firms and start-ups can benefit greatly from city support services, such as industry incubators.

The green economy is a vast mosaic of differentiated products and services, requiring very diverse labour and capital inputs to produce and services to measure, prevent, limit environmental risk and minimise pollution and resource use (ECOTEC, 2002). City governments can improve the business environment, through initial grants for factory facilities, land-use regulations and one-stop services to reduce unnecessary red tape for green industry start-ups (*e.g.*, Los Angeles). Cities' support for new green industries can extend to support for eco-industrial parks, where greater eco-efficiency can be a source of business opportunities for firms, which can realise profits by exchanging waste and energy.

The development of a dynamic, greener economy will be crucially dependent on the availability of skilled and trained people to fill the new jobs, which cities are well placed to facilitate.

The Renewables 2007 Global Status Report (REN21, 2007) estimated that the number of jobs from renewable energy manufacturing, operations, and maintenance exceeded 2.4 million in 2006, including some 1.1 million for biofuels production. According to the REN21 Global Report for 2009, jobs from renewable energy continued to expand rapidly during 2008 (REN21, 2009). As business evolve during the green transition, demands are placed on education institutions and training systems to adapt. The rising demand for low-carbon products will require the simultaneous development of very diverse skills. For example, demand for low emission residential estates will require developers knowing the building materials with low-embedded energy use, engineers and designers able to embed energy efficient products in the building, manual workers with the technical capability to install and maintain these products, and salespeople able to promote such estates in the market.

Skill creation for the new "green jobs" can be more efficiently organised by pooling learning resources of education institutions and industries at the regional level.

The essential challenge will be to anticipate what the employment effects and labour reallocation across industries will imply in terms of future skill needs and possible absorption of laid-off workers. Extensive retraining will be necessary, as there will be significant changes in the profiles, tasks and work methods assigned to workers in traditional occupations (*e.g.* plumbers, electricians, metal workers, and construction workers) (Table 2). In the absence of well-developed frameworks to undertake such analysis at the national level, regional institutions, such as regional and municipal departments or task forces, universities and vocational institutions, business associations and trade unions are better positioned to assess labour effects of the green transition and provide training tailored to local labour market needs (*e.g.*, Oakland Apollo Alliance, USA).

Table 2. Green firms and green jobs

Category	Sectors	Examples of Jobs
Renewable Energy	- Hydroelectric - Solar PV - Solar thermal - Geothermal - Wind - Bio-energy - Combined Heat and Power (CHP)	- Energy Engineers - Electrician and plumbers installing the systems - Mechanics building the infrastructure - Renewable energy plant operators
Transportation Efficiency	- Urban Public transport - Railways	- Public transport drivers and employees - Bus retrofitters - Builders of rail networks
Green Manufacturing, Construction and Product Design	- Retrofitting - Energy efficient buildings' materials - Domestic and office equipment and appliances - LED (light emitting diodes) - Cleaner coal technologies - Biodegradable products - Hybrid vehicles	- Engineers and scientists working on energy efficiency improvements (efficient lighting, smart metering, low energy monitors…) - Chemists developing environmentally friendly packaging, cleaning products and sprays - Employees of firms producing green building materials (alternative cement, recycled wood…)
Waste and Pollution Mitigation	- Mobile and stationary air pollution source controls - Water conservation and reuse - Pulp and paper recycling - Aluminium recycling -Electronic recycling	- Workers employed for renewing water infrastructure - Hazardous material removal workers
Environmental Analysis, Training and Consulting	- Landscape - Building maintenance and contracting - Public administration - Specialised consulting and marketing - Green Venture capital and other financial services	- Energy contractors - Specialised consultants - Trainers - Marketing - Green-civil engineers - NGOs

Source: Adapted from UNEP (2009) "Green Jobs: Towards Decent Work in a Sustainable, Low-Carbon World", www.ilo.org/integration/themes/greenjobs/index.htm.

Third Pillar: Raising the value and consumption of green products and technologies

The large scale deployment of low-carbon technologies will depend not only on advanced scientific research but on how fast firms and people learn to appreciate their added value.

Behavioural changes are thus as important as end-of-pipe solutions. These changes and learning processes happen at the local level. Better understanding what drives the demand for low-carbon goods and what are the main resistances behind slow adoption of new technologies is thus of critical importance. Cities in OECD and in some non-OECD countries are increasingly raising local awareness through consumer education programmes, eco-standards and eco-labelling, and best-practice demonstration sites. It makes sense to develop and implement these programs locally, as local and targeted information is more effective to raise demand (OECD, 2008e). While these initiatives have yet to be rigorously assessed, it is increasingly clear that systemic changes in consumption habits are critical for raising market penetration of green goods and services.

Local and regional government can go a long way to increasing local green consumption by financing arrangements reducing the upfront cost hurdles and unit costs of distributed energy technologies.

Marginal price incentives can shift preferences of more sensitive consumers. Direct observation and imitation by other consumers can then lead to wider market penetration. The City of Berkeley's Financing Initiative for Renewable and Solar Technology (FIRST) programme reduces cost hurdles by providing loans to homeowners to purchase and install solar photovoltaic systems at interest rates and payback periods similar to those for home mortgages. Borrowers repay the city through an additional, transferrable tax added to their annual property taxes. The California Public Utilities Commission (CPUC) developed a state-wide Solar Hot Water incentive program. The proposed incentive amount for residential SWH systems is expected to be about USD 1 500 per system on average. Effective programmes to facilitate and reduce the cost of green investments often involve multilevel governance coordination between national, regional and local governments (Box 3) (Corfee-Morlot *et al.*, 2009; IEA, 2009c).

