Chapter 2

CITIES

Main points

- Building better, more productive cities can boost economic prosperity and help tackle climate change. On current trends, fewer than 500 cities in three key groups – Emerging Cities, Global Megacities, and Mature Cities – will account for over 60% of global income growth and half of energy-related greenhouse gas emissions growth between now and 2030. Action in these cities, particularly Emerging Cities, will have disproportionate benefits for the global economy and climate.
- Growth today typically involves poorly managed, unstructured urbanisation whose economic, social and environmental costs outweigh the benefits. Urban sprawl costs the US economy alone an estimated US$400 billion per year.
- A shift to more compact urban growth, connected infrastructure, and coordinated governance could boost long-term urban productivity and yield environmental and social benefits. Such an approach has the potential to reduce urban infrastructure capital requirements by more than US$3 trillion over the next 15 years. New analysis suggests that the world's 724 largest cities could reduce greenhouse gas emissions by up to 1.5 billion tonnes of carbon dioxide equivalent (CO_2e) annually by 2030, primarily through transformative change in transport systems.
- All cities can improve resource productivity in the short term through cost-effective investments in building energy efficiency, waste management, transit and other measures. However, these benefits will typically be overtaken by economic and population growth within seven years without a broader, structural shift in the model of urban development.
- We are already seeing many cities shifting towards better-managed urban growth, particularly in transport. Over 160 cities have implemented bus rapid transit systems. China's urban rail networks will total 3,000 km in length in 2015. Nearly 700 cities have implemented bike-sharing schemes, and a range of smarter transport systems, such as car-sharing, have taken off in numerous cities.
- Scaling and accelerating the shift to compact, connected, coordinated growth will require countries to put urban areas at the heart of their economic development strategies, and consider greater fiscal autonomy for cities. Only 4% of the 500 largest cities in developing countries are deemed creditworthy in international financial markets. The international community should redirect and scale up multilateral development bank financing for smarter urban infrastructure, and help cities build creditworthiness.

1. Introduction

Cities are engines of national and global growth. Urban areas account for half the world's population, but generate around 80% of global Gross Domestic Product (GDP).[1] They are also associated with around 70% of global energy consumption and energy-related greenhouse gas emissions.[2]

The world is now experiencing a new, different type of urbanisation. By 2030, around 60% of the global population will live in urban areas. Cities and urban areas[3] will house nearly all of the world's net population growth over the next two decades: 1.4 million people are being added to urban areas each week, roughly the population of Stockholm.[4] By 2050, the urban population will increase by at least 2.5 billion, reaching two-thirds of the global population.[5] This urban transition is being driven by cities in the developing world, where 90% of urban growth is projected to take place.[6] In 2030, China's cities will be home to close to 1 billion people or 70% of the population.[7]

The stakes for growth, quality of life and carbon emissions could not be higher. The structures we build now, including roads and buildings, could last for a century or more, setting the trajectory for greenhouse gas emissions at a critical time for reining these in.

City administrations are often acutely influential, with sharper local powers than national policy-makers.[8] But climate risk is rarely near the top of their priority list. They face other pressing issues: public safety, delivery of basic services, housing, chronic traffic congestion, municipal budgets.

The structures we build now, including roads and buildings, could last for a century or more, setting the trajectory for greenhouse gas emissions at a critical time for reining these in.

Planning for more compact, better-connected cities with strong mass transit systems will help policy-makers tackle these pressing challenges. Such cities are more productive, socially inclusive, resilient, cleaner, quieter and safer. They also have lower carbon emissions, showing that the goals of economic growth and climate change can work together. The lessons are being learned. South American cities such as Curitiba and Bogota are flagships for the benefits of bus rapid transit systems. But these are not typical. In the last 10 years, population densities in Chinese cities have declined on average by 25%, for example.[9]

This chapter begins by charting the growing contribution of cities both to the world economy and carbon emissions. Next, it reviews the most common form of urban expansion across countries today, and examines an alternative growth pathway, giving special attention to urban form, transport, and initiatives which boost short- to medium-term resource productivity. Next, it discusses the kinds of urban policy frameworks needed to scale up that alternative pathway, through planning policy, pricing instruments, fiscal and finance mechanisms, governance, and legal powers. It concludes with recommendations.

