OECD Green Growth Studies

Green Growth in Cities

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BETTER POLICIES FOR BETTER LIVES

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Foreword

Green growth has been a strategic pillar of the OECD's work since 2009, when OECD member countries mandated the organisation to develop a *Green Growth Strategy*. Green growth has entered almost all areas of work across the OECD, including the Directorate for Public Governance and Territorial Development. The directorate's mission is to help governments at all levels design and implement strategic, evidence-based and innovative policies to strengthen public governance; respond effectively to diverse and disruptive economic, social and environmental challenges; and deliver on governments' commitments to their citizens.

This publication is the final report of the OECD Green Cities Programme, initiated by the 2010 OECD Roundtable of Mayors and Ministers in Paris, and presents the project's main findings and policy recommendations. The aim of the programme is to better understand the concept of green growth in cities; the potential of urban policies for urban and national green growth; and to inform national, sub-national and municipal governments as they seek to address economic and environmental challenges by pursuing green growth. This report also contributes to the *OECD Green Growth Studies* series and joins a thematic work stream that includes the recent publications *Linking Renewable Energy to Rural Development* (2012), *Compact City Policies: A Comparative Assessment* (2012) and *Cities and Climate Change* (2010). The focus of this study is on OECD member countries and recommendations are primarily addressed to policy makers in OECD countries. Numerous findings and recommendations are nonetheless valuable for non-member countries, notably for those with high levels and rates of urbanisation.

Green Growth in Cities synthesises findings and evidence from six in-depth case studies of urban green growth policies carried out in 2011 and 2012: four at the city level (Paris, Chicago, Stockholm and Kitakyushu) and two national studies (China and Korea). It also draws on data from the *OECD Metropolitan Database*. The analytical approach for the case studies was developed in the *OECD Regional Development Working Paper*, "Cities and Green Growth: A Conceptual Framework". The work of the OECD Green Cities Programme benefited from guidance by the OECD Territorial Development Policy Committee and its Working Party on Territorial Policy in Urban Areas, and profited from the active co-operation of the local and national government teams for the Green Cities Programme's case studies.

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Table of contents

Acronyms and abbreviations 7

Executive summary 9

Chapter 1 **What is green growth in cities?** 13

Fostering urban economic growth and development by reducing urban environmental impact 14
Conditions and scenarios for green growth in cities 19
Note 25
Bibliography 25

Chapter 2 **Why are cities important to national green growth strategies?** 27

Cities' outsize role in national growth and environmental degradation 28
How urban policies can lower the costs of meeting national environmental policy targets 34
Cities are key spenders on infrastructure relevant to green growth 36
Notes 40
Bibliography 41

Chapter 3 **What are the high-priority green growth policies for cities?** 43

Green growth policies for job creation 44
Policies to consider when the priority is attractiveness 52
Policies to consider when the priority is to foster regionally produced green goods and services 55
Policies to consider when the priority is to increase value and reduce environmental impacts 58
Notes 65
Bibliography 66

Chapter 4 **How should urban green growth governance and financing challenges be addressed?** 73

Governing the green city: A case for stronger multi-level governance tools 74
City revenues: Getting the financial incentives right for green growth 81
Mobilising private finance for green infrastructure 86
Notes 99
Bibliography 100

Annex A **Measuring green growth in cities** 105

The context for a new set of indicators 105
Proposed indicators for measuring progress towards urban green growth 109
Bibliography 130

Related OECD work on green growth and cities 131

Tables

Table 1.1. Urban activities that can reduce cities' environmental impact: Some examples 16
Table 1.2. Factors affecting cities' green growth policy priorities and scope of action 21
Table 1.3. Six green growth scenarios 24
Table 2.1. Productivity of OECD urban *versus* rural regions 28
Table 2.2. Capital costs of selected green projects in OECD cities 39
Table 3.1. Environmental and land value details of selected OECD eco-districts 59
Table 4.1. Governance gaps 76
Table 4.2. Impacts of selected urban congestion charging schemes 85
Table 4.3. C40 best practice projects for green cities 89
Table A.1. Most common environmental topics in urban indicator sets 106
Table A.2. OECD national-level green growth indicators 109
Table A.3. Tentative list of urban environmental indicators 111
Table A.4. OECD comparable metropolitan indicators 115

Figures

Figure 2.1. How cities contribute to OECD growth, 1995-2007 29
Figure 2.2. Population density and CO_2 emissions *per capita* in 73 large OECD metropolitan areas, 2006 31
Figure 2.3. CO_2 emissions from ground transportation in large metropolises 32
Figure 2.4. Suburbanisation in OECD metropolitan regions, 1995-2007 33
Figure 2.5. How a high carbon price and the rate of technical change affects GDP, 2010-2100 34
Figure 2.6. Average carbon price for a "carbon price only" policy scenario or for a complementary infrastructure policy scenario 35
Figure 2.7. Impact on GDP of a "carbon price only" policy scenario and a complementary infrastructure policy scenario 36
Figure 2.8. Gross capital formation in environmental protection by level of government, 2009 37
Figure 2.9. The share of environmental protection in local government spending, 2009 37
Figure 2.10. How some major cities apportion their budgets, 2010 38
Figure 3.1. Modelled impact of a greenhouse gas reduction policy on employment in the OECD, 2030 46
Figure 3.2. Population density and commuting by public transport in US metropolitan areas 54
Figure A.1. OECD green growth measurement framework 110
Figure A.2. Population density in OECD metropolitan areas, 2008 116
Figure A.3. Urbanised area growth, 2000-2006 118
Figure A.4. CO_2 emissions, 2006 120
Figure A.5. Air pollution, average 2001-2006 122
Figure A.6. GDP *per capita*, 2008 124
Figure A.7. GDP growth, 2000-2008 126
Figure A.8. GDP share of national value (%), 2008 128

Acronyms and abbreviations

AUD	Australian dollar (currency)
BID	Business improvement district
CO_2	Carbon dioxide
ESCO	Energy service company
EU	European Union
EUR	Euro (currency)
GDP	Gross domestic product
GHG	Greenhouse gas
KRW	South Korean won (currency)
kWh/m^2	Kilowatt hour per metre squared
PFI	Private finance initiative
PM	Particulate matter
PPP	Public-private partnership
R&D	Research and development
SEK	Swedish kroner (currency)
SME	Small and medium enterprises
t	tonne

Executive summary

Pursuing green growth in cities is more important than ever in light of the explosive urban growth expected over the coming decades. Today, for the first time in human history, over half of the world's population lives in urban areas. By the end of the century, this share is projected to rise to around 85%, out of a world population of about 10 billion. This implies there will be 5 billion new urban dwellers to accommodate in the years ahead.

Cities play disproportionately large roles in the economic and environmental performance of countries. They are critical drivers of national growth. Just 2% of OECD regions, mainly the largest OECD urban areas, generate roughly one-third of all growth in the OECD. In both India and China, the five largest cities' economies contribute approximately 15% of national GDP – roughly three times their share of the population. Cities also contribute disproportionately to energy consumption, and thus to climate change. They account for an estimated 67% of global energy use and 71% of global energy-related CO_2 emissions.

Urban policies can play an important role in achieving national environmental and green growth goals. For instance, they can lower the long-term costs to the economy of national environmental policies. Cities are responsible for a significant share of infrastructure investments, which if invested wisely can contribute to national efforts to combine growth with environmental performance. And urban form and planning can also play a key role in reducing environmental impact, as CO_2 emissions from transport are likely to be greater in less densely populated areas than in more densely populated areas.

What is urban green growth?

Urban green growth is fostering economic growth and development through urban activities that reduce environmental impact, for example low air pollution and CO_2 emissions; low consumption of natural resources including water, energy and undeveloped land; and the protection of ecological services. Urban policy makers have come to see green growth as an opportunity to create jobs and attract firms and investment, while improving local environmental quality and addressing global environmental challenges, particularly climate change.

Policy makers' interest in green growth has led to a call for more information on the policies which can actually bring about green growth in cities. This report proposes a definition of urban green growth and its key elements. It outlines some of the high priority urban policies for green growth, as well as the national policies needed to complement and support these local policies. It also outlines the governance and finance challenges – and solutions – for cities that want to grow green. The report is illustrated with examples from six urban green growth case studies: four at the city level (Paris, Chicago, Stockholm and Kitakyushu) and two national studies (China and Korea). Annex A presents a preliminary set of indicators for tracking progress towards urban green growth.

Key findings and recommendations

Benefits of green growth for cities

What are the potential impacts of green urban activities on economic growth and development? While it is not yet possible to demonstrate a link between urban activities that reduce environmental impact and resulting economic growth and development, the case studies of four urban areas in the OECD do provide preliminary insights into the types of green urban policies that are most likely to contribute to certain desired growth impacts. In this report we focus on four potential impacts and some of the key policies that can contribute to achieving them:

i. When the priority is an increase in jobs, a key policy to consider is energy-efficiency retrofits of buildings.

ii. When the priority is an increase in a city's attractiveness to firms and skilled human capital, a key policy to consider is increasing the efficiency of the transport system.

iii. When the priority is an increase in the local production of green goods and services, key policies to consider are identifying the potential for green specialisation and fostering green technology research and development (R&D) and innovation.

iv. When the priority is an increase in the value of urban land, a key policy to consider is urban redevelopment, including infill development and eco-districts.

Governing green growth

Governing the green city involves multiple levels of government and various stakeholders. Urban policy makers interested in pursuing green growth can improve co-ordination through:

- a combination of enforcement and incentives to ensure compliance when objectives diverge;
- inter-municipal co-operation to manage urban services (such as water or waste management) in a more environmentally and economically coherent way;
- working together across policy sectors – for example, in integrating environmental and economic development policies;
- developing measuring and monitoring tools that cross administrative boundaries, and a body to collect and disseminate cross-sector data at the micro-scale; and
- building local capacity to foster green growth.

Funding green growth

A major challenge to pursuing green growth in cities is raising the revenues required. Many urban revenue sources can be designed to either stimulate or discourage green growth in cities. For example, well-designed property taxes and development fees can tackle urban sprawl and raise money for funding green infrastructure. In addition, private financing can be attracted to fill the funding gap for many urban green infrastructure projects through:

- real estate developer charges and fees, to pay for the infrastructure needed to connect new development to existing infrastructure;
- value capture taxes, aimed at seizing part of the value increases of real estate due to new nearby infrastructure development; and
- public-private partnerships (PPPs), whereby the long-term risk is transferred to the private sector;
- loans, bonds and carbon finance, to attract private finance.

The national framework for greening growth in cities

Cities do not act in isolation from upper echelons of government. National governments can enhance cities' capacity to act on green growth in the following ways:

- providing financial and technical support, clear targets, and monitoring mechanisms;
- setting price signals and standards (for example, through carbon taxes or other pricing mechanisms);
- reviewing national policies' impact on local incentives, to identify and remove perverse incentives; and
- encouraging infrastructure investment in line with sustainable development and green goals.

National policies should be guided by three key principles:

i. Policy coherence across levels of government. The greener the national framework, the easier it will be to address city-specific challenges and to ensure coherence and consistency between national and local policies.

ii. A holistic approach. Efforts to foster urban green growth may not always be equitable. These concerns should be addressed through national regulations, particularly the tax and benefit system, rather than trying to ensure that each individual policy measure fulfils both environmental and equity objectives.

iii. Sophisticated policy instruments within a simple package. An overly complex system of regulations, incentives, and taxes makes impact assessment harder and raises the risk of unintended interaction effects or perverse incentives.

Chapter 1

What is green growth in cities?

Chapter 1 starts by defining urban green growth. It provides an overview of the main drivers of urban growth and the urban activities that can reduce impact on the environment. It presents four main policy instruments that urban policy makers can use to foster green growth and discusses the factors that may affect their policy choices and scope of action, including national policies. Finally, six policy scenarios illustrate the potential impact of green growth policies on the economy.

The importance of fostering greener growth in cities is all the more apparent in light of the rapid growth of cities that is expected to occur over the coming decades. Today, for the first time in human history, over half of the world's population now lives in urban areas. By the end of the century, this share is projected to rise to around 85% of a world population expected to stabilise at around 10 billion. That implies an additional five billion new urban dwellers in the years ahead. By mid-century, the world's urban population is projected to be slightly above the entire world population in 2000.

The concept of green growth has attracted much interest from governments at all levels as a potential means of stimulating growth and responding to environmental challenges. Urban policy makers are seeing green growth as an opportunity to create jobs and attract firms and investment, while improving local environmental quality and addressing global environmental challenges, particularly climate change. This interest has led to a call for more information on the policies which can actually bring about green growth in cities. However, a clear definition of urban green growth and how to measure progress towards it is lacking. This chapter proposes a definition of urban green growth and its key elements. This is followed by a discussion of scenarios under which green growth might take place and conditions that could affect its prospects for success in different urban areas. Annex A presents a preliminary set of indicators that may be used to track progress towards urban green growth.

Fostering urban economic growth and development by reducing urban environmental impact

Responding to a call from its member countries, in 2011 the OECD developed a green growth strategy, *Towards Green Growth* (OECD, 2011). This defines green growth as "fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. To do this, it must catalyse investment and innovation which will underpin sustained growth and give rise to new economic opportunities" (OECD, 2011). A city-specific definition of green growth is needed to take into account two key aspects of OECD urban areas:

i. The need for new sources of urban growth. Given the negative impacts of urban agglomeration and cities' urgent need to reduce their energy consumption and greenhouse gas emissions, urban areas have the opportunity to develop environmental policies that can foster new sources of economic growth.

ii. Policy complementarities are more identifiable at the local level. Coherent policy packages can help mitigate the trade-offs among environmental, growth and equity priorities: a properly designed policy package would address the costs of reducing environmental impact in a co-ordinated way and have less impact on the most vulnerable people. It is easier on a local scale to identify environmental and economic policies that are complementary, as activities related to environmental protection and economic development are more integrated than at the national level. Urban policy complementarities are further discussed in the section "Cities' outsize role in national growth and environmental degradation" in Chapter 2.

Taking these two considerations into account, this report proposes a definition of urban green growth that more clearly identifies activities to reduce environmental impact as potential sources of growth, and more explicitly refers to the need to internalise negative environmental externalities:

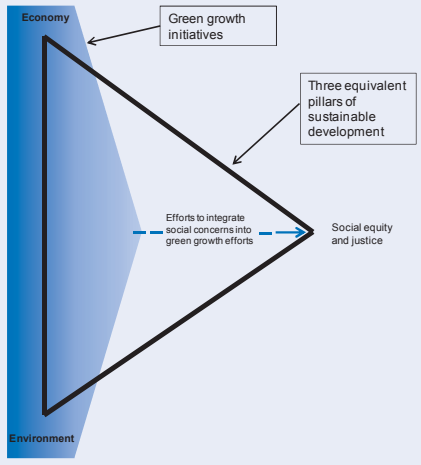
Fostering economic growth and development through urban activities that reduce negative environmental externalities and the impact on natural resources and environmental services.

This definition emphasises that green growth in cities is above all about economic growth and development. What is "green" about this growth is how it is stimulated: through urban activities (including policies and programmes) that reduce either: *i*) negative environmental externalities, such as air pollution and CO_2 emissions; or *ii*) the consumption of natural resources and environmental services, including water, energy and undeveloped land. These effects are in part the result of more readily identifiable interactions at the urban level among economic efficiency and environmental objectives. By focusing on growth, this definition recognises that polices to reduce environmental impact can only be sustained over the long term if they generate wealth (Box 1.1). While the role of innovation is not stated explicitly in the definition, as with the OECD's *Towards Green Growth* definition we see innovation as an important mechanism for fostering growth and development through activities that reduce environmental impact.

Box 1.1. **How does green growth differ from sustainable development?**

Green growth, as its name implies, focuses on two of the three pillars of sustainable development: economic efficiency and environmental protection. It does not directly address the third pillar of sustainable development, social equity. Green growth should thus be understood as a component of sustainable development, rather than a replacement for it. There is evidence, however, that green growth initiatives can provide social equity co-benefits. The figure below illustrates green growth's primarily economic-environmental focus, and the room to nudge policies towards more equitable social outcomes where possible. Nevertheless, the absence of an explicit social component remains one of the most common areas of critique of the green growth concept. Accordingly, some policy makers have explicitly pursued equity objectives alongside economic and environmental goals by focusing on jobs (such as Toronto's green jobs programme; Chicago's Green Jobs for All initiative; UNEP's approach to green, decent jobs).

Green growth as a component of sustainable development



Source: Hammer, S. et al. (2011), "Cities and Green Growth: A Conceptual Framework", *OECD Regional Development Working Papers 2011/08*, OECD Publishing, doi: *10.1787/5kg0tflmzx34-en.*

Which urban activities can reduce environmental impacts?

Urban policy makers can reduce externalities and the impact on natural resources and environmental services (or "reducing environmental impact") through interventions in six urban sectors: *i*) land-use planning; *ii*) transport; *iii*) buildings; *iv*) energy; *v*) waste; and *vi*) water. Table 1.1 presents common examples of activities in each sector that can reduce environmental impact. Adaptation to potential climate impacts is an activity in which cities are increasingly engaging, but this cuts across all sectors rather than being a sector in its own right. It is important to note that when it comes to reducing greenhouse gas emissions, what matters on a global scale is reducing the greenhouse gas intensity of production, but what matters on a national and local scale is reducing the greenhouse gas intensity of consumption. In other words, cities must not only reduce the greenhouse gas emissions produced within their borders, but also the greenhouse gases generated by producing goods and services for the city's residents that are produced beyond the city's borders. While this report outlines activities that can reduce energy consumption, it is beyond its scope to account for how lower energy consumption in one activity might lead to greater energy consumption – or carbon intensity of energy consumption – in another activity.

Table 1.1. **Urban activities that can reduce cities' environmental impact: Some examples**

Sector	Activities
Land-use planning	• Zoning that allows for a mix of land uses so as to reduce travel distances between home, work and other activities • Tax reform to encourage the development of underused lands in urban cores and to discourage urbanisation of undeveloped land in the urban fringe
Transport	• Expanding and/or improving public transport • Physical improvements to encourage walking and cycling • Attaching a price to personal vehicle travel (e.g. congestion charges)
Buildings	• Retrofitting existing building stock to increase energy efficiency • Minimum energy efficiency standards for new buildings
Energy	• Installing distributed renewable energy generation (e.g. solar panels) • District heating and cooling systems • Fees that discourage peak energy use
Waste	• Recycling household and industrial waste • Waste-to-energy and landfill methane-to-energy systems • Fees that discourage waste generation
Water	• Fees that encourage water conservation • Governance mechanisms to improve efficiency of water delivery

How is economic growth and development defined?

In the definition of urban green growth, economic growth and development is primarily as growth in gross domestic product (GDP), but also includes a broader concept of development. From an economic perspective, growth implies wealth creation, as measured by GDP or a similar metric to compare changes in the level of economic vitality in a region over time. However, GDP ignores some of the value in an economy and hides some of the risks and costs of economic activity. For instance, GDP can continue to grow for a time even as the resources upon which it depends are being depleted. In addition, the value of environmental services, natural capital and pollution are not measured as easily as other activities that are more readily valued by markets. To

capture the many other elements of growth and development, the OECD has joined other institutions in a cross-cutting international effort, *Beyond GDP,* to develop indicators that are more inclusive of the environmental and social aspects of progress (Box 1.2).

Box 1.2. **Beyond GDP: OECD contributions to measuring progress**

While GDP remains, for the most part, the dominant financial measure of growth and is treated as a reasonable indicator of material well-being and even as a proxy for quality of life, there are now debates about whether GDP remains a useful approximation of societal well-being.*

For nearly ten years, substantive OECD analysis has been leading international reflection on how to measure the progress of societies. Along with the European Commission, the European Parliament, the Club of Rome and the World Wildlife Fund, the OECD is one of the global leaders in the *Beyond GDP* initiative, which aims to develop indicators that are more inclusive of the environmental and social aspects of progress. In parallel to this cross-cutting, international effort, the OECD has proposed a more comprehensive measure of well-being with its *Better Life Index.* The index covers 11 topics (including housing, income, jobs, community, education, environment, health), each of which includes several indicators.

Note: *See, for instance Stiglitz, Sen and Fitoussi (2009), or Jackson (2009).

Source: *Beyond GDP* website, *www.beyond-gdp.eu*; *OECD Better Life Index* website, *www.oecdbetterlifeindex.org.*

It is also important to distinguish between economic growth and economic development. Carley et al. (2011) suggests that development adds qualitative or value-laden elements to the wholly quantitative metric of growth. It is the deliberateness of the effort to shape the growth in a certain direction that sets economic development efforts apart from the more abstract, and undirected, notion of economic growth. In this narrative, economic development efforts focus on catalysing specific industry sectors or improving other factors that help create a more robust economy, including the overall business climate or quality of life for that region. A similar distinction is made by Chapple (2008), who characterises growth as a change in output, while development is "qualitative, structural change that can help foster innovation and improve productivity."

Economic growth in urban areas is driven chiefly by factors such as human capital, physical capital (e.g. infrastructure) and innovation, as well as by spatial phenomena such as economies of agglomeration and proximity to markets (OECD, 2009; OECD, 2012d):[1]

- Human capital has the greatest influence on regional growth in all types of regions. It can be measured according to the presence of highly-skilled workers and the absence of low-skilled workers. Significantly, much of the evidence suggests that the drag effect on the economy of large concentrations of people with no, or very limited, skills is clearly very important. For many places, therefore, greater attention to the lower-to-middle end of the skills spectrum may pay greater dividends than additional investments in tertiary education.
- Investment in infrastructure can lead to higher growth provided that other key factors, such as improvements in education and innovation, are also in place. However, infrastructure investment does appear to reach a point of diminishing returns and in some of the wealthiest urban areas, the growth impact of additional infrastructure investment can be limited.

- Innovation and knowledge creation tend to matter most in the more advanced urban regions. They are therefore particularly important for metropolitan regions. For these regions, both evidence of investment in knowledge creation (patents and patent citations, R&D spending, etc.) and the presence of relatively high employment shares in knowledge-intensive and high-tech sectors are important.

It is important to note that these are all factors that can be shaped by policy – unlike drivers such as geographical location or natural endowments. These three growth drivers – skills development, infrastructure policies and innovation – are also central to strategies for "greening" urban economies. As will be seen, they are the critical loci of interaction between environmental and growth policies. It is also important to consider the potential impacts of green urban activities on economic growth and development. Chapter 3 focuses on four potential impacts:

i. An increase in jobs.

ii. An increase in the attractiveness of a metro-region.

iii. An increase in the local production of green goods and services.

iv. An increase in the value of urban land.

How might cities foster green growth activities?

Sub-national authority and policy-making powers to stimulate green growth encompass a range of instruments. Although government policy making is sometimes simplistically characterised as a choice between carrots (incentives) and sticks (obligations), the options are actually much more diverse. Meeus and Delarue (2011) note the "tambourine" role that sub-national authorities play when they lead by example, in addition to the powerful influence they have in conceptualising and implementing an action plan. Similarly, the role of the mayoral "bully pulpit", or the ability to exhort consumer and business behavioural changes, is regularly cited as a significant weapon in a mayor's arsenal (Capello et al., 1999; Keirstead and Schulz, 2010; Tang et al., 2011; Energie-Cities, 2006). Support for technology innovation is another important function for sub-national governments seeking to facilitate change within the local energy system (Capello et al., 1999). Sub-national authorities can promote the development of local energy services and energy efficiency equipment markets via their role as the owner/operator of municipal buildings, district heating and public street lighting systems (Rezessy et al., 2006). We identify four main types of policy instruments that can be employed by sub-national authorities:

i. Regulatory authority. Local government may meet environmental objectives through its powers to design, implement or enforce regulation, particularly related to land-use, service provision and master planning. For instance, some cities have implemented expedited permit programmes to streamline the regulatory permitting process for projects that support environmental targets.

ii. Public spending and procurement. A city can align public spending with environmental goals in how it manages investments, subsidies, loans, tax breaks, procurement and public-private partnerships. In some cases, government spending can foster markets for new green goods and services and counter gaps in the supply of finance at the early stages.

iii. Financial tools. Taxes and fees are used by local government as incentives or disincentives to change individuals' behaviour regarding transport, land-use,

housing, waste, water and energy. Property taxes, for example, can be redesigned to encourage more compact development by levying a higher tax rate on single-family homes than for multi-family dwellings.

iv. Information and convening. Consumer education programmes, eco-standards and eco-labelling and best-practice demonstration sites can help raise public awareness, change consumption habits and increase market penetration for green goods and services.

These levers can be applied internally (i.e. towards internal government operations, facilities, and staff) or externally (i.e. towards the public, local businesses, or others in a position to take action to help implement the city's goals) (Hammer, 2009). The use of multiple policy levers also allows a local authority to adopt an iterative approach, layering policies one on top of another to make the most of their complementarities for maximum impact. An iterative approach might also prove helpful to local authorities hesitant to fully commit the city to one approach where they have little knowledge or experience. Some sub-national authorities prefer to start with an educational or technical assistance initiative before they move towards a regulatory strategy, believing it makes the most sense to promote voluntary actions before establishing some type of requirement.

Conditions and scenarios for green growth in cities

The transition to green growth is likely to play out differently in different urban areas, depending on national context and baseline conditions. National policies will play a critical role in determining the extent to which urban policy makers are able to foster growth while implementing policies that reduce environmental impact. Existing political and environmental conditions within urban areas themselves will also shape how and to what extent green growth develops. It is also important to consider both the scenarios in which urban activities to reduce environmental impact might contribute to growth, and those scenarios in which they might have no effect or a negative effect on growth.

What national policies are needed to foster urban green growth?

National government policies can support or undermine urban green growth initiatives. It is important to identify and remove perverse incentives so as to encourage urban policies that are in line with national goals. Three broad principles need to be borne in mind when pursuing green growth in cities:

i. Policy coherence across levels of government is critical. The greener the national framework, the easier it will be to address city-specific challenges and to ensure coherence and consistency between national and local policies. At times, national initiatives may make the need for local action unnecessary; in other cases, they may create new opportunities for cities to act. If co-ordination is poor, national and local initiatives can undermine each other.

ii. A holistic approach is necessary. Efforts to foster urban green growth may have undesirable, inequitable distributional consequences. These concerns should be addressed through national regulations, particularly the tax and benefit system, rather than trying to ensure that each individual policy measure fulfils both environmental and equity objectives.

iii. Policy instruments should be sophisticated but the package should be simple. The design of specific instruments will in many cases need to be quite sophisticated in order to avoid creating perverse incentives. For example, policies to increase the efficiency of urban travel, such as congestion charges (discussed in the section "City revenues: Getting the financial incentives right for green growth" in Chapter 4), will probably be more effective if they vary according to vehicle type, peak hours, etc. Nevertheless, it is important to keep the overall policy package as simple as possible. An overly complex system of regulations, incentives, and taxes makes impact assessment harder and raises the risk of unintended interaction effects or perverse incentives.

The need for policy coherence, in turn, implies a need to understand the distinct contributions to green growth policies that different levels of government can make. The national framework is particularly important for setting the pricing signals to discourage environmental externalities, such as greenhouse gas emissions. So for example, a strong national framework based on a carbon tax or price will broaden the range of environmentally effective options available to cities. If national policy settings are not supportive, some seemingly desirable city-level initiatives may have limited effect or even generate perverse outcomes. With a strong national framework in place, much can often still be done most efficiently at the level of regions or cities. For example, policies to ensure adequate skills in making existing buildings more energy efficient or for encouraging clusters of green industry are probably best designed at city level. Even if there is a national framework in place, there must still be considerable scope for place-specific adaptations, since information about local conditions can be crucial to the effectiveness of such efforts. The same is true of policies dealing with urban form and the built environment: while national or supra-national (e.g. European Union) standards may be needed, much depends on the nature of the existing buildings in a given place, the materials available and the framework for zoning and land use. These are all more efficiently addressed at the urban level. One cannot design all-encompassing, effective solutions from the capital. National governments and cities must therefore work together.

What factors affect cities' green growth policy priorities and scope for action?

A range of baseline conditions can shape a city's policy priorities and its capacity to act in a given sector. These include the city's natural resources asset base; existing technology, which may lock it into a certain growth path (Unruh, 2000; Unruh 2002); and local economic conditions with may constrain certain policy choices, etc. These variables include, broadly, physical and demographic characteristics, level of economic development, and type government, industrial mix, and energy sources (Table 1.2). These factors will determine which policies cities choose to meet their environmental goals, as well as the likelihood of achieving strong growth. Although all regions can enjoy growth (OECD, 2009), and the logic of pursuing greening initiatives at the city level is clear, there are nonetheless some limitations to the concept of green growth that policy makers at both the national and regional/city level must keep in mind as they move forward. Furthermore, the pace of growth presents both challenges and opportunities for green growth, particularly in rapidly growing urban areas, such as in Asia (Box 1.3). Whether these factors impede or accelerate green growth will depend on how well local officials assess their greening needs and opportunities and structure an implementation strategy that leverages the support and involvement of other key stakeholders.

Table 1.2. **Factors affecting cities' green growth policy priorities and scope of action**

Physical setting and demographic composition	
Size	The scale of urbanisation varies widely among small, medium, large and mega-cities, with direct implications for policy making. Even when challenges may be shared across cities of different size (congestion, insufficient quantity or quality of housing supply, high unemployment levels, deteriorating natural resources), the magnitude of these challenges – and the policy responses that must be envisaged as a result – are distinct. In the case of congestion, a small city may respond with a more efficient bus network, while a mega-city will require a large-scale overhaul to the entire transportation network.
Density	Densely populated cities may experience higher levels of congestion, compared to less-dense cities. Even so, dense areas may also be able to take advantage from a wider range of public transit options (metro, tram) that would not be sufficiently cost-effective in less-dense areas.
Climate and geographic conditions	Coastal cities facing flood risks due to potential sea level rise and extreme weather events may prioritise climate adaptation strategies over mitigation measures. Compared to cities that experience temperature extremes, cities with a temperate climate might be less apt to invest in district heating and cooling because the costs and benefits are less straightforward.
Technology/infrastructure	Past investment in technology and infrastructure can lock a city onto a path from which it can be difficult to deviate. These sunk investments may appear to offer cost advantages that make alternative technologies seem overly expensive.
Demographic composition	Policy makers in ageing cities, for instance, will need to focus on providing an appropriate housing market, transportation system and health care system for an increasingly elderly population. At the same time, policy makers face the added challenge of a shrinking labour market.
State of economic development	
Level of development	Some cities in well-developed countries may be in a position to focus on quality-of-life measures (increasing parks and open space, tackling congestion, improving the performance of public service provision), while cities in less-developed countries may first need to address basic provision of services (waste and water management, decent housing). In addition, these countries tend to make use of considerably different financing mechanisms to fund green growth strategies.
Poverty rates/level of inequality	The level of inequality in a city may shift policy priorities towards measures targeting greater social balance.
Pace of growth	The scale and speed of urbanisation – and its related challenges (migration, insufficient quantity or quality of housing supply, congestion, social inequity) – may require fast-growing cities to react more quickly, and with larger-scale investments, than cities experiencing less rapid growth. On the other extreme, shrinking cities would approach policy making with markedly different objectives.
Energy mix and industrial profile	
Industrial profile	Cities home to heavy industry may prioritise measures to mitigate pollution or reduce energy consumption in the industrial sector. By contrast, service-based cities may focus on strategies to increase the quality of life.
Energy sources	A city's sources of energy can be either an asset (as is the case of the Paris region's significant geothermal reserves) or a handicap (fossil-fuel-dependent regions) in the transition to a greener, clean-energy economy.
Form of government	
Federal *versus* centralised	A city's capacity to act is shaped to a large extent by its level of autonomy and fiscal capacity to design and implement policy.

Hammer, S. et al. (2011), "Cities and Green Growth: A Conceptual Framework", *OECD Regional Development Working Papers 2011/08*, OECD Publishing, doi: *10.1787/5kg0tflmzx34-en*.

Box 1.3. **Green growth in rapidly growing Asian cities**

The importance of fostering greener growth in cities is all the more urgent in regions experiencing rapid urban growth. While urban population growth is set to continue within the OECD, as population concentration within countries increases and rural populations fall, most of this growth is projected to occur in non-OECD economies, chiefly in Asia. The choices made by governments seeking to manage this explosive urbanisation will have large and lasting consequences for the environment.

This dramatic urban growth presents both challenges and opportunities. Local environmental challenges must be tackled on an unprecedented scale, particularly those concerned with water supply and waste disposal, as well as air pollution. At the same time, choices made about urban form and infrastructure will have great implications for addressing climate change. Yet there will clearly be opportunities too. Better environmental policies may be good for urban growth, as they enhance cities' attractiveness. Moreover, the creation of entirely new conurbations will open up opportunities to build from scratch green infrastructure, housing and transport systems, making it economically attractive to make green choices that would be prohibitively costly in established cities. For example, at today's prices and with today's technology for natural gas-powered vehicles, it might well be cost-effective to design and build new cities that use neither coal nor oil-based fuels, generating substantial environmental, health and productivity benefits (Romer, 2012). For existing cities, this would be an extremely expensive and politically difficult undertaking.

The findings presented in this report and in the companion case studies point to many promising initiatives. However, there is no denying that most cities outside the OECD differ in important – and very relevant – respects from most OECD cities. First, they are growing much faster. Secondly, they tend to be poorer and less well endowed with human capital. Thirdly, they are far more industrial than most OECD urban areas. Finally, they are more dynamic demographically, with consequences for housing and service provision. The OECD, with initial support by the government of Japan, is undertaking work on green growth in fast-growing Asian cities. This offers an opportunity to see to what extent OECD best practice can "travel" to such very different contexts and also to identify policies and approaches in dynamic Asia that may profitably inform urban policy making in the OECD.

Source: Matsumoto, T., P. Cheshire, T. Kidokoro (forthcoming), "Green Growth in Fast-Growing Asian Cities: Opportunities and Challenges", *OECD Regional Development Working Papers*, OECD Publishing.

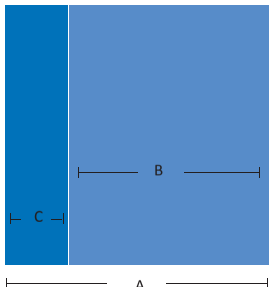
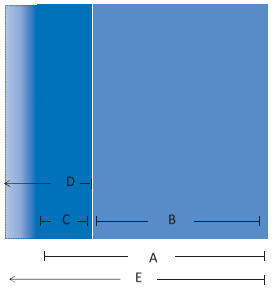
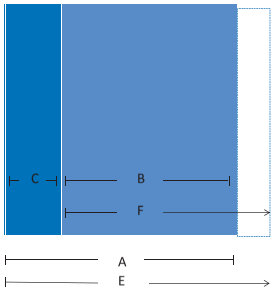
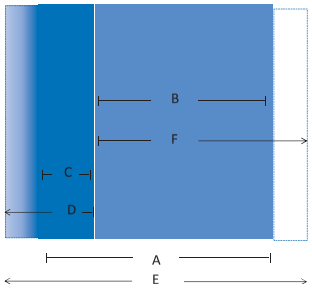
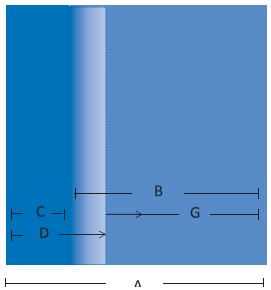
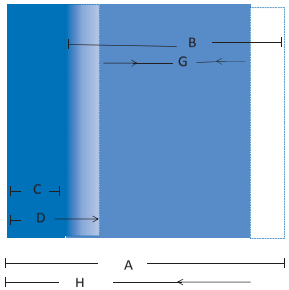
Six scenarios for understanding the potential economic impact of green growth policies

Pursuing green growth in an urban context requires first agreeing on desirable scenarios. Six scenarios presented in Table 1.3 explore the potential economic impacts of different green policy packages. Although it is important to understand the extent to which growth occurs in sectors specifically aimed at promoting environmental protection or resource-conservation services or technology, these sectors generally represent a relatively small subset of the larger service and manufacturing economy in a metropolitan region. What is important, therefore, is the extent to which green growth initiatives contribute to overall economic expansion in a city region, with that growth attributable either to green sector growth (Scenario 3), economic greening (Scenario 4), or multi-sector growth (Scenario 5). In each of these cases, the level of economic activity triggered by a greening strategy is sufficient to grow the entire regional economy by some amount. Scenario 1 envisages no growth occurring, while Scenario 2 indicates displacement of

growth from one sector to another. Although these scenarios are not optimal, they could be seen as desirable when compared to a no-growth or negative-growth scenario. Scenario 6 displays a situation where environmental policies are so onerous that they actually result in shrinkage of the region's economy with business closures and job losses.

Among the proposed green growth scenarios identified in Table 1.3, Scenarios 2 and 6 reflect one of policy makers' biggest concerns: that there are likely to be winners and losers as cities begin to work towards green growth. Some urban economies may grow a great deal, others will grow less, and some might potentially shrink if the process is managed poorly. In a similar vein, some business sectors may thrive, while others may see little change in economic activity level. A city heavily dependent on businesses likely to decline as a result of competition from green businesses could face considerable negative economic impacts. While national governments will be primarily concerned about the net impacts across all regions in their country, this potential zero-sum game – whereby negative impacts in some cities offset gains in others – warrants attention from national policy makers.

Table 1.3. **Six green growth scenarios**

No impact on growth		Positive growth			Negative growth
Scenario 1: No impact	Scenario 2: Sectoral displacement	Scenario 3: Green sector growth	Scenario 4: Economic greening	Scenario 5: Multi-sector growth	Scenario 6: Economic stagnation/de-growth
					
Green policies have no impact on economic growth. The total economy (A) remains constant in size, since the traditional (B) and green (C) sectors neither expand nor contract. This scenario could be the result of ineffective policies on both the environmental and economic front, or of policies that may have delivered desirable environmental outcomes without any demonstrable economic impact (e.g. a tree planting programme).	Overall economic activity in the metropolitan region remains constant (A), but growth in one sector displaces economic activity in another. Growth in the green sector (from C to D) could be offset by losses in the traditional economy (from B to G). For instance, policies to promote renewable energy technology may result in the shrinkage of economic activity in other energy sectors, such as fossil fuel extraction.	Green policies expand the total level of economic activity (from A to E). The green sector expands (C to D), while the metropolitan region's traditional economy (B) does not change. For example the metropolitan region might import and deploy large quantities of renewable power technology, and then export the power to other areas. Although job growth would occur in the renewable sector, other local economic impacts would be minimal.	Economic greening results from an environmental policy that increases the overall metropolitan regional economy (from A to E) due to an expansion of the traditional economy (from B to F). The green sector (C) neither expands nor contracts. For example, the introduction of congestion pricing in New York City was projected to deliver significant efficiency gains in the local retail, banking and service sectors, with little impact on green sectors.	Multi-sector growth, considered the ideal outcome for most policy makers, occurs when green policies result in expansion of both the green sector (from C to D) and the traditional sectors (from B to F), increasing the output of the overall economy (from A to E).	Economic stagnation, or negative growth, occurs when green policies lead to a contraction of the metropolitan regional economy (from A to H). Although some growth in the green sector may occur (from C to D), this expansion is outpaced by losses in the traditional economy (from B to G). An example would excessively onerous green policies that overburden local businesses, forcing them to leave the area or cease operations altogether.