Box 3. A new multilevel approach to green growth: Local-national government building efficiency programmes

- **The Crown Energy Efficiency Loan, in New Zealand**, is a financial instrument to assist central and local government agencies to implement energy efficiency projects. It complements the 2007 National Energy Efficiency and Conservation Strategy, which required 10% improvement in in-house energy efficiency in central and local government over five years. Local authorities and other publicly agencies borrow funds from the government and repaid over 5 years; ideally, loan repayments are structured such that the energy cost savings exceed the cost of the loan repayments. The Crown Energy Efficiency Loans finance energy efficiency measures previously recommended by audits carried out by independent energy experts, and are allocated based on the project's cost effectiveness, projected CO_2 emission reductions, contribution to renewable energy, potential for replication by public and private sectors, and co-benefits. As of June 2008, loans exceeding USD 23 million have been granted to 230 projects to achieve estimated cost savings of USD 60 million and reductions in CO_2 emissions of nearly 23 000 tonnes per year – the equivalent of taking 6 500 cars off New Zealand roads.
- **The Low Income Retrofitting Project in Greece** is an initiative of the national government in cooperation with municipalities to improve energy efficiency in homes built before the 1980s for families with incomes of less than EUR 60,000 a year. The national government works with national associations of private businesses and the local community (municipalities and private business) to identify and inform low- income households about this project. The project focuses on increasing energy and cost savings through projects to increase the energy efficiency of insulation, windows, and heating, and to install solar collectors and cool roofs. The Ministry of Development created an agreement with national business associations to freeze the costs of these services for two years. The programme is evaluated through an "auto-verification" scheme in which the associations must evaluate whether their industry members are implementing technologies that meet the national standards – which can result in a conflict of interest.
- **Upper Austria's Regional Market for Third-Party Financing** (TPF) links municipal and private energy efficiency projects with financing in order to remove the barrier of high upfront investment costs. This programme originally linked municipalities with investors interested in financing energy efficiency renovations in public buildings, and was later expanded to link building, lighting and renewable energy projects in the public and private sectors with energy financing. TPF projects look to Energy Service Companies (ESCOs), which guarantee that energy costs will be reduced by a certain percentage after energy improvements are made, to provide pre-financing energy-conservation schemes. ESCOs are responsible for financing energy-saving measures as well as implementation, operation and maintenance, and subsequent energy savings are then used to cover investment costs over an agreed pay-back period (typically 10 to 15 years). Out of eleven participating ESCOs, two are publicly owned; the rest are private. Municipalities enter TPF projects on a voluntary basis and are responsible for collecting all relevant data prior to setting up the project. Depending on the status of the owner, the regional government may fund the upfront investment costs for energy performance contracts up to 12% in the case of private owners, and up to 20% for municipalities. The upper limit in both cases set at EUR 100,000 per project. Funding comes on top of other State (Upper-Austria) subsidies. The budget comes from the broader climate change programme of Upper Austria.

Source: IEA (2009c), Innovations in Multi-Level Governance for Energy Efficiency: Sharing experience with multi-level governance to enhance energy efficiency, OECD/IEA, Paris.

Municipal programmes investing in information and communication technologies (ICT) can significantly lower the information asymmetries that often lead to energy overuse.

An example is the provision of new smart metres that display and record real-time energy consumption data and analyse electricity demand patterns to encourage changes in energy usage, which can be a key tool in city energy conservation awareness-raising campaigns. Recent research at the MIT Portugal Program has shown that smart metres produced energy savings of up to 20% for households in Lisbon. City-level demonstration projects, even of a limited scale, have been very effective. A multi-year survey in the city of Blacktown, Australia, shows that awareness of the Blacktown Solar City project grew to 44% two years after its initiation. Of the people surveyed, 91% had switched to energy-saving light bulbs, 73% had chosen an appliance because of its energy rating, 42% had installed insulation to reduce energy use, 30% had signed up for green electricity and 5% had installed solar panels during the two years of the project's implementation.[9] This demonstrates the potential impact of government information campaigns, coupled with wide technology deployment (*e.g.* roll-out of smart metres), on local and regional green spending and energy efficiency.

Pillar 4. Supporting research and innovative applications of green technologies

Eco-innovation is the most important determinant of sustained growth of the green sector and of efficiency improvements in resource use of firms and consumers.

Cities and regions can catalyze green innovation by increasing and improving the targeting of R&D funds. There is also the potential for municipalities to strengthen the development and deployment of low-carbon and environmental technologies through networking platform for eco-innovation, in partnership with private sector researchers and universities. One relevant example is represented by Knowledge Transfer Networks (KTNs) initiated by regional development agencies in the UK. KTNs bring together diverse organisations and provide activities and initiatives that promote the exchange of knowledge and the stimulation of innovation. A major review of the KTNs in the UK showed that 75% of business respondents rated KTN services as effective; 50% developed new R&D and commercial relationships with people met through these networks; and 25% made a change to their innovative activities as a result of their engagement within KTN (OECD, 2010c).

Clean-tech projects have continued to attract capital, even during the 2008-2009 economic crisis.

Deloitte's 2009 survey on Global Trends in Venture Capital reports that 63% of surveyed venture capitalists anticipate an increase in their investment in clean-tech, the highest percentage among all sectors considered. In this regard, centralised systems incur the risk of being too far removed from the market place, and thus unable to link scientific and technical R&D with commercial technology development. To the contrary, systems organised around urban or regional networks can better address commercialisation challenges and early stage capital constraints for business start-ups. In support of this hypothesis, it is interesting to note that the few highly successful examples of green clusters are in countries such as Finland (e.g. the Lahti green tech-cluster), or France (*pole de competitivité* TENERRDIS) which are taking concrete steps to "regionalise" innovation systems, through decentralised funding schemes and empowerment of regional authorities. Multi-level and multi-agency policy coordination is needed to put in place hard technology infrastructures, like science parks, that can encourage new private investments in R&D for eco-innovation.

Government support could have a role to further "direct" innovation towards zero or low-carbon technologies.

The market for some of the most novel low-carbon solutions is still comparatively small, thus their growth potential might be hampered by commercialisation constraints. Technological change in energy efficiency might thus be biased in favor of relatively large enterprises, in carbon-intensive sectors, that can afford financing costly research and problem solving services. Innovation that "builds on the shoulders of giants" might delay the market penetration of immature "backstop technologies" – those that are zero-emission and not dependent on constrained resources. As shown by Acemoglu *et al*. (2009), delaying intervention not only leads to further deterioration of the environment, it allows dirty innovation to continue to outpace clean innovation, widening the gap between dirty and clean technology.

Targeted public financing can increase small and medium-sized firms' demand for energy efficiency services.

