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**

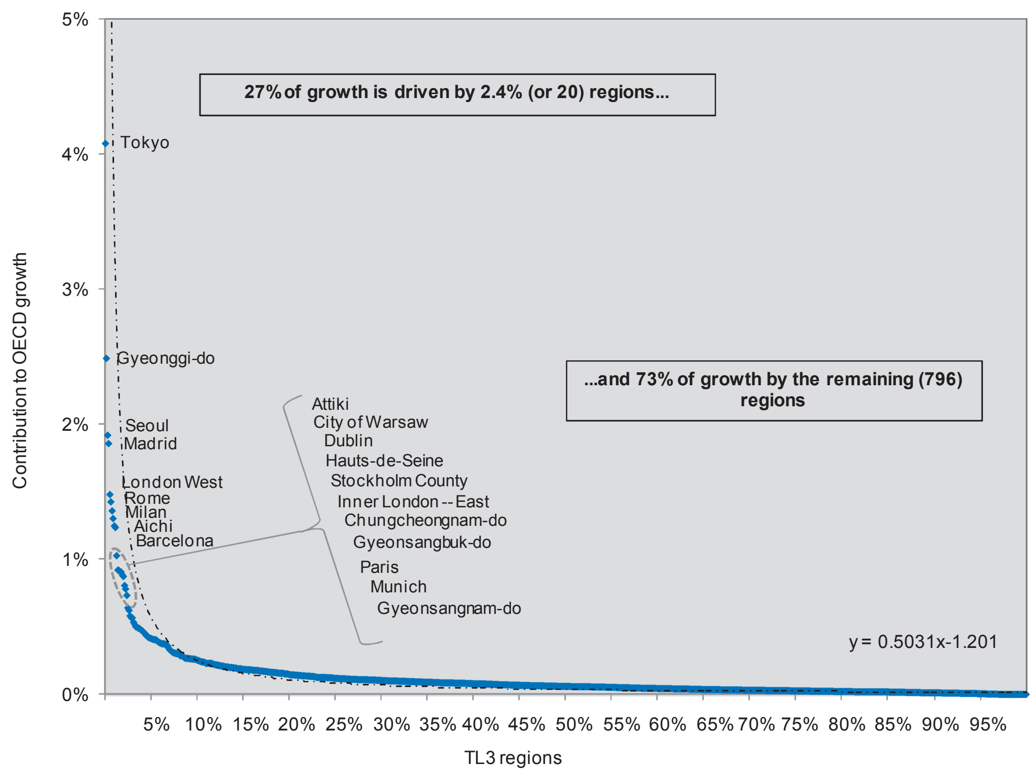
	Average			Median		
	Predominantly urban	Rural close to a major city	Remote rural	Predominantly urban	Rural close to a major city	Remote rural
Population/km^2	1175.0	52.5	21.7	488.8	45.2	9.7
Unemployment rate (%)	8.2	8.5	8.8	7.5	8.2	8.5
Employment rate (%)	66.5	66.1	70.0	66.7	66.2	70.0
Participation rate (%)	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).