Source: Hammer, S. et al. (2011), "Cities and Green Growth: A Conceptual Framework", *OECD Regional Development Working Papers 2011/08*, OECD Publishing, doi: *10.1787/5kg0tflmzx34-en*.

Note

1. The term "economies of agglomeration" is used to describe the benefits that firms obtain when locating near each other.

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Chapter 2

Why are cities important to national green growth strategies?

Chapter 2 provides evidence for the important role cities play in both national growth and environmental performance. While cities can generate the positive effects of agglomeration economies, such as higher income and productivity levels, they are also vulnerable to negative agglomeration effects such as congestion, pollution and pressure on natural assets. This chapter underlines the strong link between cities' environmental performance and urban form and demonstrates how cities can lower the abatement costs of national environmental policy targets, notably through transportation and land-use policies. This points to the key challenge of greening urban infrastructure, within the context of lagging global investment in infrastructure.

Both national and local governments have begun to pursue green growth, but their efforts have often occurred independently of one another. This chapter makes the case that national governments would benefit from incorporating urban policies into their national green growth strategies. First, cities tend to play disproportionately large roles in both national economic and national environmental performance. Second, modelling has demonstrated that urban policies can lower national environmental policies' long-term costs to the economy. Third, cities are responsible for a significant share of infrastructure investments, and the nature of these investments can either undermine or contribute to national efforts to combine growth with environmental performance.

Cities' outsize role in national growth and environmental degradation

What role do cities play in national growth?

Cities are critical drivers of national growth. Urban areas in the OECD tend to feature higher income and productivity than rural areas (Table 2.1). Just 2% of OECD regions, mainly the largest OECD urban areas, generate roughly one-third of all growth in the OECD (Figure 2.1) (OECD, 2011). The pooled labour market offered by urban areas makes it easier for firms to find workers with the right skills. This – along with the presence of large numbers of suppliers and buyers – attracts firms to urban areas. Higher wages due to higher productivity in turn attract more workers, setting in motion a self-reinforcing process driven by these "agglomeration effects". As centres of innovation, cities play a disproportionate role in knowledge generation, which will clearly play a critical role in strategies to address climate change and resource scarcity.

Table 2.1. **Productivity of OECD urban *versus* rural regions**

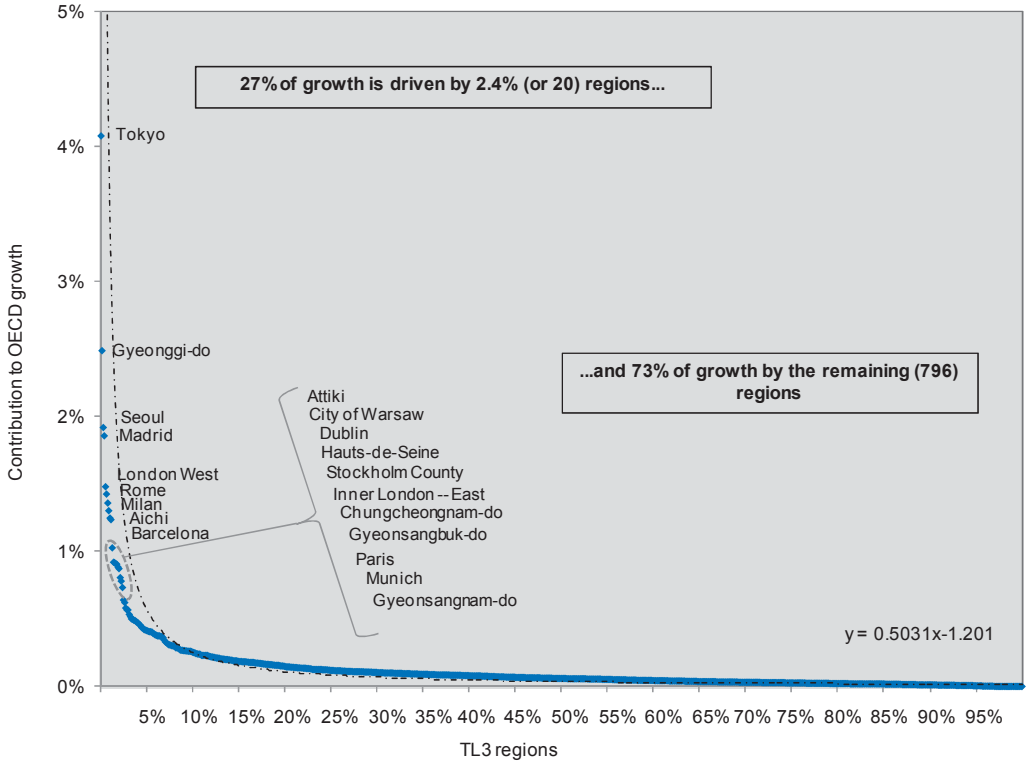
	Average			Median		
	Predominantly urban	Rural close to a major city	Remote rural	Predominantly urban	Rural close to a major city	Remote rural
Population/km^2	1175.0	52.5	21.7	488.8	45.2	9.7
Unemployment rate (%)	8.2	8.5	8.8	7.5	8.2	8.5
Employment rate (%)	66.5	66.1	70.0	66.7	66.2	70.0
Participation rate (%)	73.5	73.3	76.0	74.2	74.5	76.0
GDP *per capita*	30 576	19 719	23 076	29 640	21 267	23 129
GDP per worker	73 055	53 864	55 460	70 826	55 472	58 073

Note: Participation and unemployment data are for 2009; GDP and employment for 2008 and population density for 2010. GDP is measured in PPP constant USD.

Source: OECD Regional Database, http://stats.oecd.org/Index.aspx?datasetcode=REG_DEMO_TL3.

Figure 2.1. **How cities contribute to OECD growth, 1995-2007**

OECD TL3 regions



Note: The OECD uses two definitions of regions: *i*) a higher level (Territorial level 2 or TL2) that consists of 362 larger regions; and *ii*) a lower level (Territorial level 3 or TL3) that is composed of 1 794 smaller regions. All the territorial units are defined within national borders and in most of the cases correspond to administrative regions. Regions at the lower level (TL3) are contained within the higher level (TL2). There are no GDP data for TL3 regions in Australia, Canada, Mexico, Switzerland and the United States.

Source: OECD Regional Database, *http://stats.oecd.org/Index.aspx?datasetcode=REG_DEMO_TL3*.

The benefits associated with agglomeration economies are not, however, unlimited. Negative externalities – congestion, air and water pollution, and the loss of ecosystems on which the city depends –can, in some cases, reach a point where they undermine the competitiveness of a metropolitan area (OECD, 2006). These negative attributes are not internalised by firms and households and may only show up as direct costs in the long term. They include high transportation costs (e.g. congested streets) and loss of productivity due to long commuting times, higher health costs and environmental degradation. Negative externalities are also associated with historical decisions about how the city should grow.

What role do cities play in national environmental performance?

Compared to their population size, cities have disproportionately high energy consumption. They account for an estimated 67% of global energy use and 71% of global energy-related carbon dioxide (CO_2) emissions (IEA, 2010). Nevertheless, they hold the potential for decoupling GDP from carbon dioxide emissions, in other words maintaining or increasing GDP growth while reducing their carbon emissions. For example, the 40 large-city members of the C40 Climate Leadership Group (OECD and non-OECD cities) alone represent 4% of the world population but generate 18% of global GDP and 10% of global carbon emissions (C40 & ARUP, 2011). Estimates of urban CO_2 emissions *per capita* vary greatly throughout the OECD, with the highest emissions recorded in US metropolitan regions and the lowest in Mexican metropolitan regions (Figure 2.2). In addition, the geographical concentration of people and economic activity often causes a range of other environmental pressures, including air and water pollution, as well as the accumulation and (often inappropriate) disposal of household and industrial waste. For instance, OECD projections suggest that without new policies, by 2050 the health impacts of urban air pollution will continue to worsen to become the top environmental cause of premature death worldwide (OECD, 2012a).

Cities are also particularly vulnerable to climate change impacts. A 50cm sea-level rise combined with projected business-as-usual socio-economic growth could triple by 2070 the population exposed to coastal flooding and trigger a ten-fold increase in the value of assets exposed, accounting for 9% of global GDP (Nicholls et al*.,* 2008). Rising temperatures – exacerbated by the urban heat island effect – increase the likelihood of heat waves, spikes in energy demand and power blackouts, threatening both the local economy and public health.

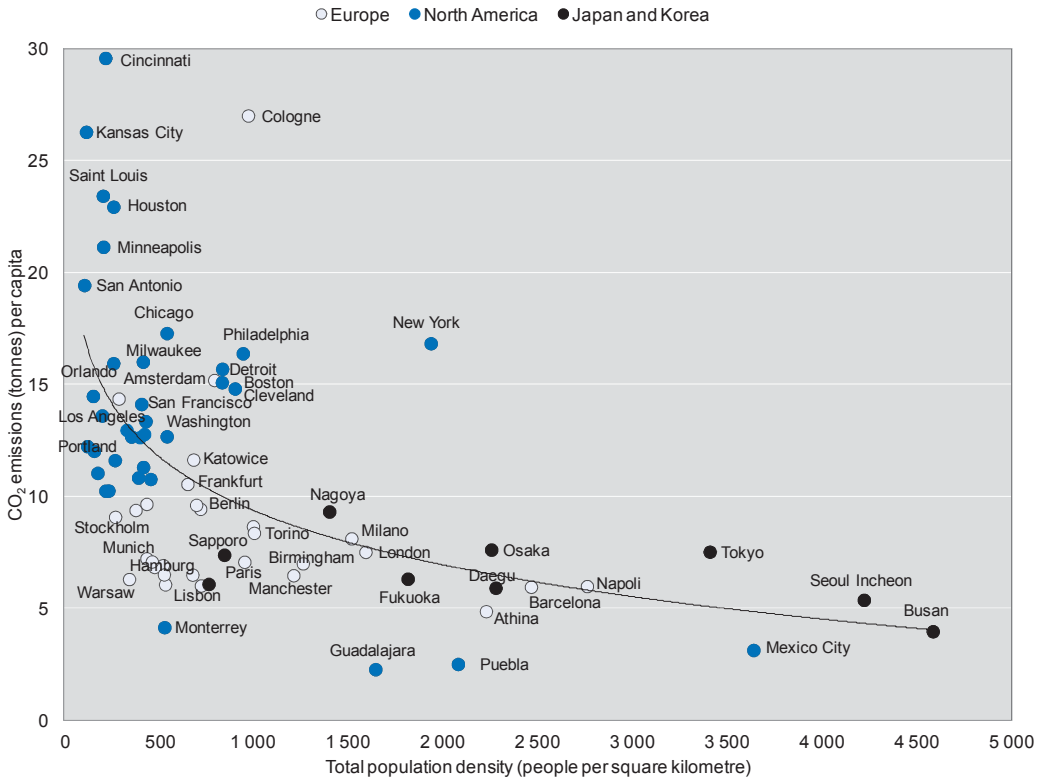
Complementarities and synergies between environmental and economic objectives are at the heart of the concept of green growth; compared to higher levels of government, cities offer more easily identifiable policy synergies and complementarities.[1] Urban policy makers are more likely to identify and combine complementary climate policies within and across sectors given the interconnectedness of urban policy sectors such as transport, land-use planning, and economic development (OECD, 2010). Increasing the complementarity and coherence of policy packages across sectors and levels of government can help mitigate the trade-offs among environmental, growth and equity priorities. For example, congestion, pollution and public service constraints affect not just environmental quality, but also the efficiency of local economic activities and a city's ability to attract firms and skilled workers. Complementary policy packages address the costs of reducing environmental impact in a co-ordinated way and can have less regressive impacts. For example, urban policies that respond to the negative effects of urban agglomeration address both environmental and economic growth priorities.

How does urban form affect national green growth?

Urban form matters to environmental outcomes. The layout of cities is one of several critical factors influencing energy demand and greenhouse gas emission levels. In OECD metropolitan areas, CO_2 emissions from transport are likely to be greater in less densely populated areas than in more densely populated ones. A comparison of the 73 largest OECD metropolitan areas, using the comparable definition of functional metropolitan areas developed by the OECD, reveals an inverse relationship between population density

and *per capita* CO_2 emissions (Figure 2.2).[2] It must be acknowledged that these data include emissions from industry and other non-transport sources, so a metropolitan area's industrial makeup would perhaps have a greater influence on where it fits on this curve. However, the relationship between overall CO_2 emissions and density does point to the global environmental impact of local urban form. American and Canadian cities tend to be characterised by large *per capita* CO_2 emissions and low population density, while European cities with the same densities tend to emit less CO_2 *per capita*. Large metropolitan areas in Japan, Korea and Mexico tend to have lower CO_2 emissions *per capita* and high population density levels. A study of CO_2 emissions from transport that compares cities based on administrative definitions rather than functional urban areas finds a similar relationship between density and CO_2 emissions (Figure 2.3) (Kennedy, 2011).

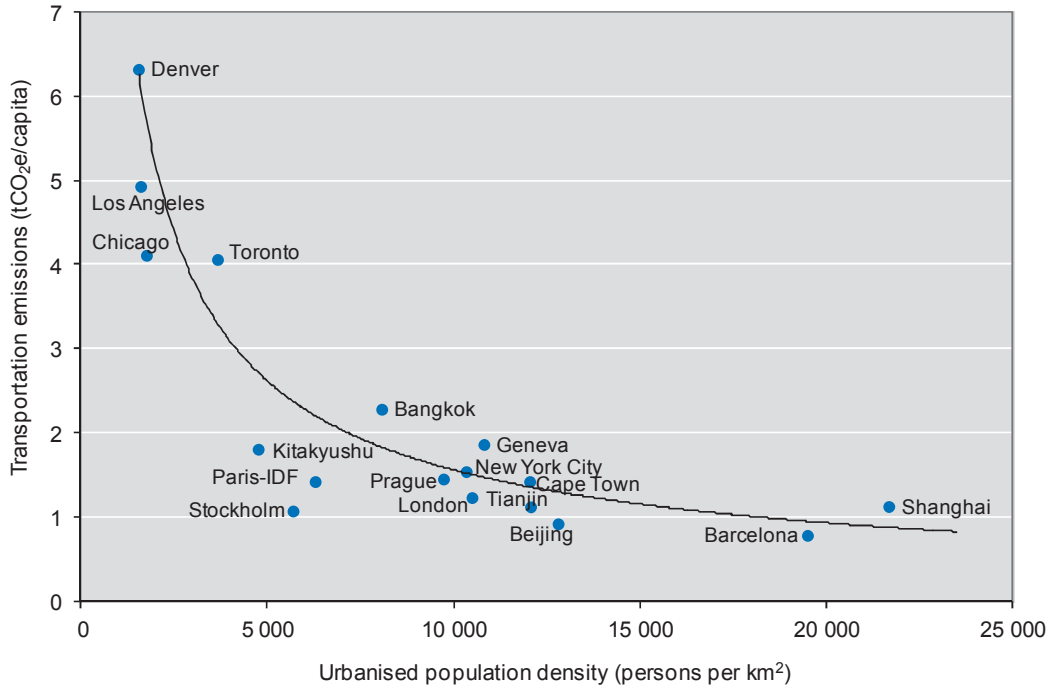
Figure 2.2. **Population density and CO_2 emissions *per capita* in 73 large OECD metropolitan areas, 2006**



Note: Data unavailable for Australia, Chile, Israel and New Zealand.

Source: OECD (2012), *Redefining "Urban": A New Way to Measure Metropolitan Areas*, OECD Publishing, doi: *10.1787/9789264174108-en*.

Figure 2.3. **CO_2 emissions from ground transportation in large metropolises**



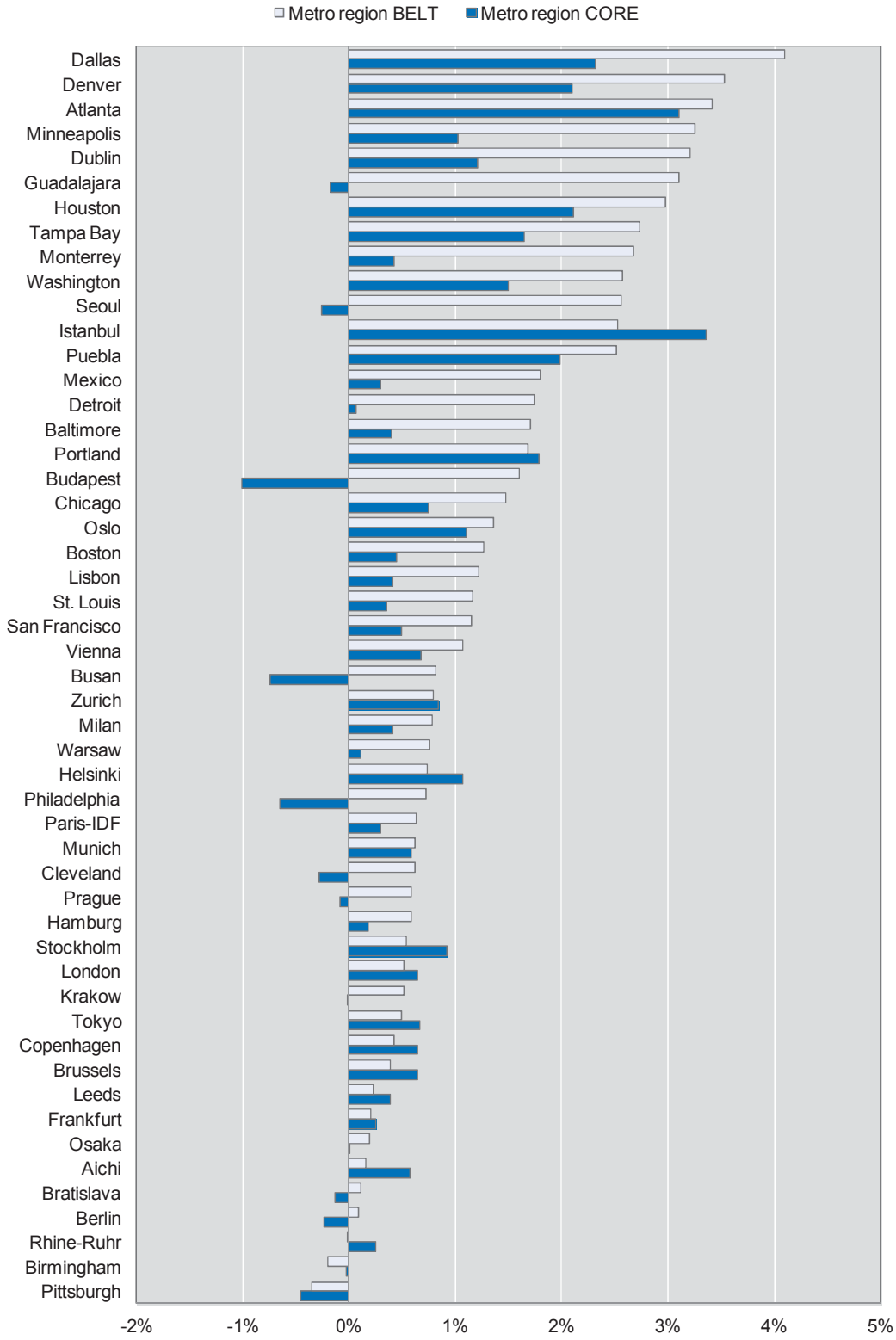
Notes: 1. The density of the urbanised land surface is calculated without including green areas. 2. Analytical units and reference years used for these calculations: Barcelona (city, 2006); Geneva (canton, 2005); London (Greater London, 2003); Paris-IDF (IDF region, 2005); Prague (Greater Prague, 2005); Chicago (Chicago Metropolitan Area, 2005), Denver (city and county, 2005); Los Angeles (county including 88 towns or cities, 2000); New York (city, 2005); Toronto (Greater Toronto, 2005); Bangkok (city, 2005); Beijing (province, 2006); Shanghai (province, 2006); Tianjin (province, 2006), Cape Town (city, 2006); Kitakyushu (city, 2007), Stockholm (city, 2011).

Source: Kennedy, C. (2011), calculations (personal communication) adapted by C. Kennedy, October 2011, using methodology from Kennedy, C. et al. (2009), "Greenhouse Gas Emissions from Global Cities", *Environmental Science and Technology*, Vol. 43, No. 19, American Chemical Society, Washington, US; City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan; City of Stockholm (2012), "OECD Green Cities Stockholm Background Report", internal document, City of Stockholm, Sweden.

In most OECD cities, suburbanisation means that the periphery is growing faster than the core, potentially exacerbating CO_2 emissions (Figure 2.4). While urban expansion is a normal response to a growing population, higher rates of growth on urban peripheries or belts than in urban cores may indicate urban sprawl. Urban sprawl involves uncontrolled expansion of urban development characterised by low density, segregated land use and insufficient infrastructure provision. It can involve leapfrog development, whereby development "leaps" over undeveloped land.

Figure 2.4. **Suburbanisation in OECD metropolitan regions, 1995-2007**

Annual average total population growth rate



Source: OECD Metropolitan Database, http://dotstat.oecd.org/Index.aspx?Datasetcode=CITIES.

How urban policies can lower the costs of meeting national environmental policy targets

Modelling studies using a dynamic computable general equilibrium model, IMACLIM-R, demonstrate that urban policies can reduce the cost of meeting international carbon emissions targets. The model assumes that in a second-best economy characterised by imperfect competition, foresight and labour market flexibility, a high price on carbon will be required between 2010 and 2100 to achieve global targets for reducing carbon emissions. This will decrease GDP compared to a business-as-usual scenario involving no carbon price (Waisman et al., 2012; Figure 2.5). However, the decrease in GDP depends on the speed at which technological change can reduce emissions.

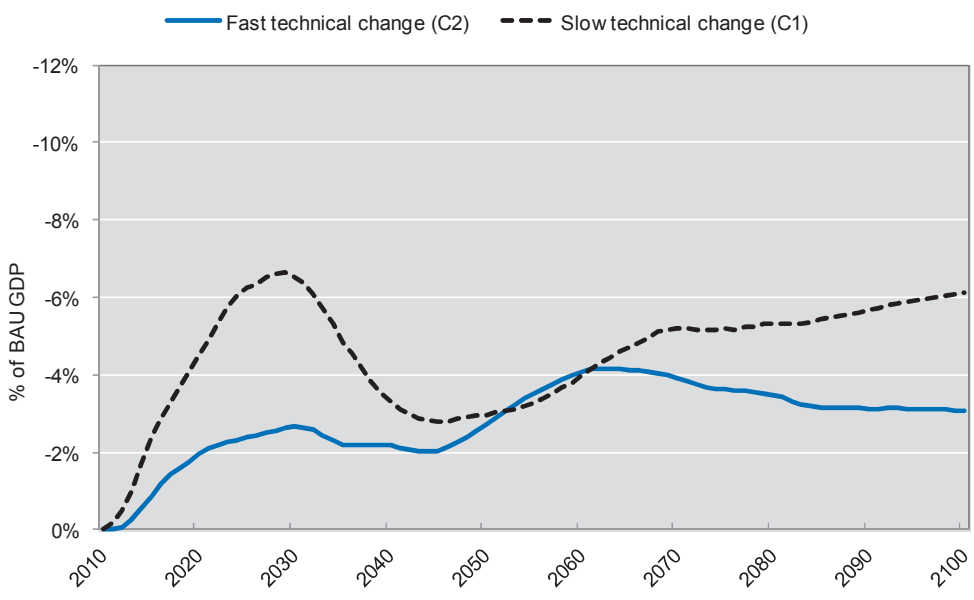
Within this model, policies that have the effect of shifting travel to low-carbon modes and reducing the need for mobility can meet the same global carbon emissions targets with a smaller rise in carbon prices and smaller GDP losses. These policies involve either:

i. investment to favour public transport over private vehicle use;

ii. changes to the built environment that reduce the need for motorised travel; or

iii. changes to production and distribution processes that reduce the need for motorised travel.

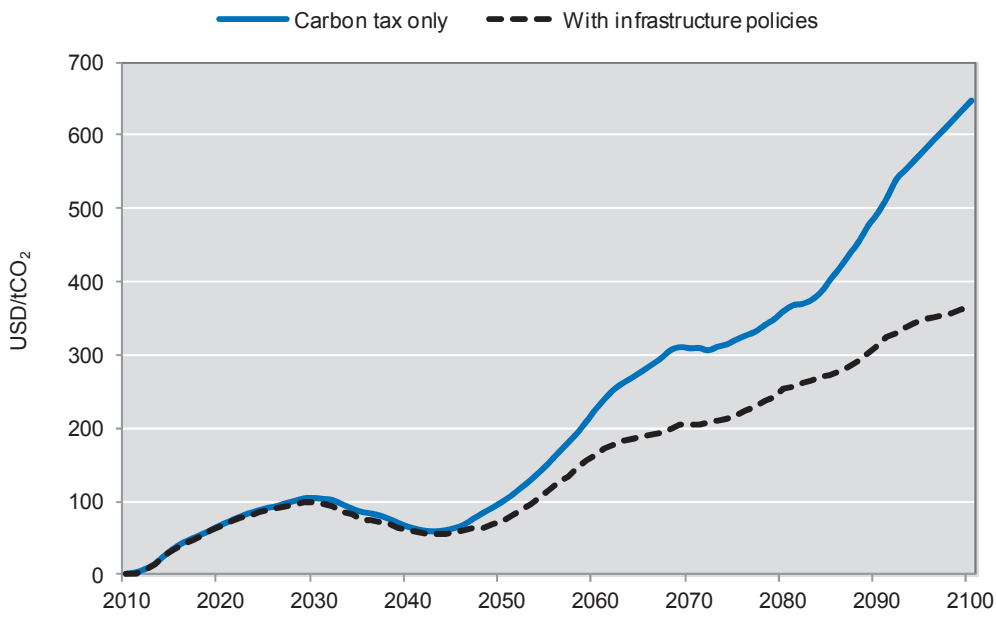
Figure 2.5. **How a high carbon price and the rate of technical change affects GDP, 2010-2100**



Source: Waisman, H., C. Guivarch, F. Grazi and J.C. Hourcade (2012), "The IMACLIM-R Model: Infrastructures, Technical Inertia and the Costs of Low Carbon Futures Under Imperfect Foresight", *Climatic Change*, Vol. 114, No.1, SpringerLink.

The smaller rise in carbon prices and the benefits to GDP under the scenario involving these transportation polices (the "complementary infrastructure policy scenario"), compared to the "carbon price only scenario" are felt over the long term. The required carbon price in the two scenarios does not begin to distinguish itself until roughly 2050 (Figure 2.6). However, a difference in the impact on GDP is already demonstrated as early as 2025 (Figure 2.7) (Waisman et al., 2012).

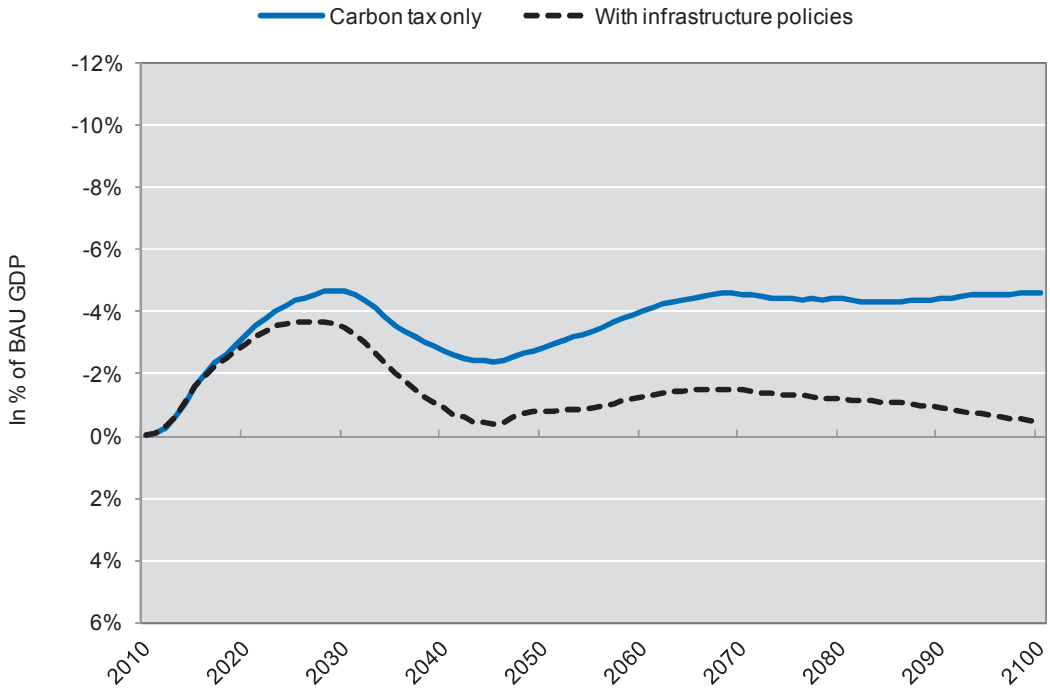
Figure 2.6. **Average carbon price for a "carbon price only" policy scenario or for a complementary infrastructure policy scenario**



Source: Waisman, H., C. Guivarch, F. Grazi and J.C. Hourcade (2012), "The IMACLIM-R Model: Infrastructures, Technical Inertia and the Costs of Low Carbon Futures Under Imperfect Foresight", *Climatic Change*, Vol. 114, No.1, SpringerLink.

The impact in the model of shifting travel to low-carbon modes and reducing the need for mobility points to an important role for urban areas. The first two policy interventions listed above involve increasing investment in public transport or changing the built environment. Both of these activities take place primarily in cities. Investment in public transport is in large part under the authority of municipal governments (see the section "Cities are key spenders on infrastructure relevant to green growth" below). Changing the built environment can involve policies to reduce urban sprawl, increase urban density and encourage infill development. Cities typically take the lead on these policies. These findings complement other research that shows that two other urban policies – increasing the density of a city and applying and congestion charges to vehicle travel– can reduce the abatement costs of national climate policies (OECD, 2010).

Figure 2.7. **Impact on GDP of a "carbon price only" policy scenario and a complementary infrastructure policy scenario**



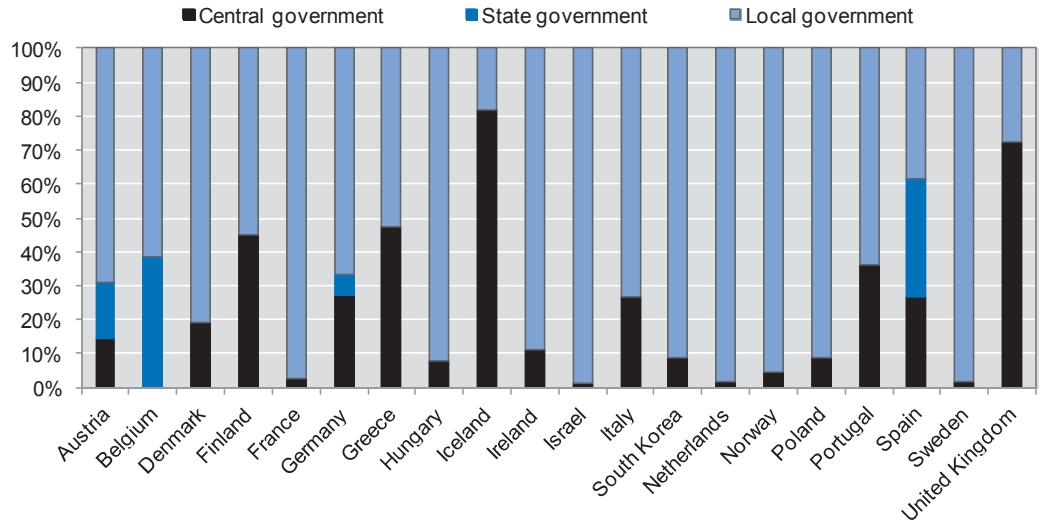
Source: Waisman, H., C. Guivarch, F. Grazi and J.C. Hourcade (2012), "The IMACLIM-R Model: Infrastructures, Technical Inertia and the Costs of Low Carbon Futures Under Imperfect Foresight", *Climatic Change*, Vol. 114, No.1, SpringerLink.

Cities are key spenders on infrastructure relevant to green growth

What share of green infrastructure spending is carried out by local governments?

Sub-national governments are historically responsible for two-thirds of public investment across the OECD. While in some European OECD countries (e.g. France, the Netherlands, Norway and Sweden), capital expenditure on environmental protection (rather than green growth more broadly) is incurred almost entirely by local government, in other countries (e.g. the United Kingdom and Iceland), local government spending represents less than one-third of total government expenditures in this sector (Figure 2.8). In decentralised countries such as Spain or Belgium regional government expenditures on environmental protection accounts for nearly one-third of total environmental expenditure. On average among European OECD countries, capital expenditure on environmental protection by local government represents 75% of all government environmental expenditure. Local governments spend an average about 8% of their capital budget on environmental protection. In 2009, capital expenditure on environmental protection represented, on average, 7.6% of total local government gross capital formation, with large disparities among countries – ranging from below 2% (e.g. Iceland, Denmark and Sweden) to almost 15% (e.g. Hungary and Greece) (Figure 2.9). However, this is generally not the main target of local governments' spending; gross capital formation by local government in OECD countries is mainly channelled to economic affairs, education, housing and general public services.

Figure 2.8. **Gross capital formation in environmental protection by level of government, 2009**

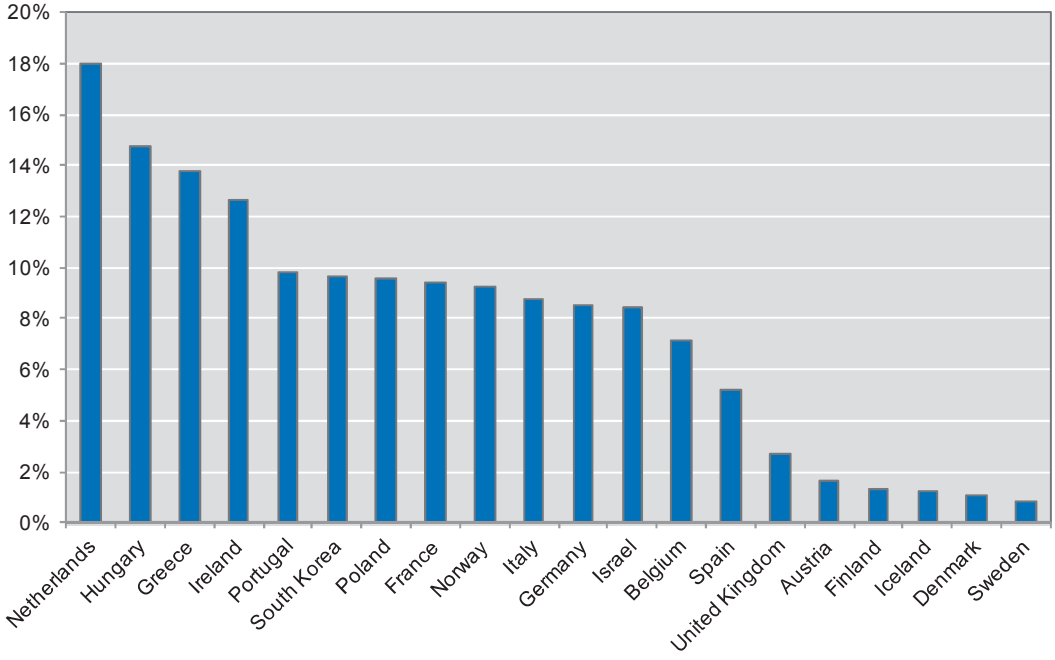


Notes: The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Source: OECD, *National Accounts Database*, 2009.

Figure 2.9. **The share of environmental protection in local government spending, 2009**

Percentage of total local government gross capital formation

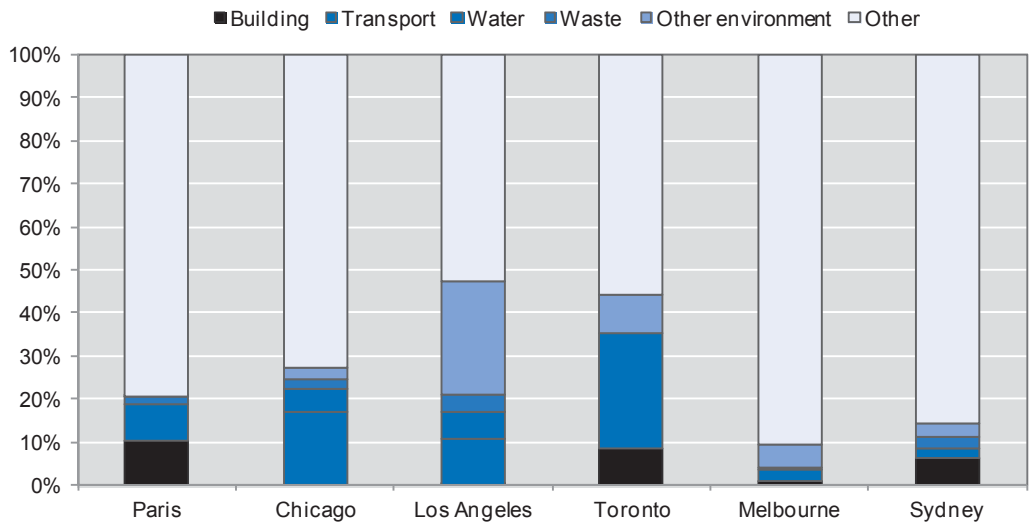


Notes: The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Source: OECD, *National Accounts Database*, 2009.

Beyond specific spending on environmental protection, urban spending in sectors with green potential (transport, building, water, waste and other environmental services) represents between 10% and 45% of total urban expenditures (Figure 2.10). This means that cities have relatively large scope to green these sectors further. The share is particularly high in Canadian cities like Toronto, where these sectors represent 44% of total city current and capital expenditures, mainly due to large shares in transport spending. These expenditures can stimulate green growth through creating employment opportunities: in the short term in construction and in the medium and long term in maintenance or transport. The building sector can also represent important opportunities for green growth through construction jobs, and new markets for green building products, etc. Green growth projects in the building sector can also promote equity by improving housing conditions for low-income households. Green spaces, parks management, environmental services, streets and sanitation, power and environmental protection – grouped together as "other environment" (Figure 2.10) – can also present green growth opportunities.