SMEs are generally much less likely to embark on environmental improvement programmes than larger companies (Zutshi & Sohal, 2004). Many have not established indicator systems owing to a lack of resources such as finance, personnel, time and technical knowledge as well as motivation and awareness. So the dilemma is how to translate this higher need for energy efficiency services in higher demand for these services, given current resource constraints. Targeted innovation vouchers, which provide financing for university-industry collaborations, might do the trick. An innovation voucher is delivered to firms to financing specific innovations. They can enable new SMEs in green industries to collaborate with public research institutions by submitting technical problems to be solved.[10] These vouchers can be effective at promoting the transfer of knowledge between the research and the business community, and also speed the pathway to commercialisation of experimental research in energy efficiency.

Box 4. Eco-Innovation Clusters

Much of the eco-innovation is concentrated in space and occurs in "green clusters". Clusters specialised in eco-innovation are not yet common as in other industries, despite very promising market commercialisation opportunities. Some relevant examples can however be identified. The Lahti Cleantech cluster in Finland encouraged innovation and development of environmental technologies by bringing together small and large enterprises, educational organisations and regional authorities. As a result, 170 new jobs have been created, 20 new clean-tech companies have set up in the Lahti region and the project has attracted more than EUR 30 million in total investment. In the Rhône-Alpes Region of France, regional and national investments in R&D were instrumental to the development of the Tenerrdis competitiveness cluster, which is promoting scientific collaboration to develop clean technologies applied to construction, transport and energy production. Tenerddis brings together 185 stakeholders, who developed, over 2005-2008, 226 R&D projects, for a total of EUR 440 million of investments, of which EUR 200 million came from public funding.

Source: Kamal-Chaoui, L. and A. Robert (eds.) (2009), "Competitive Cities and Climate Change", OECD Publications, Paris, www.oecd.org/dataoecd/30/36/44232251.pdf. ;
Cooke, P. (2008), "Green Clusters: Green Innovation & Jacobian Cluster Mutation", International Journal of Innovation and Regional Development.

Partnerships between government and academia have proven fruitful in the set-up of eco-innovation clusters.

These clusters successfully merge excellence in education, frontier research in environmental technologies, and job creation through spin-offs, venture capital and integration of enterprises. Clusters mobilise specialised knowledge and resources and organise them in a functioning system. Within the cluster, proximity and complementarities generate the critical mass to sustain industrial development in novel and risky fields. Commercially successful regional poles in bio or nano-technology show that each cluster has a distinctive genesis process which is deeply rooted on local industrial histories or scientific and technical leaderships. It is thus hard to design effective policy packages that can replicate *ex-novo* the most effective innovation ecosystems. However, public policy can accelerate their development, by directed R&D, enabling infrastructure, and institutional platforms for collaboration (Box 4).

Developing monitoring and evaluation tools to measure progress on green growth

An urban green growth strategy should invest in data generation, market information and analysis of the local economy.

More systematic data collection and data integration are needed to better know how the local economy uses energy, generates greenhouse gas emissions. Analysis of these data should focus on understanding how local energy use and emissions are related to economic activity. Prioritisation of expenditures is easier and more efficient when it is grounded on a solid analysis of the baseline situation. This baseline picture should be the result of an accurate monitoring of markets, local industry and innovation strengths, consumers' expectations, and of the national regulatory framework (the evolution of carbon pricing in particular). Benchmarking the current green job activity and the growth scenarios to other cities can also facilitate the identification of achievable targets and enabling policies. Given the wide heterogeneity in carbon emission factors, industrial and innovation capacities, and market demand within countries, the baseline assessments and the selection of targets must be undertaken locally, case by case. However, cities and agencies can effectively share common or standardised tools that optimise data collection across localities, help defining the relevant geographic scale for measurements, list meaningful and quantifiable indicators such that they are comparable across locations, regions and nationally (Corfee-Morlot in OECD, 2008a; Corfee-Morlot, 2009).

Indicators should be designed to capture expected progress in terms of abatement, cost-effectiveness, net job creation, and equity, for each policy instrument.

While extensive work has been undertaken on sustainability indicators, there has still been no consistent effort to monitor and evaluate urban policies under the double metric of "*environment*" and "*income/productivity*" effects. Such a set of integrated indicators could send a cleaner and more effective message to policy makers. For instance, if transportation objectives are only thought in greenhouse gas emission terms, other desired attributes of a smart transportation system – quality of service, affordability, accessibility, social costs – may get short shrift (Kahrl *et al*, 2009). Inter-municipal cooperation should address the shortage of usable tool-kits helping municipalities to set the goals, action, evaluation, and reporting of municipal green growth strategies (Box 5). Finally, more knowledge sharing is needed to move towards an optimal design of pilot projects for green growth. Demonstration projects can not only guide project selection and scaling, but also raise public awareness and political support for the strategy.

Box 5. Monitoring the transition to low-carbon cities in the Netherlands

The transition to low-carbon cities requires strong strategic and management capacities. A good example is the "transition management approach" adopted by the government of the Netherlands. This approach sets a long-term vision, which constitutes a framework for formulating future policy objectives and transitional pathways. Interim targets and short-term policies are derived by back-casting from the long-term objectives.

The Energy Transition Programme first identified seven priority themes (bio-based raw materials, sustainable mobility, chain efficiency, new gas, sustainable electricity, energy in the built environment, and "greenhouse as energy source") for the transition to a sustainable energy system, based on a multi-stakeholder consultation process and scenario studies. For each theme, representatives from industry, academia, NGOs and the government worked together and proposed several paths and experiments. The Energy Transition Task Force, consisting of leading stakeholders, has been working to identify favorable opportunities and specify what needs to be done by the government, by the universities and the other partners to exploit them. Some of the selected transition experiments are currently under way. The transition management approach is expected to enable the government to organise its policy around a cluster of options, without choosing specific solutions, while giving an overall policy direction to the market. It also provides opportunities for the government to facilitate networks and coalitions among actors in the transition paths as well as to build mutual trust with stakeholders by sharing common goals.

Source: OECD (2010c), "Eco-Innovation in Industry Enabling Green Growth", OECD, Paris.

Cities need pricing signals on carbon and other environmental goods to make green-growth policies cost-effective

Urban green growth policies must be embedded in supportive national frameworks with policies and price signals.