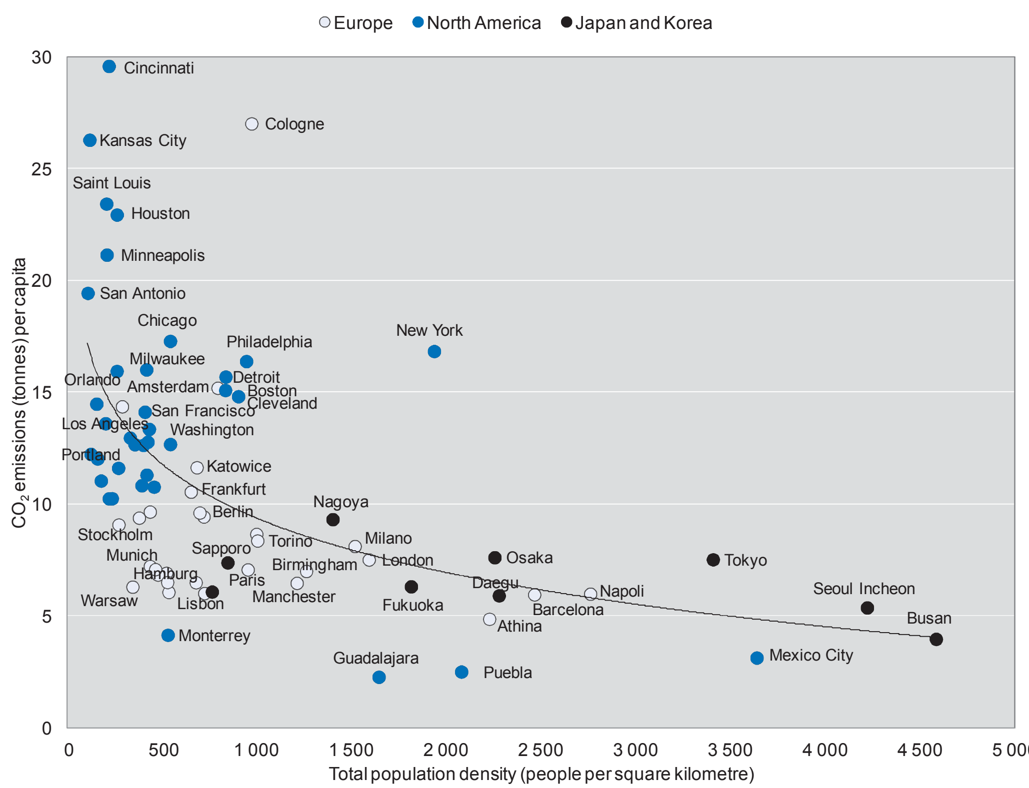
Cities are also particularly vulnerable to climate change impacts. A 50cm sea-level rise combined with projected business-as-usual socio-economic growth could triple by 2070 the population exposed to coastal flooding and trigger a ten-fold increase in the value of assets exposed, accounting for 9% of 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).

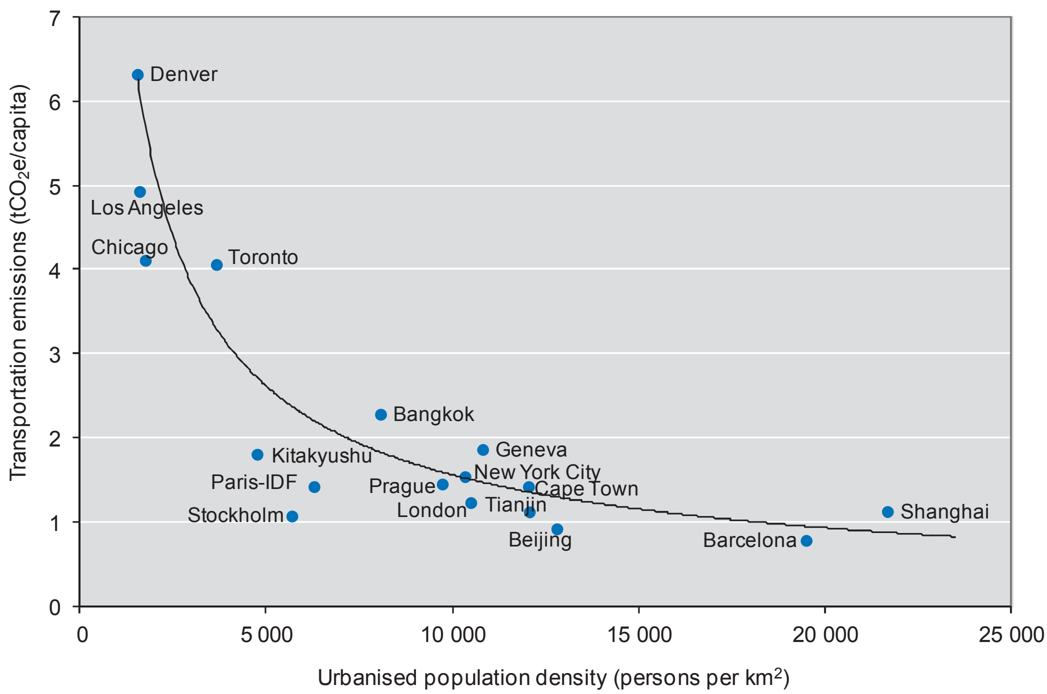
Figure 2.2. **Population density and CO_2 emissions *per capita* in 73 large OECD metropolitan areas, 2006**