Figure 2.10. **How some major cities apportion their budgets, 2010**



Source: Merk, O., S. Saussier, C. Staropoli, E. Slack, J-H. Kim, (2012), "Financing Green Urban Infrastructure", *OECD Regional Development Working Papers 2012/10*, OECD Publishing, doi: *10.1787/5k92p0c6j6r0-en*.

What are the additional green urban infrastructure investment needs?

Investment in green urban infrastructure is currently challenged by global fiscal constraints. Resources are scarce, and public authorities at all levels must do more with less. This decrease in public investment flows hits sub-national governments especially hard. Some fiscal stimulus packages (e.g. in the US and South Korea) have incorporated urban green growth initiatives, providing more room for public investment in the short term. Since 2010, however, most OECD countries have attempted to curb public debt by reducing public expenditure. As a result, many cities around the world have been faced with local budget cuts due to reduced intergovernmental transfers and lower tax bases.

At the same time, global infrastructure needs are huge. According to OECD research (2007), sufficiently improving the world's infrastructure will require an estimated USD 35-40 trillion by 2030 – i.e. USD 2 trillion a year, or 2.5% of global GDP. Major sectors that need increased investment include transportation (needs estimated at 11 USD trillion), telecoms, electricity and water (needs estimated at USD 16 trillion) (OECD, 2007; OECD, 2012c). Consistent with these projections, the International Energy Agency estimates that, in the energy sector alone, meeting global population growth, especially for emerging economies (Brazil, Russia, China, India, Indonesia and South Africa), will require an average investment of USD 48 billion a year until 2030 (IEA, 2011).

Greening urban systems is expensive and requires shifting investments. Preliminary estimates of C40 (Cities Climate Leadership Group) city greenhouse gas emissions suggest that the total capital costs of public and private infrastructure investments required to mitigate the group's current emissions (i.e. without factoring in population growth), would be approximately USD 3 trillion (Hoornweg et al., 2011). These investments may take several years to realise. Individual calculations per city confirm the extent of these costs: London has estimated that meeting the Mayor's target to reduce carbon dioxide emissions by 60% by 2025 will cost about GBP 40 billion (roughly USD 64 billion); and the Mayor's existing climate change mitigation programme is projected to cost about GBP 14 billion by 2025 (KPMG, 2011). Table 2.2 summarises the capital costs of some urban green projects, giving a sense of the types of costs involved in greening cities.

Table 2.2. **Capital costs of selected green projects in OECD cities**

Project	City	Capital costs (USD million)	Annual greenhouse gas savings ($ktCO_2e$)
Transportation			
Bus rapid transit	Vancouver	39.2	1.8
Congestion charging	London	244	120
Bike sharing	Paris	132	18
Buildings			
Solar air heating	Montreal	2	1.3
Energy			
Solar centre receiver station	Seville	41	110
Urban wind power	Toronto	1.2	0.4
Solid waste			
Source-separation and methane production	Sydney	75	0.4
Incineration-based combined heat and power (CHP) plant	Gothenburg	453	205
Water/wastewater			
Biogas from sewage	Stockholm	15	14

Note: $ktCO_2e$ is thousand tonnes of CO_2 equivalent.

Source: Kennedy, C. et al. (2010), "Getting to Carbon Neutral: A Review of Best Practices in Infrastructure Strategy", in Bose, B. K. (ed.), *Energy Efficient Cities: Assessment Tools and Benchmarking Practices,* World Bank, Washington, DC.

Funding climate change adaptation in cities will require significant investment as well. Global climate change adaptation costs vary, but one estimate puts them at between USD 49 billion and 171 billion a year until 2030 (UNFCCC, 2007); cities will need to bear a large share of this cost. On the other hand, without these measures, damage caused by climate change-related disasters, especially to infrastructure, is likely to increase costs for cities.

Notes

1. A policy complementarity signals a benefit in the form of the return generated when one policy is enacted along with another (De Macedo and Oliveira Martins, 2006).
2. The OECD definition of metropolitan areas is applied to 29 OECD countries and 1 148 functional urban areas are identified. The methodology identifies urban areas as "functional economic units", thus overcoming previous limitations linked to administrative definitions and increasing the possibility of cross-country comparison. The methodology consists of three main steps: the first step identifies contiguous or highly interconnected densely inhabited urban cores. The second step identifies interconnected urban cores that are part of the same functional areas, and the third step defines the commuting shed or hinterland of the functional urban area.

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Chapter 3

What are the high-priority green growth policies for cities?

The OECD has conducted four green city case studies (Paris, Chicago, Stockholm and Kitakyushu). These consider the potential impacts of urban green growth policies on i) *jobs;* ii) *urban attractiveness;* iii) *local production of green goods and services; and* iv) *the value of urban land. While the small number of case studies and limited data are not sufficient to provide extensive evidence of the impact of urban green growth activities on the above goals, the case studies do offer preliminary insights into the types of policies that are most likely to contribute to each goal in urban sectors such as land use, transportation, the built environment, energy and waste. The chapter highlights examples of these policies and strategies to overcome obstacles in implementation.*

The concept of green growth has been promoted as a way for cities to increase their sustainability and their economic performance. Urban policy makers at national and local levels are eager to understand which urban activities to reduce environmental impact can actually contribute to economic growth and development. The call to better define specific policies for green growth in cities led the OECD to conduct case studies in four metropolitan areas: the Paris/Ile-de-France region, the Chicago Tri-State metro-region, the City of Kitakyushu, Japan, and the City and County of Stockholm, Sweden. In each of these metropolitan areas we review policies in each of the sectors listed in Chapter 1 – land-use planning, transport, buildings, energy, waste and water – and attempt to assess the opportunities for urban green growth policies to contribute to one or more of the following four outcomes:

i. an increase in jobs

ii. an increase in the attractiveness of the metro-region

iii. an increase in the local production of green goods and services

iv. an increase in the value of urban land

When urban activities to reduce environmental impact appeared to contribute – or have the potential to contribute – to one of these increases, we took this as evidence of policy complementarities at the urban level between environmental and economic policies. While such complementarities are often created through policy packages designed and implemented in cities, they may also arise among policies adopted at different levels of government. This could be the case, for example, when a national climate change framework stimulates urban efforts to foster green technology clusters, or when support for energy-efficiency retrofits for low-income households helps mitigate the regressive impact of higher energy prices. It is important to make the most of policy complementarities, as doing so can increase the chances that green growth policy packages will mitigate the trade-offs between environmental, growth and equity priorities.

The number of case studies is too small to allow us to demonstrate a link between green urban activities and economic growth and development. However, the experiences of these four urban areas – along with examples from other cities– do provide preliminary insights into the types of policies that are most likely to contribute to each of the above impacts. The rest of this chapter is organised around these impacts and the green urban policies that may best support them.

Green growth policies for job creation

A key reason many governments have pursued green growth is to stimulate job creation. In the wake of the 2008 financial collapse and economic downturn, saving and creating jobs has been an important component of the green elements of national stimulus packages (Pollitt, 2011). Many policy makers saw in the crisis an opportunity to accelerate the transition to greener growth. In this report, we define green jobs as activities that produce goods and services that reduce negative environmental externalities and the impact on natural resources and environmental services. While the OECD has not endorsed an official green jobs definition, this definition is close to earlier approaches taken by the OECD, Eurostat, and the US Bureau of Labour Statistics, which use green industries and products as the starting point for defining green jobs. Based on such an industry or output approach, around 2% of European employment and 2.4% of

US employment can be considered to be green (European Commission, 2009; BLS, 2012; OECD, 2012c). However, broader definitions result in a much larger share of green jobs (Box 3.1).

Box 3.1. **Defining green jobs**

In 1999, the OECD and Eurostat offered a definition of green jobs as "activities which produce goods and services to measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems." (OECD/Statistical Office of the European Communities, Luxembourg, 1999). Building on this definition, Eurostat estimated 2% of employment in the European Union to be in green jobs (European Commission, 2009). Similar approaches, such as that used by the US Bureau of Labour Statistics, count jobs in businesses that produce green goods and services and estimate the number of green jobs based on the sales share of green goods and services in those industries (BLS, 2012). Based on this *output* approach, 2.4% of US employment was estimated to be green in 2010 (BLS, 2012; OECD, 2012c).

Other green job definitions are broader, such as the definition proposed jointly by the United Nations Environment Programme, International Labor Organisation, International Organisation of Employers and the International Trade Union Confederation in 2008. This defines green jobs as "work in agricultural, manufacturing, research and development (R&D), administrative, and service activities that contribute substantially to preserving or restoring environmental quality. Specifically, but not exclusively, this includes jobs that help to protect ecosystems and biodiversity; reduce energy, materials, and water consumption through high-efficiency strategies; de-carbonise the economy; and minimize or altogether avoid generation of all forms of waste and pollution" UNEP/ILO/IOE/ITUC, 2008). Based on this definition, about 25% of jobs in Europe could be estimated to be green (OECD, 2012c).

Increasingly, governments are developing their own green jobs definition, oriented around existing definitions from international institutions, and from the work of the US Bureau of Labour Statistics. An OECD survey on green jobs found that out of the 27 countries that responded, 10 had adopted a green jobs definition, 5 were developing a definition, 12 had not decided on defining or counting green jobs, and 9 estimated numbers of green jobs based on recently adopted or experimental definitions (OECD, 2012c and 2012e).

Source: OECD/Statistical Office of the European Communities, Luxembourg (1999), The Environmental Goods and Services Industry: Manual for Data Collection and Analysis, OECD Publishing, doi: *10.1787/9789264173651-en*; BLS (Bureau of Labor Statistics, US Department of Labor) (2012), "Employment in Green Goods and Services – 2010", news release, USDL-12-0495, 22 March 2012, BLS website, *www.bls.gov/news.release/pdf/ggqcew.pdf*; UNEP/ILO/IOE/ITUC (2008), *Green Jobs: Towards a Decent Work in a Sustainable, Low-Carbon World*, UNEP/ILO/IOE/ITUC, Geneva; OECD (2012), *OECD Employment Outlook 2012*, OECD Publishing, doi: *10.1787/empl_outlook-2012-en*; OECD (2012), "Summary of Country Responses to the OECD Questionnaire on Green Jobs", supporting material for Chapter 4 of OECD (2012), *OECD Employment Outlook 2012*, OECD Publishing, doi: *10.1787/empl_outlook-2012-en*; European Commission (2009), *Employment in Europe 2009*, European Commission, Brussels.

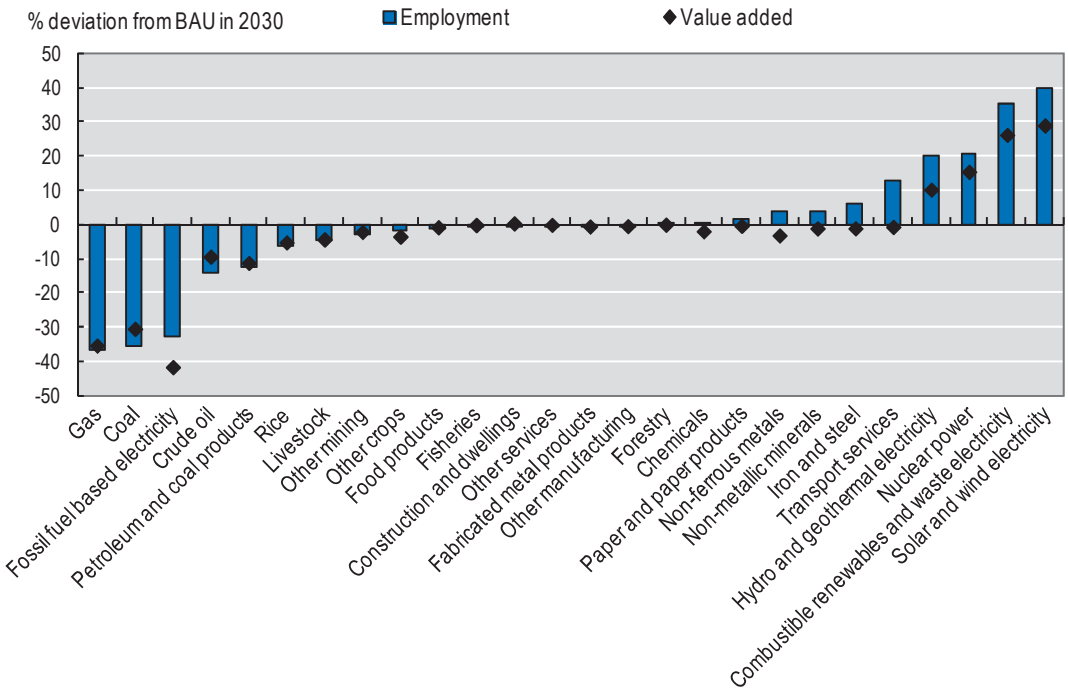
Is there evidence that policies to reduce pressure on the environmental can result in net job growth?

While definitions of "green jobs" can be useful for some purposes, what ultimately matters is not the number of "green jobs" created under this or that definition, but rather the aggregate employment impact of greening the economy. Over the long run, green growth policies should have no net impact on aggregate employment, but they are likely to trigger significant job reallocation among different sectors. The OECD's ENV-linkages

model[1] predicts that climate change mitigation policies will have no net long-term impact on aggregate employment levels when compared to a business-as-usual scenario, at least where labour markets are flexible and functioning well. They can have a negative impact on employment where labour markets are characterised by important rigidities. In addition, the model predicts significant reallocation of jobs among sectors. Policy-induced job losses are expected to be highest in carbon-intensive sectors, whereas job gains are expected to occur mostly in low-carbon sectors (Figure 3.1) (OECD, 2012c). However, the model results suggest that the scale of reallocation will be modest in aggregate when compared with the underlying rates of job reallocation observed in OECD economies in recent decades. These two results point to the importance of labour-market policies in any green growth package – flexibility in the labour market and effective, adaptable skills policies will smooth the transition to a low-carbon economy. For cities, the most relevant sectors are construction and dwellings, transport services, and combustible renewables and waste electricity. Under this policy scenario, by 2030, small job losses are predicted for construction and dwellings (-0.58%), while jobs would be created in transport services (+13.03%) as well as in combustible renewables and waste electricity (+35.48%), compared to business as usual. The strong employment growth estimated for low carbon-emitting energies (+29%) is unlikely to have major impacts on urban labour markets, since these are for the most part space-intensive and therefore primarily rural activities.

Figure 3.1. **Modelled impact of a greenhouse gas reduction policy on employment in the OECD, 2030**

Policy-induced labour reallocation



Note: Simulated impacts of greenhouse gas mitigation policy are shown as deviations from the baseline scenario that assumes no new mitigation policy measures are implemented and takes no account of how the resulting environmental damage would affect economic activity and well-being.

Source: OECD (2012), *OECD Employment Outlook 2012*, OECD Publishing, doi: *10.1787/empl_outlook-2012-en*.

Why have urban policy makers interested in green job creation focused on building energy-efficiency retrofits?

Many cities have been attracted to energy efficiency retrofits in existing buildings (referred to here as "retrofits") for their potential to generate jobs, contribute to energy conservation and reduce vulnerability to higher fossil fuel prices:

i. Retrofit investments can create jobs for a range of skill levels. According to estimations, every EUR 1 million retrofit investment can create on average 11 jobs, many of which are local (Arene, 2007; City of Toronto, 2011). These include low to medium skilled jobs that are accessible to a large range of workers, including unemployed manufacturing and construction workers (Schrock, 2009; Schrock and Sundquist, 2009).

ii. Energy savings gained through retrofits can finance the investments without upfront costs: This is the case when the retrofit is done by energy service companies (ESCOs – discussed further below) as this can allow building owners to improve building energy efficiency without upfront investment or special loans. ESCOs absorb upfront investments and offer average annual energy savings of 26%, which allow for payback periods of 8-12 years (NYC, 2011). If a price on carbon were to be introduced, retrofits could be an important way of lessening the impact of higher energy prices on poorer households.

Changes in the labour market due to green growth policies may result in temporary higher unemployment, because the skills of the existing workforce might not immediately match the skill demand of new companies and activities (OECD, 2012c). This potential challenge is less pronounced in the area of buildings retrofits, where many jobs can be done by regular construction workers, and new skills can be upgraded relatively easily. Low-skilled retrofit jobs can offer opportunities to conventional construction workers or employees from other-carbon intensive sectors that are expected to experience the largest job losses (Figure 3.1). This makes building retrofits a suitable activity to focus on in the early phase of a transition towards green growth. In Chicago, for instance, it has been found that most tasks in single-family residential retrofits involve the installation of insulation and window replacement. Insulation jobs are relatively low-skilled, while window replacement jobs involve semi-skilled carpentry experience, most of which can be acquired on the job. Higher skills are needed for retrofits of multi-family residences or large commercial buildings with more sophisticated heating, ventilation, air conditioning and electrical systems. However, in Chicago, these buildings represent a much smaller share of buildings to be retrofitted than single-family residential houses (Schrock, 2009; Schrock and Sundquist, 2009).

Retrofits can reduce urban CO_2 emissions if they are accompanied by falling energy demand. The extent of those benefits will depend, among other things, on the local climate and the CO_2 intensity of the city's energy supply. In its BLUE Map scenario, the International Energy Agency (IEA) estimates that energy consumption in the buildings sector must be reduced by around one-third of the baseline scenario level by 2050 given that there will be an increase in the global number of households of 67%, and in service sector floor area of 195% over that time. It further estimates

that the residential sector needs to account for 63% of all energy savings (IEA, 2010; IEA, 2011).

However desirable it may be on other grounds, enhanced energy efficiency is unlikely to contribute much to emissions reduction if it is not accompanied by a high carbon price. The broader national framework is thus critical. This is because increasing energy efficiency will, all other things being equal, increase real incomes: it will cost less (in terms of expenditure on energy) to achieve the same level of consumption or production. In addition, firms who increase energy efficiency faster than their rivals will gain in terms of competitiveness. What matters from a climate change perspective is how that additional income is spent. Some of it may be spent directly on increased energy consumption, because higher incomes and better fuel efficiency may allow people to drive larger vehicles or keep their homes warmer in winter. This temptation is likely to be particularly great for firms, since they use energy as an intermediate input rather than a final consumption good: increased energy efficiency increases the potential return on a unit of energy consumed and thus increases the incentive to consume. Alternatively, consumers may spend more of the energy saved on other goods and services, which may be equally or even more energy and CO_2-intensive. To these direct income and substitution effects must be added the possibility that faster growth, fuelled by greater energy efficiency, may lead to higher fuel consumption and thus higher emissions.[2]

These are more than merely theoretical considerations. The energy efficiency of the developed economies has been rising for over a century and yet fossil fuel consumption and emissions have continued to climb. The energy intensity of GDP has fallen particularly rapidly since the oil-price shocks of the 1970s, but the income and substitution effects outlined above, as well as the effects of aggregate growth, have meant that the declining carbon intensity of consumption has not checked the growth of emissions. Moreover, one cannot take declining carbon intensity for granted: if, for example, rising incomes in developing countries pass a threshold relative to energy prices, demand for energy-intensive goods like air conditioning might take off, increasing energy intensity. Much depends on the composition of final demand.

On their own, then, energy efficiency measures must therefore be seen as – at best – a very imperfect substitute for demand reduction. They may even, in isolation, have the perverse effect of leading to increased fuel consumption and emissions (Burniaux et al., 1995). Nevertheless, they are an indispensable element of any serious green growth strategy, since they can play a critical role in softening the impact of higher fuel prices (resulting from a carbon tax or some other price-based mechanism) on production and consumption. Moreover, programmes to help low-income households improve energy efficiency can also help mitigate the distributional consequences of many demand-reduction policies, as these can sometimes hit the poorest hardest. In short, energy efficiency measures are a necessary but not sufficient element of a policy to address climate change.

How can urban policy makers enable building energy-efficiency retrofits?

A number of cities have focused first on retrofitting government-owned buildings. This is often easiest to finance and allows local governments to lead by example. For instance, in the mid-1990s the City of Berlin (Germany) established energy saving partnerships to retrofit public sector buildings. These were managed by the Berlin Energy Agency and implemented in co-operation with energy service companies. A large part of the city's own buildings have been renovated through this mechanism, and some of them are currently going through a second phase of improved retrofitting (Box 3.2). In 2011, Chicago announced plans to retrofit up to 100 public buildings. It is estimated that these will generate 375 new jobs (of unknown duration) and lead to USD 4-5.7 million annual savings for the city (Public Building Commission of Chicago, 2011). The City of Toronto (Canada) has initiated a large-scale tower renewal programme, which targets a large number of concrete frame apartment towers built between 1945 and 1985. The retrofits are expected to create several thousand person-years of employment and are expected to result in a 50% energy cost reduction, 20% water efficiency improvements, and over 30% of waste diversion rate improvements (City of Toronto, 2011). Stockholm is retrofitting energy inefficient buildings constructed in the 1960s andm1970s as part of the Swedish "Million Homes" programme. The energy consumption of such buildings in the Stockholm Järva district is aimed to be reduced by 50%, which allows a payback period of 15 years (Enarsson, 2012, cited in OECD, 2013c).

While the retrofitting of government-owned buildings can model good practices, the impact of these retrofits is limited, as the vast majority of building stock in OECD cities is privately owned. Increasing the number of private buildings that undergo energy-efficiency retrofits is crucial for raising the energy efficiency of the overall building stock. Urban policy makers tend to play an enabling role in private-sector retrofits rather than directly subsidising them. Energy performance contracts and energy service companies (ESCOs) have become the key mechanism for implementing energy efficiency retrofits in privately-owned buildings, although mainly for commercial and institutional energy retrofits, and less for residential retrofitting. An energy performance contract is concluded between a building owner and an ESCO, which allows building owners to improve building energy efficiency without upfront investment or special loans. ESCOs guarantee that the financial gains from energy savings are sufficient to repay the retrofit, with pay-back periods typically ranging from 10-15 years (Hammer et al., 2011). Policy makers can facilitate the use of ESCOs for privately owned building retrofits by pooling potential customers and connecting them to companies that meet certain performance standards. The City of Berlin overcame this problem by partnering with the Berlin Energy Agency and investment banks that provide loans for retrofits by residential property owners and tenants (Box 3.2). In Germany, a well-functioning ESCO market has developed due in large part to four factors: *i*) political and legal commitments to achieve national energy efficiency objectives; *ii*) third-party financing, in particular through the public investment bank *Kreditanstalt für Wiederaufbau* (KfW); *iii*) firms and public-private partnerships (PPPs) offering a range of energy services, from project development to implementing energy performance contracts; and *iv*) rising energy prices which made energy performance contracts more attractive (BEA, 2008). This final factor deserves to be highlighted, as the market for ESCOs would likely not need support from public policy if a carbon price were in place.

Box 3.2. **Energy efficiency retrofits in Berlin**

A significant number of Berlin's public and private buildings have been retrofitted with the help of low-interest credit and energy service companies. In 1994 Berlin's Senate set CO_2 emission reduction goals of 25% by 2010 and 40% by 2020 (compared to 1990 levels). Since 1995, the *Berliner Energie Agentur* (BEA) has co-ordinated energy saving partnerships between the City of Berlin, utility companies, and the public investment bank *Kreditanstalt für Wiederaufbau* (KfW). Focusing on large public buildings, the BEA prepares public tendering and implements energy performance contracts (EPCs). By 2011, the BEA had engaged 1 400 public buildings in energy saving partnerships, which account for annual savings of EUR 2.9 million in energy for the City of Berlin and 67 900 tons of CO_2 emission reductions (City of Berlin, 2011; BEA, 2011). New programmes – EPC *plus,* EPC *light*, and EPC *green* – are currently being introduced to expand and optimise early retrofits and to tackle buildings with suboptimal conditions for energy savings.

Private building owners, tenants and housing corporations can access KfW loans via the energy efficiency retrofit programme (*Energie-Effizienz Sanierung*), as well as from local banks, such as the *Investionsbank Berlin*. Rent increases of up to 11% annually help landlords to refinance loans. The higher rents should be compensated through lower energy bills. Since the early 1990s, over EUR 4 billion have been invested in retrofits in Berlin. This has resulted in the renovation of around one-third of the city's residential buildings, including 273 000 prefabricated slab apartments, energy savings of up to 50%, and 631 000 tons of avoided CO_2 emissions every year (City of Berlin, 2011).

Source: BEA (Berliner Energieagentur) (2011), "Energy Saving Partnership, Better Practice Exchange 2011", Berliner Energieagentur, Berlin; City of Berlin (2011), "Climate Protection in Berlin", Senatsverwaltung für Gesundheit, Umwelt und Verbraucherschutz, Berlin.

How can urban policy makers lower barriers to energy-efficiency retrofits?

Flexible financing schemes – including for low-income households – and information provision can help expand energy efficiency retrofits to private owners and tenants. For example, the UK Energy Act of 2011 (the "Green Deal") provides a flexible and inclusive financing mechanism. It enables retrofit financing for private and commercial building owners and tenants, who repay their energy efficiency investments through their energy bill. A "golden rule" guarantees that the payback is never higher than the actual savings realised on the energy bill. In addition, a special energy company obligation makes sure that low-income homes with fewer opportunities for energy savings can equally profit from Green Deal regulations. Financial obligations are attached to the building, even when tenants move or owners sell their house (DOECC, 2012). In another financing mechanism, local governments subsidise low-interest loans to property owners for renewable energy or energy-efficiency investments, which property owners repay over time through slightly higher property taxes. Known in the US as Property Assessed Clean Energy (PACE), and exemplified by the Berkeley FIRST (Financing Initiative for Renewable and Solar Technology) programme, this mechanism eliminates the problem whereby property owners who intend to sell their property have little incentive to invest in efficiency upgrades. It does so by transferring the repayment obligation to the new property owner (OECD, 2012d; OECD, 2010c; Speer, 2010).[3] To overcome barriers related to lack of information on energy performance and efficiency measures in private homes, the City of Paris has developed an online thermographic city map that helps residents visualise the energy efficiency of Paris buildings (City of Paris, 2011). In the

Chicago Tri-State metro region, the Energy Impact Illinois programme addresses both financial and informational barriers to foster private retrofit investments (Box 3.3).

Box 3.3. **Energy Impact Illinois**

Energy Impact Illinois seeks to remove the key institutional barriers preventing more widespread investment in retrofits. It was established in 2010 by the City of Chicago, the Chicago Metropolitan Agency for Planning, and the City of Rockford in recognition of the fragmented and fledgling energy efficiency market in the region, which was facing impediments like multiple and incomplete information sources, inadequate financing products that did not meet market needs, and difficulties connecting trained workers with appropriate jobs. The programme was started with USD 25 million from the US Department of Energy's Better Buildings Neighborhood Program, authorised through the *American Recovery and Reinvestment Act (ARRA)* of 2009. Most of the programme funds (USD 15.75 million) are for improving access to finance across the multi and single family residential and commercial building sectors. This activity is accomplished mostly through revolving loan funds and/or credit enhancements, such as loan loss reserves. These have allowed the programme to secure commitment of USD 128.5 million in private investment from multiple financial institutions nationwide.

An additional USD 6.5 million is dedicated to increasing public access to information, through a broad-based marketing campaign, a web-based information system and on-line building energy tools to help consumers understand their home or building's greatest energy savings potential. Finally, USD 200 000 of grant funds are committed to developing a workforce intermediary to align the workforce with the jobs created through Energy Impact Illinois and other energy efficiency programmes in the region.

Source: OECD (2013), "Cities and Green Growth: The Case of Chicago", *OECD Regional Development Working Papers 2013/06*, OECD Publishing, doi: *10.1787/5k49dv6c5xmv-en*; CMAP (2009), "Energy Impact Illinois – Program Summary", CMAP, Chicago.

What other urban initiatives to reduce environmental impact could contribute to job growth?

Public transport is a potential contributor to urban green job growth. Under a scenario of strong climate change mitigation policies, the OECD ENV-linkages model predicts a 13% increase of jobs in transport services by 2030, which would account for two-thirds of all job creation (Figure 3.1; OECD, 2012c). This is due to the large size of the transport sector. While it is unclear how many of these jobs would be in urban transport services, a recent study by UNEP (2011) highlighted the large number of jobs already existing in the public transportation sector in several cities: 164 043 people are employed in operating Mumbai's public transport system, 78 393 in New York and 24 975 in London. Anecdotal evidence also shows that jobs in green transport, including public transport, have risen over the past decades. For instance, since 1990, employment in green transportation across 21 regions in the state of California increased by roughly 16% to over 36 000 jobs in 2008 (Center for Community Innovation, 2010). In the Chicago Tri-State metro-region, public mass transit jobs represent 26% of all green jobs in the region, as defined by the Brookings Institution (2011). While public transport can be a significant employer in urban areas, it is hard to make the case that the sector should be a priority for urban policy makers interested in increasing green jobs, as public transport investment should be driven by service need rather than job growth targets.

Waste-to-energy and recycling also hold potential for green job creation in cities. The OECD ENV-linkages model predicts that under a scenario of strong climate change mitigation policies, the strongest job growth would be in low-emitting energies, notably in combustible renewables and waste electricity (35%) (Figure 3.1). The cities of Kitakyushu, Paris and Stockholm all have important waste-to-energy production sectors which have created jobs. In 1991, Kitakyushu began building a recycling cluster, Kitakyushu Eco-Town, to revitalise its shrinking industrial base (Box 3.5). Kitakyushu provides Eco-Town with electricity produced from waste incineration. Since its launch, 1 418 jobs have been created in this cluster (OECD, 2013b). Paris Ile-de-France provides 50% of the region with district heating that is partially powered by waste-to-energy and biomass plants (Kamal-Chaoui and Plouin, 2012). The city of Stockholm meets almost 80% of the city's heating requirements with district heating, 8% of which is powered through waste incineration (OECD, 2013c). With respect to recycling, the growing scarcity of rare metals and rising resource prices are causing the recycling sector to gain in importance. Due to the lack of space in cities, other renewable energies such as wind, solar, or hydro, offer fewer urban job opportunities in cities, apart from R&D activities, sales, or headquarter functions.

Policies to consider when the priority is attractiveness

This report defines attractiveness as a city's ability to attract firms and skilled human capital. Attracting firms and high-skilled workers is a high priority for many cities. Different cities attract different types of firms and human capital, depending on factors such as its production system, industrial specialisation, history or geography. In the attempt to explain urban growth and what makes cities attractive to firms and people, some scholars focus mainly on attracting firms and on production factors, infrastructure, institutions, and labour markets (Storper and Schott, 2009; Storper 2010). Other scholars focus mainly on attracting skilled people and factors such as climate, quality of life, taxes, prices, wages, and amenities (Glaeser et al., 2001 and 2005). A variety of city indices evaluate cities' attractiveness and often take into account local infrastructure and public service delivery as key factors in their attractiveness and competitiveness (Clark, 2011; PricewaterhouseCoopers, 2011; Economist Intelligence Unit, 2012). In this report, we focus on two factors that can influence attractiveness: environmental performance, notably carbon emissions; and firms' access to a wide labour pool. Transport policies are important instruments for improving both.

What is the evidence that policies to reduce environmental impact can improve urban attractiveness?

Modelling results suggest that attractiveness is likely to increase with decreasing local carbon emissions. IMACLIM-R, a computable general equilibrium model, simulates the interactions between changes in energy consumption, carbon emissions and economic growth. In this model, urban attractiveness equals expected labour productivity and specifically the capital return investors expect to receive from investments in a given metro-regional market. The model predicts that local CO_2 emissions reductions can lead to increasing attractiveness. The policies simulated in the model to reduce urban energy consumption and CO_2 emissions were urban densification and congestion charges (OECD, 2010a).

Why should policy makers interested in increasing attractiveness focus on transport policies?

Increasing the alternatives to personal vehicle travel can improve both the environmental quality of cities and local workers' access to firms. Urban transport policies affect environmental quality primarily in terms of pollution and CO_2 emissions. In cities where more people commute by public transport, CO_2 emissions *per capita* tend to be lower, whereas in cities where more people commute by car, CO_2 emissions *per capita* tend to be higher (US Census, 2012; *OECD Metropolitan Database*). In US cities road transportation is the second largest contributor to CO_2 emissions, accounting for 29% of all urban CO_2 emissions (OECD, 2010a). Congestion imposes a cost on personal vehicle users, thereby impinging on accessibility. The Texas Transportation Institute found that congestion costs in very large US metropolitan areas ranged from USD 1.5 billion to USD 11 billion in 2010. For example, in 2010, congestion costs for each car commuter in the Chicago metropolitan region were USD 1 568, and total losses due to congestion amounted to USD 2 317 million. Chicago ranked highest among very large US metropolitan areas in terms of congestion costs due to truck delay, which amounted to 2.3 billion in 2010 (Texas Transportation Institute, 2011). Reducing congestion through improving transport system efficiency not only reduces congestion costs, but also contributes to efficiency gains in services that depend on the city's transport system. European data show that people in denser cities, which also tend to have higher shares of commuting by public transport, commute shorter distances and spend less time commuting (Eurostat, 2012).

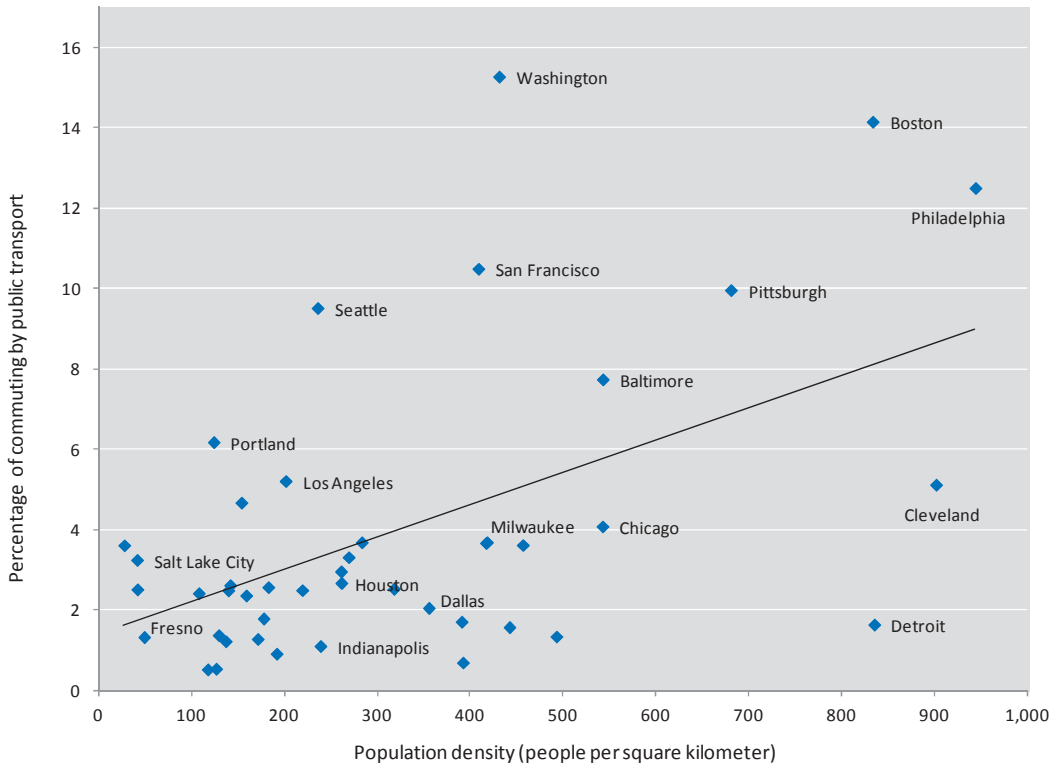
How can urban policy makers increase accessibility through alternatives to personal vehicles?

Accessibility can be improved by implementing congestion charges, and by strategically upgrading public transport services. The introduction of congestion charges has proven to be effective in a number of cities, including Stockholm, London and Singapore (Table 4.2 in Chapter 4). Congestion charges can significantly reduce congestion, as well as transport-related CO_2 emissions and pollution, and may lead to higher shares of trips by public transport or non-motorised forms of travel (OECD, 2013c; Box 3.4). Another way to improve a city's transport system efficiency can be to improve services in areas of high demand. This was done in Mexico City, where the implementation of a Bus Rapid Transit (*Metrobùs*) replaced a large number of inefficient micro-buses (small carriers that operate without fixed stops) and bus lines. For example, the introduction of *Metrobùs* on Avenida Insurgentes, one of the busiest avenues of Mexico City, reduced travel time between the neighbourhoods of Indios Verdes and El Caminero from 2 hours and 40 minutes to 23 minutes, increased average travel speed from 12km/h to 19km/h in the bus lane, and to 17km/h for other traffic. It also led to a 15% reduction in car use on this road, and reduced over 107 257 tonnes of CO_2 equivalent emissions during its first three years of operation (2005-2008) (OECD, 2012b).

Integrating land-use with transport planning is also an important means for improving accessibility through public transport and non-motorised travel. Land-use plans that promote urban infill can optimise the use of existing infrastructure and increase population density to levels needed to sustain an efficient public transport service. This can partly explain the observation that cities with higher population density tend to have a

higher share of population commuting by public transport (Figure 3.2). Land-use plans that specifically encourage a mixture of land uses within the same zone can increase proximity between the places where people live and work. Transit-oriented development can increase access to public transport by concentrating development around public transport infrastructure. Mixed-use and transit-oriented development therefore contributes to a compact urban form and can significantly enhance integrated land-use and transport planning.

Figure 3.2. **Population density and commuting by public transport in US metropolitan areas**



Note: Based on OECD definition of US Metropolitan Areas. This definition is applied to 29 OECD countries and 1 148 functional urban areas are identified. The methodology consists of three main steps: the first step identifies contiguous or highly interconnected densely inhabited urban cores. The second step identifies interconnected urban cores that are part of the same functional areas, and the third step defines the commuting shed or hinterland of the functional urban area. New York City is an outlier (1 934 density, 34.82% public transport) and therefore not featured in this graph. The data for population density is for 2008; the data for commuting by public transport is for 2006-2010.

Source: OECD Metropolitan Database, *http://dotstat.oecd.org/Index.aspx?Datasetcode=CITIES* and US Census (2012), "American Community Survey", US Census website, *www.census.gov/acs/www/*, accessed 25 October 2012.