For instance, carbon taxes, and climate change levies, are almost always introduced at the national level, as they would distort competition between regions. One of the exceptions is the carbon tax introduced in the City of Boulder (Colorado, USA) which is low enough not to have a negative impact on the city's attractiveness for citizens and companies. While it is a source of funding for city investment and supports local capacity to act on green initiatives, it is arguably not high enough to have a substantial impact on reducing carbon emissions as the behavioural effects of such a small increase in the price of energy will be marginal even if price elasticities were to be high. In order for the carbon tax to have a real impact on reduction of carbon emissions, it would in many countries have to increase the price of carbon significantly, especially since price elasticity is relatively low in the short term. To avoid distortions to competitiveness, supra-national co-ordination might be necessary.

Cities could be compensated by national governments for investments that produce environmental goods enjoyed beyond the metropolitan region.

This compensation, for example via a government grant, internalises the positive externalities of these goods that cannot be subject to regular pricing mechanisms. It could also take into account that some of these local territories, for example in greenbelts or national parks, have fewer possibilities to construct or attract economic activities and thus to increase local tax revenues. Insertion of ecological criteria in government grants has been introduced in Brazil and Portugal, as well as some German states such as Saarland. Common measurement tools are needed to permit national governments to make comparable assessment of funding decisions.

4. What financing and co-ordination mechanisms do cities need to successfully implement green growth policies?

Taxes and local pricing instruments can be leveraged to meet green growth and sustainable development priorities

Taxation is a powerful instrument in creating green growth.

It has a clear impact on economic growth or employment growth, by the extent to which it taxes for example economic activity or labour. At the same time, it has environmental impacts defined by the way in which it taxes resources, pollution and economic inputs that are to a more or lesser extent clean (labour, investments, etc.). Over the last decades, many governments in OECD countries have made substantial efforts to "green" their taxation systems. They have introduced environmental taxes, such as carbon taxes (*e.g.* Sweden since 1991), climate change levies (*e.g.* United Kingdom since 2001) and other similar fiscal instruments aimed at stimulating environmental sustainability. Some countries, such as the Netherlands, have made greening of their tax system an explicit policy goal, and introduced comprehensive reform of the tax system. This green taxation has in many instances created a double dividend: a greener economy, but also more employment growth, as the green taxation reforms have in many cases shifted taxation from labour to polluting activities.

Local taxation should be considered a key tool for achieving green growth objectives, rather than just a revenue source.

Attention by policy-makers and researchers has been mostly focused on greening taxation at the national rather than the sub-national level. However, like national taxation, local revenue sources are not neutral: revenue sources, rates, exemptions and composition all impact the price of certain goods and services for citizens and firms, such as urban transportation options, land development and housing. As citizens and firms are in most cases price elastic (at least to a certain extent), these price-related mechanism will be able to influence the behaviour of citizens and firms. A key challenge for sustainable urban finance is thus to combine revenue-raising capacity with the introduction of fiscal incentives that stimulate sustainable development and green growth. There is room for greening sub-national taxes, especially those that have a large impact on the main economic sectors that are essential to green growth: sustainable public transport; sustainable building; brownfield development; energy efficiency.

Transportation fees for sustainable public transport

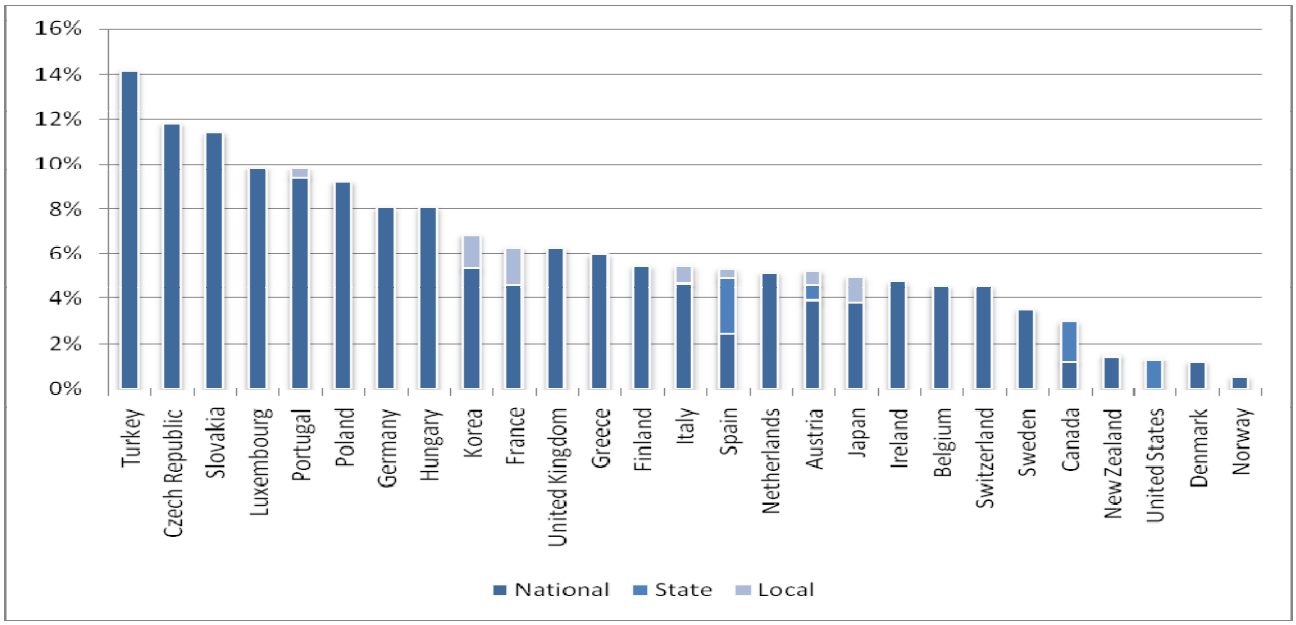
Local fees and taxes can greatly influence the development of sustainable urban transport through discouraging car use and stimulating public transport.

Fiscal disincentives for car use will be more effective when alternative traffic solutions, such as public transport, are in place, which is why some metropolitan areas use these types of revenues to finance public transit.

Cities in the OECD have overall limited taxing powers to reduce car use.