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**



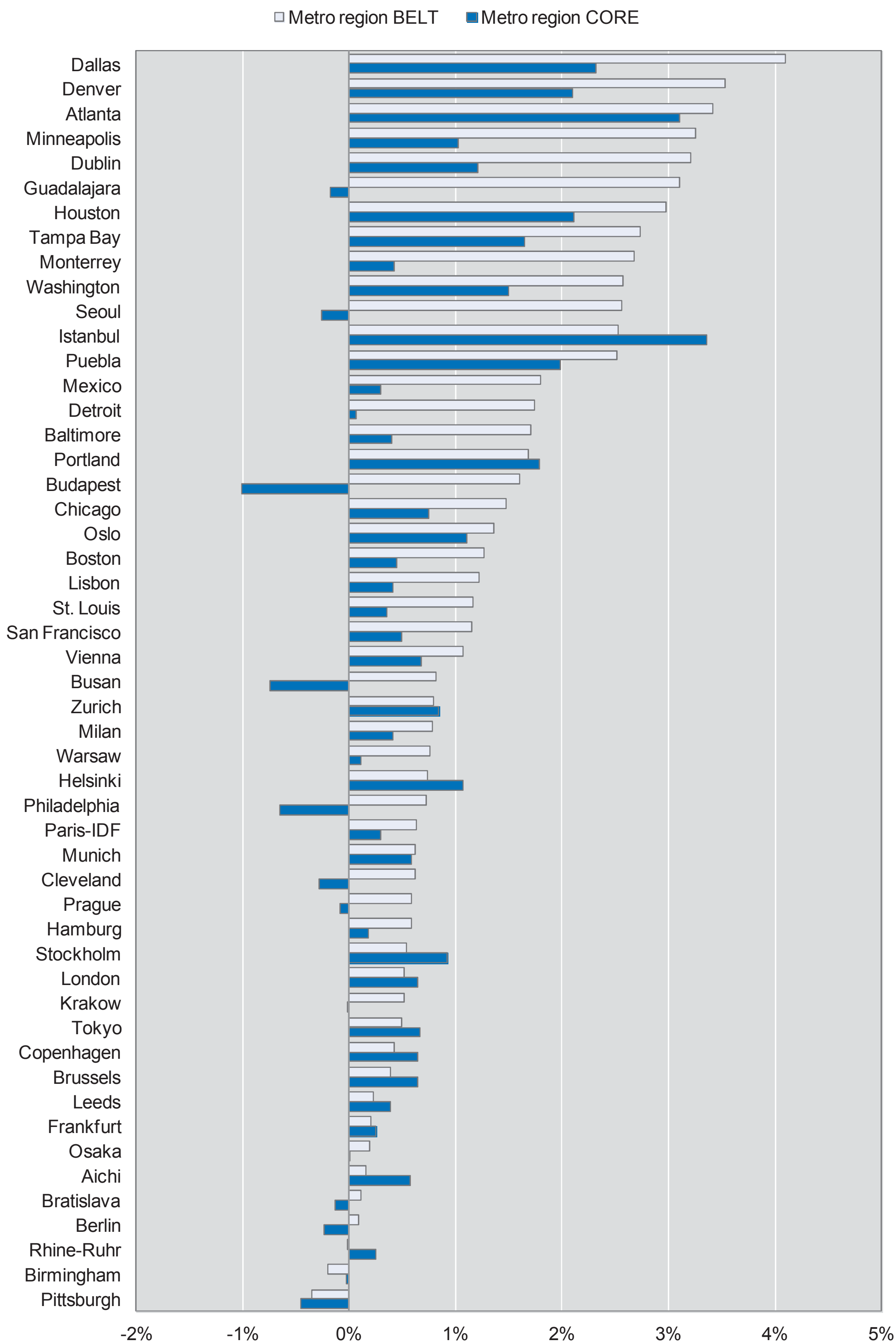
Notes: 1. The density of the urbanised land surface is calculated without including green areas. 2. Analytical units and reference years used for these calculations: Barcelona (city, 2006); Geneva (canton, 2005); London (Greater London, 2003); Paris-IDF (IDF region, 2005); Prague (Greater Prague, 2005); 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.