Box 3.4. **Congestion charges in the City of Stockholm**

The City of Stockholm first implemented a congestion charge in 2006. Since then, traffic to and from the city centre has declined on average by approximately 20%, and queuing times in and around the city centre have decreased by between 30 and 50%. Greenhouse gas emissions have fallen by approximately 10% in the city centre and are stable in the city as a whole, despite a higher population. The system could be further improved to achieve higher air quality, promote more energy efficiency, and counteract the impacts of a growing population. For example, higher-polluting vehicles could be charged higher rates (such as in Singapore and Milan), which more closely ties the congestion charges to greenhouse gas reduction goals.

Some cities, like London, use congestion charge revenue to finance public transport. However, in Stockholm the national government currently decides how to use revenue from congestion charges, as they are considered as a national tax. Discussions are underway to allow the City of Stockholm, in co-operation with the county, to have greater control over the use of these revenues. This would be an important first step in getting public buy-in for an expansion of the congestion charge or implementation of restrictions based on vehicle size.

Source: OECD (2013), "Cities and Green Growth: The Case of Chicago", *OECD Regional Development Working Papers 2013/06*, OECD Publishing, doi: *10.1787/5k49dv6c5xmv-en*.

Policies to consider when the priority is to foster regionally produced green goods and services

The emerging green sector is gaining increasing attention from urban policy makers for its potential to contribute to growth, job creation, and climate change mitigation. This report focuses on the local production of green goods and services, rather than greening existing industries or increasing demand for green products. We define green goods and services as those that reduce negative environmental externalities and the impact on natural resources and environmental services. Many cities have identified green technologies and other activities in the green sector as opportunities for building on existing regional industries to create regional green specialisations.

How can urban policy makers strengthen local production of green goods and services?

Many green goods and services are still produced in fledgling industries and depend on public sector support for innovation. The market for green goods and services is still relatively immature and implies higher commercial risk and capital cost for companies that invest in and innovate green products. Small firms often lack access to finance and information, face challenges in getting products to market, and tend to have more difficulties attracting the necessary skills (OECD, 2011b). In addition, regulatory systems may impose climate change abatement requirements on entrants, and thus slow down innovation (OECD, 2010c). While much of the framework conditions for green growth are shaped by national governments, urban policy makers also play a role in fostering local green industries. Cities and regions can invest in research, provide an efficient knowledge infrastructure, foster the participation of small and medium enterprises (SMEs) in knowledge networks, support skill development, help improve the matching of labour supply and demand, and give targeted incentives, such as facilitating access to finance for innovative companies in the green sector (Hammer et al., 2011; OECD, 2011b). Furthermore, cities and regions can play a crucial role in improving co-operation between universities and local companies to foster joint R&D activities and product commercialisation. Stockholm Kista Science City is a good example of

a publicly-supported innovation hub that links university research with private commercial activities for green innovation (OECD, 2013c).

Box 3.5. **Green growth clusters in Kitakyushu, Paris and Chicago**

The Kitakyushu Eco-Town is an environmental industrial park that focuses on resource circulation and eco-industries. In 1997, the Japanese government recognised it as the first of its kind in Japan. The Eco-Town is situated on 38.6 hectares in the Hibikinada area of the Wakamatsu ward and comprises 29 industrial plants, 16 research facilities and a waste-to-energy plant. Recycling activities range from plastic bottles, automobiles and electronic home appliances, to mixed construction waste, fluorescent tubes and office equipment.

Total investments (private and public) in the Eco-Town amount to JPY 66.8 billion: as of March 2012, 72% were from private sources, 15% from the national government, 10% from the City of Kitakyushu and the rest from other sources, including Fukuoka prefecture. Since its launch in 1991, the Eco-Town has created 1 418 jobs and aims to attract more companies and jobs to the area. In co-operation with businesses, government and academia, research facilities in Kitakyushu focus on practical research areas, in particular on higher value-added recycling activities.

Advancity and Moveo are two major green innovation clusters in Paris Ile-de-France. Advancity constitutes a major cluster for clean technologies and sustainable urban growth, with a focus on urban habitat, mobility and territorial organisation. Around 20 higher education and research institutions representing over 130 laboratories and around 3 000 researchers are members of the cluster. It also brings together nearly 100 organisations, including 11 large companies, nearly 50 SMEs and more than 20 local governments. Advancity has attracted nearly a dozen leading French and international firms in the construction industry, transportation and water management.

The multi-regional cluster Moveo (Haute and Basse Normandie and Ile-de-France) is devoted to sustainable mobility, notably the development of electric or hybrid vehicles. The cluster focuses on research into mechatronics and the recycling of materials for automobiles. The cluster has more than 300 members, including 76 large firms. In its three host regions it conducts 70% of the country's automotive R&D and represents 18% of patents filed in France, according to the National Institute of Intellectual Property (INPI). To date, 216 projects have been registered, representing some EUR 700 million in R&D outlays. It is difficult at this stage to assess the contribution of the Moveo cluster to a "sustainable automobile" industry, which is still very competitive. For example, some investments have been delayed, including construction of a Renault factory designed to produce batteries to power its electric vehicles.

The Milwaukee Water Council in the Chicago Tri-State metro-region advances the interests of more than 150 companies and research institutions located in the greater Milwaukee region, all of whom produce goods, services, or research that relates to water in some way. Formally established in 2009, the Water Council grew out of an analysis launched by officials from the Milwaukee 7, a non-profit economic development organisation focused on the seven-county region around Milwaukee. The Water Council launched a venture fund to provide capital to water technology start-ups and began work on a business incubator. The council has worked with the University of Wisconsin at Milwaukee and the City of Milwaukee to procure land adjacent to the School of Fresh Water Sciences for testing and showcasing cutting-edge water treatment technologies. Twelve percent of firms in the Council work globally to satisfy water supply or treatment needs of cities and regions (White and Lenz, 2009). The economic activity driven by these firms is sizeable, as collectively they employ roughly 20 000 people in the immediate area. Five of the eleven largest water firms in the world have operations in the Milwaukee region, with their local operations doing USD 10.5 billion in business annually, the equivalent of 4% of the total global water market.

Source: OECD (2013), *Green Growth in Kitakyushu, Japan*, OECD Green Growth Studies, OECD Publishing, doi: *10.1787/9789264195134-en*, Kamal-Chaoui, L. and M. Plouin (2012), "Cities and Green Growth: Case Study of the Paris/Ile-de-France Region", *OECD Regional Development Working Papers 2012/02*, OECD Publishing, doi: *10.1787/5k9fd0fg78bs-en*; OECD (2012), *OECD Territorial Reviews: The Chicago Tri-State Metropolitan Area, United States 2012*, OECD Publishing, doi: *10.1787/9789264170315-en.*

Identifying green firms and innovation assets is an important first step for cities to take stock of their green sectors and for designing targeted policies for green industries. A number of OECD cities provide examples of successful approaches (Box 3.5). The City of Kitakyushu's Eco-Town was built with the help of public investments and is home to a specialised recycling cluster and several research institutions. The city-supported Kitakyushu Science and Research Park hosts public and private R&D activities such as in high value-added recycling and supports research commercialisation (OECD, 2013b). The Paris Ile-de-France region is home to a rich network of research institutions and innovative companies that are brought together in publicly-funded "competitiveness poles", some of which are focused on green innovation (Kamal-Chaoui and Plouin, 2012). In the Chicago Tri-State metro-region, the Milwaukee Water Council connects firms and public research institutions working on water-related technologies. This public-private initiative has boosted the metro-region's position as a world-renowned water technology cluster.

What are common obstacles to fostering the production of green goods and services?

A number of emerging green industries require specific or upgraded skills. Skill shortages and mismatches between skill supply and demand in local labour markets can hamper the growth of green companies. In the Chicago Tri-State metro region, for instance, skill shortages and mismatches were identified as potential barriers to growth in renewable energy and other green sectors. Responding to these shortages, employers and trade unions in the region are complementing federal, municipality and local education policies with targeted training programmes (OECD, 2012d). For example, in 2008 the Mechanical Contractors Association of Chicago established a green construction institute to train local building contractors, apprentices and journeyman in the skills needed to upgrade to green jobs (MCA Chicago, 2011).

The limited capacity of SMEs for research, development and the commercialisation of innovative products constrains their innovative potential. Local economies are often influenced by large companies that concentrate R&D assets and resources. Smaller firms in turn often lack access to finances and capacity to pursue their own research and to commercialise innovative products. This is a challenge for example in the Stockholm metro-region, where multinationals dominate the space for innovation – a situation which may be undermining the potential of innovative SMEs (OECD, 2013c). A similar challenge faces the City of Kitakyushu, where major corporations are key players in the local economy and make up for the bulk of R&D activities. Kitakyushu has started to provide targeted support to SMEs and invests in R&D activities in its Eco-Town recycling cluster and the Kitakyushu Science and Research Park, including commercialisation support (OECD, 2013b). The Ile-de-France region has created a regional co-investment fund specifically to support innovative SMEs. The region's current master-plan allocates EUR 906 million between 2011 and 2014 to enhance the innovation potential of SMEs and small and medium-sized industries (Kamal-Chaoui and Plouin, 2012).

Cities and regions often possess important innovation assets which are insufficiently networked regionally. If existing assets, innovation actors and resources are well identified and pooled, they can be better co-ordinated and actors can co-operate across regions and sectors. Inventories of green innovation and industry

assets and regional innovation strategies can help to identify and organise local innovation resources and potential for green goods and services (OECD, 2011a). The Milwaukee Water Council has created a regional inventory and network of actors and assets in water technologies in the Chicago Tri-State metro region, which has developed into a strong water technology cluster (Box 3.4). Another exemplary regional innovation network is in the Öresund region, a cross-border region involving both Denmark and Sweden. Bringing together universities in Copenhagen and Malmö, the Öresund Science Region has developed into a strong regional innovation ecosystem with numerous innovation platforms, a number of which focus on green goods and services. This regional network not only strengthens research and development in emerging green sectors, but also fosters regional collaboration between research activities and businesses to increase the commercialisation of new products (Streijffert, 2008).

Policies to consider when the priority is to increase value and reduce environmental impacts

Urban redevelopment, including infill development and eco-districts, can increase urban land value and reduce environmental impact.[4] Redevelopment and infill development are important, and often overlooked, ways of fostering urban green growth as they can reduce urban sprawl, increase the efficiency of public service delivery and attract investment to urban cores (OECD, 2012a). Urban redevelopment projects are increasingly taking the form of eco-districts, which include environmental performance criteria in the conditions for redevelopment. These projects pay particular attention to the environmental sustainability of activities in the district, including energy efficiency, public and non-motorised transport, waste and water recycling, as well as other low-carbon and resource-efficient designs, materials and technologies.

What is the evidence for economic and environmental benefits of urban redevelopment and eco-districts?

Redevelopment, including infill development and eco-districts, can increase the value of not only the redeveloped property but also of the surrounding neighbourhoods. Research has demonstrated that both small and large-scale redevelopment projects have a positive impact on property values, particularly in cases of redevelopment close to residential and park areas, or of formerly polluted brownfields (de Sousa et al., 2009). Brownfield redevelopment can also increase the value of neighbouring areas, in part due to improvements to infrastructure and other urban amenities (de Sousa et al., 2009). Redevelopment projects that increase energy efficiency or feature other green characteristics can further improve land values. Studies of labelling schemes for energy efficient buildings in the US, such as LEED or Energy Star, have shown that eco-labelling tends to increase property values (Miller et al., 2008; Wiley et al., 2010; Fuerst and McAllister, 2009, 2011a and 2011b). Property values in eco-districts also tend to be higher than the average prices elsewhere in the city (Table 3.1).

Table 3.1. **Environmental and land value details of selected OECD eco-districts**

Eco-district	Year	General information		Investments – public and private		Energy consumption / CO_2 emissions		Special features	Land value	
		Area/density	Description	Total	Stakeholders/share	Goal	Performance		Price	City average
Royal Seaport Stockholm Sweden	2010 - 2025	236 ha redevelopment	10 000 dwellings 30 000 offices 600 000 m² commercial	EUR ~ 10.6 billion (by 2012)	EUR 7.1 billion private EUR 2 billion City of Stockholm, financed by land sale and lease EUR 340 million County Council EUR ~ 700 million State EUR 450 million Fortum Energy	25 kWh/m² 1.5 tCO_2 *per capita* in 2020	50 kWh/ m²	• Smart grid • Closed water, wastewater and energy eco-cycle	Similar to prices in the surrounding area	EUR 3 500/m² - EUR 5 900/m² in the city centre
Higashida Smart Community Kitakyushu Japan	1993 on-going	191 ha	900 residents 210 corporations and organisations	EUR 532.3 million	EUR 283.3 million private corporations EUR 171 million MLIT EUR 65.8 million METI EUR 11.3 million City of Kitakyushu 0.9 million by MOE	Estimated 30-35% CO_2 reduction in residential and commercial buildings		• Smart grid with dynamic pricing scheme • Environmental education complex • Car sharing system	EUR 520/m² Residential land price Higashida	EUR 767/m² Residential land price within the region
Hammarby Sjöstad Stockholm Sweden	1996	160 ha redevelopment (130 ha developed) density: 131 residents/ha	9 000 dwellings; 200 000 m² commercial 20 000 inhabitants	EUR 1.8 - 2.4 billion	EUR 0.48 billion public EUR 693 City of Stockholm to Local Investment Programme EUR 2 billion, city and Fortum Energy	50 kWh/m²		• District heating and cooling • Vacuum waste collection system	EUR 960/m² (1st phase) EUR 3 600/m² (2nd phase)	EUR 3 400/m² - EUR 5 700/m² in the city centre
Kronsberg Hannover Germany	1994	1 200 ha	6 000 dwellings 15 000 residents	EUR ~ 2.2 billion	EUR ~ 2.2 billion EU Thermie Project Kronsberg Environmental Liaison Agency – KUKA (51% Hannover municipality and 49% local stakeholders' consortium)	Aim for further 30% reduction of energy consumption	45-55 kWh/m²	• Large scale development project		EUR 1 000 - 2 000/m²
HafenCity Hamburg Germany	2006 - 2025	157 ha redevelopment	6 000 dwellings 2 million m² 1 800 residents	EUR ~7 billion	EUR 1.53 billion city EUR 5.5 billion private		50 kWh/ m² (HafenCity Eco label)	• Climate change adaptation: streets 7.5 to 8 metres above sea level	EUR 2 850/m² - 8 000/m²	EUR 2 000 - 2 500/m²
Vauban Freiburg Germany	1993 - 2010	41 ha redevelopment density:122 residents/ha	2 000 dwellings 5 000 residents	EUR 500 million	EUR 42 million EU LIFE and Federal Environmental Foundation (DBU) EUR 30 million city utility	65 kWh/m² maximum	100 passive houses with 15 kWh/m²	• Co-housing projects	EUR 2 300/m²	EUR 1 300/m²

Table 3.1. **Environmental and land value details of selected OECD eco-districts** (*cont.*)

Eco-district	Year	General information		Investments – public and private		Energy consumption / CO_2 emissions		Special features	Land value	
		Area/density	Description	Total	Stakeholders/share	Goal	Performance		Price	City average
Augustenborg Malmö Sweden	1998	32 ha	1 800 dwellings 3 000 residents	EUR ~ 28 million	EUR ~ 12 million City EUR~ 12 million MKB EUR 2.9 million Swedish Local Investment Programme EUR 1.2 million EU LIFE and Environment Department	"CO_2 slim club" aims for further 15% reduction of energy consumption	~ 25% lower energy consumption than surrounding building stock	• 90% of storm water led to storm water system • 9 500m² roof garden • only 50% tenant turnover	EUR 3 200 - 4 500/m²	EUR 2 800/m²
Barangaroo Sydney Australia	2011 - 2015	22ha redevelopment	2 500 m² 6 ha park 23 000 residents and workers	EUR 4.8 billion	New South Wales Government Barangaroo Delivery Authority	Carbon neutral, zero waste		• Offers new water front access for citizens		EUR 4 800/m² - EUR 8 000/m² in the city centre
Temps durables Paris Ile-de-France		10ha redevelopment	1 300 apartments	EUR ~ 18 million	Public-private partnership with private investor-developer consortium. No risk for the city	50 kWh/m² maximum		• CO_2 free district heating from local biomass plant • 100% renewable energy	EUR 2 800/m²	EUR 3 300/m²
Debonne Grenoble France	2008 - 2013	8.5 ha redevelopment	850 dwellings 3 500 m² office, 16 000 m² commercial	EUR ~ 6.6 million	EUR 2 million - collectivities SEM SAGES constructor	43 kWh/m²		• 47 500 kWh clean energy production	EUR 2 700 - 3 700/m²	EUR 2 500 /m²
BedZED London United Kingdom	2002	1.7ha density:148 residents/ha	82 dwellings 1 405m² offices 2 500m² commercial	EUR 17 million	EUR 14 million-construction EUR 2.5 million taxes EUR 0.5 million planning and audit costs	Carbon neutral	34.4 kWh/m²	• 0.16 cars per resident • 39% of households do car sharing	20% higher than average	

Notes:

1. Purchase prices/m^2 correspond to those found in an online search of local real estate companies.

2. Single years given under "Year" correspond to the year of completion of respective eco-districts; time-spans correspond to projected construction periods.

3. Acronyms: MLIT (Ministry of Land, Infrastructure, Transport and Tourism, Japan), METI (Ministry of Economy, Trade and Industry, Japan), MOE (Ministry of the Environment, Japan).

Table 3.1. **Environmental and land value details of selected OECD eco-districts** (*cont.*)

Sources: City of Hannover (2004), "Hannover Kronsberg Handbook. Planning and Realisation", *www.connectedcities.eu/downloads/showcases/kronsberg_hannover_handbook.pdf*; Energy Cities (n.d.), "Kronsberg: Project Description", *www.energy-cities.eu/IMG/pdf/Sustainable_Districts_ADEME1_Kronsberg.pdf*; Le Devoir (2010), "Quand la chaleur humaine remplace le chaffage", online newspaper article, *www.ledevoir.com/environnement/actualites-sur-l-environnement/298692/quand-la-chaleur-humaine-remplace-le-chauffage*, accessed 25 October 2012; Danish Architect Centre (2012), "Stockholm Royal Seaport: Aiming for World Class Sustainability", Danish Architect Centre website, *www.dac.dk/en/dac-cities/sustainable-cities-2/show-theme/master-plan/stockholm-royal-seaport-aiming-for-world-class-sustainability/*, accessed 25 October 2012; Stockholm Royal Seaport (2012), "Sustainable New City District by Waterfront", Stockholm Royal Seaport website, *www.stockholmroyalseaport.com*, accessed 25 October 2012; Danish Architect Centre (2012), "Hammarby Sjöstad: Integrated Sustainability as a Main Focus", Danish Architect Centre website, *www.dac.dk/en/dac-cities/sustainable-cities-2/show-theme/master-plan/hammarby-sjostad-integrated-sustainability-as-a-main-focus/?bbredirect=true*, accessed 25 October 2012; SECURE (Sustainable Energy Communities in Urban Areas in Europe) (2008),"Hammarby Sjöstad – Benchmark Study", *www.secureproject.org/download/18.360a0d56117c51a2d30800078406/Hammarby+Sj%C3%B6stad_Sweden.pdf*; Hammarby Sjöstad (2011), "Environmental Goals", Hammarby Sjöstad website, *www.hammarbysjostad.se/*, accessed 25 October 2012; Clark, G., J. Huxley and D. Mountford (2010), *Organising Local Economic Development: The Role of Development Agencies and Companies*, Local Economic and Employment Development (LEED), OECD Publishing, doi: *10.1787/9789264083530-en*; Hafen City (2012), "Hafen City Status Report: Facts and Figures", *www.hafencity.com/upload/files/artikel/HafenCity_facts_and_figures_2012.pdf*; Reed, A. (2010), "HafenCity: A Case Study on Future-Adaptive Urban Development", Worldchanging website, *www.worldchanging.com/archives/011536.html*, accessed 25 October 2012; ADEME (*Agence de l'Environnment et de la Maîtrise de l'Energie*) (2008), "Guidebook of Sustainable Neighbourhoods in Europe", *www.energy-cities.eu/IMG/pdf/ademe_sustainable_districts_en.pdf*; Bioregional (2012), "BedZED, UK", Bioregional website, *www.bioregional.com/flagship-projects/one-planet-communities/bedzed-uk/*, accessed 25 October 2012; International Energy Agency (2009), *Cities, Towns and Renewable Energy: Yes In My Front Yard*, OECD Publishing, doi: *10.1787/9789264076884-en*; Sustainability Victoria (2011), "Vauban, Germany: Community Leadership Delivering Sustainable Urban Renewal", Government of Victoria, Australia, *www.sustainability.vic.gov.au/resources/documents/Business_Models_For_Enabling_Sustainable_Precincts_Case_Study_Vauban.pdf*; Vauban (2008), "Stadtteil Vauban, Freiburg, Vauban website, *www.vauban.de*, accessed 25 October 2012; Barangaroo (2012), "Barangaroo – Sustainability", Barangaroo website, *www.barangaroo.com*, accessed 25 October 2012; Kazmierczak, A. and J. Carter (2010), "Adaptation to Climate Change Using Green and Blue Infrastructure: A Database of Case Studies", *www.grabs-eu.org/membersArea/files/malmo.pdf*; Malmö (2012), "Augustenborg", Malmö website, *www.malmo.se/*, accessed 25 October 2012; SEM SAGES (2007), "Le bâtiment de bureaux à énergie positive", press release, Grenoble, *www.concerto-sesac.eu/IMG/pdf/press_release-3.pdf*; City of Kitakyushu (2012), "Background Paper on the City of Kitakyushu – OECD Green Cities Programme", internal document, City of Kitakyushu, Japan; UK-Sweden Sustainability (2006), "Augustenborg, Malmö – Detailed Information", *www.ukswedensustainability.org/projects/augustenborg_details.jsp*, accessed 19 March 2013.

Infill development and redevelopment, also helps to keep urban areas compact, avoid urban sprawl and reduce pressure on the environment. Cities with a compact urban form and high population density are likely to have lower CO_2 emissions *per capita* (Chapter 2, Figures 2.2, 2.3 and 2.4), notably through lower transport emissions and lower electricity consumption (Box 3.6) (OECD, 2012a). Infill and redevelopment projects such as eco-districts that adhere to high environmental standards have the potential to reduce environmental impacts even further. Energy consumption and CO_2 emissions *per capita* in eco-districts tend to be lower than average across cities. District heating systems, low carbon energy supply, non-motorised mobility and public transport accessibility, high recycling rates, and other sustainability indicators are typical features of eco-districts that can improve environmental performance.

Box 3.6. **Beyond density: The characteristics of compact cities**

Recognition of the role that urban form plays in both urban environmental and economic performance has led to interest in the concept of compact cities. An important distinction must be made between density, which refers only to the number of residents per square kilometre of urbanised land, and compact cities, which encompasses a wider set of characteristics: dense and proximate development patterns, urban areas linked by public transport systems and accessible local services and jobs (table below).

Characteristics of compact cities

Dense and proximate development patterns	Urban areas linked by public transport systems	Accessibility to local services and jobs
• Urban land is intensively used • Urban agglomerations are contiguous or close together • Distinct border between urban and rural land use • Public spaces are secured	• Effective use of urban land • Public transport systems facilitate mobility in urban areas	• Land use is mixed • Most residents have access to local services either on foot or using public transport

Compact urban form is correlated with economic, environmental and social benefits. Economic benefits take the form of increased labour productivity, reduced infrastructure costs, and more efficient use of land resources. Environmental benefits include lower air pollution and CO_2 emissions from transport, reduced transport energy consumption, and conservation of farmland and ecosystems. Social benefits include greater access to services and improved health.

Source: OECD (2012), *Compact City Policies: A Comparative Assessment*, OECD Green Growth Studies, OECD Publishing, doi: *10.1787/9789264167865-en*.

How can urban policy makers foster infill development and eco-district development?

Cities can foster infill and redevelopment through making underused urban land available and imposing environmental performance standards on private development. Infill and redevelopment can be fostered by cities through making publically owned land available through land lease or sale, as was the case for instance for district redevelopments in Stockholm. This allows cities to specify conditions for development, environmental performance standards, density requirements or building codes for energy efficiency. Redevelopment of the Hammarby Sjöstad eco-district in the City of

Stockholm began in 1996. The city authorities required all new buildings in the district to meet an energy efficiency standard of 50kWh/m^2 a year. The goal for the Stockholm Royal Seaport eco-district is to reduce annual energy consumption to 25kWh/m^2 by 2020 (OECD, 2013c). In Paris Ile-de-France, a number of eco-districts are currently in the planning phase, such as the Temps Durables district in Limeil-Brévannes, which is aiming for 100% renewable energy supply through solar and biomass, district heating, and a maximum of 50kWh/m^2 per year of energy consumption in its new buildings.

To be successful, infill development must overcome the conditions that tend to favour development at the urban fringe. Development of previously undeveloped land outside the urban core, known as greenfield development, tends to be seen by developers as less expensive and more easily developed. For infill development and redevelopment to compete, public intervention is often needed to provide incentives and lower the barriers to redevelopment. This can involve:

- changing the property tax structure to remove incentives for greenfield development;
- imposing development fees that more fully internalise the costs of greenfield development, including extending services and environmental impacts (see the section "City revenues: Getting the financial incentives right for green growth" in Chapter 4);
- providing information by cataloguing land available for redevelopment, which can help potential developers to assemble sufficient properties to make the project viable; and
- establishing infill and redevelopment targets; for example Portland, Oregon introduced a "refill" rate to create transparency about redevelopment and infill trends (Box 3.7).

Box 3.7. **Monitoring tools for brownfield development in Portland, Oregon**

Portland's Buildable Lands Inventory helps decide on the necessity of enlarging the city's boundaries. While a state law requires Portland Metro, the metropolitan regional council, to review the capacity of the urban growth boundary every 5 years to ensure a 20-year land supply, the city has developed a detailed and sophisticated land-monitoring process to inventory vacant land and track the refill rate. The refill rate is defined as the rate at which new development occurs through infill or redevelopment.

In 2009, the city found that the refill rate for new industrial development was 20%. For non-industrial use, 52% of new capacity was built on developed land (Metro, 2009). The residential refill rate has climbed steadily, from 30.4% between 1997 and 2001 to 33% between 2001 and 2006 (Metro, 2009). Metro predicts the rate will rise to 38% from 2010 to 2030 (Metro, 2010). If it does, the urban growth boundary will be able to accommodate 11 300 additional dwellings without expanding. Refill rates are highest in the central city and lowest in suburban residential neighbourhoods. Most residential refill is multi-family housing, often as part of transit-oriented development. Portland prioritises transport projects that support refill and invests in transit-oriented developments to achieve a higher density and greater mix of uses than prevailing market conditions would support given developers' construction costs and income from rent or sale (Metro, 2011).

Source: OECD (2012), *Compact City Policies: A Comparative Assessment*, OECD Green Growth Studies, OECD Publishing, doi: *10.1787/9789264167865-en*.

One issue urban policy makers face is how to apply the practices and lessons of eco-districts more widely across an urban area in order to provide a greater return on public investment. Eco-districts are by nature limited in scale, which can make it easier to implement higher environmental performance standards. Scaling these standards up is more difficult, however (Box 3.8). Infrastructure lock-ins, vested interests, financial capacity, technological feasibility and governance structures tend to hamper city-wide implementation. This means that even if some eco-districts might represent cutting-edge sustainable redevelopment, their key features cannot be scaled up. In order to be a valuable testing ground for the whole city, eco-districts should therefore prioritise areas and technologies which are easier and more likely to be implemented in the rest of the city. The cities of Stockholm and Kitakyushu have both started applying certain features of their eco-districts across the urban area. In Stockholm the higher energy performance standard in Hammarby Sjöstad has influenced practices by building developers in other parts of the city and in Stockholm County (OECD, 2013c). The City of Kitakyushu, in parallel to developing the Eco-Town recycling cluster, has implemented policies to accelerate municipal waste recycling, which has led to significant recycling rate increases (OECD, 2013b).

Box 3.8. **Scaling up the lessons from eco-districts**

The City of Stockholm has taken the lessons from developing its first eco-district in Hammarby Sjöstad and incorporated them into the planning of a new eco-district in Stockholm Royal Seaport. After the completion of Hammarby Sjöstad, the City of Stockholm assigned the Department of Industrial Ecology of the Royal Institute of Technology to evaluate the environmental profile of the district. While the findings reflect overall success, several lessons for improvement emerged: *i*) integrate ambitious environmental goals from the beginning of the planning process; *ii*) pursue a holistic vision that takes into account both technological barriers and behavioural aspects of future users of the buildings; and *iii*) combine operational improvements with economic incentives for citizens to foster a more sustainable way of living (Pandis and Brandt, 2009).

The Eco-Town recycling cluster in Kitakyushu has served as a recycling laboratory for a number of years, with a focus on recycling industrial waste, such as sludge. The city of Kitakyushu is currently identifying several other areas of the city where the proximity of companies and residential or commercial buildings would allow a scaling up the recycling of industrial excess heat to feed into residential heating. Previously, the city implemented a pricing policy for waste disposal bags (pricing conventional rubbish bags higher than bags for waste recycling) which strongly pushed up recycling rates and created input for the recycling facilities in the Eco-Town area (OECD, 2013b).

Source: Pandis and Brandt (2009), *Utvärdering av Hammarby Sjöstads miljöprofilering -vilka erfarenheter ska tas med till nya stadsutvecklingsprojekt i Stockholm?* (*Evaluation of the Hammarby Sjöstad's Environmental Profile – What Experiences Should be Taken to New Urban Development Projects in Stockholm?*), KTH, Stockholm; OECD (2013), *Green Growth in Kitakyushu, Japan*, OECD Green Growth Studies, OECD Publishing, doi: *10.1787/9789264195134-en.*

Notes

1. ENV-Linkages is a recursive dynamic neo-classical general equilibrium model. It is described in detail in Burniaux et al. (2010).
2. For more detailed analysis of these "rebound effects" and the relationship between energy efficiency and energy demand, see Burniaux et al. (1995). They find that moderate but steady increases in energy efficiency would, other things being equal, lead to higher emissions than under a "business as usual" scenario.
3. For more information about the status and limitations of PACE programmes in the US, see US Department of Energy (2012) "PACE Financing" DSIRE (Database of State Incentives for Renewables & Efficiency), website, US Department of Energy, *www.dsireusa.org/solar/solarpolicyguide/?id=26*, accessed 1 February 2013.
4. Infill is when more units are constructed on an already developed lot, while redevelopment is when a structure is removed and another is built in its place.

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Chapter 4

How should urban green growth governance and financing challenges be addressed?

This chapter assesses the main governance and financing challenges in implementing green growth in cities. Multilevel governance – co-ordination across sectors and among different levels of government, private sector and civil society – is an important tool for integrating environmental and economic priorities into urban activities. This chapter proposes a framework for addressing potential gaps in co-ordination and suggests ways in which national governments can enable green growth in cities. This is followed by a discussion of the opportunities for increasing funding for urban green growth, which include aligning local revenue sources (including taxes, fees and charges) with green growth priorities. It will also be essential to mobilise private finance for green infrastructure investments, through mechanisms such as public-private partnerships, development charges, loans, bonds and carbon finance.

While previous chapters have explored the specific policies that can foster green growth in cities, there are also important governance and financing challenges that can either support or undermine the success of such policies. Getting the policy climate right for urban green growth involves multiple levels of government and multiple sectors. At the same time, fostering green growth will require investments in infrastructure. This chapter first discusses how to resolve the potential gaps in co-ordination that may arise when pursuing economic growth and development through urban activities to reduce environmental impact. It then discusses opportunities to increase funding for green infrastructure, primarily by aligning revenue sources with green growth objectives and mobilising private sector finance.

Governing the green city: A case for stronger multi-level governance tools

Governing the green city is a challenge, as it involves multiple levels of government and other stakeholders. A trend towards increased decentralisation has resulted in the transfer of greater responsibilities to local authorities, but often without being accompanied by the necessary funding or training. This means that local governments are required to do more, and better, with less. And because multiple sectors are involved in green growth strategies – land-use planning, transport, buildings, energy, waste and water to name a few – policy makers must seek complementarities among administrations that traditionally focus only on a specific sectors. This examines the governance challenges that can emerge in the pursuit of green growth in cities. It does so by applying an OECD framework for understanding the gaps in multi-level governance to the concept of green growth. It draws on lessons from the four OECD green cities case studies, as well as and two national case studies (China and Korea).

What is multi-level governance?

Multi-level governance characterises the mutually dependent relationships – be they vertical, horizontal, or networked – among public actors situated at different levels of government (Charbit and Michalun, 2009). In practice, multi-level governance refers to "the explicit or implicit sharing of policy-making authority, responsibility, development and implementation at different administrative and territorial levels, i.e. *i*) across different ministries and/or public agencies at central government level (upper horizontally), *ii*) between different levels of government at local, regional, provincial/state, national and supranational levels (vertically); and *iii*) across different actors at sub national level (lower horizontally)" (Charbit, 2011). In the pursuit of green growth in cities, a multi-level governance framework can be useful for identifying some of the key challenges to implementation.

Why does multi-level governance matter for green growth in cities?

With greater interdependence among governing authorities, managing relationships between and across levels of government has become increasingly necessary and complex. There are two primary reasons for this complexity. First, decentralisation trends over the past three decades have transferred fiscal, political and administrative competencies from the central government to local authorities, in some cases significantly expanding their policy scope. Yet this transfer of responsibilities is not always accompanied by sufficient allocation of funds, leading to limits in both fiscal and technical capacity at the local level. As a result, the effectiveness of policy implementation suffers. To achieve desired outcomes, vertical co-ordination among

different levels of government is required (Charbit, 2011). Second, the complexity of governance arrangements is increased by the cross-cutting nature of urban green growth, involving sectoral policies related to energy, building, transport, water and waste, in addition to economy-wide policies targeting innovation, investment and the labour market. Regardless of the institutional context in a given setting, there is no single agency capable of addressing all aspects of green growth. Rather, different ministries, public agencies and private and other non-governmental actors need to co-ordinate policy design and implementation with local needs and competences. Integrated policy making requires policy coherence across a range of traditionally distinct sectors and/or line ministries (Hammer et al., 2011). These challenges make a strong case for a multi-level governance framework as a means of effectively managing co-operation and capacity among different levels of government in the pursuit of green growth in cities.

Additionally, managing relationships among public authorities in the pursuit of green growth in cities can prove challenging due to:

- A need for coherent local implementation of nationally driven policies. National policies can take a "one-size-fits-all" approach to policy implementation that can ignore variations in local assets and capacity. Accordingly, green growth strategies designed by the central government, as in the case of Korea and China, require implementation strategies to be adapted to different kinds of cities and regions. All cities may not have equal capacity to implement national policies.
- An already complex governance landscape in urban areas. Urban areas continue to grow at a rapid rate, yet the governance structures in place for addressing the challenges related to urban expansion are not always well-adapted to this evolving metropolitan landscape. Since 1990, most urban growth has occurred in suburban areas surrounding central cities (OECD, 2012b), implying that more and more localities must manage the traditional externalities associated with urban expansion, such as sprawl, congestion and water and air quality. The relevant scale of governance for addressing these kinds of spill-overs may cross administrative boundaries, as is often the case with public transportation networks in metro areas, water basin planning initiatives, and inter-municipal agreements to manage waste collection and disposal.
- The need to involve private sector and civil society stakeholders. Meaningful involvement of the private sector can also help to ensure that green growth strategies work and meet actual market demand (e.g. by evaluating potential market opportunities and challenges, and financing and implementing projects). Civil society organisations can help spur the behavioural change needed to stimulate demand for green goods and services. Yet the integration of these actors into public policy making is rarely straightforward.

How can public authorities identify challenges to multi-level governance?

Public authorities can identify and address multi-level governance challenges by focusing on potential gaps in co-ordination between local, regional and national-level actors. To manage relationships between and across levels of government more effectively, the OECD has developed a diagnostic tool to identify the challenges, or "gaps", that impede effective governance between actors (Table 4.1) (see Charbit and Michalun, 2009; Charbit, 2011; Allain-Dupré, 2011; OECD, 2011a). This multi-level governance framework has been applied in various policy contexts, such as public investment (Allain-Dupré, 2011), sub-national finance (Blöchliger, et al., 2010;

Vammalle and Gaillard, 2011) and water reform (OECD, 2011b; OECD, 2013b), and has recently been adapted for green growth[1] (Hammer et al., 2011).

Table 4.1. **Governance gaps**

Objective gap	An **objective gap** occurs when diverging or contradictory objectives between levels of government or departments/ministries compromise their adoption of joint targets. The objective gap may also arise if policy priorities do not align with the interests or needs of private sector stakeholders, causing them to exit the local market entirely or restrict efforts to expand in the city/region.
Administrative gap	An **administrative gap** occurs when there is a geographical mismatch between the green growth challenge or opportunity and administrative boundaries, which can create environmental and economic impediments. Administrative boundaries (municipalities, regions, and states) are rarely set to align with environmental challenges, resulting in a mismatch at the sub-national level that hinders policy coherence (Moss, 2007).
Policy gap	A **policy gap** refers to the sectoral fragmentation of policy making across ministries and public agencies within the national government administration or across departments within sub-national government administrations (this is also referred to as a "silo approach" to policy making). A policy gap can lead to vertical and horizontal policy inconsistencies. Further, it can create uncertain market conditions that inhibit companies from entering the marketplace or from obtaining capital for infrastructure investments, business operations or expansion.
Information gap	An **information gap** occurs when there is uneven information between and across levels of government when designing, implementing and delivering public policies. It can be exacerbated by the lack of capacity to collect, analyse and interpret data. It may also occur when knowledge of what is happening on the ground is not shared between national and local stakeholders.
Capacity gap	A **capacity gap** is when there is insufficient technical expertise, infrastructure or other resources to design and implement policy. The capacity gap is not restricted to the sub-national level; it also applies to the national level (e.g. managing multi-level relations, allocating responsibilities and funds and ensuring co-ordinated policy approaches among central actors).
Fiscal gap	A **fiscal gap** refers to the difference between revenues and required expenditures, but can also occur when budget practices do not align with policy needs. In the context of green growth, mobilising private capital may be difficult if investors are wary of an unproven market with a potential disconnect between the expected return on green investment and the actual payback. Because the fiscal gap is such a pervasive challenge for cities and countries, the final section of this report is dedicated to the issue of finance.
Accountability	An **accountability gap** refers to the lack of transparency in policy making across constituencies. With private sector participation in some sectors, traditional government accountability is changing. In this context, the accountability gap can be reflected in the market entry process, award criteria, or contract provisions for unforeseen contingencies.
Market gap	A **market gap** reflects a misalignment between policy-making goals and the ability of private sector stakeholders to deliver these goals. Because businesses fulfil many different roles in delivering green growth – as direct service providers, partners in policy advocacy, technological innovators, or targets of public policy in terms of rule compliance or behavioural change – the private sector should be a critical partner in co-ordination efforts to advance green growth.