While the chapter is targeted at a wide readership, it is particularly pertinent for countries which have a significant portfolio of rapidly growing cities. Several other chapters also address urban issues, including Chapter 4: Energy (particularly urban air pollution); Chapter 5: Economics of Change (how mass transit systems can help reduce the distributional effects of fuel taxes and carbon pricing); Chapter 6: Finance (unlocking funding for smarter infrastructure); and Chapter 7: Innovation (improving energy efficiency in buildings).

2. Cities, global growth and carbon emissions

Cities are engines of national and global growth, accounting for around 80% of global economic output.[11] Some 150 of the world's largest metropolitan economies produce 41% of global GDP with only 14% of the global population.[12]

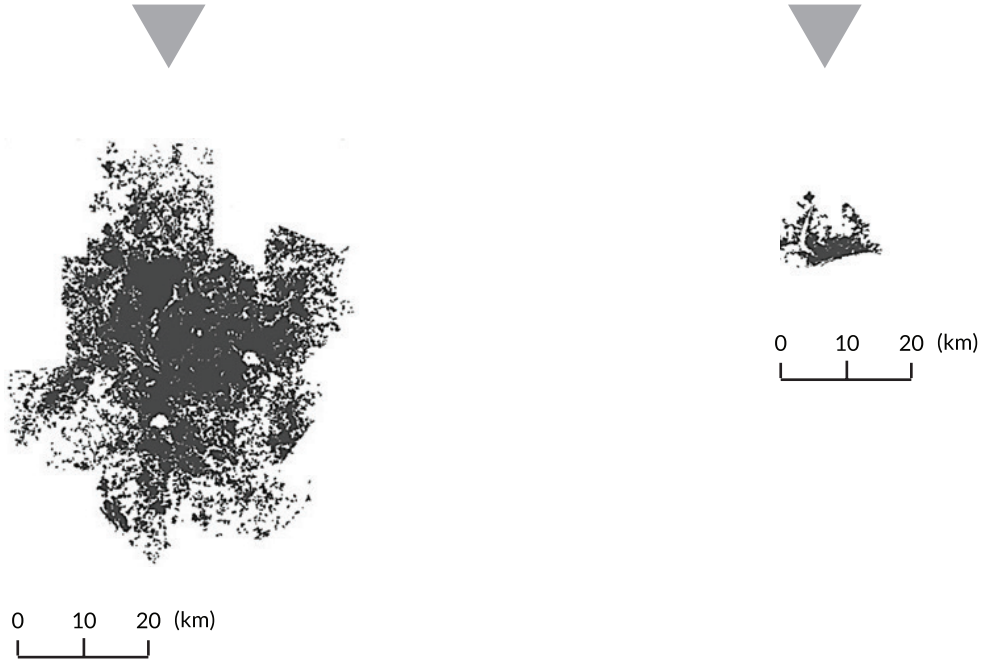
Most successful high-income countries have economically dynamic cities at the heart of their regional and national economies, from Tokyo in Japan to London in the United Kingdom. Cities are also rapidly transforming the economic landscape of emerging markets. Already the 90 largest Chinese cities account for over US$6 trillion – the size of the national economies of Germany and France combined.[13] And cities in India generate two-thirds of GDP, 90% of tax revenues, and the majority of jobs, with just a third of the country's population.[14]

Cities are also key drivers of global energy demand and greenhouse gas emissions, accounting for around 70% of both, according to the International Energy Agency (IEA).[15] Urban emissions from emerging economy cities are already converging with those of developed cities.[16] Beijing, Shanghai and Tianjin, for example, have per capita emissions comparable to those of large European and some North American cities.[17]

Research for the Commission used a database of the world's largest cities to identify three groups that are particularly important in terms of impacts on the global economy and climate out to 2030. The three groups

Figure 1

Atlanta and Barcelona have similar populations and wealth levels but very different carbon productivities



	ATLANTA	BARCELONA
POPULATION:	2.5 MILLION	2.8 MILLION
URBAN AREA: TRANSPORT	4,280 KM²	162 KM²
CARBON EMISSIONS: TONNES CO_2 PER PERSON (PUBLIC + PRIVATE TRANSPORT)	7.5	0.7