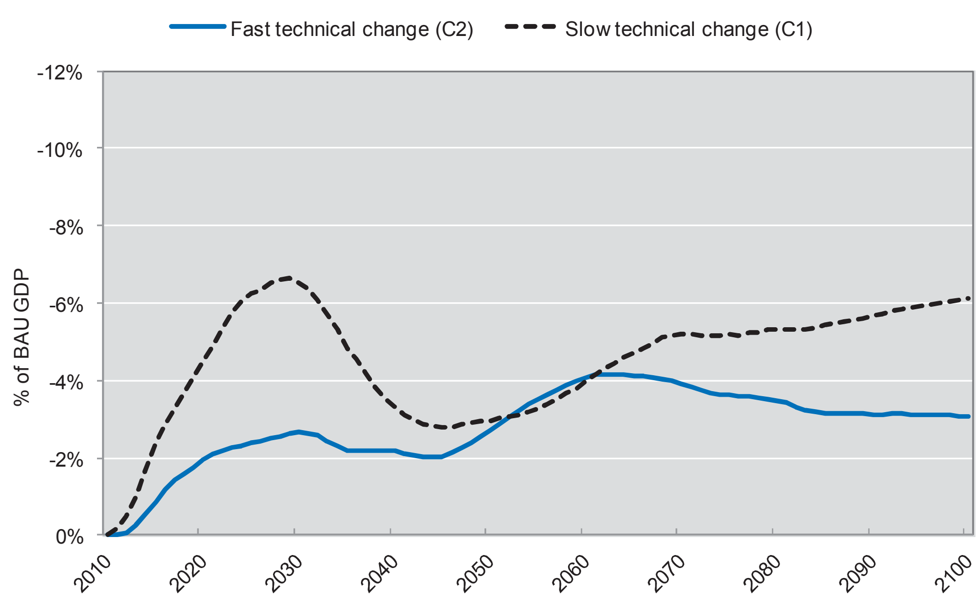
Within this model, policies that have the effect of shifting travel to low-carbon modes and reducing the need for mobility can meet the same global carbon emissions targets with a smaller rise in carbon prices and smaller GDP losses. These policies involve either:

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.

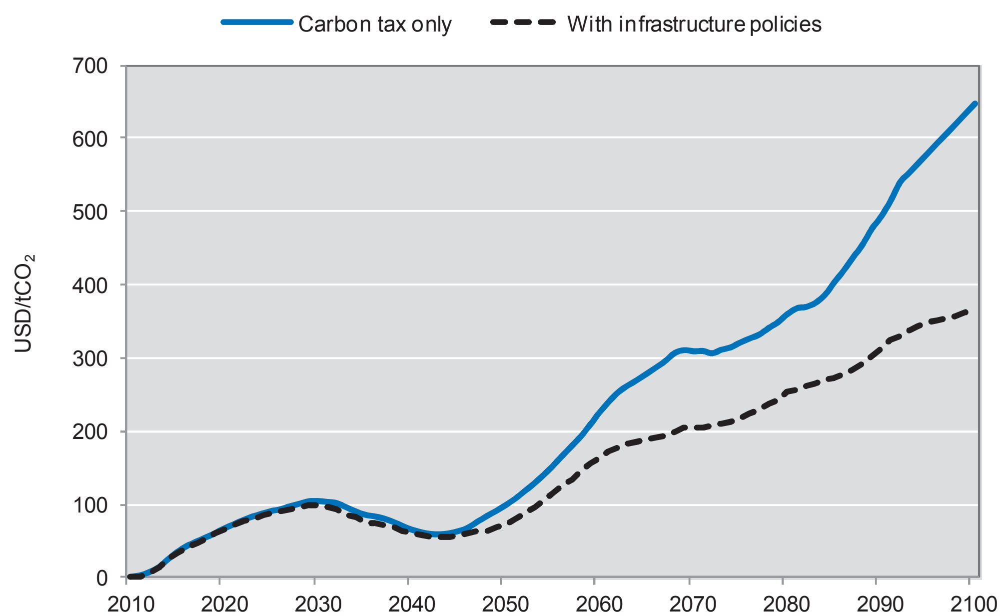
Figure 2.5. **How a high carbon price and the rate of technical change affects GDP, 2010-2100**



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).