Source: Charbit, C. (2011), "Governance of Public Policies in Decentralised Contexts: The Multi-level Approach", *OECD Regional Development Working Papers 2011/04*, OECD Publishing, doi: *10.1787/5kg883pkxkhc-en*; Hammer, S. et al. (2011), "Cities and Green Growth: A Conceptual Framework", *OECD Regional Development Working Papers 2011/08*, OECD Publishing, doi: *10.1787/5kg0tflmzx34-en*; Moss, T. (2007), "Solving Problems of 'Fit' at the Expense of Problems of 'Interplay'? The Spatial Reorganisation of Water Management Following the EU Water Framework Directive", in P. P. Mollinga, A. Dixit and K. Athukorala (eds.), *Integrated Water Resources Management: Global Theory, Emerging Practice and Local Needs*, Sage Publications, New Delhi, Thousand Oaks, London.

How can urban policy makers close the gaps to governing green cities?

Several recurring governance gaps can be identified within the six green cities case studies: the objective gap, the administrative gap, the policy gap, the information gap, the capacity gap, and the fiscal gap. These are each discussed in turn below, with the fiscal gap discussed in detail in the sections "City revenues: Getting the financial incentives right for green growth" and "Mobilising private finance for green infrastructure" in Chapter 4.

Closing the objective gap through enforcement, incentives and negotiation

When objectives diverge, a combination of enforcement and incentives is needed to ensure compliance. In practice, meeting the dual objectives of green growth is not straightforward, as it often requires changing deeply imbedded economic practices and paradigms. In China, the government has revised its incentives structure in order to align economic and environmental objectives, but more fundamental changes to accountability structures may be needed. For instance, performance evaluation for local officials has traditionally centred on economic growth and job creation, the results of which are linked to career advancement (OECD, 2007; Li and Zhou, 2005 cited in OECD, 2013c). While the political incentives generated dynamic regional competition for economic growth and investment attraction, local governments tended to ignore or violate national environmental regulations (Marquis et al., 2011; Zhang, 2008; OECD/CDRF, 2010). In the 11th and 12th Five-Year Plans (2006-2010 and 2011-2015, respectively) the central government has introduced environmental targets as part of performance evaluations for local officials. This is a step in the right direction, but additional changes to the performance evaluation metrics are required, given that economic performance still has more weight than evaluation and advancement criteria. In another instance, China is looking to ensure that land development projects meet both economic and environmental objectives. Historically, environmental laws are often ignored or rarely enforced in the pursuit of economic growth and development. This can be because enforcement officers risk losing their jobs if they report violations that would implicate politically-connected large firms (NAO, 2011; ISPRE, 2012 in OECD, 2013c). As a response, the government has introduced a differentiated evaluation system for land development. The system classifies land into four types of functional zones according to the region's resources; each zone is assigned different development targets to ensure that local governments respond to different sets of incentives. The system has yet to be implemented, but represents a promising initiative.

Conflicting objectives among stakeholders can also be resolved through formal partnership tools that help clarify roles and responsibilities. In Korea, for instance, the development of Gangneung-si, one of the central government's "green city" demonstrations projects, was halted following conflicting objectives between the two ministries involved in the project. The Ministry of Environment sought to focus on the environmental protection elements of the project, while the Ministry of Land, Transportation and Maritime Affairs stressed the development objectives and maximising return on investment. Ultimately, the project was able to proceed once a memorandum of understanding for collaboration was signed by the two ministries, as well as by regional and city government authorities.

Closing the administrative gap through inter-municipal co-operation and metropolitan governance

Inter-municipal co-operation can help manage urban services (such as water or waste management) in a way that is more environmentally and economically coherent. As we have discussed, the evolution of the institutional landscape in rapidly urbanising countries (like China or Korea) or in suburbanising metropolitan areas (like Paris-IDF and Chicago) means that administrative boundaries no longer reflect functional economic and environmental realities. One result is that it is increasingly difficult to assess – and address – water (e.g. upstream and downstream) and air pollution sources (e.g. in the transportation sector) that are generated in one jurisdiction but which affect neighbouring localities. Another potential outcome is a zero-sum game at the metropolitan scale where local jurisdictions treat neighbouring municipalities as competitors rather than partners. In China and Korea, for instance, local governments perceive investment, especially foreign direct investment, as a crucial source of economic growth, and hence compete with their neighbouring jurisdictions in attracting business. The same is true in the Chicago Tri-State metro-region, where the Indiana Economic Development Corporation launched an "Illinoyed?" campaign to lure firms to Indiana from its neighbouring state, Illinois, with the promise of lower corporate tax rates.

Even where formal instruments for inter-municipal co-ordination exist, they may not always work properly. Paris-IDF includes nearly 1 300 municipal institutions. On top of these, several hundred inter-communal structures have been created, but most are small and rarely include a large population (IAU, 2010). The result is an overwhelming number of **additional** local authorities in an already crowded institutional landscape. This ultimately limits any potential economies of scale and authority in negotiating contracts with private service providers.

Metropolitan governance structures can bridge the gap between administrative boundaries and environmental and socioeconomic realities, but in most countries within and outside the OECD, there is as yet no well-developed strategy for institutionalising regional or metropolitan governance of the green city.[2] For example, in Paris-IDF, a weak regional government coupled with a history of divergent interests between the 1 300 local administrations within the metro-region has for decades rendered credible metropolitan governance difficult. For one thing, in contrast to federally organised countries like Germany, Italy or Spain, the French legal framework does not authorise hierarchical relationships between sub-national levels of government, meaning that no sub-national body, including the regional council, can impose its leadership in the metropolitan region. Consequently, a very competitive political and institutional system results in a constant need for consultation (Kamal-Chaoui and Plouin, 2012).

Nonetheless, Metropolitan governance initiatives emerging from our case studies offer some promising examples of how they can be a key tool for pursuing integrated policy goals at an effective scale:

- In China, a more collaborative inter-urban framework is being attempted to help local authorities meet urbanisation and green development targets, particularly tackling congestion, air pollution, health problems and greenhouse gas emissions (OECD/CDRF, 2010). Since 2008, China has approached inter-municipal collaboration through central and provincial government intervention, issuing several regional strategies that cross administrative boundaries of provinces (e.g. the Yangtze River Delta region) and municipalities (Pearl River Delta region). In 2009, Guangzhou and Foshan signed a co-operation agreement, the

first inter-municipal co-operation agreement in China, as encouraged by the provincial authority (OECD/CDRF, 2010).

- In the case of Paris-IDF's crowded and at times contentious institutional landscape, a move toward a flexible, voluntary form of inter-communal co-operation may be a step in the right direction. In 2003, the City of Paris proposed a discussion mechanism with the outlying suburbs. This led to the establishment of the Metropolitan Conference in 2006 as a forum for discussion and informal consultation among elected officials in the Paris region. This was followed by Paris Métropole, a study group that includes 188 Paris-IDF local governments as well as the *départements* and the Regional Council of Ile-de-France. Paris Métropole has its own budget and is independent of existing institutions.
- In the Chicago Tri-state metro-region, metropolitan governance could be strengthened by deepening ties between each of the three state's existing metropolitan planning organisations. These organisations are ideally placed to contribute substantially to the creation of a Tri-State regional vision and agenda as they are equipped with a comprehensive, multi-sector vision of their jurisdiction, including both the challenges faced in a given domain (transportation, housing, land use), as well as the potential complementarities and trade-offs between these issues. They also possess a wealth of regional quantitative data in a variety of areas pertinent to urban and metropolitan development, along with solid experience in engaging citizens to help shape a regional vision.

Closing the policy gap by breaking down policy silos

The cross-cutting, integrated policy-making approach needed to foster green growth in cities means that governments will need to overcome traditional policy fragmentation – the tendency to work in "policy making silos". Such silos are present at all tiers of government. Korea provides just one case in point. For instance, national climate change statistics on the environment, land use and sea levels and meteorological trends were historically collected separately by a handful of different ministries and rarely shared. As a result, each ministry based its climate change scenarios on different baseline information, resulting in at times conflicting policy measures (Lee et al., 2009). At the local level, authorities struggled to integrate green growth objectives into an already fragmented local development policy framework, a result of separate plans for municipal economic development, spatial development and sectoral plans (OECD, 2012a).

In the Stockholm metro-region, "networked governance" rather than formal metropolitan institutions is seen as the best way to achieve stronger, more enduring policy implementation that can outlast political cycles and achieve multi-sectoral objectives. Networked governance brings together a multiplicity of public-sector agencies, private-sector firms, NGOs and other actors to deal with the complex problem of sustainability (Huppe et al., 2012). Although some observers criticise the structure for the frequent meetings and negotiation required in the absence of an empowered regional institution, others maintain that there are benefits to having regional stakeholders grouped in such inclusive non-binding planning processes, particularly in the case of climate change and green growth (OECD, 2013a). Moreover, because large metropolitan regions are complex, with the powers to implement planning strategies spread out among a large number of private and public bodies, a genuine consensus on regional goals, strategies and commitments makes concerted regional action easier to achieve. Stockholm

authorities point to such successes as the construction of the Citybanan (a railway tunnel through Stockholm) and the Stockholm Agreement on future transport infrastructure in the region.

Closing the information gap by harmonising data collection

Harmonised measuring and monitoring tools are essential for bridging the information gap. In most cases, cities and countries lack effective tools for measuring and monitoring progress toward green growth targets. In Paris-IDF, there is a lack of reliable regional data on eco-activities, due in part to definitional problems related to official terminology. In China, the central government has not yet come up with a clear definition of a low-carbon city, a designation it has been actively promoting. This concept is naturally challenging, because what is relevant in one part of the country may be very different in another part of China, reflecting different geographies, economic bases, or energy supplies. In the absence of a common definition, pilot cities and provinces use different standards: some focus on performance (e.g. changes in *per capita* carbon emissions, and carbon intensity per unit of GDP), while others emphasise specific programmes, policies and systems (e.g. bus rapid transit systems; onsite renewable energy provision requirements in building codes; tree-planting initiatives) (OECD, 2013c). Proposed indicators for urban green growth are discussed in Annex A.

The development of a body to collect and disseminate cross-sector data at the micro-scale could be a first step in improving the measuring and monitoring capabilities of metropolitan regions. This need was highlighted by government and private sector stakeholders in the case study of the Chicago Tri-State metro-region. The OECD recommended establishing a research centre whose mandate would be to collect data and indicators relevant to green growth in the metro-region from existing research centres, with the goal of providing a strong evidence base for future metropolitan green growth initiatives. This research centre could link with local, county, state and federal authorities responsible for the policies and programmes that affect economic development, workforce development, innovation, green growth capacity, transportation and logistics in the metro-region. The constant sharing of key data and indicators with all levels of government institutions relevant to policy and economic performance in the metro-region is vital in ensuring that the policies and programming truly reflect the reality on the ground and can respond effectively to the green growth challenges the metro-region faces. The research centre could also maintain regular contact with key public, private and community stakeholders in the region to share information, monitor progress in the development and implementation of key region-wide strategic plans and recommend changes to these plans as needed.

Closing the capacity gap by building local competencies for green growth

As mentioned earlier, many local authorities are incurring greater responsibilities without the necessary funding or training to support them. In China, a lack of expertise in integrating environmental and economic development policies at the local level, particularly in small and medium-sized cities, has hindered the effective implementation of environmental targets and green growth implementation at the local level (OECD, 2013c). Kitakyushu is building green growth capacity by requiring staff to regularly transfer between administrative offices focused on economic development and those centred on environmental affairs. This policy is an explicit effort to build "green growth personnel" who understand inter-sectoral linkages and trade-offs between short-term economic imperatives and long-term sustainability goals. This approach is not

unique in Japan, where administrative staff routinely move every two years, but Kitakyushu's practice of structuring the rotation so as to foster a common understanding of green growth is worth emulating.

How can national governments support green growth in cities?

Cities do not act in isolation from upper echelons of government. National governments can enhance cities' capacity to act on green growth in the following ways:

- Bridging the gap between national and local approaches to green growth. National plans often do not account for the spatial elements of green growth, nor for cities' existing contributions to green growth. Urban green growth initiatives can run the risk of being stand-alone, flagship green projects that are dependent on short-term political cycles; long-term sustainable economic growth calls for a systematic, citywide, multi-sectoral approach.
- Providing the technical assistance, funding and knowledge 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.
- Setting strong national and international environmental targets and baseline standards to remove policy obstacles, prevent harmful competition among regions and promote a "race to the top" (OECD, 2010a). At the same time, cities need flexibility in how they meet these targets in order to innovate urban-level policy responses that can then be scaled up.
- Establishing national price signals and standards – e.g. through carbon taxes or other pricing mechanisms. Such signals can enhance the incentives for firms to adopt and develop green innovations and help to indicate the commitment of governments to move towards greener growth. They can also enhance efficiency in allocating resources by establishing markets for green innovation and will lower the costs of addressing environmental challenges.
- Creating a common set of urban environmental and economic indicators to compare best practices and measure the impact of green growth projects on environmental, economic and social priorities. National governments can help develop a common methodology and support capacity building at the sub-national level.
- 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. This will be developed further in the next section.

City revenues: Getting the financial incentives right for green growth

A major challenge to pursuing green growth in cities is raising the revenues needed for investment in urban activities that will foster growth by reducing environmental impact. Cities' revenue sources are tied to many of these infrastructure-related sectors, such as building and transport. How these revenue sources are designed – especially property taxation – can either stimulate or discourage green cities. Fiscal policies – operating within and across levels of government – should be reconsidered to identify unintended consequences for green growth and sustainable development

(Corfee-Morlot et al., 2012). At a minimum, this means eliminating the anti-green bias of some existing local tax provisions and the perverse incentives created by many environmentally harmful subsidies. This section explores the concept of "greenable" infrastructure investments, green urban revenue sources and financial incentives for greening the urban property tax. City and local government revenue sources are usually classified according to revenue types: tax revenues, fees and charges and intergovernmental grants. To assess the potential green impacts of these sources they are further classified according to where their revenue base originates (i.e. transportation, building sector or other sectors).

How can property taxes and development fees be designed to tackle urban sprawl?

Property taxes should be designed to limit urban sprawl. Throughout the OECD, local governments earn the most revenue from property taxes. For example, municipalities in the peri-urban fringe of many German agglomerations compete with each other by developing new land to attract inhabitants and companies, thereby producing revenue for financing public services. This dynamic is made possible by municipal autonomy in land-use planning and large demand for undeveloped land; the result is to undermine sustainable planning principles. The impact of property taxes on land use, density and urban sprawl depends on policy choices: what is included and excluded from the tax base, how property value is defined for different classes of property (e.g. residential, multi-residential, farm, commercial and industrial properties), what percentage of the value is taxable, and how effective tax rates vary within and among property classes.[3] By altering the relative price of property, these taxes can influence a number of decisions about property improvement, size and location – and ultimately increase or decrease urban sprawl (Deskins and Fox, 2010). Decreasing sprawl through property taxes requires the following priority actions:

- Eliminate policies that favour single-family homes over apartments because the former encourage less dense development. Perverse incentives are created when single-family residential properties are offered lower taxes than higher-density properties of the same value (Haveman and Sexton, 2008).
- Tax the land value, not the property. When property taxes are based on land value, rather than buildings or other improvements to the property, owners have an incentive to develop the land to its most profitable use. Replacing a traditional property tax with a land-value tax, or a split-value tax that includes higher rates for land value and lower rates for structures or other improvements (as implemented by some municipalities in the US state of Pennsylvania), could encourage development in the urban core.

Development fees or charges can also discourage sprawl and fund infrastructure. A development charge is a one-off levy on developers to finance the growth-related capital costs associated with new development or, in some cases, redevelopment. These charges are levied on works constructed by the municipality, and the funds collected must finance the infrastructure needed for the development.

Development charges that reflect the true cost of providing services can buttress planning tools by guiding development away from high-cost areas to more efficient locations (Tomalty and Skaburskis, 2003). Pricing policies can be an effective planning tool because "they directly engage developers, they make them accept the full project

costs, they recognise and publicise the need to correct for the external costs of development by increasing the cost of land, and they raise funds for infrastructure development and compensation programmes" (Skaburskis, 2003). For example, the extension of the metro-line in Copenhagen was financed through fees from the development of the Ørestad area of Copenhagen (OECD, 2009).

When urban form and density are not fully factored into the development charge, a market distortion occurs which can result in inefficient allocation of resources (GTA Task Force, 1996). In order to have the required effect, the charges have to be differentiated by location to reflect the different infrastructure costs. The costs of services may vary by location for at least three reasons (Tomalty and Skaburskis, 1997). First, the distance of each development from major facilities makes a difference. A development far away from an existing water treatment plant, for example, may require an additional pumping station. To be efficient, development charges would be higher in these locations. Second, there will be infrastructure cost savings for nodal or infill development because the infrastructure is already there. Third, service standards may vary in different developments (e.g. household water use versus waste generation). Whatever the reason for the differential costs, efficient land use requires that developments imposing higher infrastructure costs on the city pay higher development charges than developments imposing lower costs. Pamela Blais (2010) notes that, in addition to varying by location, charges should also differ according to the density and type of development to avoid low-cost areas subsidising high-cost areas, small lots subsidising large lots, and smaller residential units subsidising larger units.

Area-specific charges allow municipalities to vary the charge according to the different infrastructure costs imposed by each area on the city. A uniform charge subsidises inefficient uses of land; developments that impose higher costs are subsidised by developments that incur lower costs. In practice, however, many cities are missing opportunities to use development charges to foster green development:

- Most Canadian municipalities impose the same charge on all properties of a particular type regardless of location. This means that they are not using development charges as a financial instrument to discourage inefficient and costly land uses (Tomalty and Skaburskis, 2003). In Ontario, for example, with the exception of municipalities in the York Region few municipalities differentiate development charges by location. Presumably, the practice of uniform charges has been adopted for administrative simplicity and perhaps also for reduced conflict with developers (OECD, 2010c), but it is clearly inefficient. One result is likely to be over-development of low-density housing and under-development of high-density housing relative to what is economically efficient (Slack, 2002). In British Columbia, however, area-specific development charges are more common.[4] The provincial government's *Development Cost Charge Best Practices Guide* suggests that development charges be varied according to density to encourage more compact development and reduce the amount of roads needed, increase the viability of transit and leave a smaller ecological footprint (British Columbia Ministry of Community Services, 2005).
- In US jurisdictions, development impact fees are widely used but their design is generally not consistent with efficient pricing of infrastructure (McGuire and Sjoquist, 2003). The reason is that fees are generally the same for an infill development close to existing services and for a greenfield development on the outskirts of a city. Municipalities generally use one of two methods for

calculating impact fees on single-family homes: a uniform charge regardless of size or a sliding scale that responds to either interior square footage or the number of bedrooms (Burge, 2010).

Other problems can arise from the way in which the charge is determined. In Ontario, for example, municipalities are only permitted to charge the infrastructure costs for services that are already delivered in the municipality and only for standards of service that do not exceed the average level of service over the previous ten years. If a municipality chooses to encourage compact development by increasing transit service, for example, the development charge cannot be used to cover costs that exceed the existing standard. Although these provisions were instituted to ensure that developers are not liable to pay for gold-plated services (services that exceed what existing residents currently enjoy), they make it difficult for municipalities to recover transit costs (OECD, 2010c).

Other financial means for encouraging compact cities include:

- Selling additional building rights. In São Paolo, for example, the building rights for additional floor space on the top of existing buildings that exceeded normal maximum density were sold in areas authorised for higher-density development. Similar mechanisms were used in the state of Maharashtra, India, where the maximum floor space index was increased, and the extra floor space sold to developers. Both initiatives have generated additional infrastructure funding while increasing urban density. The sale of additional building rights is particularly relevant for growing cities with scarce land, as long as construction and safety standards are taken into account.
- Taxing low-density development. France introduced a scheme in 2010 to tax development that does not meet minimum density requirements. The City of Austin, Texas in the US has introduced a special transportation levy on all municipal utility bills, based on the estimated average number of daily motor vehicle trips per household, in effect penalising less-dense development.

How can transportation fees and charges be designed to promote urban green growth?

Transport fees should discourage car use and encourage public transit and non-motorised travel. While national or state/provincial governments control most transportation-related taxes, local governments often set transport fees and charges. The following instruments have been used successfully to reduce car traffic and emissions, and raise funding for local public transportation infrastructure:

- Congestion charges are fees for road use that are applied exclusively or more intensely during peak traffic periods. Congestion charges have reduced air pollution, including a decrease in carbon dioxide emissions of up to 19.5% in the cities where they have been introduced (Beevers and Carslaw, 2005) (Table 4.2). Higher polluting vehicles may be charged at higher rates (as in Singapore and Milan), which more closely ties the congestion charges to greenhouse gas reduction goals. Some cities (e.g. London) use the revenue from congestion charges to finance urban public transport (see also Box 3.4 in Chapter 3).

Table 4.2. **Impacts of selected urban congestion charging schemes**

	London	Stockholm	Singapore	Milan
Introduced	2003	2006	1975-1998 (2nd generation)	2008
Reduction in CO_2 emissions (%)	19.5%	13%	n.a.	9%
Period of effect	2002-2003	January-July 2006	n.a.	January-December 2008
Other effects	Reductions of emissions (NOx, PM10), car traffic	Reductions of emissions (NOx, CO, PM10), vehicle passages	Reductions of car traffic and the share of travel done by car	Reductions of emissions (PM10, NOx) and traffic volumes

Notes: PM10 = particulate matter; NOx = nitrogen oxides; CO = carbon monoxide.

Source: OECD (2010), *Cities and Climate Change*, OECD Publishing, doi: *10.1787/9789264091375-en.*

- Variable parking fees and taxes can reduce car trips and encourage public transport use (OECD, 2010a). Parking fees can even more effectively discourage car use by charging higher rates in congested areas or during peak hours (as in Los Angeles and New York City). The revenue can be used to finance public transport.
- High occupancy toll (HOT) lanes encourage carpooling by charging a toll on vehicles with less than a minimum number of occupants (usually two or three). The effectiveness of HOT lanes is mixed, considering the relatively high costs of collecting tolls: for example, a major HOT lane in Los Angeles has operating expenses totalling 27% of gross revenues (Dachis, 2011).

How can utility fees be designed to promote urban green growth?

Water, waste and energy fees should be used to signal the scarcity of the resource being consumed. This will discourage resource consumption and waste generation, which can in turn increase efficiency and revenues. Many local governments already do link fees to actual consumption of water and energy and generation of waste, but many others could strengthen this link to promote conservation and reduce waste. Fees tied to resource consumption or waste generation can fund service delivery and infrastructure improvements, although this is best considered as part of a funding package that also includes taxes and transfers.

How can national policies create the right incentives?

As noted above, national government policies can support or undermine local green development. The following national policy actions can encourage infrastructure investment by cities in line with sustainable development and green goals:

- Remove national obstacles to local incentives. National regulations may in some cases constrain local governments' ability to act. For example, several countries (e.g. Denmark) require cities to seek national government approval to use revenue from congestion charges, as they are considered new taxes. Strengthen local authority to act. National governments could also introduce requirements and standards for infrastructure cost recovery by municipalities (e.g. Netherlands).

- Compensate cities for environmental service provision and the opportunity costs of environmental preservation. A large share of many cities' revenues comes from development rights, building permits and the income related to new development. When green growth policies reduce the amount of new development, cities may lose an important revenue source. Some national governments have begun to compensate local governments for these opportunity costs by revising their grant allocation formulas to account for environmentally-protected municipal land.
- Provide specific-purpose and matching grants to align local action with national green growth and sustainable development goals. Green urban infrastructure investments are often public goods with effects beyond local governments; intergovernmental grants would therefore have to internalise these externalities, which can be done through specific purpose grants. A way to align national and urban green objectives consists of matching grants, which depend on co-funding by the local government that receives the grant. This reduces the marginal cost of investment for local governments and therefore increases the level of infrastructure they are willing to provide. For example, Portuguese national grants reward municipalities for designating Natura 2000 sites and other protected areas within their boundaries, representing 5% of all money allocated through this grant. Several Brazilian states allocate state tax revenues to municipalities based in part on the amount of land they set aside for environmental protection (OECD, 2010a).

Mobilising private finance for green infrastructure

Private financing can fill the funding gap for many urban green infrastructure projects. However, this requires three preconditions: a market for green urban investment projects, good returns on investment and limited risk. It is not possible to engage the private sector if there is no market for urban green projects; and if there is a lack of appropriate projects, the size of the market might be too small. In deciding on their investment portfolio, each private investor considers the trade-off between projected return on investment and risk. To gain the interest of private investors, urban green infrastructure projects need to be marketable and promising with regard to returns and risk, involving high potential yields or limited risk, or both.

Relatively limited market size might pose a challenge for private financing of urban projects. The potential market for urban green investment projects is small and fragmented. Attracting private investment, such as through large loans or issuing of bonds, often requires the assistance of intermediaries or banks, which are sensitive to economies of scale. Small investment projects can mean prohibitively large transaction costs. With less frequency of investment projects at the city level than at the country level, capacity building for attracting private finance and contract negotiation for small urban development is also more challenging. This will be less problematic for large metropolitan areas, but smaller cities might benefit from pooling projects and capacity when mobilising private finance.

The relatively high cost of clean technologies can make them appear less attractive as an urban investment to private investors. Returns on green urban investment are often lower than other investment options. In many sectors, clean technologies are still being developed, and the negative externalities of dirty

industries are not always taken into account; this means that the private sector may favour dirty technologies and sectors. In the energy sector, for example, only a limited number of countries have introduced carbon taxes to internalise negative externalities of fossil fuels, while many countries still have fuel subsidies that stimulate fossil fuel consumption. As a result, the costs of generating energy from coal or natural gas are still considerably lower (up to five times depending on the technology) than from renewable energy sources, even if the price of clean energy seems to be dropping quickly (WEF, 2010). The benefits of clean technologies tend to spill over to other actors beyond the investors, leading to under-investment in clean technologies from a societal point of view. Policy must take this spill-over into account.

The high risk associated with newer technologies can also reduce financing options for urban green projects. Risk profiles vary according to the technology and its stage of development; the technology development stage determines which type of financing is most appropriate. For example, venture capital financing is generally suited for unproven and untested technologies, while project finance is used for mature technologies, such as wind and solar power. Government-supported policies thus need to be tailored to the stages of a technology's development. Financing methods also depend on the project phase. This means that urban green projects with high capital intensity and high technology risk will be most difficult to finance.

In these contexts, several instruments can attract private finance for urban green infrastructure, discussed in more detail in the sections which follow:

- public-private partnerships (PPPs), whereby the long-term risk is transferred to the private sector;
- the use of development charges and impact fees to get property developers to pay for the infrastructure needed to connect new development to existing infrastructure (discussed in more detail above);
- loans, bonds and carbon finance could all be used more to attract private finance.

How can public-private partnerships fund urban green growth investments?

Public-private partnerships (PPPs) are broadly defined as long-term contractual agreements between a private operator/company (or a consortium) and a public entity, under which a service is provided, generally with related investments (Saussier et al., 2009). The notion of public-private partnerships is multifaceted and covers a wide diversity of contractual agreements characterised by different risk-sharing and financing schemes, as well as different organisational forms – from management contracts to the private finance initiative (Box 4.1; OECD, 2008). Fundamental to this funding approach is the private partner's long-term relationship with the public partner and assumption of some investment risk. The type of PPP arrangement determines the private operator's level of participation, exact role and involvement in the project's different stages (design, completion, implementation and/or funding). Unlike traditional public sector procurement, where the private contractor simply designs and/or builds what the public sector orders, PPPs involve a process in which private operators bid for a contract to design, finance and manage the risks involved in delivering public services or assets. In return, the private

contractor receives fees from the public body and/or user tolls for the long-term operation and maintenance of the asset.

Box 4.1. **Types of public-private partnerships**

Two families of PPPs – concessions and private finance initiatives (PFIs) – differ according to how the private operator is remunerated. For concessions, payments are usually made by users or are substantially connected to the number of users (e.g. shadow tolls). As a consequence, the private operator bears the demand risks because revenues are directly and substantially connected to the consumption level. In contrast, payment for PFIs is based on making the infrastructure available and is usually affected by the capabilities of the operator to meet performance targets. Consequently, the demand risk is more extensively transferred in concessions than in PFIs.

Public-private partnerships can be either solicited or unsolicited, depending on who initiates the project. For a solicited project, the competent authority (central or local government) identifies a potential PPP project and solicits proposals from the private sector. For an unsolicited project, the private sector identifies a potential PPP project and requests designation of the project as a PPP from the competent authority. In this case, the concessionaire is selected under a competitive bidding process, although the initial proponent (the private actor who proposed the project) may obtain extra points in the bid evaluation. Not all countries accept unsolicited project initiation, but the following countries have participated in this type of PPP: Chile, India (sub-national), Pakistan, Philippines, Russian Federation (sub-national), United States (sub-national), and South Africa. Solicited projects cost governments considerable time and money to initiate, whereas unsolicited projects benefit from the efficiency of the private sector and their assumption of associated costs and risks. As a result, in countries where both solicited and unsolicited projects exist (e.g. South Korea), unsolicited projects may be favoured. Unlike unsolicited PPPs, however, solicited projects can be implemented in line with a government's overall infrastructure investment plan and priorities. For this reason, the government of South Korea has recently made efforts to promote more solicited projects.

Source: Merk, O., S. Saussier, C. Staropoli, E. Slack, J.-H. Kim (2012), "Financing Green Urban Infrastructure", *OECD Regional Development Working Papers 2012/10*, OECD Publishing, doi: *10.1787/5k92p0c6j6r0-en*.

Cities often use PPPs to achieve their green infrastructure objectives. The C40 Climate Leadership Group (a global network of 40 large cities committed to reducing greenhouse gas emissions) has identified a list of "best practice" projects for green cities. Several of these are governed through PPPs (Table 4.3). The different types of contracts indicated for the PPP projects show the diversity of contractual practices among these various cases. Considering this diversity, it is difficult to draw general conclusions about the efficiency of PPPs: much depends on the institutional, technological and economic circumstances.

Table 4.3. **C40 best practice projects for green cities**

	Activity	City	Country	Governance
Transport	Bicycle sharing	Paris	France	PPP
		London	UK	PPP
		Barcelona	Spain	PPP
		Oslo	Norway	PPP
		Lyon	France	PPP
		Stockholm	Sweden	PPP
		Brussels	Belgium	PPP
		Seville	Spain	PPP
		Dublin	Ireland	PPP
		Copenhagen	Denmark	NGO
	Bicycle paths	Bogota	Columbia	In-house
	Congestion charge	Stockholm	Sweden	Procurement
Energy	Renewable energy supply	Austin	United States	In-house
		Melbourne	Australia	Procurement
		Rizhao	China	Public
		Barcelona	Spain	Public
	Energy savings	Chicago	United States	In-house
		Copenhagen	Denmark	In-house
		Tokyo	Japan	Public
	Street lighting	Los Angeles	United States	In-house
Building	Energy savings	Berlin	Germany	PPP
		London	UK	PPP
		Stuttgart	Germany	In-house
		Paris	France	PPP
Urban development		Dongguan	China	PPP
Waste	Waste management	Gothenburg	Sweden	PPP
		Sydney	Australia	PPP
		Dhaka	India	NGO
Water	Water distribution	Tokyo	Japan	In-house
		Emefuloni	South Africa	PPP
		Austin	United States	Public

Source: Merk, O., S. Saussier, C. Staropoli, E. Slack, J.-H. Kim (2012), "Financing Green Urban Infrastructure", *OECD Regional Development Working Papers 2012/10*, OECD Publishing, doi: *10.1787/5k92p0c6j6r0-en*.

Urban green PPPs might face challenges if their objectives are to decrease consumption. Such objectives appear incompatible with concession contracts, in which the gains of the private operator are positively linked to the level of consumption. The frequent use of concession-type contracts for water utility contracts in France illustrates this problem: when private operators' payment is based on the amount of water consumed, the objective of conserving water conflicts with the operator's objective of increasing earnings (Box 4.2).

Box 4.2. **Beyond concession contracts for sustainable water services**

The private sector provides water services to 75% of France's population. France is one of the three countries worldwide (along with Chile and the United Kingdom) with the highest share of private sector provision in this sector. Some municipalities would like to achieve environmental targets such as reduced water losses, improved resource protection and reduced consumption. However, the contracts that allow municipalities to partner with private operators are concession or lease contracts, both of which base payment to operators on the volume of water consumed. This clearly undermines their willingness to reduce water consumption. A new paradigm is therefore necessary, and there are many options. For example, concession and lease contracts could be replaced with PFIs, in which operators are paid through their capacity to reach quality targets (e.g. volume reduction of water consumption). Mixed payments provide another alternative: consumers pay for water services, while citizens' taxes cover costs of other services that benefit the whole of society (e.g. resource protection, leakage reduction). Thus, a continuum of PPPs is possible, which mixes concessions and PFIs.

Source: Merk, O., S. Saussier, C. Staropoli, E. Slack, J.-H. Kim (2012), "Financing Green Urban Infrastructure", *OECD Regional Development Working Papers 2012/10*, OECD Publishing, doi: *10.1787/5k92p0c6j6r0-en*.

Green projects face high uncertainty regarding technological and legal developments. In most standardised PPPs, project technologies are built in or traditional, and market-tested throughout the long-term and repeated government procurement processes. However, some green technologies, including resource recirculation or renewable energy technology, are new and less verified in the field. Sometimes, they need to be modified to meet new environmental or energy-saving criteria. New technologies are less likely to be acceptable to project developers or financial investors, since they are more vulnerable to various risks such as technology failures. Limited experience with green PPPs increases the level of uncertainty in the processes of project design, implementation, financing, operation and maintenance. For this reason, cities like Amsterdam have introduced forms of co-operation that aim to promote knowledge exchange between the different actors involved in green finance (Box 4.3).

Box 4.3. **Amsterdam's Green Finance Lab**

The Green Finance Lab is an initiative of the City of Amsterdam and the Dutch bank ABN AMRO. It forms part of the Amsterdam Sustainability Programme and a Green Deal between the City of Amsterdam and the Dutch national government. The Green Finance Lab aims to find new financing mechanisms for realising the transition towards a sustainable metropolis (including environmental services, energy, water, raw materials and transportation). The lab serves as a forum for stakeholders from different sectors (public, private, NGO and research) to develop new financial solutions for sustainability challenges. In 2011, the first lab focused on financing green areas around Amsterdam, followed in 2012 by the organisation of "chambers" for sponsorship, donations, private investment zones and value capture finance. Each chamber brings together entrepreneurs (from the private, social or public sector) and investors. These entrepreneurs frame their proposals in parameters that give maximum information to investors (e.g. cash flow, risk management), while investors comment, coach and help search for innovative solutions if conventional mechanisms fall short.

Source: Merk, O., S. Saussier, C. Staropoli, E. Slack, J-H. Kim, (2012), "Financing Green Urban Infrastructure", *OECD Regional Development Working Papers*, 2012/10, OECD Publishing, doi: *10.1787/5k92p0c6j6r0-en*.

This uncertainty makes for a complex trade-off between flexibility and rigidity in contracts. The more complete a contract is, the more likely costly renegotiations can be avoided. However, completeness also means rigidity. In a complex and uncertain environment, contracts need flexibility rather than rigidity, to be adaptable to unanticipated contingencies and open to incorporating new incentives for co-operative behaviour. However, less complete contracts do not protect against opportunistic behaviour by the public body or the private partner. The often high uncertainty of green projects thus increases the need for flexibility and, as a consequence, the insecurity and instability of PPP relationships under permanent threat of opportunism.

In the context of technological evolution, PPPs may sometimes be too rigid: if they cannot easily incorporate new technologies during the life of the contract, they lose their comparative advantage over internal public solutions and traditional procurement. Thus, PPPs may not always be a good candidate for green projects with strong technological components. Some national governments (e.g. South Korea) have put packages in place to stimulate urban green infrastructure PPPs by taking away some of the risks and uncertainty (Box 4.4).

Box 4.4. **National incentives for green infrastructure PPPs: The case of South Korea**

The national government of South Korea launched its First Five-Year Action Plan for Green Growth in 2009. This has promoted various kinds of financial and tax incentive policies to facilitate green infrastructure PPP financing. These include:

- Construction subsidies: According to the PPP Act, the government may grant a construction subsidy to the concessionaire if it agrees to maintain the user fee at an affordable level. The timing of the subsidy is determined during the concession agreement and depends on the concessionaire's equity investment plan. The timing of the distribution reflects the completion level of the project and the schedule and scope of equity investment. The amount of subsidy is determined in each individual concession agreement. When announcing a project, the government discloses an approximate ratio of the construction cost that it is willing to subsidise. The exact ratio of subsidy to construction cost is determined through consultation and is stipulated in the concession agreement. As a result, the amount of subsidy varies for each project. The government has set a subsidy guideline for road projects of 20%-30% of the total project cost. It has set a subsidy guideline for railway projects of up to 50% of total project cost. The ratio of subsidy to construction cost for environmental projects is stipulated by law (50% to 80%) and included in the government's public notification. Generally speaking, green-oriented projects are eligible for larger subsidies than other projects.

- Compensation for base cost: The government assumes a portion of investment risk. This risk is limited to what the government's costs would have been in the case of a public-financed project. The government payment is made for the amount of shortfall in the actual operational revenue compared to the share of investment risks by the government.[1] When the actual operational revenue exceeds the share of investment risks, government subsidies are redeemed on the basis of and within the limit of the amount previously paid. On the part of the private participant, subsidies are provided only when the actual operational revenue surpasses 50% of the investment risk.