Car users are in many cases not charged for their use of the road network, non-residential parking is free in many cities, and personal income tax regulation often favours automobile use over transit, as the costs of owning, operating and parking a car are in many cases deductible for firms and individuals, whereas transit benefits for employees are not. Companies in OECD countries often provide subsidies (frequently stimulated by fiscal arrangements) to their employees for their individual motorised transport and free company parking, rather than for public transportation. In many non-OECD countries, such as India, Indonesia and Egypt, fuel subsidies provide further disincentives for the reduction of car use. They are usually provided by central governments, but mostly benefit the urban population in these countries. Some cities and regions have introduced motor vehicle or fuel taxes, although this remains a predominantly national tax in most OECD countries (Figure 9). In Canada, for example, excise taxes on gasoline and diesel are collected by both federal and provincial governments, as well as by some select metropolitan regions (Montreal and Vancouver), with combined excise taxes up to 30.5 ¢/L in Vancouver. Similar effects on fuel consumption could be attained by a pay-as-you drive insurance, although such schemes have not been introduced yet (Parry, 2005).

Figure 9. Fuel taxes: little room for local and state involvement



Note: Tax revenues as share of total government revenues (central and local), including petroleum excise taxes.
Source: OECD Revenue Statistics Database.

While overall taxing powers to reduce car use are limited, congestion charges and parking fees are underutilised.

Congestion charges, as introduced in Singapore, Stockholm and London, have lead to the reduction of traffic volumes, shifts in transit modal shares and reduction of congestion responsible for a considerable part of greenhouse gas emissions. In some cases, the receipts from the congestion charge are used to finance urban public transport; this is the case in London. Alternative effective measures, mostly used in the United States, are high occupancy toll (HOT) lanes. HOT lanes make use of the infrastructure provided by high occupancy vehicle (HOV) lanes introduced in many OECD countries. HOV lanes are highway lanes on which only vehicles with a minimum number of occupants (usually two or three) are allowed to drive, in order to promote car pools. Parking fees and taxes are price-elastic, and there is ample evidence that they are effective in reducing car trips and decreasing the car share in the modal split. Parking fees could be differentiated in order to make them even more effective. A parking surcharge might be levied on drivers who arrived at parking garages during the morning peak hours, and spatially differentiated parking fees could rival time-differentiated congestion fees (Arnott *et al*, 1991). The cost per minute associated with meter parking is however nominal in most cities, although some cities (such as Los Angeles) make use of congestion pricing for parking.

Value-capture taxes can fund robust public transport systems.

Public transport is stimulated in almost all cases by public subsidies; there are hardly any cities that run public transport systems exclusively funded by tickets or other private funding sources. Public transport is thus developed in cities that have found fiscal resources to fund metropolitan transit. A local tax that is frequently used to finance public transportation is the value capture tax. The base for a value capture tax is an increase in property values arising from public infrastructure development. This increased value results from the increased desirability of the location, better access, and the potential for higher rents, increased resale value and higher-density development. Value capture taxes can be imposed or can take the form of a negotiated agreement; they may be levied as an ongoing annual charge or as a one-time tax. Value capture taxes have been used to finance transport infrastructure in cities as different as Hong Kong, Miami, Milan and Bogotá. A value capture tax can

only be applied when the property value increase can be unambiguously attributed to infrastructure investment. Value capture taxes are less useful when property taxes are assessed on a yearly or regular basis, since the annual assessment captures any increases in the property value that might result from public infrastructure investment; this does however not take place in most OECD countries.

Fiscal incentives and property taxes for sustainable building

Local property taxes often discourage compact city development and promote low-density development, the primary source of local tax revenue in many OECD cities, which is sometimes skewed in favour of single family houses.

Multifamily rental housing in the United States, for example, bears an effective tax rate (tax divided by property value) that is considerably higher than the rate for single-family owner-occupied housing: at least 18% in 2001 (Goodman, 2006). The higher tax rate for apartments observed in the national totals holds for 10 of the 12 states that are identified in the Residential Finance Survey data. One of the explanations is the explicit policy of sub-national jurisdictions to tax apartments more heavily than single family houses: apartments are often classified as commercial real estate rather than as housing and many local governments tax commercial property at a higher rate than residential real estate. Implemented like this, the residential property tax promotes low-density development and disproportionally burdens lower-value properties.

Some cities have introduced property tax reform to favour compact development.

Through differential taxation, a special area tax can be applied on suburban properties or use a set of cascading taxes that gradually increase as one moves away from the city centre towards the periphery. A relatively simple form of such a tax might be a higher standard property rate for suburban inhabitants or preferential rates for multiple dwellings. Although the introduction of such a tax could be politically difficult to implement, there are cities that have introduced a tax along these lines. The City of Austin, USA has for example introduced a special transportation levy on all city utility bills, based on the estimated average number of daily trips made by individuals residing in different types of property. The levy averages USD 30-40 per year for a typical household, but differentiation takes place according to housing type (Litman, 2009). Depending on local circumstances, such a tax could have social consequences if lower-income groups have difficulties finding affordable housing in city centres and are dependent on car use, which might already be taxed in other ways.

Brownfield development to reduce the urban environmental footprint

Brownfield development could be stimulated by pricing the costs of sprawl and congestion into greenfield development.

Brownfield or infill development in many OECD metropolitan regions usually offers few benefits to developers. It also takes more time to complete, and so occurs less frequently unless specifically stipulated by local governments. Suburban municipalities have thus actively pursued the development of previously undeveloped land, or greenfields. Because suburban municipalities typically have a greater supply of greenfields, they can be more attractive to developers and can benefit from the revenues and revenue bases brought in by greenfield development. Most property tax systems tax land and structures on the land at the same rate, so they provide limited incentives to develop undeveloped land within cities. Distortions created by the property tax may result in the inefficient spatial expansion of cities, which makes the tax one possible cause of urban sprawl (Brueckner & Kim, 2003). Sprawl is stimulated when it is more beneficial for developers or other actors to develop on undeveloped land outside of cities rather than within cities. Placing proportionally higher taxes on land than on built structures would make it more costly to hold on to vacant or underutilised, centrally located sites. Reducing the tax burdens on development and redevelopment of urban land could facilitate revitalisation and the replacement of obsolete buildings in older central cities. More compact development can be stimulated by introducing a form of land taxation such as a split-rate property tax. The key characteristics of such a tax, applied in Sydney, Hong Kong, the U.S. cities of Pittsburgh and Harrisburg and other cities within OECD countries such as Denmark and Finland, is that land value is taxed more heavily than the buildings on the land,

thereby providing an incentive to develop it. This is in contrast to the conventional equal-rate system that applies the same tax rate to land and to build structures on it.