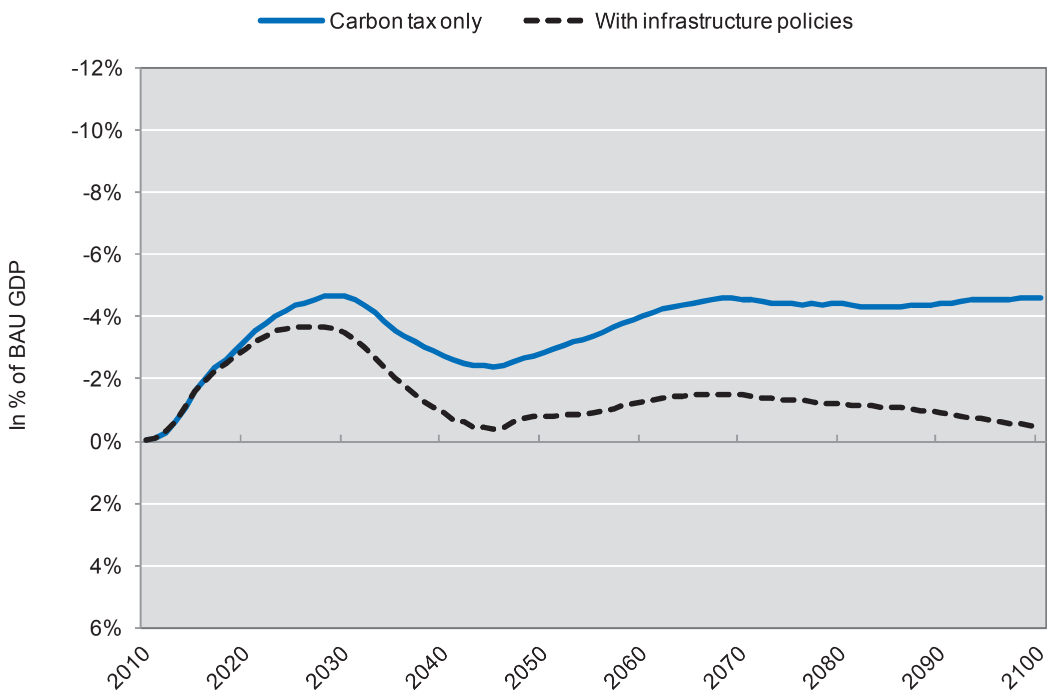
Figure 2.6. **Average carbon price for a "carbon price only" policy scenario or for a complementary infrastructure policy scenario**



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**



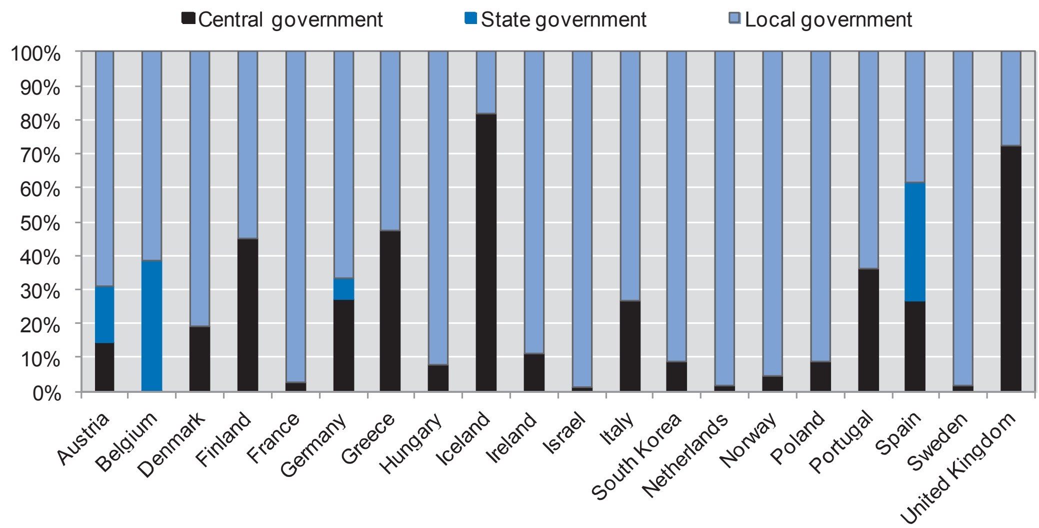
Source: Waisman, H., C. Guivarch, F. Grazi and J.C. Hourcade (2012), "The IMACLIM-R Model: Infrastructures, Technical Inertia and the Costs of Low Carbon Futures Under Imperfect Foresight", *Climatic Change*, Vol. 114, No.1, SpringerLink.