Box 4.4. **National incentives for green infrastructure PPPs: The case of South Korea** (*cont.*)

- Infrastructure Credit Guarantee Fund (ICGF): Since 1994, the ICGF has provided credit guarantees to concessionaires who want to obtain loans from financial institutions for PPP projects. According to the PPP Act, the ICGF is managed by the Korea Credit Guarantee Fund. The ICGF consists of annual government subsidies, guarantee fees and investment returns. When the project guaranteed by the ICGF defaults, the ICGF subrogates on behalf of the project company. Additional government contribution can be granted if the funds are insufficient. The limit of the credit guarantee per concessionaire is KRW 100 billion, but in cases where the director of the management institution considers it necessary, the limit may be raised to KRW 200 billion. The guarantee fee will have a maximum annual fee rate of 1.5%.
- Tax incentives: To facilitate infrastructure financing, the government provides tax incentives that are stipulated in the PPP Act. Details of the tax incentives are also included in the PPP Basic Plan in four categories: special taxation, corporate tax, local tax and exceptions from charges. The PPP Act directs the government to enact special taxation for infrastructure bond, value-added tax, foreign investment zone, and infrastructure fund. A separate taxation rate of 14% is applied to the interest revenue from infrastructure bonds. A 0% tax rate is applied for the value-added tax for infrastructure facilities or construction services. Reduction of and exemption from taxes, including corporate tax, income tax, acquisition tax, registration tax, and property tax, are applied to foreign investment in the foreign investment zone. With respect to the dividend income distributed for the infrastructure fund, a 5% tax rate is applied to the dividend income from the equity investment portion up to KRW 300 million and a 14% tax rate is applied to the dividend income from the equity investment portion exceeding KRW 300 million. Local tax exemptions for PPP projects, which include an exception for three times the registration tax within the capital region and an exemption from acquisition and registration tax, are included as well.[2]

Notes: 1. Share of investment risks is the amount of operational revenue that guarantees the internal rate of return comparable to the government bond's rate of return on the private sector's capital. 2. The capital region includes the city of Seoul and Kyonggi province.

Source: Merk, O., S. Saussier, C. Staropoli, E. Slack, J.-H. Kim (2012), "Financing Green Urban Infrastructure", *OECD Regional Development Working Papers 2012/10*, OECD Publishing, doi: *10.1787/5k92p0c6j6r0-en*.

What are the conditions for successful public-private partnerships?

PPPs may help increase public awareness and expand the diversity of stakeholders in green city development. Creating a favourable environment for private sector participation by strengthening cash flow from concessional loans and grants may contribute directly to the establishment of new green projects, resulting in the realisation of projects that could not be pursued with traditional government procurement alone. Private firms can not only implement corporate social responsibility by participating in green projects, they can also create markets for green products by facilitating a better investment environment. Although most green projects are highly uncertain, PPP diversifies business risks and stakeholders by promoting joint public-private activities. It enables the implementation of large infrastructure projects too costly for either the public

or private sector to pursue on its own. Because all participating agencies make joint contributions to increasing resources by collaborating with the private sector, more green projects can take advantage of government subsidies and public funds, with risks distributed more evenly among the participants.

Competition and expertise within the private sector can enhance the efficiency and effectiveness of green public investment under PPP. Since PPP enables the efficient undertaking and operation of large projects related to the green economy throughout competitive bidding and concession contracting processes, it has been adopted to support projects more amenable to private sector participation. The public and private sectors have been co-operating in a wide range of areas based on the accumulation of experience by the private sector in green investment. The PPP is expected to improve the conditions for businesses' entry into the market and facilitate capacity building. Enhancement of efficiency and effectiveness, however, requires well-designed, well-implemented concessions and related government regulations, and depends on several conditions:

- Effective partnerships: Unlike traditional procurement for assets or services, which uses shorter-term contracts to acquire or renovate public assets, a green PPP is a global contract, which may last for between 15 and sometimes more than 90 years. Establishing a real partnership based on co-operation, expertise and credible commitment is essential and requires a different approach than shorter contracts. For complex green PPPs in particular, the public body must also acquire the internal knowledge and expertise necessary to define the terms of the agreement.
- Interaction and negotiation: Interaction and negotiation with one or several operators during the call for bidders can clarify the objectives of the partnership and offer innovative technological solutions not yet envisioned by the public body. This interaction in the bidding phase is especially helpful for green PPPs negotiated in an uncertain environment with complex technologies that vary in their speed of obsolescence. In order for this phase to be efficient, the public body must gain enough expertise and generate sufficient competition to challenge private partner candidates.
- Clear environmental objectives: Weight must be given to environmental objectives in the procedure to award PPP projects. Adding green requirements to the project specification after PPP design will be costly and problematic (e.g. incompatible with the technological choices put in place). In addition, environmental targets must be measurable and clearly defined, with approaches for *ex post* monitoring explicitly described in the contract. Since most of these methods and protocols evolve over time (due to changes in both innovation and demand), they should also be adaptable.
- Flexibility: Discussion with private operators for a green PPP should focus on efficient and flexible solutions that allow for a speedy response to changing requirements and new technologies. This is an option-value trade-off that might increase costs. In addition, the contract should describe and anticipate how relationships will evolve in response to unanticipated events (e.g. renegotiation and termination procedures).

Where feasible, PPPs could be designed so that operators are paid solely on their ability to achieve environmental targets. This arrangement would send a clear signal about the willingness of the city to favour green aspects in bid selection. The private

operator would also have greater incentives to take green commitments seriously. In this case, the selection of the best candidate should be based not on one single criterion (e.g. price), but on the economically most advantageous criteria such as whole life costs, quality, deliverability, flexibility, innovation and level of risk transfer. However, given the higher costs involved, the willingness and capacity of cities to enter into this game remains an open question.

How can contributions by developers fund green growth in cities?

Requiring project developers to pay for infrastructure

Development charges (discussed in section "City revenues: Getting the financial incentives right for green growth" in Chapter 4) are appropriate for financing infrastructure in areas experiencing new growth or redevelopment, but not applicable to maintenance and replacement of old services. Municipalities across North America levy development charges or impact fees to pay for infrastructure in new developments.[5] Municipalities in Asia make extensive use of value capture taxes, aimed to seize part of the value increases of real estate due to new nearby infrastructure development.

Historically, municipalities have required developers to provide or pay for on-site services, such as streets, street lighting, sidewalks and other public facilities within the subdivision. Subdivision agreements between the municipality and developer require the developer to take responsibility for providing (or funding) these services to meet municipal specifications as a condition of subdivision approval. Over the last 30 years, municipalities have extended the responsibility to developers to pay for the off-site costs associated with new development. These growth-related costs have traditionally included "hard" costs for roads, water and sewage systems and, in some jurisdictions, "soft" costs for services like libraries, recreation centres and schools. The rationale for charging developers for off-site growth-related costs is that "growth should pay for itself" and not be a burden on existing taxpayers (Slack, 2002).[6]

Several studies investigating who ultimately pays the development charge conclude that who bears the burden – the new homebuyer, developers or pre-development landowners – depends to a large extent on the demand and supply conditions in the market for new housing (Slack and Bird, 1991). Most studies conclude that, over the long-term, development charges are borne by the new homebuyer. In some cases, the predevelopment landowner, or some combination of the homebuyer, predevelopment landowner and the developer, may bear the cost. To the extent that the new homebuyer bears the cost, the beneficiaries of the infrastructure pay for it.

Capturing value connected to infrastructure investment

Developers can also pay for sustainable transport infrastructure by capturing the value increases resulting from new public infrastructure investment. Countries have had mixed success with this method: Singapore, for example, has made ample use of such instruments to finance infrastructure, but Poland has experienced difficulties implementing similar instruments (Box 4.5).

Urban green infrastructure can also be financed by local businesses, for example via business improvement districts (BIDs). Originally invented in Ontario, Canada, BIDs have been widely used in the US and Europe since the 1960s. This mechanism helps to finance and manage improvements to commercial and industrial environments based on

the agreement by a majority of businesses (either land owners or tenants) to accept an additional levy. Once a district is established, revenue is available through long-term debt for capital investment. Initially, BID resources often support additional safety and sanitation services, but they can develop into much more sophisticated investments and initiatives, such as joint promotional initiatives. The district governing board, usually consisting of city government and private business representatives, can tap into a host of financing methods for district improvement. The boundaries of such districts are usually a contiguous commercial or industrial area within a central city location, though they can also be effectively used in suburban and ex-urban industrial locations. In cases of multiplicity of fragmented jurisdictions at the local level, coupled with multiple tax rates and fiscal systems, BIDs have become an attractive new addition to local fiscal and management instruments. BIDs are only workable when there is a critical mass of businesses willing to pay for particular services. They are also good tools for tightly bound, reasonably healthy commercial and industrial centres that are densely populated by the owners/users. However, BIDs are less effective in areas that are more spread out or have a high degree of mixed land use, where it is harder for the payer to capture the benefits of targeted improvements in services.

Box 4.5. **Lessons from betterment levies in Poland**

Poland is one of the few OECD countries with a mechanism intended to capture windfalls due to planning decisions. The levy is assessed through a parcel-by-parcel appraisal, in order to determine the real value increase attributable to a new or revised plan. The municipalities administer the levy and keep its revenues. Another financial instrument using land values in Poland has been the "adjacency levy", based on the market value increase of land resulting from the installation of local public infrastructure (e.g. roads, sewers, water supply and other utilities). The law permits local authorities to set levy rates of up to 50% of project costs. Most local governments have adopted the levy.

In practice, assessing the incremental land value created by local plans or public improvements, such as new infrastructure provision, has proved to be very difficult. Special appraisers were hired to estimate before-and-after land values, parcel by parcel, within improvement districts designated by the local government. However, the Supreme Administrative Court set aside many of the appraisers' decisions, finding wrongful determination of land-value gains. Administrative costs were high, running to as much as 30% of revenue collections. A case study of Szczecin, a city in the north-west of Poland with approximately 400 000 inhabitants, found that only 26 land parcels were assessed for land-value gains and that the total amount of revenue collected was equal to 0.6% of public infrastructure investment in the areas designated as improvement districts. The betterment statute was annulled after less than a year, primarily because the controversy over land-value determination outweighed the revenue generated (Gdesz, 2005).

The disappointment over the betterment levies in Poland reflects a tendency worldwide to abandon parcel-by-parcel betterment levies. Countries that continue to use some sort of betterment levy, such as Colombia, have transformed it from parcel-by-parcel estimates of land value gains into a citywide bundle of public works projects, financed in part through a citywide fee, broadly differentiated by benefit zone and other factors (Peterson, 2009).

Source: Merk, O., S. Saussier, C. Staropoli, E. Slack, J.-H. Kim (2012), "Financing Green Urban Infrastructure", *OECD Regional Development Working Papers 2012/10*, OECD Publishing, doi: *10.1787/5k92p0c6j6r0-en*.

Loans, bonds and carbon finance

Broader access to loans and bonds could help to mobilise finance for green urban investment. Bonds provide institutional investors, such as pension funds with stable yields and limited risks. Urban green infrastructure investments currently use both to a limited extent, but they could be leveraged more often for infrastructure investments (Della Croce et al., 2011). There is a relationship between access to borrowing and cities' own revenue sources: the more revenue sources a city has, the higher its perceived repayment capacity, and thus the greater its access to debt markets, including loans.

Local governments' access to private loans could increase as long as sound local financial management practices are in place. Some OECD member states' fiscal rules may ban local governments from borrowing or issuing bonds; while others constrain the size of municipal budget deficits or debt levels. In most OECD countries, local governments are only allowed to borrow to finance investment (the golden rule for debt financing). In some countries, only long-term borrowing is limited to investment, while short-term loans may be used to finance operating expenditures. Local borrowing is also subject to prudential regulations, based on debt service and repayment capacity. In most countries, collateral restrictions exist for debt issuance. As a result of all these constraints, local governments generally have a low debt-to-GDP ratio; only in a few OECD countries (e.g. Denmark, Iceland, Italy and the Netherlands) does the stock of local government liabilities reach 10% of GDP or more. However, sound local financial management practices could limit the perception of fiscal irresponsibility that underlies many of the constraints on sub-national access to borrowing.

Green bonds

Green bonds (Box 4.6) are promising vehicles for cities to attract private finance and provide a channel for directing institutional investor capital towards green projects (Della Croce et al. 2011). Institutional investors, such as pension funds, invest in infrastructure. For example, the Ontario Teachers' Pension Plan owns a subsidiary that runs container port terminals in Vancouver and New York/New Jersey; and other Canadian pension funds are not only funding, but also running toll roads in major cities in Australia and the US. Institutional investors in OECD member countries seek long-term investments with steady yields and limited risks; their portfolios are thus dominated by bonds, accounting for half of total assets under management in OECD pension funds. The share of bond investment in green infrastructure is currently small, and even smaller for green urban infrastructure, but three promising models exist:

i. Multilateral development banks: banks like the World Bank have started to fund green bonds. To ensure returns, the World Bank's green bonds are structured with standard financial features, such as an AAA credit rating. Urban green investment projects are estimated to make up 20% to 25% of the green bond portfolio.[7] Other development banks have created similar instruments: the European Investment Bank has Climate Awareness Bonds for financing green projects in several cities, such as district heating in Paris.

ii. US green bonds: Unlike many other countries, the US has a well-developed market of tax-exempt local bonds that can substantially help finance cities. These include Clean Energy Renewable Bonds, Qualified Energy Conservation Bonds, Property Assessed Clean Energy Bonds and Build America Bonds (Della Croce et al., 2011). Some cities, such as Chicago, have developed their own green bond programme for energy efficiency and renewable energy goals.

Such programmes, however, are only viable for cities that have credit ratings similar to the national credit ratings; if not, a national programme would make more sense.

iii. Climate-specific institutional investors groups: Several institutional investors have grouped together to form climate change groups (e.g. Institutional Investors Group on Climate Change and the Investor Network on Climate Risk). They are creating their own financing packages, such as climate bonds, and could potentially be interested in urban sustainability projects.

Box 4.6. **What are green bonds?**

Green bonds are fixed-income securities issued to raise the necessary capital for a project that contributes to a low-carbon, climate-resilient economy. While green bonds can be issued by governments, multilateral banks or corporations, most to date have been issued as AAA-rated securities by the World Bank and other multilateral development banks, such as the European Investment Bank (EIB) and the Asian Development Bank (ADB). Green bonds have been designed to attract capital from institutional investors, or as a means for governments to direct funding to climate change mitigation. The current market size for all green bond issuance – approximately USD 15.6 billion – is still marginal (0.017%) compared to the capital held in global bonds markets.

Source: Merk, O., S. Saussier, C. Staropoli, E. Slack, J-H. Kim (2012), "Financing Green Urban Infrastructure", *OECD Regional Development Working Papers 2012/10*, OECD Publishing, doi: *10.1787/5k92p0c6j6r0-en*.

Green bonds are most promising when cities and national governments co-operate. Cities generally have lower credit ratings than their respective national governments, as their default risk is considered to be higher (Canuto and Liu, 2010). When cities and local governments issue green bonds, investors look for risk compensation. Some form of urban-national co-operation is thus required in order for green bonds to be a viable option for cities. For this reason, the US federal government financially supports municipal bonds (through tax exemptions and subsidies). For cities in low and middle-income countries, the World Bank offers green bonds as part of project financing within a country's assistance portfolio; co-operation with national governments is therefore necessary.

Green infrastructure banks can also help solve market failures and the challenge of limited market size. These development banks serve to unify finances and distribute funding at the national or local level for projects like waste infrastructure or water treatment. Development banks like the Green Investment Bank (GIB), set up by the UK, may offer financial benefits such as technical assistance or a lengthened loan repayment period. For this purpose, the UK Government has unified local government spending into a lump sum of GBP 100 million to invest in smaller waste infrastructure projects (typically in the range of GBP 15-25 million), on a fully commercial basis. The waste infrastructure projects will be transacted initially through specialised fund managers experienced in this sector in order to ensure that government funds are deployed on equal terms with private capital. The bank manages the full procurement process of these types of loans and investments. Another example is the Chicago Infrastructure Trust, set up in 2012 at the city level.

Carbon finance and carbon markets

Cities could take better advantage of opportunities provided by carbon finance (Clapp et al., 2010). Two greenhouse gas offset mechanisms were put in place by the Kyoto Protocol under the United Nations Framework Convention on Climate Change (UNFCCC): the Clean Development Mechanism (CDM) and Joint Implementation (JI). These could be sources of revenue for greening metropolitan areas. The CDM allows developed countries to purchase certified carbon credits from approved emission reduction projects in developing countries, and JI allows them to be purchased from emission reduction projects in other developed countries. In addition, voluntary carbon markets can be used to put a price on carbon, independent of any national emissions cap. Another option is to use domestic carbon offsets as an incentive mechanism, by agreement between local and national governments; in this case national governments could agree to pay local governments for emission reductions achieved by local policies, thus assisting with the achievement of national mitigation targets.

However, to date the participation of cities and urban mitigation projects in the global carbon markets remains extremely limited for the following reasons (Clapp et al. 2010; World Bank, 2010):

- limited autonomy of urban authorities to directly regulate greenhouse gas emissions;
- limited budgets and access to start-up capital;
- limited institutional and technical capacity;
- difficulties in measuring the effects of urban mitigation projects with existing methodologies and lack of standardised methodologies (e.g. for greenhouse gas inventories at the urban level);
- small scale of municipal-level greenhouse gas reduction initiatives (e.g. improving the efficiency of street lights) that do not warrant the transaction costs of pursuing carbon finance;
- lack of support from national governments.

Overcoming these barriers could help cities to make more use of carbon finance. Cities' future use of these instruments must be integrated into urban planning and financial frameworks so that carbon financing, if and when available to support urban mitigation projects, also contributes to the broader urban sustainability agenda.

Notes

1. The multi-level governance framework has been adapted for green growth with the addition of the "market gap" to take into account the potential disconnect between public policy objectives and market conditions.
2. A 2012 survey of 53 global city governments indicated that only about 20% have a co-ordinated strategy for green growth (LSE/ICLEI, 2012).
3. Effective property tax rates are calculated as total property tax revenues divided by the market value of properties.
4. Municipalities in British Columbia can only levy development cost charges for roads, drainage, sewers, water and parkland. The City of Vancouver, under its own legislation, can also levy for affordable housing and day care facilities.
5. In Canada, development charges are also referred to as development cost charges and lot levies. In the United States, impact fees are also called development fees, capacity fees, facility fees, capital recovery fees, system development charges, expansion fees, and mitigation fees (Burge, 2010).
6. Other exactions (formal or informal) on the developer are part of the subdivision approval process but are not strictly development charges. These include, for example, land dedications that require the developer to set aside land for roadways, other public works or school sites, or for environmental needs; parkland dedications that require a portion of the land used for development to be set aside for parkland (or a cash payment in lieu of parkland); density bonuses granted to developers (i.e. higher densities than permitted in the Official Plan, in return for meeting conditions such as providing day care or preserving a historic building); connection fees to permit developers to buy into existing capacity of water and sewer facilities; and over-sizing provisions (sometimes called front-end financing) that require developers to provide more infrastructure than is required for their development. The municipality, in some cases, agrees to recover part of the costs on behalf of the developer from future benefitting owners.
7. Personal communication with a spokesperson of the World Bank Capital Markets Department.

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Annex A

Measuring green growth in cities

This annex presents an overview of the indicators currently available to inform green growth policies in cities.

The case studies informing this report have aimed to increase urban policy makers' understanding of which green policies are most likely to contribute to employment growth, urban attractiveness, the local production of green goods and services, and urban land values. However, this report stops short of assessing specific urban green growth policies' impact on economic growth or the environment, as the data to conduct such an assessment still do not exist. This is itself a major problem for urban policy makers: many cities seeking to foster green growth lack reliable, valid metrics for measuring their progress.

Ultimately, any attempt to measure environmental impact at anything lower than a global scale should focus on the environmental impact of consumption rather than of production, owing to the presence of international trade. In many developed countries, for example, falling carbon intensity of GDP and lower emissions of other environmental "bads" in recent decades have been driven in large measure by structural changes such as the shift from manufacturing to services. As a result, the carbon intensity of production in those countries falls, while the carbon intensity of consumption rises, as they import an increasing share of the energy-intensive goods they consume. Yet data on the carbon intensity of consumption are scarce even at the national level; at the urban level they are even more limited or non-existent.

This means that the effects of green growth policies can only be measured using data and indicators that at best do not present the full picture and at worst may distort it. With these limitations in mind, this annex presents a preliminary set of indicators that may be used to track urban areas' progress towards fostering green growth. This indicator set is focused on local environmental performance rather than the global environmental impact of local consumption, but the indicators presented represent an important first step and are in many cases the best currently available. Provided policy makers are aware of their limitations, they remain potentially useful for informing policies *ex ante* and evaluating them *ex post*. In addition to providing an overview of existing green growth indicators, the annex explains why indicators specific to urban areas are needed. Finally, drawing on the framework developed by the OECD in *Towards Green Growth: Monitoring Progress* (OECD, 2011a), it presents a preliminary set of indicators to monitor urban areas' socio-economic growth, environmental impact, economic opportunities and policy responses.

The context for a new set of indicators

What urban environmental indicators already exist?

A number of international urban indicator sets include environmental elements. Seven indicator sets stand out (Box A.1). Many of the same environmental indicators can

be found in each of the indicator sets, but are often defined differently (Table A.1). The number of indicators in each set ranges from 10 in the European Common Indicators initiative to 474 in the Eurostat Urban Audit (OECD, 2011b).

Table A.1. **Most common environmental topics in urban indicator sets**

Theme	Common environmental topic
Land use	Size and growth of built-up area Amounts and accessibility of public green and open space
Urban air	Frequency of exceeding air quality standards Emission of air pollutants by source
Water use	Water consumption *per capita* Connection rates to the supply network, service interruptions and quality of drinking water
Urban water quality	Connection rates to wastewater treatment and degree of treatment Bathing water quality
Waste management	Generation and disposal of municipal solid waste Recycling rates
Transport and traffic	Modal split Network length of public transport systems
Climate change and energy	Carbon emissions Intensity of energy and electricity consumption, by sector
Environmental health	Number of residents exposed to noise
General, awareness and behaviour	–

Source: OECD (2011), "Urban Environmental Indicators for Green Cities: A Tentative Indicator Set", Working Party on Environmental Indicators, ENV/EPOC/WPEI(2011)6, OECD, Paris.

Box A.1. **Seven urban indicator sets**

- The **Urban Audit** is a collection of quantitative information on the quality of life in European cities. It is a joint effort by the Directorate-General for Regional Policy of the European Commission and Eurostat to provide reliable and comparative information on selected urban areas in European Union countries. The second full-scale Urban Audit took place between 2006 and 2007, and involved 321 European cities in the 27 countries of the EU, along with 36 additional cities in Norway, Switzerland and Turkey. Data collection currently takes place every three years, but annual data collection is being planned for a smaller number of targeted variables. An extensive methodology manual has been published (European Communities and Eurostat, 2004). An Urban Atlas accompanies the Urban Audit and was first released in 2009 to 185 cities, including all EU capitals and a large sample of large and medium-sized cities participating in the Urban Audit. Full coverage of all EU countries was expected to be available in 2011.
- The **European Common Indicators** were developed in 2003 (Ambiente Italia Research Institute, 2003) on the initiative of the European Commission and are focused on monitoring environmental sustainability at the local level. A set of 10 environmental sustainability indicators were developed in conjunction with stakeholders, and methodologies for collecting the data for each indicator have also been produced in different European languages. The intention was for participating cities to be able to publish and compare their data with those from other cities via the European Environment Agency's "EnviroWindows" web site, but as of February 2011, no data appear to have been made available. Notwithstanding this lack of uptake, the indicator definitions and the associated methodologies remain of interest for green cities.

Box A.1. **Seven urban indicator sets** (*cont.*)

- The **Global City Indicators Facility** (GCIF) is a decentralised, city-led initiative that enables cities to measure, report and improve their performance and quality of life, facilitate capacity building, and share best practices through an easy-to-use web portal. The GCIF also aims to enhance city government accountability to the public and it has a strong focus on the performance of city public services, including those for water supply, waste water and solid waste. Environmental quality of life is described by one indicator only (PM_{10}). Methodology sheets for each indicator have been developed, and an ISO (International Organization for Standardization) standard for city indicators is in development. The GCIF was initiated by the World Bank in 2008 and is now run by the Global City Indicators Facility, based at the University of Toronto, which oversees the development of indicators and assists cities to join the programme. As of early 2011, more than 125 cities worldwide were participating in the programme.
- The **Quality of Life Reporting System** (QOLRS) is run by the Federation of Canadian Municipalities (FCM), which monitors and reports on social, economic and environmental trends in Canada´s largest cities and communities. The QOLRS is a member-based initiative. Starting with 16 municipalities in 1996, the QOLRS has grown to 24 communities in seven provinces, including the major cities. QOLRS's reports and statistics correspond to the municipal boundaries of member communities. A handbook gives definitions of all indicators in the QOLRS (FCM, 2003).
- The **Cities Data Book** (CDB) is a very comprehensive set of urban indicators formulated in 2001 by the Asian Development Bank and intended to improve urban management and performance measurement. The broad categories of the environment-related indicators are the same as those found in other indicator sets (water, waste water, solid waste, noise, etc.), but the CDB's indicators go into greater detail reflecting the specific concerns addressed by this institution (e.g. the wide range of methods of sewage disposal found in Asian cities) and the purpose of the indicators (ADB, 2001). The CDB does not appear to have been updated since it was published in 2001.
- The **Global Urban Indicators** (GUI) database was established to monitor progress on the implementation of the UN-Habitat Agenda. The database comprises 236 cities across the globe, including in OECD countries, though as a whole the indicators focus strongly on the concerns of cities in developing countries. The programme has produced two main databases (GUI Databases I and II in 1996 and 2001) for presentation at the Habitat II and Istanbul +5 conferences, containing data for 1993 and 1998 respectively. The next GUI Database (III) will continue to address the Habitat Agenda's key issues, with a specific focus on the Millennium Development Goals, particularly Target 11 on the improvement of slum dwellers. Nine of the total 42 key and complementary indicators in the GUI dataset are also of interest in the present report.
- The **Global Sustainable Urban Development Indicators,** developed by the White House Office of Urban Affairs and the US Department of Housing and Urban Development, are designed to measure progress in American cities towards sustainable urban development and inform supportive policy, planning and investment. Their framework includes three dimensions of sustainable urban development: social well-being (e.g. health and safety), economic opportunity (e.g. a diversified and competitive local and regional economy) and environmental quality (e.g. efficient land use and use of renewable resources). The indicators are still being selected; future work will include the selection of several American cities to pilot the new system.

Source: OECD (2011), "Urban Environmental Indicators for Green Cities: A Tentative Indicator Set" Working Party on Environmental Indicators, ENV/EPOC/WPEI(2011)6, OECD, Paris; Urban Audit website, *www.urbanaudit.org/index.aspx*; European Common Indicators website: *http://ec.europa.eu/environment/urban/common indicators.htm*; European Reference Framework for Sustainable Cities, *www.rfsustainablecities.eu*; Global City Indicators Facility, *www.cityindicators.org*; US Department of Housing and Urban Development, *www.huduser.org*.

How well can these indicators measure cities' performance on green growth?

The existing indicator sets described above suggest a wealth of information about cities' environmental and economic performance, but they are not comparable across countries, not necessarily regularly updated, and may not be formulated to allow for easy collection. A key challenge is to make these indicators comparable (OECD, 2012; OECD, 2011a). At the urban level, data generation and collection are limited by the lack of comparable data. To overcome this obstacle, the OECD has developed a *Metropolitan Database* that defines urban areas by functional rather than administrative boundaries, allowing for comparisons of cities across the OECD. Currently, data are being collected for 17 indicators in over 200 urban areas across the OECD (Box A.2).

Box A.2. ***OECD Metropolitan Database*: Comparable urban indicators**

To enable robust cross-country comparisons, the OECD has developed a metropolitan database based on a methodology to define functional economic areas that is comparable across cities and countries (Table A.2). The methodology is based on population density and travel-to-work flows and consists of three steps: *i*) identify contiguous or highly interconnected urban cores through gridded population data (thereby ignoring administrative boundaries); *ii*) connect non-contiguous cores that belong to the same functional area in order to take into account polycentric urbanisation patterns; and *iii*) identify urban hinterlands, or "worker catchment areas" of the urban labour market, which reside outside the densely populated urban core (OECD, 2012) (table below).

A new definition of cities is needed because defining cities solely by their administrative boundaries poses a number of methodological limitations. Administrative units tend to be unevenly sized and highly heterogeneous within and between countries. These differences can lead to a mischaracterisation of the nature, scale and shape of urbanisation in a given area. For example, the difference in population density between two cities depends in large part on the delineation of the city boundaries. In other cases, municipalities with a dense urbanised core might include within the administrative limits vast natural territories (lakes, forests, mountains), resulting in much lower estimates of density than actually observed within the populated core.

Metro-regional database indicators

Economic	Environment	Social	Demographic
GDP (millions of USD)	Air pollution	Unemployment	Population (persons)
GDP *per capita* (USD)	CO_2 emissions per capita (metric tonnes per person)	*Crime statistics*	Population density (people per km^2)
GDP growth (%)	Urbanised area (%)		Population growth (%)
GDP share of national value (%)	Urbanised area growth (%)		Population share of national value (%)
Employment	*CO_2 emissions by sector (transport, industry,…)*		
Participation rates			
Total Patent Co-operation Treaty (PCT) patent applications			
Total co-patents			

Note: Italics indicate future indicators still to be developed.

Source: OECD (2012), *Redefining "Urban": A New Way to Measure Metropolitan Areas*, OECD Publishing, doi: *10.1787/9789264174108-en.*

Another key issue is the ease with which indicators can be collected and updated. While the seven urban environmental indicator sets listed in Box A.1 were developed through extensive stakeholder consultation and testing, only the Urban Audit appears to be updated regularly (OECD, 2011b). Furthermore, while the same themes recur in most of these urban environmental indicator sets, how the indicators themselves are defined can greatly affect the ease with which they are collected. For example, it is much easier to collect data for an indicator defined as "number of days particulate matter PM_{10} concentrations exceed local air quality limit values" than one defined as "percentage of population living in areas where air quality does not comply with local standards", because the former requires only one monitoring station while the latter requires numerous monitoring stations and calculating how the population is distributed across the urban area (OECD, 2011b).

Proposed indicators for measuring progress towards urban green growth

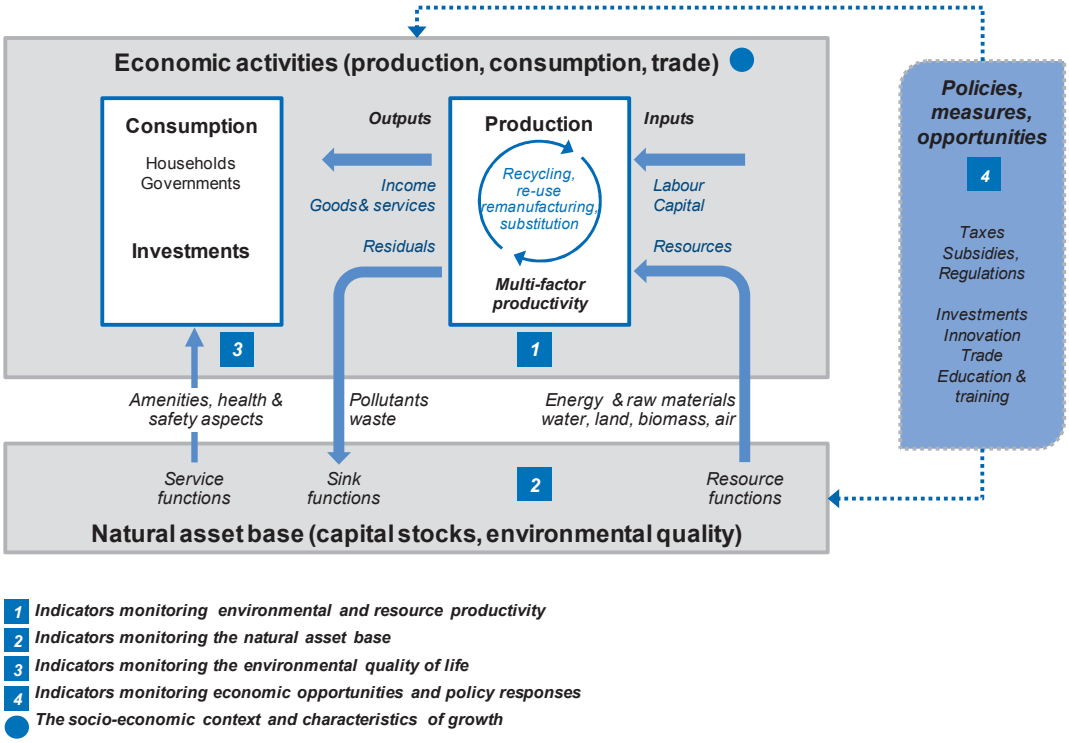
Monitoring green growth in cities calls for collecting comparable data on urban areas' environmental and economic performance, as well as on policy responses and economic opportunities. Sets of indicators created by the OECD to measure environmental performance and green growth have been created for the national level. To work at the urban level, it makes more sense to organise them around key sectors and policy issues (areas of intervention). The OECD's *Towards Green Growth: Monitoring Progress* framework provides a useful starting point for developing an urban green growth indicator set. The framework is composed of five key indicator sets: four sets of indicators related to the environment and a fifth set that provides the socio-economic and growth context (Table A.2). Figure A.1 presents how these sets of indicators influence and interact with one another.

Table A.2. **OECD national-level green growth indicators**

Indicator groups	Topics covered
Environmental and resource productivity	Carbon and energy productivity Resource productivity Multi-factor productivity
Natural asset base	Renewable stocks: water, forest, fish resources Non-renewable stocks: Mineral resources Biodiversity and ecosystems
Environmental dimension of quality of life	Environmental health and risks Environmental services and amenities
Economic opportunities and policy responses	Technology and innovation Environmental goods and services International financial flows Prices and transfers Skills and training Regulations and management approaches
Socio-economic context and characteristics of growth	Economic growth and structure Productivity and trade Labour markets, education and income Socio-demographic patterns

Source: OECD (2011), *Towards Green Growth: Monitoring Progress: OECD Indicators*, OECD Green Growth Studies, OECD Publishing, doi: *10.1787/9789264111356-en*.

Figure A.1. **OECD green growth measurement framework**



Source: OECD (2011), "Green Growth Strategy Synthesis Report", ECO/CPE/WP1(2011)2, OECD, Paris.

These national indicators need to be modified to apply to cities. The focus on environmental and resource productivity translates into measures of energy and resource efficiency. Indicators relating to the natural asset base become indicators related to environmental pressures, such as consumption of energy, water and undeveloped land. The environmental dimension of quality of life translates into indicators on urban residents' health and access to basic services. Economic opportunities and policy responses are measured by the strength of metro-regional production of green goods and services and the application of resource fees and charges (similar to those discussed in the section "City revenues: Getting the financial incentives right for green growth" in Chapter 4 on aligning urban revenues with green growth objectives). Indicators of growth and socio-economic characteristics are similar for national and local levels, as measures of GDP, productivity, education, income and labour markets, among others, are available at the metropolitan regional level.

A proposed set of 80 indicators of urban environmental performance is presented in Table A.3 (OECD, 2011b). Combined with indicators of growth and socio-economic characteristics, this set of indicators can be considered a starting point for assessing the impact of cities' efforts to foster economic growth and development through urban activities to reduce environmental impact. Most of the indicators in Table A.3 are not yet readily available or not necessarily available in a way that allows for comparison with other urban areas. Each indicator in the table is assessed in terms of policy relevance, analytical soundness and measurability, which are the same criteria used for the national green growth indicators (OECD, 2011a). The table also classifies indicators of the pressure-state-response framework:

- pressures: indicators of environmental pressures
- state: indicators of environmental conditions
- response: indicators of societal responses

Where possible, indicators are presented as the ratio between the parameter of interest and another variable (e.g. population, GDP, urban area), in order to facilitate comparisons among cities and to link the environmental indicators to socio-economic indicators. Not all 80 indicators are needed to assess this impact. Rather, this list should be considered as a menu for urban policy makers to choose from in deciding how to measure progress (OECD, 2011b).