Local energy fees to increase efficiency

Energy-efficiency clusters could be stimulated by mechanisms, such as fees and charges, that put a price on high energy use.

These could be effective instruments to signal the higher cost of internalising environmental externalities. Fees and charges are ideal for funding local services where specific beneficiaries can be identified and non-payers excluded, such as in energy. Fees are particularly effective when they recover full costs and when fees are paid according to individual or household use, as these give residents incentives for more efficient use of resources. In addition, charging households for their energy consumption (and not the average household's consumption in a city) might stimulate them to invest in energy efficiency measures, such as isolation and energy renovation measures.

Electricity fees are used to a varied extent in cities throughout OECD countries, and are most effective where individual consumption is priced by unit.

In several cities, the costs of urban utilities are not (completely) covered by user fees. In this case utilities, such as electricity, are cross-subsidised by local tax resources. Sometimes, cities apply preferential tariffs for large industrial energy users in order to attract manufacturing and other employment. Even when urban utility fees exist, they are in many cases not differentiated to households: households might pay an average price based on total energy consumption in a city, quarter or apartment block. In that case the behavioural effects of fees are limited, as the financial benefits of reduced consumption for a household are marginal. In order for fees to be efficient, they will have to price the number of units consumed by the different consumers. Such a scheme requires equipment in houses and apartments (such as individual energy meters) which is lacking in many cities.

Some form of national regulation might be needed in order for cities to play their role.

This could take the form of mandatory cost coverage for public utilities, in order to avoid that energy costs (and increases in energy costs) get hidden in a larger local tax revenues pool. Central governments could also make sure that inter-city competition will not lead to a downward race of preferential electricity tariffs for large industrial users. Although many cities have formulated energy reduction targets, the costs of investments in individual electricity meters – which will not bring them financial benefits – might constrain them from installing them. National regulation or investment subsidies might help local public utilities to introduce these equipments required for unit-pricing.

New financial instruments are needed to support urban sustainability and green growth programmes

Cities are responsible for large parts of government expenditure, including expenditures that could impact green growth objectives, such as environmental protection, transport and buildings.

Local governments in many OECD countries are responsible for amounts of public spending on environmental protection (which includes waste management, waste water management, pollution abatement, protection of biodiversity and landscapes, and R&D on environmental protection) that are almost similar to that of their respective national governments (OECD, 2009h). Transportation is in many OECD countries a shared responsibility, with local governments taking care of local infrastructure, regional governments for regional infrastructure and national governments for national infrastructure. Similar shared responsibilities can also be found with respect to the built environment and land use. Debates on environmental federalism have shown that local governments can play an important role in environmental policies, especially when they are able to

internalise externalities. As local governments often lack the revenue streams needed to build green infrastructures, measures to stimulate green growth might put additional pressure on city budgets and increase the need for additional resources and reform of national and international mechanisms, most notably carbon markets.

A variety of financial instruments have been developed to create a market for carbon emissions and carbon offsets, some of which are open for cities to use as a revenue source.

Cap-and-trade mechanisms have been put in place in different countries (including parts of the United States), at the European level (EU Emissions Trading Scheme) and at the global level, following the Kyoto Treaty. In addition, voluntary carbon markets have been developed in which carbon offsets are traded. Cities are part of some of these mechanisms (such as the Chicago Climate Change Exchange), and have in some cases set up some cap-and-trade mechanisms themselves (Los Angeles, Chicago, Santiago, and most recently (2010) in metropolitan Tokyo). Certain cities, such as London, have explicitly defined emissions trading as a business opportunity that would increase their metropolitan competitiveness (City of London, 2006). Cities could earn revenues from the two mechanisms that the Kyoto protocol put in place to create carbon offsets, the Clean Development Mechanism (CDM)[11] for developing countries (non-Annex 1 countries) and Joint Implementation (JI) for developed countries (Annex 1 countries), both certified and issued by the UNFCCC.[12] In addition to this, voluntary carbon markets have been created that are unconnected to an emissions cap. In these voluntary markets, carbon offsets are verified by another carbon market standard, twelve of which are currently operational. Carbon offset markets have been promoted as an important part of the solution to the climate crisis because of their economic and environmental efficiency. Their cost-effectiveness allows for lower caps or voluntary commitments and the potential to deliver sustainable co-benefits as a by-product through technology transfer and capacity building.

Urban usage of these instruments has been marginal so far.

Of the 1224 CDM projects currently registered, only a limited number have been urban projects. There have been two urban transportation projects: the Bogotá bus rapid transit, TransMilenio, and the Delhi subway regenerative breaking system. A similar marginal number of CDM projects (0.57%) and generated certified emission reductions (CERs) by 2012 (0.16%) deal with energy efficiency in the urban building sector (Fenhann, 2010), such as in Khayelitsha (South Africa). In addition, some projects are implemented in other urban sectors, such as electricity and solid waste (Chandigargh, India and Urimqi, China). JI projects have also been applied in a limited number of metropolitan regions (North Rhine-Westphalia in Germany and Rhône-Alpes in France). Carbon offsets realised by urban projects in the voluntary market are equally marginal: projects have been implemented or prepared in Sao Paolo, Timisoara, Lille and Newcastle (Kamal-Chaoui and Robert (eds.) 2009, Clapp, 2010).

Marginal urban use of carbon markets to raise revenue for greenhouse gas emissions-reduction projects can partly be explained by high measurement costs to prove the additionality of projects.

This *additionality* criterion is part of the Kyoto protocol to ensure that the mechanisms result in additional carbon reductions and are not used to finance activities that would otherwise also have taken place. Several mitigation efforts in cities are however notably difficult to measure, because emissions are diffuse, costly to identify and to aggregate into calculations of total emissions. CDM challenges that are particularly problematic for the urban transport sector are the definition of project boundaries, complex up-stream and down-stream leakages, the establishment of a reliable baseline, and the implementation of a reliable monitoring methodology. There are similar challenges for using CDM in the urban building sector: fragmentation and complexity of construction projects, as well as small scale and disperse emission points making the registry and the "measurable, reportable and verifiable" procedures (MRV) costly and time-consuming under the current CDM framework. Some "soft" measures taken in cities, such as optimised architecture design for passive heating or cooling, are not quantifiable in terms of greenhouse gas mitigation and thus not recognised and credited in the project provision (Cheng *et al.*, 2008). Additional barriers include devolution of national authority, lack of expertise with these instruments at local level, lack of measurement instruments and expertise, costs and risks associated with project approval by UNFCCC and implementation (Clapp, 2010).