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**

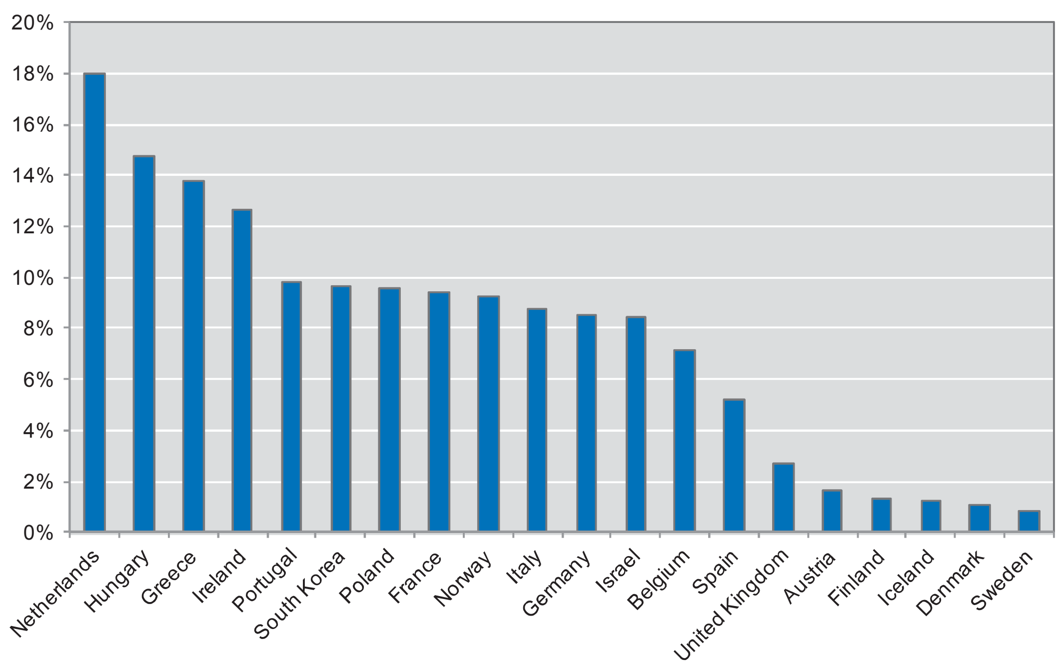


Notes: The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

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

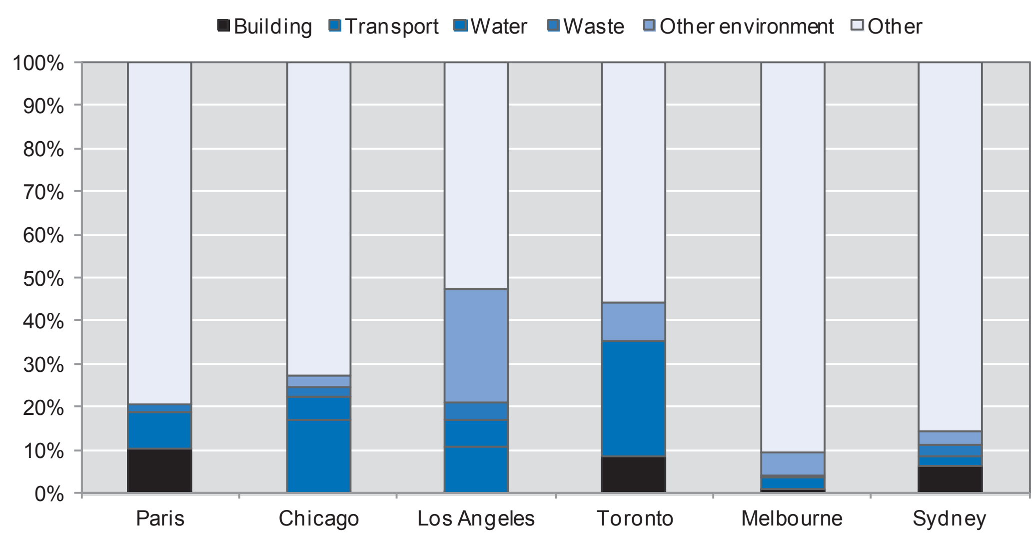


Notes: The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

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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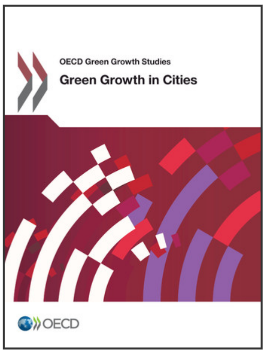

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