Table A.3. **Tentative list of urban environmental indicators**

Pressure (P) State (S) Response (R)	Main (M) Comple-mentary (C)	Main and complementary indicator	Policy relevance	Analytical framework	Measurability	
					Data availability	Data quality
Land use						
P	C	Extent of built-up area	1	1	2	1
	M	Urban growth	1	1	2	1
	C	Share of new development (residential, commercial, industrial) built in mature areas, downtown, near transit locations and on greenfield land	1	1	3	2
S	M	Density of city/metro region (resident population/km^2), by area	1	1	1	1
	C	Inland or coastal areas within metro area covered by water over a large part of the year in m^2 *per capita*	2	1	1	1
	M	Area of green space accessible to the public in m^2 *per capita* or as a share of built-up area	1	1	1	1
	M	Percentage of citizens living within 300 m from public open space > 5 000 m^2	1	1	2	2
	M	Proportion of population within a 15 min. walk of green space	1	2	2	2
	C	Percentage of population living within 500 m of commercial services	2	1	2	2
R	C	Extent of re-naturalised waterways and redeveloped waterfront areas opened up to the public, as a proportion of total open public space	3	1	1	1
	C	Proportion of city/metro brownfield sites that has been redeveloped	3	1	1	1
	C	Area of land protected from urban development as a share of total city/metro area or of total green space.	2	1	1	1
Urban air						
P	M	Emissions to air of conventional pollutants per unit of city GDP, by source (urban transport, industries and buildings)	1	1	3	2
	M	Emissions to air of persistent organic pollutants (POPs) per unit of city GDP, by source	2	2	3	1
S	M	Percentage of urban population resident in areas where air pollutant concentrations are higher than local limit values	1	2	2	2
	M	Number of hours/days per year of net exceedances of limit values for PM10, PM2.5, O3, NO2, SO2.	1	1	1	1
Water use						
P	M	Industrial water use intensity (from network and self-supply), by sector and per unit of city GDP.	1	1	2	2
	M	Domestic water consumption (litre/capita/day)	1	1	2	2
	P	Water abstractions for public supply, *per capita*	2	2	2	2

Table A.3. **Tentative list of urban environmental indicators** (*cont.*)

Pressure (P) State (S) Response (R)	Main (M) Comple-mentary (C)	Main and complementary indicator	Policy relevance	Analytical framework	Measurability: Data availability	Measurability: Data quality
Water use (cont.)						
S	C	Compliance of public water supply with drinking quality standards as % of samples exceeding one or more standards.	3	1	3	1
	C	Non-revenue water in urban water supply networks, as a % of total or as m^3/km/day or m^3/conn/day	3	1	1	1
R	C	Percentage of buildings/houses equipped to reuse grey water	1	3	3	3
	C	Annual number of health warning (boil water) notices and supply interruptions or restrictions; or Average annual hours of water service interruptions per connection or per million cubic metres of water produced	3	1	1	1
	C	Average price of domestic water supply per m^3 or average household water bill as a share of average income	1	2	2	2
Urban water quality						
P	M	Trends in discharges of BOD, N and P from urban wastewater treatment plants (both public and industrial)	1	1	2	1
S	M	Compliance of urban wastewater treatment plants with local effluent limits	3	1	2	1
	C	Compliance of urban streams and lakes with local ecological and chemical water quality criteria	3	2	3	2
	M	Compliance of metro area bathing sites (coastal and freshwater) with quality standards.	2	1	1	2
	M	Number of Blue Flag sites within metro area (for coastal cities)	2	1	2	1
R	C	Percentage of population connected to public sewerage, of which connected/not connected to a treatment plant	2	1	1	1
	M	Population connected to urban wastewater treatment plants with primary/secondary/tertiary treatment level	1	1	1	1
	C	Proportion of urban storm water receiving treatment before being discharged	1	3	3	3
	C	Annual number of storm water/sewage overflows in city/metro region per 100 km of network length	2	3	3	1
	C	Proportion of treated effluent that is re-used	2	1	2	2
	C	Average household wastewater treatment charges	1	1	2	2
	C	PAC expenditure on urban water services per unit of city GDP	2	1	3	3
Waste management						
P	M	Municipal solid waste generation intensity in city/metro area (kg/cap/year and per unit of city GDP)	1	1	1/2	2
	M	Household waste generation intensity per unit of PCFE and per kg/cap/year	2	1	1/2	2
	M	Construction, industrial and hazardous waste intensities in city/metro area per unit of city GDP/year.	1	2	2	2
R	M	Percentage of households served by separate collection of recyclable waste fractions)	2	1	2	1
	M	Waste recycling rates (paper, glass, batteries, PVC, bottles, metals	1	2	2	2
	M	Shares of municipal waste recycled, composted, incinerated with/without energy recovery, landfilled	1	1/2	1	2
	M	Movement, treatment and disposal of hazardous waste as a share of production of hazardous waste in city/metro area	2	3	3	3
	M	Proportion of construction/demolition (C&D) waste being recovered/recycled out of total produced	1	2	3	3
	C	Amount of toxic waste collected from households and SMEs *per capita* per year	2	2	3	3
	C	PAC expenditure on urban waste management services per unit of city GDP	2	1	3	3

Table A.3. **Tentative list of urban environmental indicators** (*cont.*)

Pressure (P) State (S) Response (R)	Main (M) Comple-mentary (C)	Main and complementary indicator	Policy relevance	Analytical framework	Measurability: Data availability	Measurability: Data quality
Transport and traffic						
P	C	Passenger and freight transport intensity by mode *per capita*, resp. unit of city GDP	1	1	2	2/3
	M	Urban traffic intensity: veh-km travelled on city/metro area roads by passenger cars and goods vehicles per unit of city GDP, per network length, and *per capita*	1	1	2	3
	C	Share of city trips by motorised private transport, by public transport, by bicycle and on foot	2	1	3	3
	C	Share of children going to school on foot, by bicycle, by school bus, on public transport, and by private car	2	1	3	2
	C	Number of people commuting into/out of the city as a share of population				
S	C	City/metro road network length in km/capita	1	2	1	1
	C	Length of public transport network in km/ capita, by rail, light rail, bus, bus rapid transit	1	2	1	2
	M	Percentage of residents living within 500 metres of transportation connection	2	2	3	3
	M	Average travel speed on primary thoroughfares during peak hours	1	2	3	3
R	C	Capacity and use of Park and Ride facilities in metro area in places/capita	2	1	3	1
	C	Total length of bicycle lanes in km/capita	3	2	1	1
	C	Levies and charges specifically aimed at relieving urban congestion	1	n.a.	n.a.	n.a.
	C	Household expenditure on transport services as a share of total household expenditure	2	1	2	1
Climate change and energy						
P	M	Carbon intensity of regional/city GDP in tonnes of CO2e/unit/year, broken down by sector	1	2	2	2/3
	M	Carbon intensity of local energy production in tonnes of CO2e//unit/year	1	2	3	3
S	M	Energy intensity, by sector (manufacturing, transport, commercial & public service, residential), TPES and TFC *per capita* or unit of city GDP	1	1	3	3
R	M	Share of city/metro region energy consumption that comes from renewable resources as a percentage of total city TFC.	2	1	2	2
	M	Share of city/metro region energy production that comes from renewable resources	1	1	2	3
Environmental health						
P	M	Proportion of residents exposed to traffic noise of >55 dB(A) by day and >45 dB(A) by night	1	3	3	3
	M	Percentage of urban population residing in areas where air pollutant concentrations are higher than local limit values	2	3	2	2
	C	Proportion of urban population residing in designated natural and industrial hazard zones	2	2	3	3
S	C	Number of reported episodes of illness attributable to diseases carried in drinking-water and bathing water over a defined period *per capita*	2	2	1	1
	C	Number of people reported to have been affected by diseases arising from drinking water and basing water over a defined period *per capita*	2	2	1	1
	C	Post-neonatal death rates due to respiratory diseases	1	2	2/3	2
	C	Environmentally induced health problems and related costs in disability-adjusted life years	1	3	3	3
	C	Concentration of lead in blood of city/metro area population	3	2	3	3
R	M	Number of hospital admissions for asthma at times of peak air pollution episodes, *per capita* of population or as a share of total annual admissions for asthma	2	2	2	2

Table A.3. **Tentative list of urban environmental indicators** (*cont.*)

Pressure (P) State (S) Response (R)	Main (M) Comple-mentary (C)	Main and complementary indicator	Policy relevance	Analytical framework	Measurability	
					Data availability	Data quality
General, awareness and behaviour						
R	M	Public perceptions of urban air quality, green space provision, and public transport quality	2	1	3	1
	C	Percentage of purchase of eco-labelled products of household consumption expenditure of durable goods in city/metro area	2	2	3	3
	C	Share of eco-labelled products in public procurement by city authorities	2	3	3	3
	M	Percentage of low exhaust vehicles in total city car fleet, in taxi fleets, in company fleets, and in (city) government fleets	1	1/2	2	2
	M	Total value of projects with green building certification as a share of the total value of projects granted a building permit per year	1	2	2	2
	R	Share of city enterprises with ISO14001/EMAS certification or similar	1	2	1	1
	C	Share of electricity customers who have opted for green tariffs	3	2	1	1

Note: P/S/R refers to the OECD Pressure-State (Conditions)-Response framework; M/C indicates a main or complementary indicator; R means policy relevance; AS means analytical framework; Measur. means measurability; DA refers to data availability; DQ refers to data quality.

Source: OECD (2011), "Urban Environmental Indicators for Green Cities: A Tentative Indicator Set", Working Party on Environmental Indicators, ENV/EPOC/WPEI(2011)6, OECD, Paris.

While most of the above data are not available in a comparable way, the *OECD Metropolitan Database* provides data for 266 urban areas across the OECD (excluding Australia, Chile, New Zealand, Israel) in a way that is comparable. This provides an important first step in collecting comparable indicators of environmental and economic performance, which can provide a starting point in measuring cities' green growth. Given the requirement of comparability, the OECD has prioritised indicators that can be derived from global sources, notably data from the Earth's surface collected using remote sensing and geographic information systems (GIS) tools. The *OECD Metropolitan Database* has developed four environmental indicators: air pollution, CO_2 emissions, urbanised area and urbanised area growth (Table A.4). When complemented with socio-economic indicators from the same database, this data paints a preliminary portrait of the environmental and economic performance of OECD urban areas. The following figures (Figures A.2-A.8) illustrate this performance.

Table A.4. **OECD comparable metropolitan indicators**

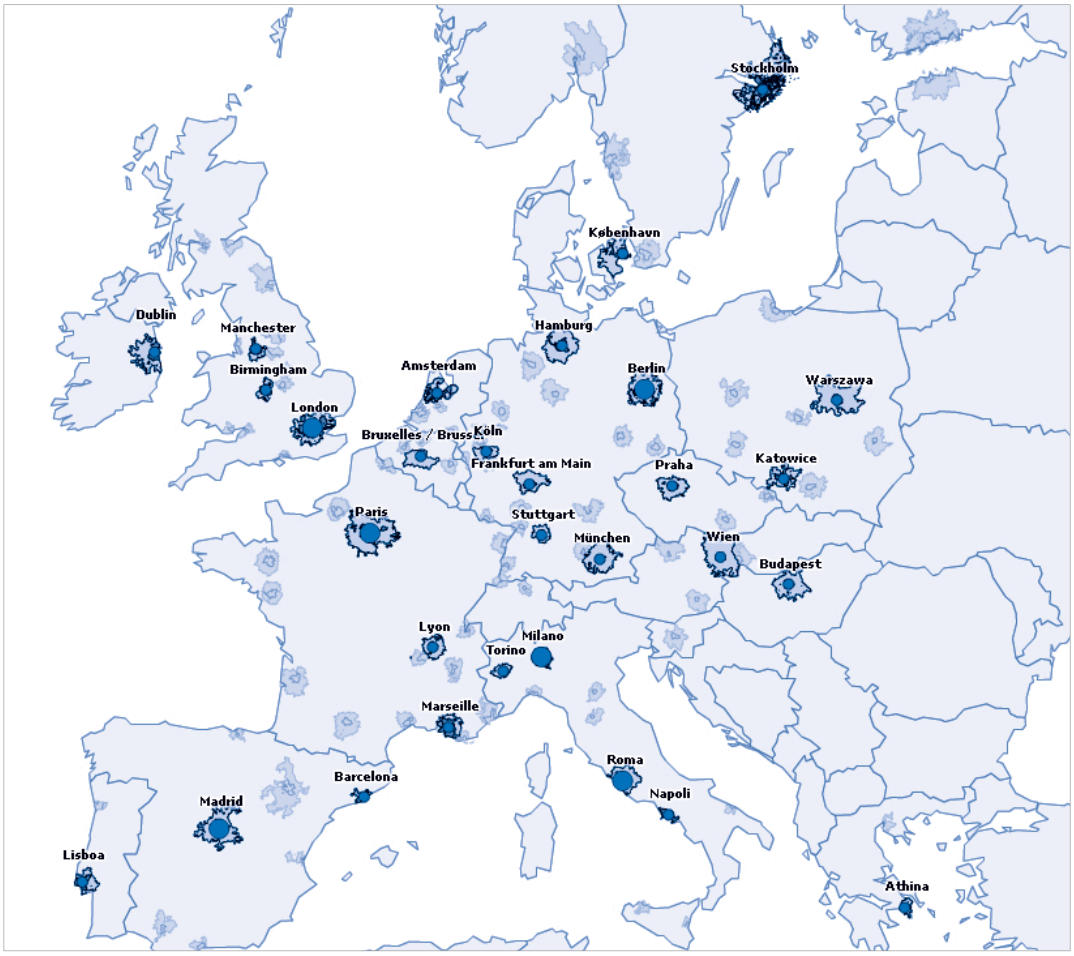
Indicator	Description	Year	Data source
Population	Total population within metropolitan areas	2008	Estimates based on population data at TL3 level from *OECD Regional Database* for non census years.
Population density	Ratio between total population and surface area within metropolitan areas	2008	
GDP	Gross domestic product measure the sum of the gross values added of all resident institutional units engaged in production. GPD are expressed in Millions of USD PPP's	2008	Estimates based on GDP data at TL3 level from *OECD Regional Database*
GDP per capita	Ratio between GDP and total population	2008	
GDP growth	Annual average GDP growth rate.	2000-2008 (2003-2008 for Mexico)	
GDP per capita growth	Annual average GDP *per capita* growth rate	2000-2008 (2003-2008 for Mexico)	
Urbanised area	Defined as the land covered with buildings or for urban uses. It includes, for example, residential and non-residential buildings, major roads and retail-ways and also open urban areas like parks and sport facilities	2005	United States: *NLCD 2001 (Version 2) and NLCD 2006 databases*; Japan: *Japan National Land Information 1997 and 2006*; Europe: *CORINE Land Cover 2000 and CORINE Land Cover Changes 2000-2006*; Canada, Korea and Mexico: *MODIS Land Cover data* 2008, urban class refers circa to year 2001-2002. Data are derived from medium spatial resolution (500m) satellite imagery and should be taken as rough estimates. Because of the different resolutions the Modis land cover is not exactly comparable with the other Land Cover data
Urbanised area growth	Annual average urbanised area growth rate	2000-2006 (2001-2006 for the US 1997-2006 for Japan)	
CO_2 emissions per capita	Ratio between emissions and total population	2005	European Commission, Joint Research Centre (JRC)/Netherlands Environmental Assessment Agency (PBL). *Emission Database for Global Atmospheric Research* (EDGAR), release version 4.1. *http://edgar.jrc.ec.europe.eu*, 2010
Air pollution	Population exposure to air pollution (PM2.5)	2005	Van Donkelaar, A., R. V. Martin, M. Brauer, R. Kahn, R. Levy, C. Verduzco, and P. J. Villeneuve, "Global Estimates of Exposure to Fine Particulate Matter Concentrations from Satellite-based Aerosol Optical Depth", *Environmental Health Perspectives*, doi: *10.1289/ehp.0901623*, 118(6), 2010. *http://fizz.phys.dal.ca/~atmos/datasets/World-PM25-20010101-20061231-RH50.TIF.zip*

Source: OECD (2012) MetroExplorer documentation.

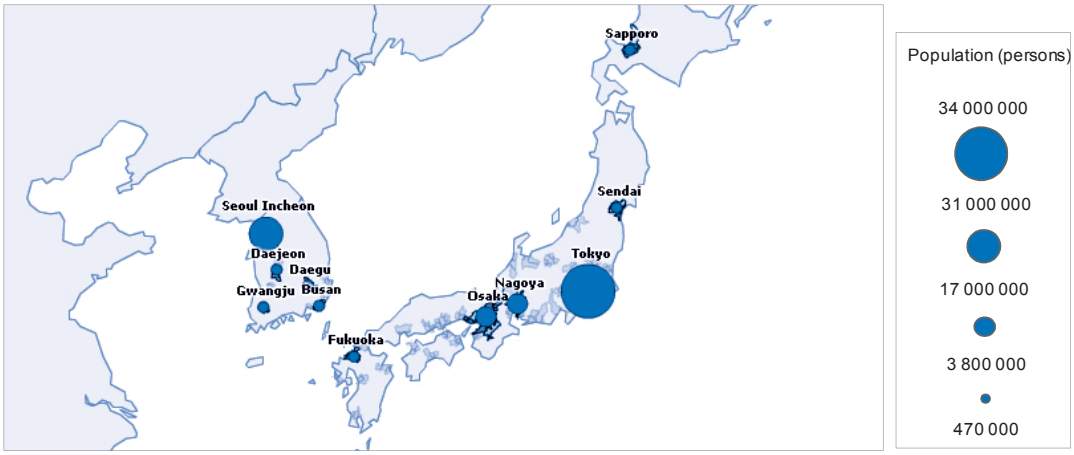
Figure A.2. **Population density in OECD metropolitan areas, 2008**

OECD metropolitan areas over 1.5 million inhabitants

Europe



East Asia

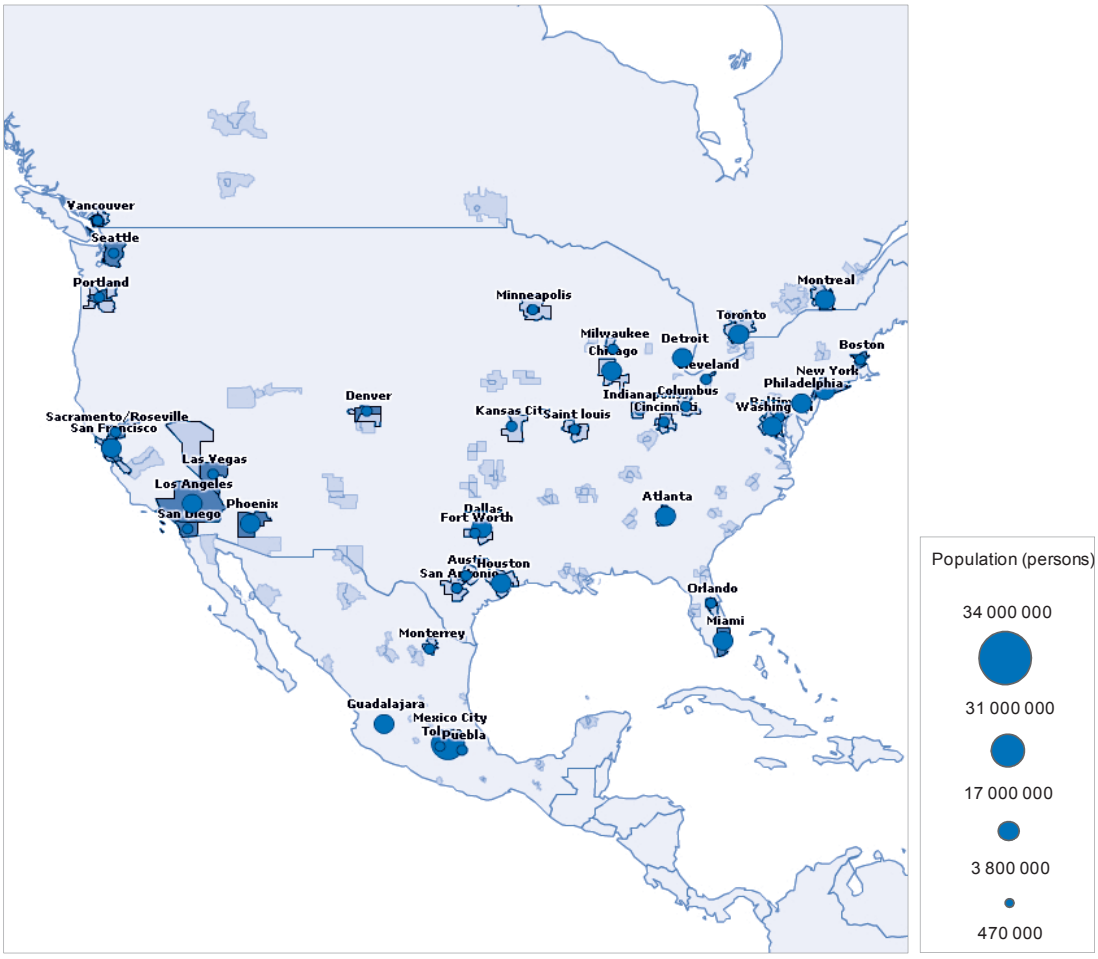


Note: Data not available for Australia, Chile, Israel and New Zealand. This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

Figure A.2. **Population density in OECD metropolitan areas, 2008** (*cont.*)

OECD metropolitan areas over 1.5 million inhabitants

North America



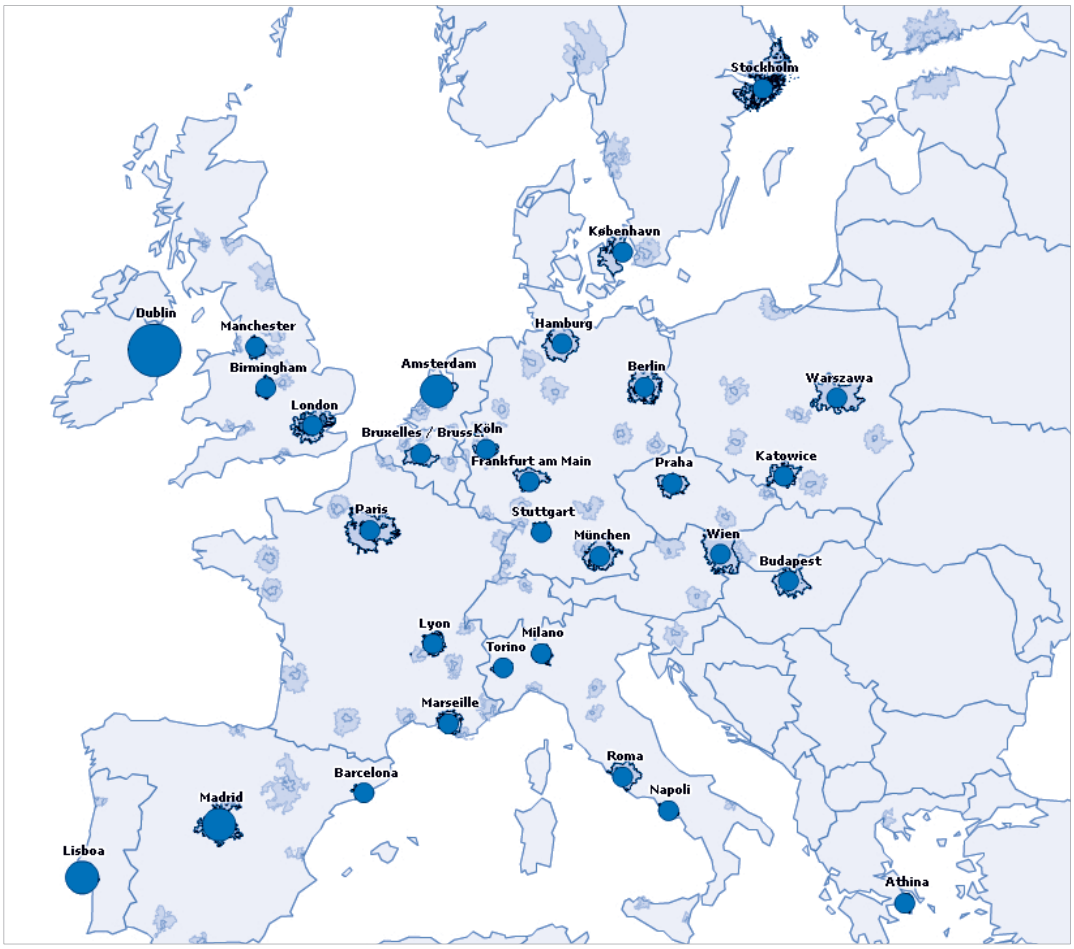
Note: Data not available for Australia, Chile, Israel and New Zealand. The OECD definition of metropolitan areas is applied to 29 OECD countries and 1 148 functional urban areas are identified. The methodology identifies urban areas as "functional economic units", thus overcoming previous limitations linked to administrative definitions and increasing the possibility of cross-country comparison. This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

Source: OECD Metropolitan Database, *http://dotstat.oecd.org/Index.aspx?Datasetcode=CITIES.* Source of administrative boundaries: National Statistical Offices and FAO Global Administrative Unit Layers (GAUL).

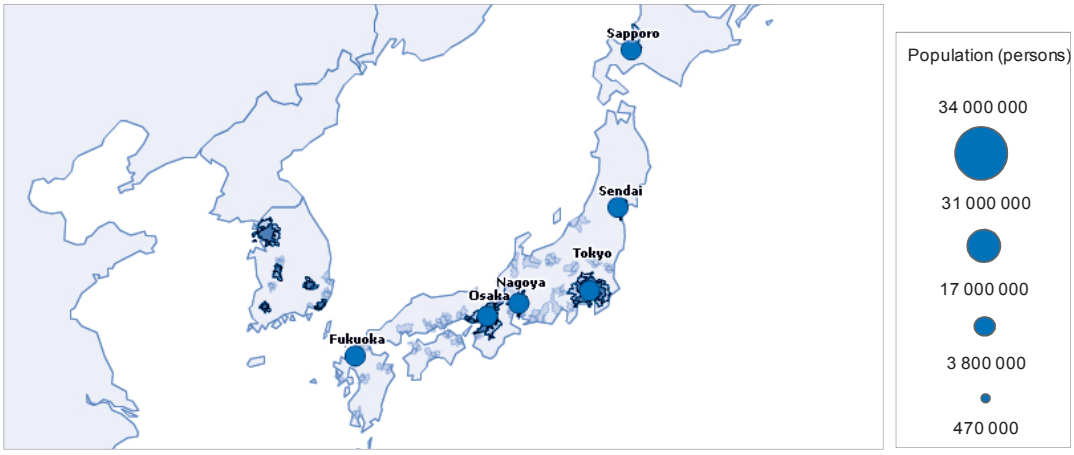
Figure A.3. **Urbanised area growth, 2000-2006**

OECD metropolitan areas over 1.5 million inhabitants

Europe



East Asia

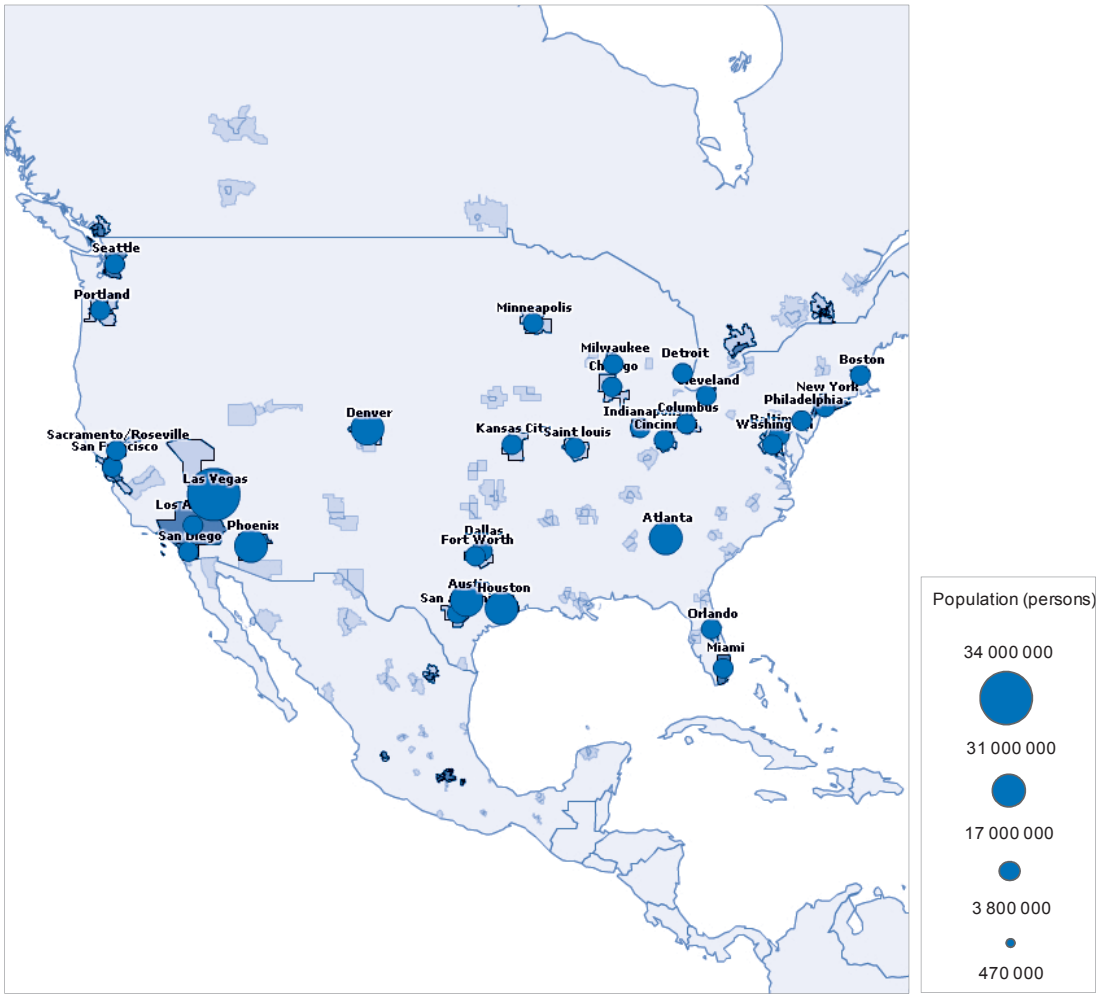


Note: Data not available for Australia, Canada, Chile, Israel, Korea, Mexico and New Zealand. Data is for 2001-2006 for the United States and 1997-2006 for Japan. This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

Figure A.3. **Urbanised area growth, 2000-2006** (*cont.*)

OECD metropolitan areas over 1.5 million inhabitants

North America



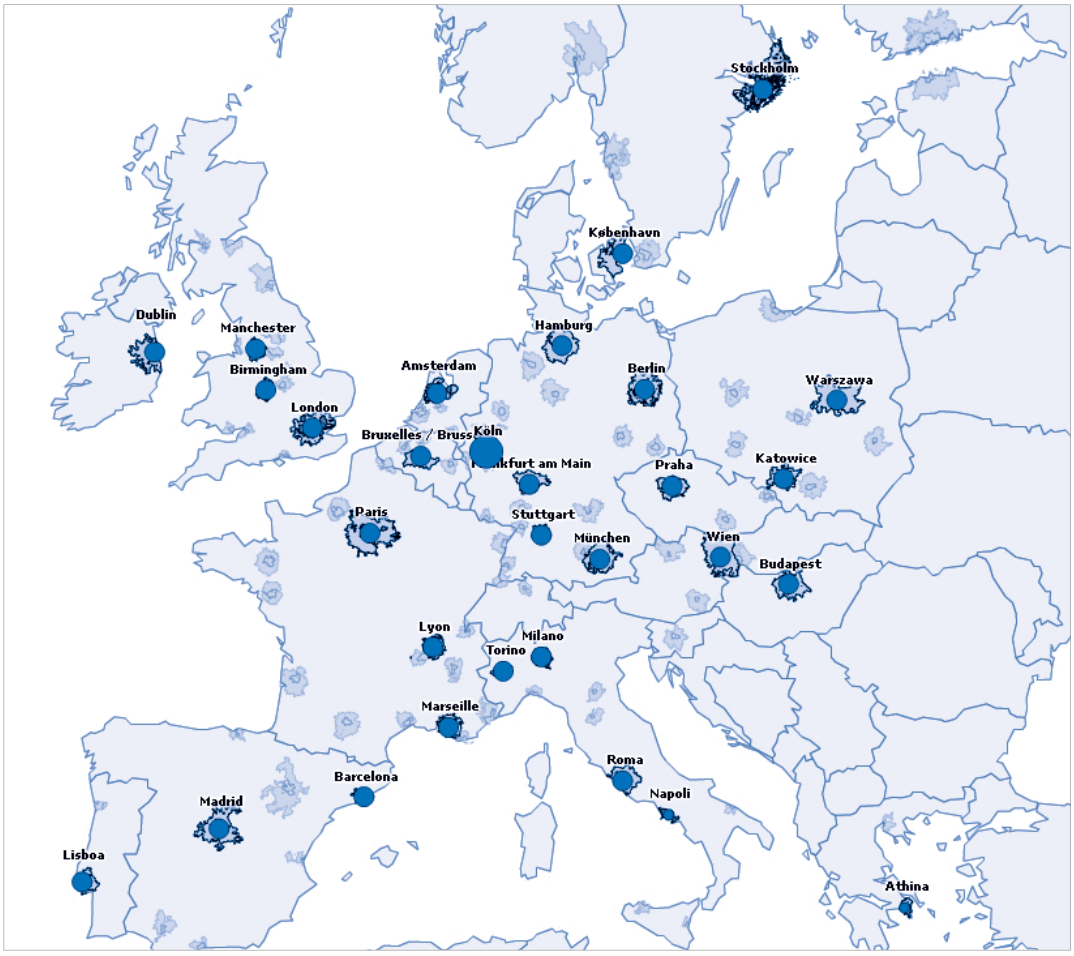
Note: Data not available for Australia, Canada, Chile, Israel, Korea, Mexico and New Zealand. Data is for 2001-2006 for the United States and 1997-2006 for Japan. The OECD definition of metropolitan areas is applied to 29 OECD countries and 1 148 functional urban areas are identified. The methodology identifies urban areas as "functional economic units", thus overcoming previous limitations linked to administrative definitions and increasing the possibility of cross-country comparison. This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

Source: OECD Metropolitan Database, http://dotstat.oecd.org/Index.aspx?Datasetcode=CITIES. Source of administrative boundaries: National Statistical Offices and FAO Global Administrative Unit Layers (GAUL).

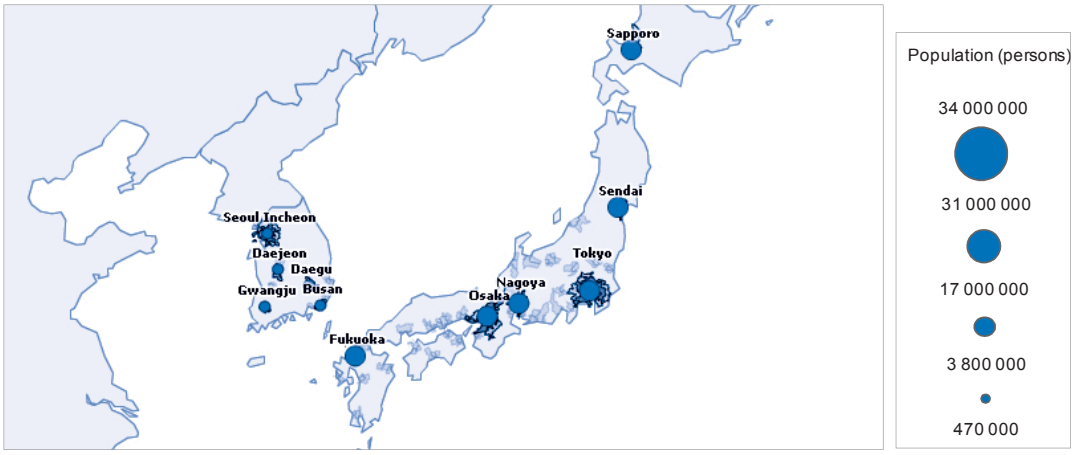
Figure A.4. **CO_2 emissions, 2006**

OECD urban areas over 1.5 million inhabitants

Europe



East Asia

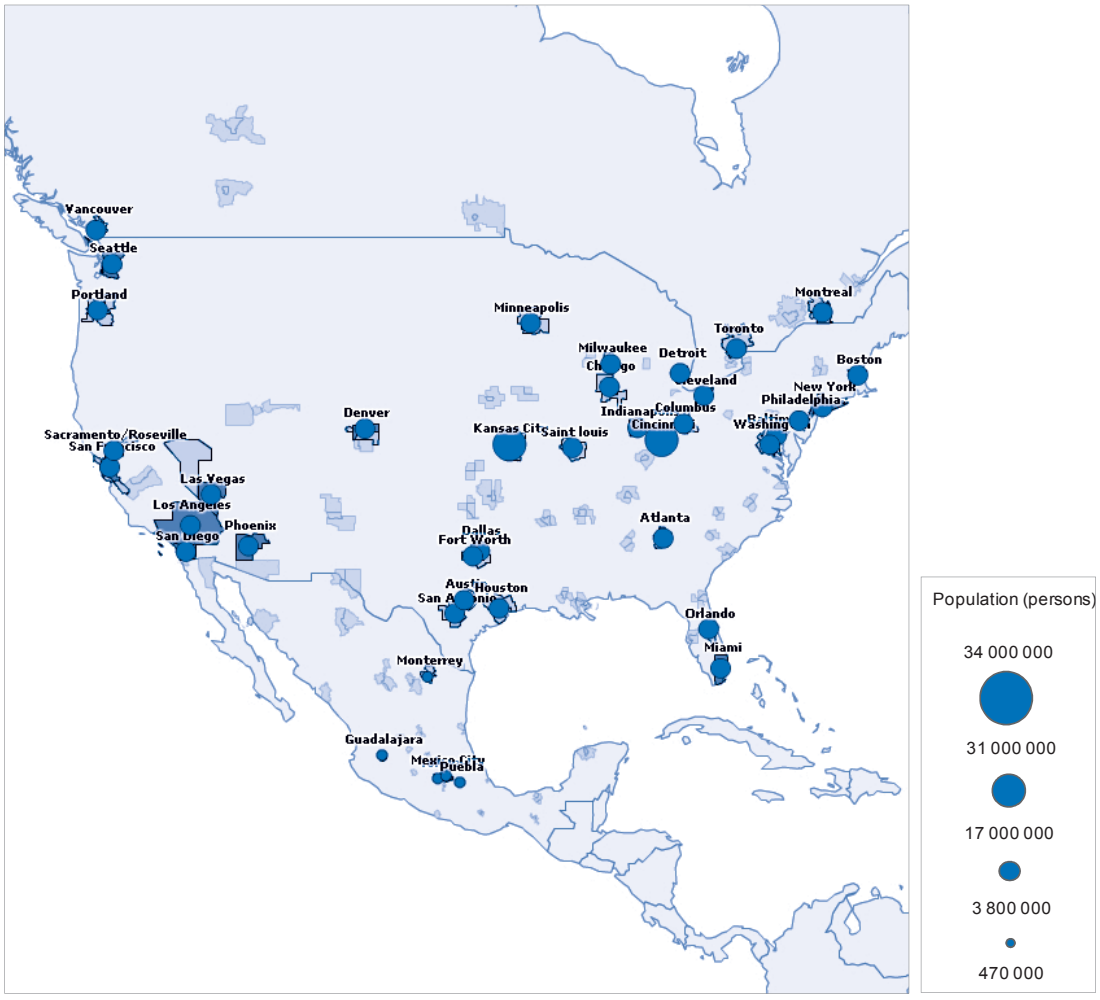


Note: Data not available for Australia, Chile, Israel and New Zealand. This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

Figure A.4. **CO_2 emissions, 2006** (*cont.*)

OECD urban areas over 1.5 million inhabitants

North America



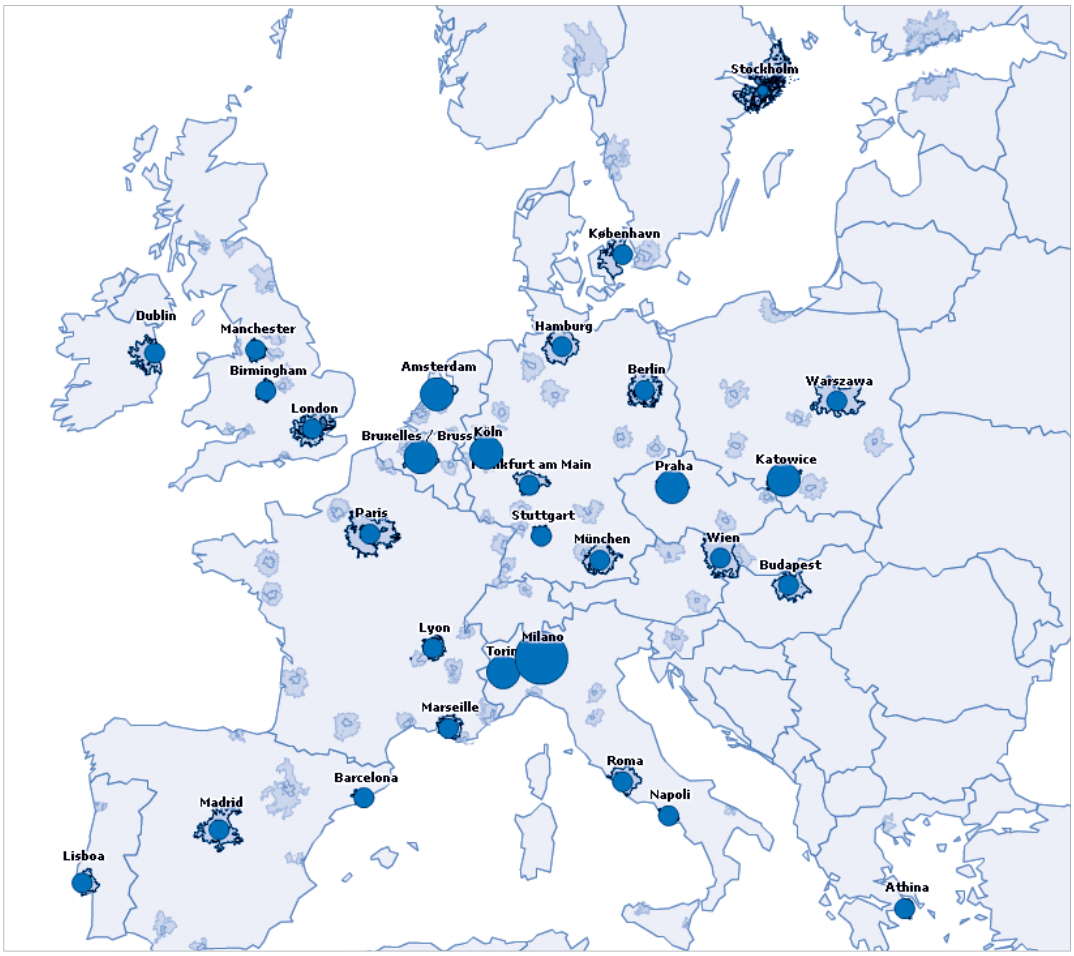
Note: Data not available for Australia, Chile, Israel and New Zealand. The OECD definition of metropolitan areas is applied to 29 OECD countries and 1 148 functional urban areas are identified. The methodology identifies urban areas as "functional economic units", thus overcoming previous limitations linked to administrative definitions and increasing the possibility of cross-country comparison. This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

Source: OECD Metropolitan Database, *http://dotstat.oecd.org/Index.aspx?Datasetcode=CITIES.* Source of administrative boundaries: National Statistical Offices and FAO Global Administrative Unit Layers (GAUL).