The possibilities for cities to use existing carbon finance instruments could be increased.

City tools for measurement and monitoring (including standard inventories), as well as expert support from national government and private sector, could facilitate market access and streamline project preparation, lowering transaction costs. If international climate negotiations were to mention transport and buildings as key areas to reduce greenhouse gas emissions, this would provide a rationale to involve urban areas. In order to keep transaction costs down and to take systems dimensions of urban problems into account, these actions should take the form of broad programmes rather than specific projects. Funding from CDM, as it is currently designed, could help to reduce public transport fares, thus increasing transit usage, and also help to finance inter-modality infrastructures, thereby facilitating modal shifts. Other CDM opportunities for the urban sector would be to explore the easily attainable targets on greenhouse gas sources related to urban transportation planning, such as urban forestry, street lighting, waste energy used for transportation purposes, etc. City involvement in CDM might require broadening the project-based approach of CDM, for instance to include a sectoral crediting mechanism beyond 2012. In addition, there is a need to develop carbon emission inventories that are harmonised across cities (Corfee-Morlot *et al.*, 2009). The C40 Large Cities Climate Leadership group has partnered with the Government of Switzerland, ECOS and the World Bank on a program called Carbon Finance Capacity Building as a precursor for cities being given access to new sources of funding currently targeted at national governments.

In addition, national governments could green urban finance by re-designing sub-national taxes and grants to sub-national governments.

Re-design of sub-national taxation could include property tax reform, in order to correct for biases towards unsustainable behaviour. In addition, governments could design grants that take environmental indicators into account in case of jurisdictional spillovers. A comprehensive greening of urban finance would also increase the coherence between urban finance and urban planning frameworks to enhance urban sustainability and to contain unlimited urban growth.

Public-private partnerships can bolster urban green growth goals under certain conditions

The use of PPPs to achieve green growth goals by cities has been growing over the last decades.

PPPs can be defined as contracts between a government and a private company, under which the private company finances and builds an infrastructure asset, subsequently maintains the asset and, in many cases, operates some element of a public service while using the asset. In return for these activities, the company is paid over a number of years for the construction costs and service operation, either through user charges, public payments or a combination of both. Cities in many OECD countries are responsible for the provision infrastructure for which PPPs are mostly used, such as transport infrastructure (which accounts for 472% of all PPPs planned and funded in the world since 1985) and to a slightly lesser extent water (30%) and buildings (21%) (OECD, 2010). The use of PPPs is particularly growing in cities with heavy investments in infrastructure, for example in cities in China where PPPs have recently been introduced to finance wastewater infrastructure (in Beijing and Guangzhou) and solid waste management projects (*e.g.* in Shenzhen and other cities in the Guangdong province). Other examples include Korea, France and the UK.

PPPs can potentially stimulate sustainable investments by private actors.

PPPs can, in the right circumstances, provide better value for money, such as lower prices, than traditional infrastructure procurement (which leaves the building of infrastructure to the private sector, but not the maintenance and operation of it) by sharing risks in innovative ways. PPPs could encourage private (as well as public) actors to take a more long-term view on spending by relating maintenance spending more closely to

capital investment. As such, PPPs might stimulate energy efficiency in public buildings as the private operator would benefit from the efficiency gains due to its investment in energy efficiency.

The use of PPPs can be problematic given that they are in many instances absent from government balance sheets.

The private party in a PPP can carry a number of the risks and thus be obliged to record the PPP on its balance sheet. Only the annual PPP-agreement payments are on the government budget. In order to circumvent national or supra-national deficit and debt rules, cities thus might not be interested in assessing a project on its merits, but only on whether it can be done as a PPP. This approach undermines value for money and long-term fiscal sustainability. Some countries have tried to limit this problem by imposing more strict accounting rules, ensuring a mandated value-for-money process, and imposing a maximum amount of transparency about the deal when it is struck. Some central governments are worried that regional and local governments are using PPPs to get around the fiscal rules set by the centre, resulting in a huge unacknowledged stock of liabilities that central government might suddenly have to take over.

There is, however, no indication that PPPs would be better suited to achieve green growth goals than traditional procurement.

Although it might create better value for money in some instances, it crucially depends on the fulfilment of certain criteria. The private sector is not always more efficient in operating certain public services: e.g., a study of cities with different types of bus operators found that the most efficient cities were equally likely to be public or private (Pina & Torres, 2006). In addition, PPPs require certain skills – for example in negotiating and the capacity to comprehend long-term capital budgeting - that most public sector officials at the city-level do not have. This might explain the existence of cases, such as the waste water treatment plant in Zagreb, where very little risk has been transferred at great cost to the taxpayer (CEE Bankwatch Network, 2008). Several OECD countries have created PPP units at the central government level to build this public capacity, but similar initiatives at the city- or regional level are hardly existent. Even if PPP contracts would appear to have been well negotiated by city officials, they sometimes choose to (or feel obliged to choose to) to bail out the private operator if its assessment of risks proved to be too optimistic, as was the case with the public bicycle rental scheme of the City of Paris (see Box 6).

Multilevel governance and co-ordination enhances the implementation of green growth policies

Green growth involves a paradigm shift in the way economic development policies are conceived at national, regional, and local levels and in the way these policies link to the business sector and civic organisations.

Urban green growth and sustainability initiatives both affect and are affected by economy-wide fiscal policies and national sectoral policies (particularly transportation, building, labour, innovation and education policy). National-level policies can undermine urban level green growth policies if potential policy obstacles are not identified and addressed (Corfee-Morlot *et al*., 2009). For this reason, local level initiatives that focus on stand-alone or "flagship" projects without regard to where these projects fit within regional and national policy frameworks risk falling short of their promise.