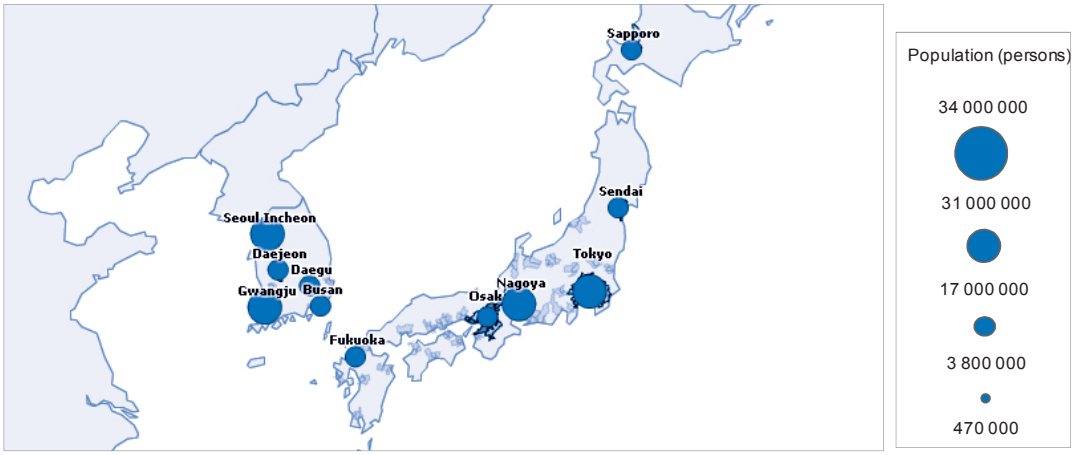
Figure A.5. **Air pollution, average 2001-2006**

OECD urban areas over 1.5 million inhabitants

Europe



East Asia

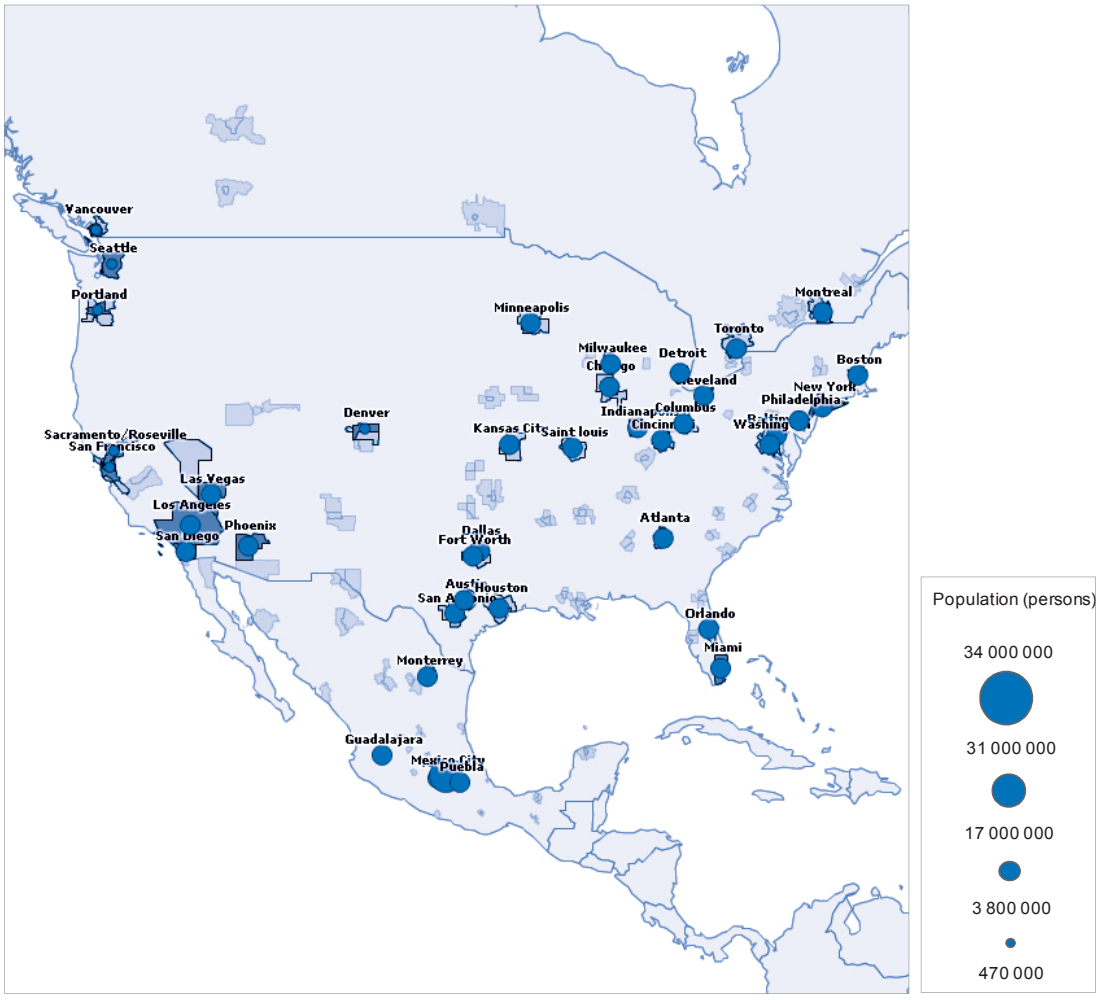


Note: Data not available for Australia, Chile, Israel and New Zealand. This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

Figure A.5. **Air pollution, average 2001-2006** (*cont.*)

OECD urban areas over 1.5 million inhabitants

North America



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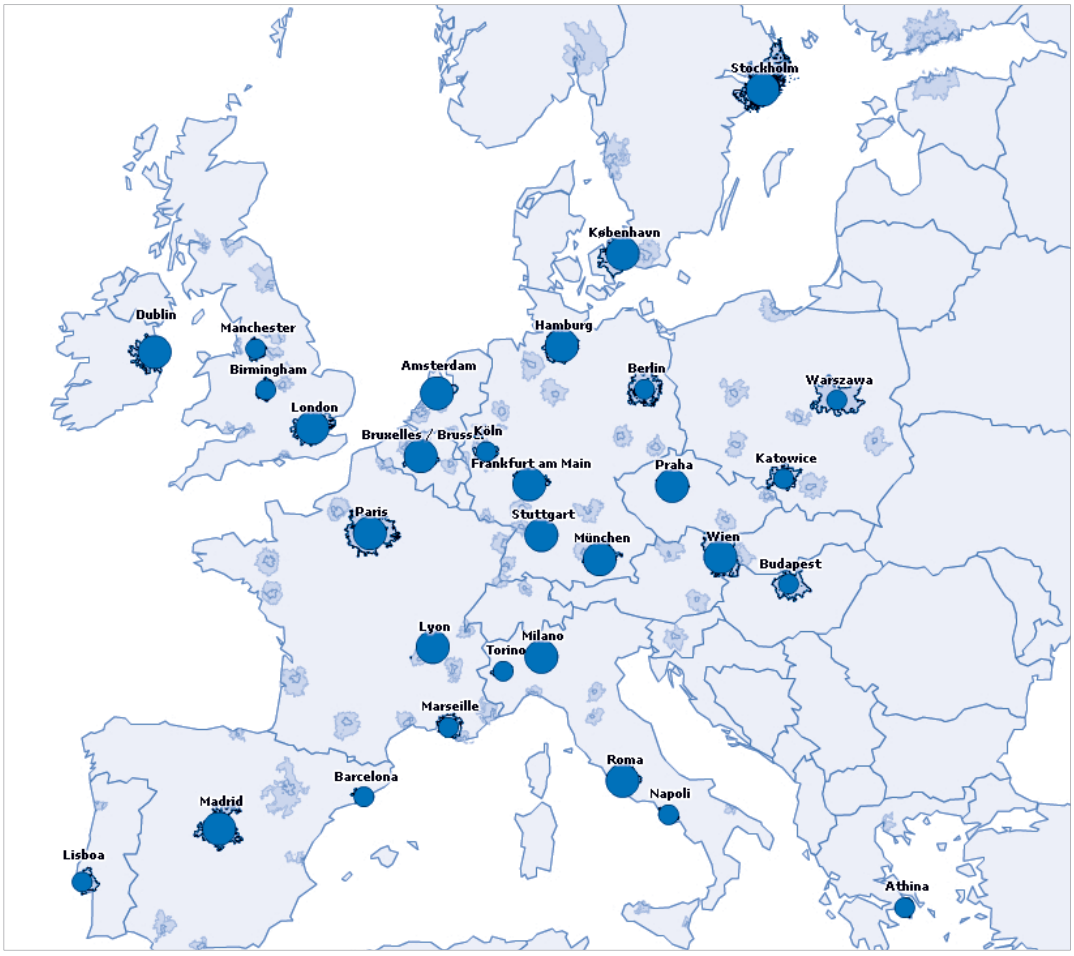
Source: OECD Metropolitan Database, *http://dotstat.oecd.org/Index.aspx?Datasetcode=CITIES.* Source of administrative boundaries: National Statistical Offices and FAO Global Administrative Unit Layers (GAUL).

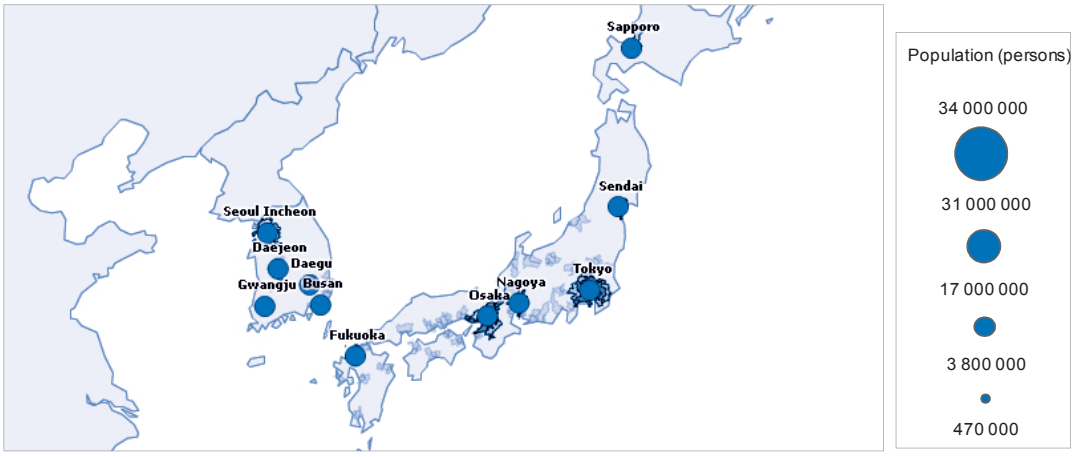
Figure A.6. **GDP *per capita*, 2008**

OECD urban areas over 1.5 million inhabitants

Europe



East Asia

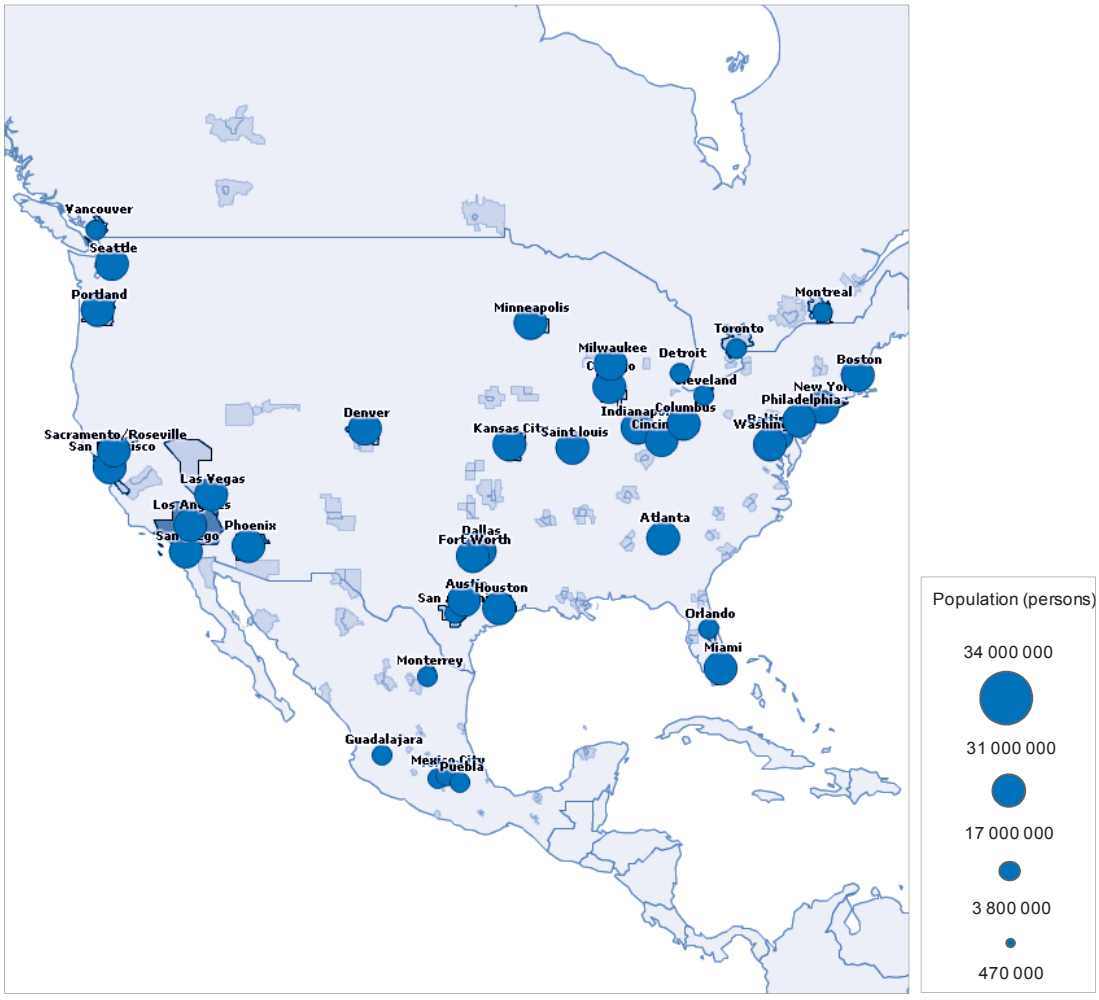


Note: Data not available for Australia, Chile, Israel and New Zealand. This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

Figure A.6. **GDP *per capita*, 2008** (*cont.*)

OECD urban areas over 1.5 million inhabitants

North America



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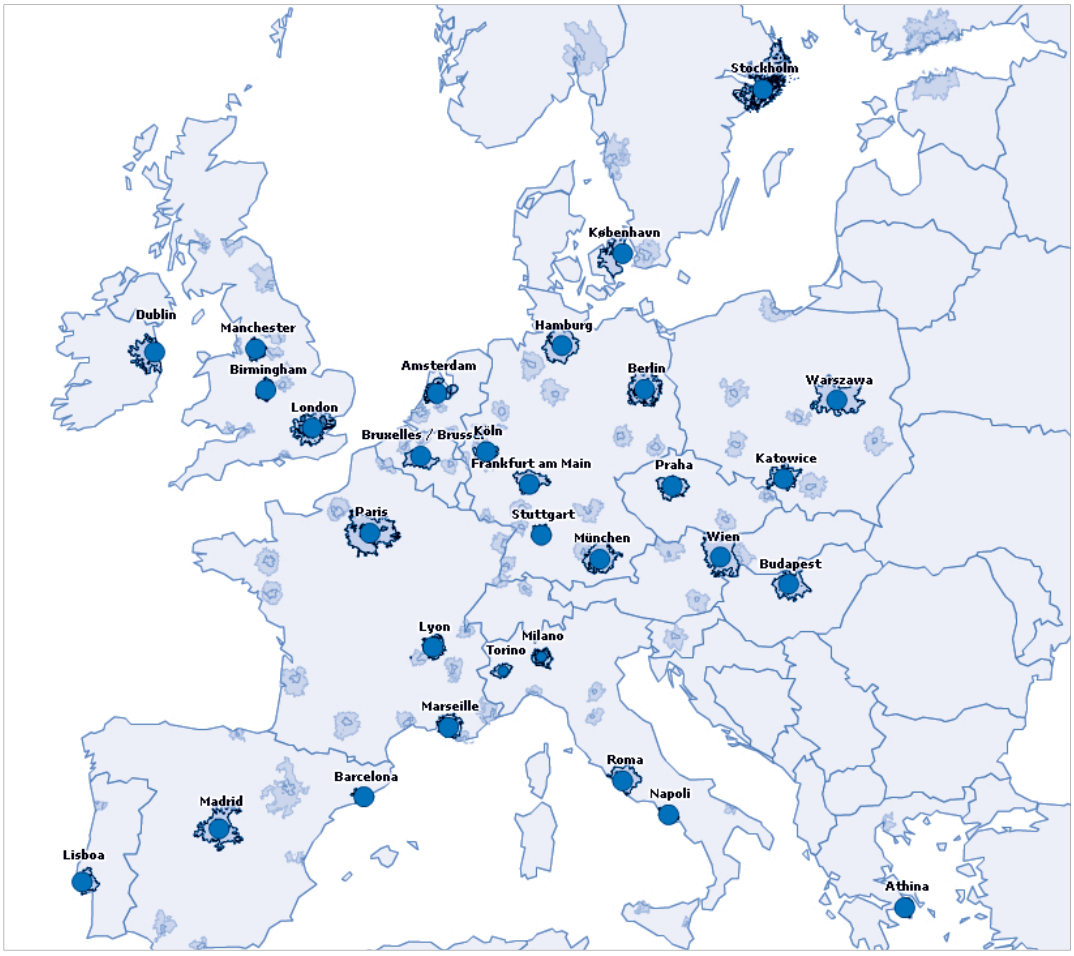
Source: OECD Metropolitan Database, *http://dotstat.oecd.org/Index.aspx?Datasetcode=CITIES.* Source of administrative boundaries: National Statistical Offices and FAO Global Administrative Unit Layers (GAUL).

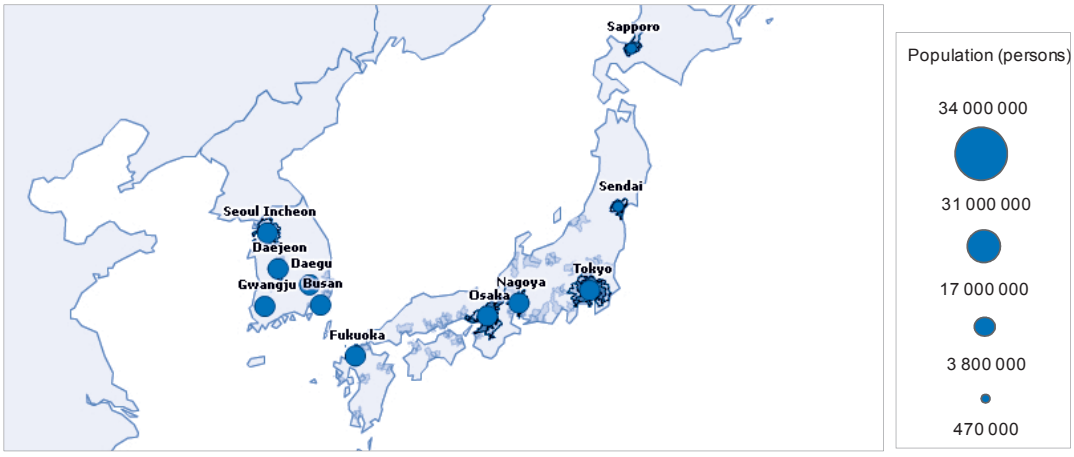
Figure A.7. **GDP growth, 2000-2008**

OECD urban areas over 1.5 million inhabitants

Europe



East Asia

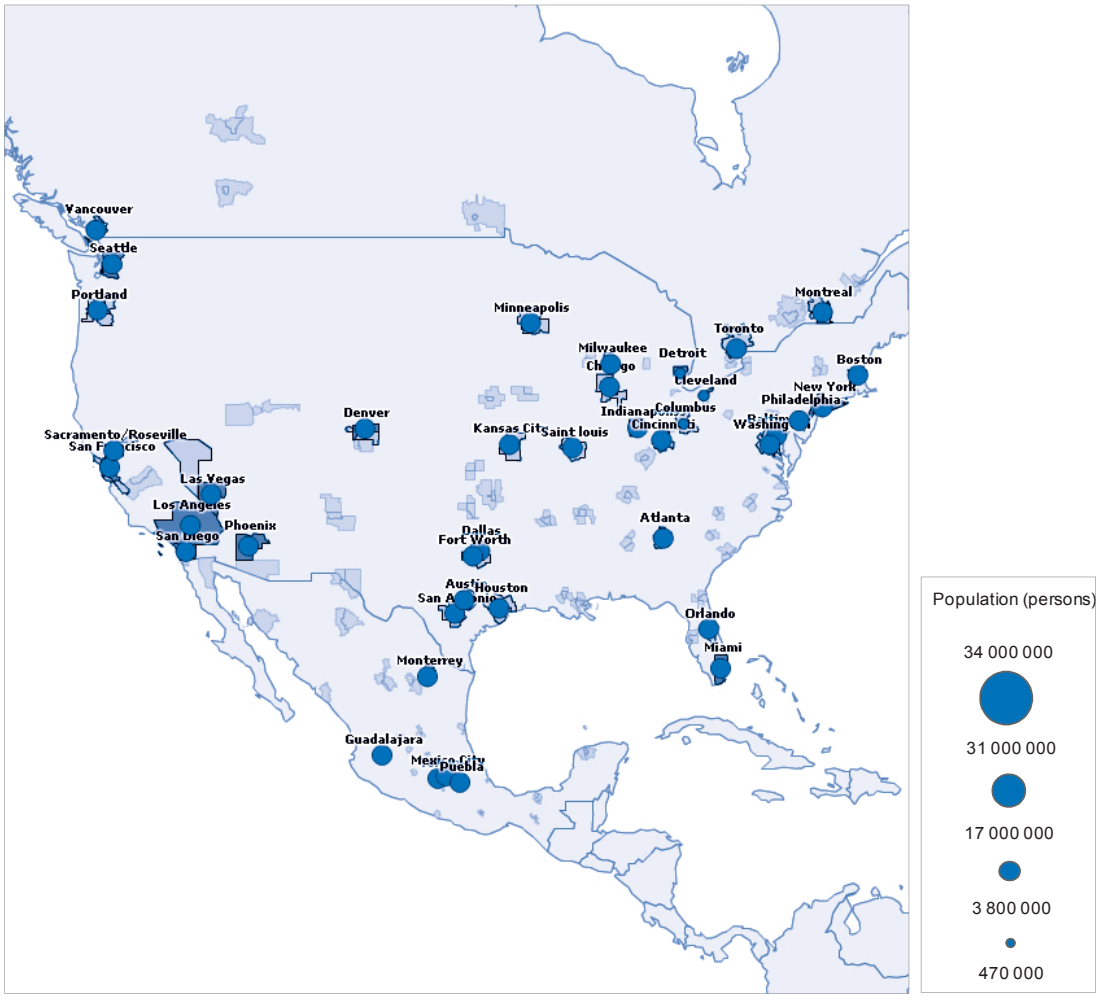


Note: Data not available for Australia, Chile, Israel and New Zealand. This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

Figure A.7. **GDP growth, 2000-2008** (*cont.*)

OECD urban areas over 1.5 million inhabitants

North America



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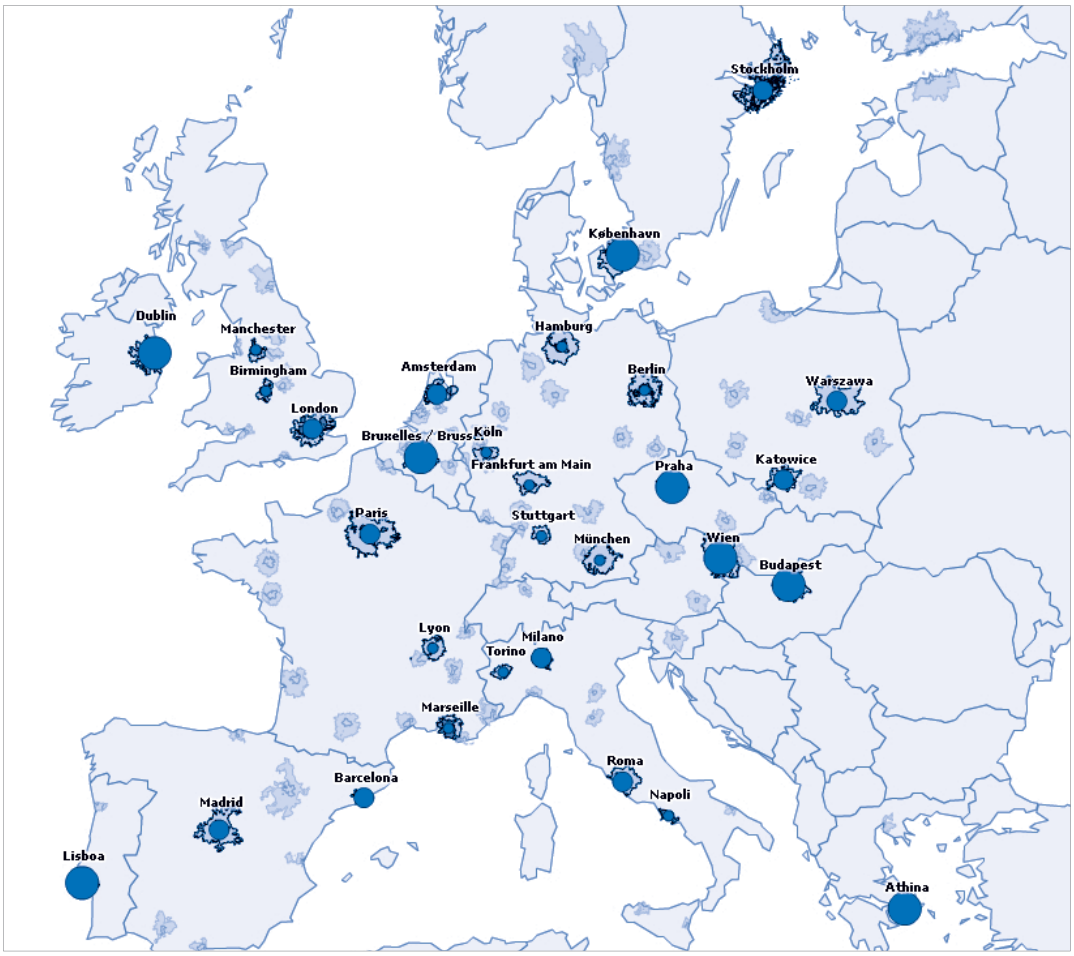
Source: OECD Metropolitan Database, *http://dotstat.oecd.org/Index.aspx?Datasetcode=CITIES.* Source of administrative boundaries: National Statistical Offices and FAO Global Administrative Unit Layers (GAUL).

Figure A.8. **GDP share of national value (%), 2008**

OECD urban areas over 1.5 million inhabitants

Europe



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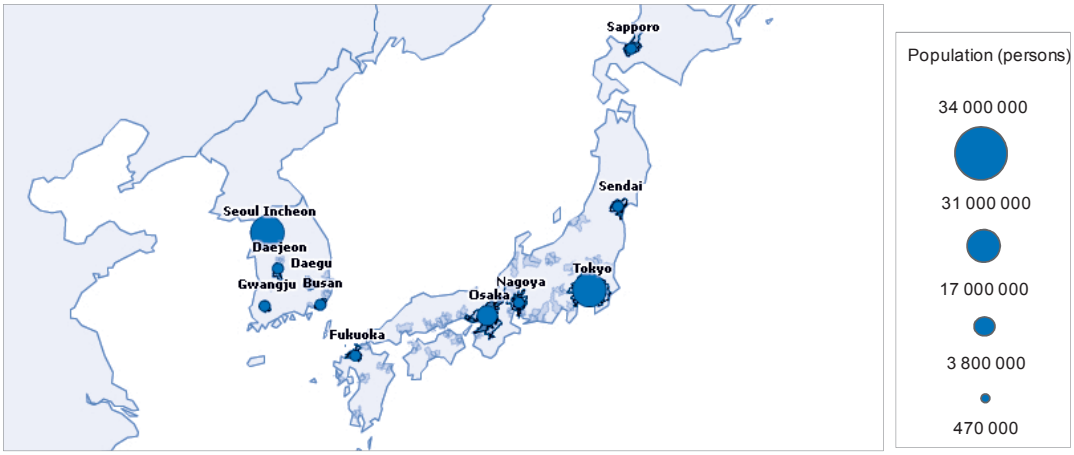

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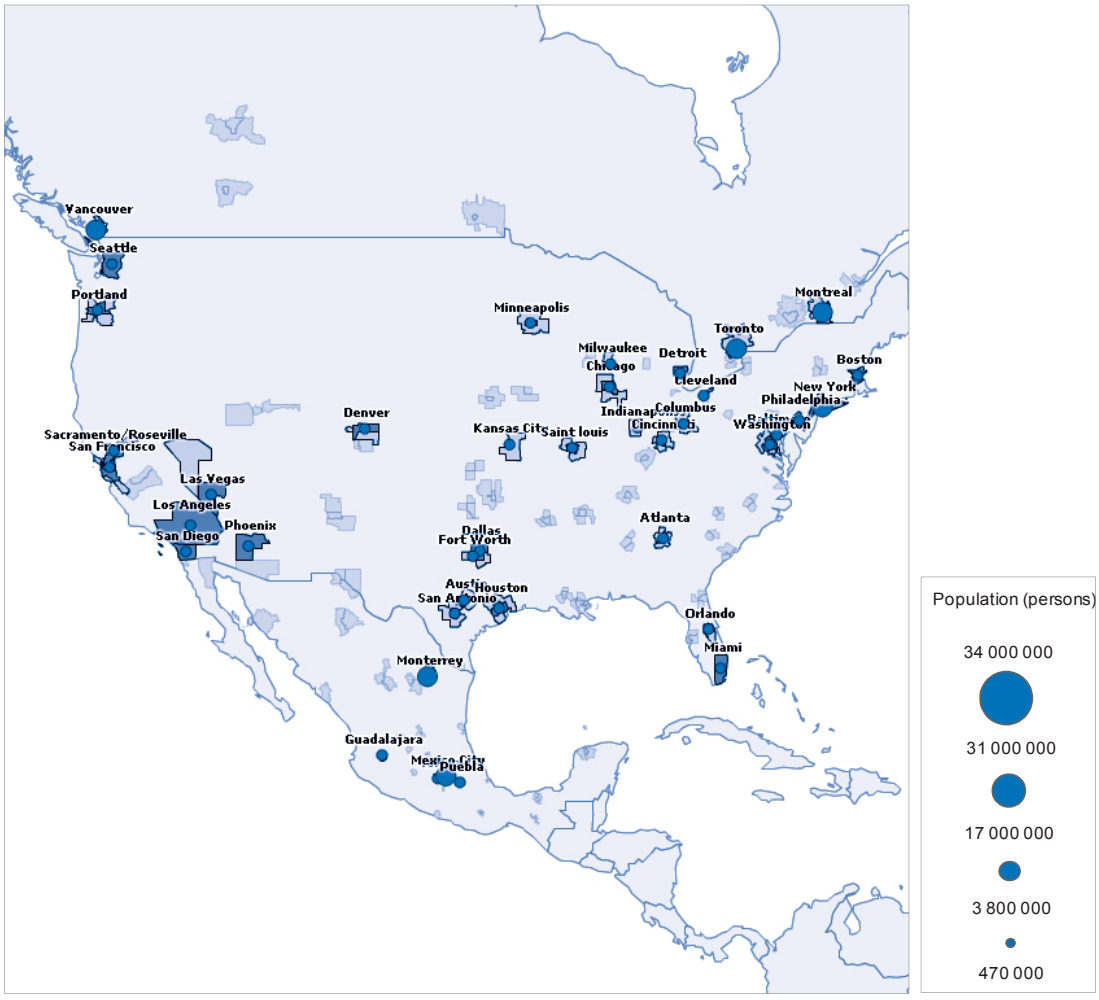
Figure A.8. **GDP share of national value (%), 2008** (*cont.*)

OECD urban areas over 1.5 million inhabitants

North America



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Source: OECD Metropolitan Database, *http://dotstat.oecd.org/Index.aspx?Datasetcode=CITIES.* Source of administrative boundaries: National Statistical Offices and FAO Global Administrative Unit Layers (GAUL).

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OECD (2012), *Redefining "Urban": A New Way to Measure Metropolitan Areas*, OECD Publishing, doi: *10.1787/9789264174108-en*.

Related OECD work on green growth and cities

- Hammer, S. et al. (2011), "Cities and Green Growth: A Conceptual Framework", *OECD Regional Development Working Papers 2011/08*, OECD Publishing, doi: *10.1787/5kg0tflmzx34-en.*

This working paper examines the state of knowledge about green growth in cities and outlines key research questions that guided the OECD Green Cities programme. It builds the case for urban green growth by examining the economic and environmental conditions that have pushed the green growth agenda to the forefront of policy debates and assesses the critical role of cities in advancing green growth.

- Kamal-Chaoui, L. and M. Plouin (2012), "Cities and Green Growth: Case Study of the Paris/Ile-de-France Region", *OECD Regional Development Working Papers 2012/02*, OECD Publishing, doi: *10.1787/5k9fd0fg78bs-en*.

This report, developed within the OECD Green Cities programme, examines the green growth potential of the Paris-Ile de France (IDF) region. It assesses socio-economic and environmental trends, spatial and environmental challenges, plans, strategies and sectoral policies as well as innovation, human capital, multilevel-governance and financing for green growth in the Paris-IDF region.

- OECD (2013), "Cities and Green Growth: The Case of Chicago", *OECD Regional Development Working Papers 2013/06*, OECD Publishing, doi: *10.1787/5k49dv6c5xmv-en*.

This report, developed within the OECD Green Cities programme, examines the green growth potential of the Chicago Tri-State metro-region in the United States. It assesses socio-economic and environmental trends, plans, strategies and sectoral policies as well as innovation, workforce development and multi-level governance mechanisms for green growth in the Chicago Tri-State metro-region.

- OECD (2013), *Green Growth in Kitakyushu, Japan*, OECD Green Growth Studies, OECD Publishing, doi: *10.1787/9789264195134-en.*

This report, developed within the OECD Green Cities programme, examines the green growth potential of the City of Kitakyushu, Japan. It assesses environmental and socio-economic trends, plans, strategies and sectoral policies as well as innovation assets and multi-level governance mechanisms for green growth in Kitakyushu.

- OECD (2013), *Green Growth in Stockholm, Sweden*, OECD Green Growth Studies, OECD Publishing, doi: *10.1787/9789264195158-en*.

This report, developed within the OECD Green Cities programme, examines the green growth potential of Stockholm City and County, Sweden. It assesses socio-economic and environmental trends, plans, strategies and sectoral policies as well as the regional innovation system and multi-level governance mechanisms for green growth in Stockholm.

- OECD (2013), "Urbanisation and Green Growth in China", *OECD Regional Development Working Papers 2013/07*, OECD Publishing, doi: *10.1787/5k49dv68n7jf-en*.

This report, developed within the OECD Green Cities programme and in co-operation with the China Development Research Foundation, examines urbanisation and green growth in China. It assesses urban and environmental trends, externalities of urbanisation as well as policies and governance for urban green growth in China.

- OECD (2012), "The Korean Green Growth Strategy and its Implementation in Urban Areas", in *OECD Urban Policy Reviews, Korea 2012*, OECD Publishing, doi: *10.1787/9789264174153-6-en.*

This chapter on the Korean Strategy for Green Growth and its implementation in urban areas assesses the contributions of sub-national governments to Korea's National Strategy for Green Growth and identifies the main challenges for effective implementation at the local level.

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Contents

Executive summary
Chapter 1. What is green growth in cities?
Chapter 2. Why are cities important to national green growth strategies?
Chapter 3. What are the high-priority green growth policies for cities?
Chapter 4. How should urban green growth governance and financing challenges be addressed?

Further reading

Green Growth in Kitakyushu, Japan (2013)
Green Growth in Stockholm, Sweden (2013)
Linking Renewable Energy to Rural Development (2012)
Compact City Policies: A Comparative Assessment (2012)
Redefining "Urban": A New Way to Measure Metropolitan Areas (2012)
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