Box 6. PPPs to fund public bicycle rental schemes: the case of Vélib' in Paris

As part of its strategy to reduce car use, the city of Paris undertook a policy to promote the bicycle as an alternative means of public transport for short distances in Paris. After an open call for tender in 2007, the city of Paris awarded the private company JC Decaux the concession to build, maintain and operate this system for a 10-year period. The investment and operational costs of the bike rental system are born by the private company, in exchange for a right on 50% of the total surface of city billboards (which generated € 57 million in 2008). Total investment costs for the system was around € 110 million; additional Vélib'-infrastructure is financed by the City of Paris (estimated to be € 8 million per year). Revenue generated by Vélib', through user payments and subscriptions, goes to the city of Paris (€ 15 million in 2008), but the private company can earn additional revenue when its operational activity reaches a very high level of quality as determined by six criteria. In order to run the system, 400 employees were hired by JC Decaux.

The public bicycle rental system was inaugurated in July 2007 with 10,600 self-service bicycles available at 750 stations, which grew into 24,000 bicycles and 1,751 stations in June 2009. The Vélib'-system has been conceived as a success: the average number of trips reached 76,660 per day in 2008 and bicycle use in the city has increased. The model proved to be a profitable operation for the city, but not for JC Decaux as it underestimated the costs for repairing and replacing damaged bicycles and was responsible for bearing this risk. In order to avoid bankruptcy of JC Decaux and subsequent halt to their operations, the city of Paris felt obliged to re-negotiate the contract and provide more favourable terms for JC Decaux. No analysis of whether this agreement still is better value for money than if it was completely run by municipal workers has been initiated.

Source: Largentaye, H. de (2010), "Velib': a case of successful co-operation between the City of Paris and the private sector in the framework of a sustainable development strategy", Presentation for OECD 3rd Annual Meeting on Public Private Partnerships, 13 April 2010.

National governments can play a role in supporting and removing barriers to greater urban governance and enhance cities' capacity to act on climate change issues.

Key roles include providing funding and technical assistance to cities and regions, such as in Finland and Sweden. Climate mandates in national urban and regional policies, such as in Australia, Austria, Canada, the Czech Republic, France, Germany, Japan, Mexico and the United Kingdom, and in the Korean "Green New Deal", can advance local climate action. Strong national targets for adaptation and greenhouse gas emissions reductions can help prevent regional competition based on environmental regulations and even promote a "race to the top" through incentives, such as Japan's "Environment-Friendly Model City" award. It is also important to align national policies to remove perverse incentives and establish positive incentives for green growth (Corfee-Morlot *et al.*, 2009).

Collaboration on the metropolitan level among municipalities, regional governments, and the private sector provides challenges and opportunities for implementing green growth strategies.

Regional coordination on green growth is necessary because green growth-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 and public service agencies (Corfee-Morlot *et al.*, 2009). The Climate Protection Agency for the Hanover Region demonstrates the effectiveness of a coordinating body on the metropolitan regional level in accelerating the shift to green technologies. Composed of the City of Hanover, the Hanover Region, 20 surrounding municipalities, the local public utility company and public transport operator, and private sector shareholders, the agency promotes energy efficiency and the use of renewable technologies. Its initiatives have resulted in increased energy efficiency of local enterprises and existing buildings, and have increased the use of solar, wind, and combined heat and power (CHP) energy (Potthoff in OECD, 2010d). In London, the creation of the Greater London Authority in 2000 resulted in the formation of the London Energy Partnership, through which the Mayor of London was able to promote the use of on-site renewable energy generation and district-based CHP generation (Bulkeley & Schroeder, 2008; Corfee-Morlot *et al.*, 2009).

Notes

1. More precisely, this modelling exercise has been carried out by employing the spatialised version of the IMACLIM-R CGE framework (Crassous et al., 2006). IMACLIM-R allows simulating the interactions between changes in energy consumption, carbon emissions and economic growth, given a set of policies and other exogenous factors. Special thanks are given to Fabio Grazi and Henri Waisman (CIRED) for modelling work with IMACLIM-R and the urban module that incorporates the OECD metropolitan database.

2. Densification indicates policies that increase the number of people per square kilometre in a given urban area. These include restrictive policies, which actively pursue densification such as through green belt policies, and enabling policies, which allow activity to be drawn to the, core such as public transportation systems or the elimination of distortions in the market such as taxes for deconcentration.

3. Such a road toll reduces average rather than marginal commuting costs by car (see Henderson, 1974 for the underlying economics of road pricing mechanisms).

4. Life cycle costing (LCC) is a structured approach that can be used to produce a spend profile of the product or service over its anticipated life-span. The results of an LCC analysis can be used to assist management in the decision-making process where there is a choice of options. See *www.ogc.gov.uk/implementing_plans_introduction_life_cycle_costing_.asp*.

5. Today, more than half of the 1 500 companies in Issy are in the ICT sector, including Cisco Systems' European headquarters, Hewlett Packard, Orange Internet, Sybase, Canal+, and Microsoft Europe.

6. See *www.sustain.ucla.edu/article.asp?parentid=6024*.

7. Although landfilling and incineration involve larger volumes, recycling now generates more revenue of the waste management industry since great economic value is bound up in discarded products and equipment. Worldwide estimates of employment in recycling are not available as we lack reliable estimates from several developing economies where recycling is growing fast. Recent estimates for the United States find that recycling generates revenues of USD 236 billion annually and offers employment to 1.1 million people at 56,000 public and private facilities (UNEP, 2009).

8. See *http://mayorsinnovation.org/pdf/IndusRebuildBrochure1.pdf.*

9. See the second issue of the Solaris newsletter at *www.environment.gov.au/settlements/solarcities/publications/solarise/index.html*.

10. An Innovation Vouchers Subsidy Scheme was introduced for the first time by the Dutch Ministry of Economic Affairs and then experimented in several OECD countries. Innovation vouchers were proposed as a key instrument for facilitating university-SME collaborations by Terry Cutler in the report for the Review of the Australian National Innovation System (Cutler & Company Pty Ltd (2008)), In Cutler's proposal of a voucher program, each voucher would be worth up to USD 15 000 and would be used to fund collaboration between the small firms and a public sector research organisation. The program would link 5 000 firms per year with public research agencies at a cost of USD 50–75 million per year. The voucher programs can be easily scaled-down at the sub-national level, targeted on energy efficiency innovations and applied by municipal departments in charge of innovation and business support.

11. CDM allows developed countries to purchase carbon credits from emission reduction projects in developing countries, and JI from emission projects in other developed countries.

12. Annex 1 countries are Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, European Community, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, and United States of America. (*http://unfccc.int/parties_and_observers/parties/annex_i/items/2774.php*)

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