Source: Bertraud and Richardson, 2004.[10]

were defined based on their population, income level and growth. The analysis shows these 468 cities will account for over 60% of global income growth between 2012 and 2030, under business-as-usual economic growth assumptions. They will account for nearly half of all growth in energy-related greenhouse gas emissions. In 2030, they will account for 60% of global GDP and around 45% of global energy-related emissions.[18]

The groups are classified as Emerging Cities, Global Megacities, and Mature Cities, defined below.[19]

- **Emerging Cities** are 291 rapidly expanding middle-income, mid-sized cities in China, India and other emerging economies, with populations of 1–10 million, and per capita incomes of US$2,000-20,000. These cities are likely to account for over a quarter of global income growth and over a third of energy-related emissions growth over the next two decades. Given the rapid change expected in these cities over the next few decades, action by this group represents the most significant short- to medium-term global opportunity for avoiding lock-in to long-lived, high-carbon urban infrastructure.[20]

- **Global Megacities** are 33 major cultural centres with populations above 10 million and per capita incomes over US$2,000, including capital cities such as London, Beijing and Tokyo. This comparatively small number of cities will account for approximately 15% of global income growth and over a tenth of emissions growth out to 2030, with considerable diversity in the pace of economic and demographic change between them. Some of these cities are already exhibiting signs of relative decoupling of economic growth from emissions growth.[21] This presents an important opportunity to explore how these cities can continue to attract talent and capital while managing growth in emissions.

Figure 2

Emerging Cities will play a significant role in growth of the global economy and carbon emissions to 2030

URBAN GROUP	PROJECTED BASE GDP GROWTH FROM 2012-2030, USD TRILLIONS	PROJECTED BASE CASE EMISSIONS GROWTH[1] FROM 2012-2030, MEGATONNES OF CO_2	PROJECTED POPULATION IN 2030, BNS	PER CAPITA IN 2030, TONNES OF CO_2 PER PERSON
Emerging Cities e.g. Bangalore, Kunming, Pune, Puebla	16	3230	~1.3	~7
Small Urban Areas Inc. villages, small towns, peripheral industrial areas pop. < 0.5 million	16	1220	~2.2	~4.6
Established Cities e.g. Stuttgart, Minneapolis, Stockholm, Hiroshima	11	390	~0.4	~12.1
Global Megacities e.g. Beijing, New York, London, Rio de Janeiro	10	1050	~0.6	~7.1
Total growth	~ 52	~ 5,890	**Total population in 2030** ~ 4.5	
Share of world growth	~ 87%	~ 65%	**Share of world pop. in 2030** ~ 55%	

Note: Energy assumptions are consistent with the IEA's Current Policies scenario. GDP figures are based on 2012 prices and exchange rates. Small urban areas are a highly diverse segment covering cities in both developed and developing countries. Estimates for this segment, especially for per capita emissions, are subject to significant levels of uncertainty and should be treated as indicative.

Source: Analysis by LSE Cities and Oxford Economics; data from the Oxford Economics Global 750 Cities database. Small Urban Areas include 26 cities in the Oxford Economics database with populations under 500,000 and those areas classified as urban in the UN World Urbanization Prospects database.

- Mature Cities are 144 prosperous, established, mid-sized cities in high-income countries with per capita incomes above US$20,000, such as Stuttgart, Stockholm and Hiroshima. These cities – which often form part of a regional economic network – will drive close to 20% of income growth out to 2030 and have the highest per capita emissions of any city group, averaging 12 tonnes of carbon dioxide equivalent (CO_2e) per capita in 2030. Growth in emissions is expected to be relatively modest, and a number of cities within this category show signs of decoupling of economic growth from emissions growth.

In addition, a less-noticed story of urbanisation is unfolding in Small Urban Areas. Over a quarter of global income growth and around a sixth of GHG emissions growth will take place in small cities, towns, peripheral industrial zones, and other urban areas of less than half a million people. This is where much of the urbanisation will take place in Least Developed Countries.

Given the significant lock-in risks associated with urban infrastructure investments, the choices all these groups of cities make now about their future model of urban expansion will play an important role in determining the global economic and emissions pathway for decades and even centuries to come. This is particularly the case for rapidly growing Emerging Cities and Small Urban Areas (see Figure 2). The stakes could not be higher.

3. The rising costs of unmanaged, unstructured global urban expansion

In much of the world, urban growth is now characterised by poorly managed, unstructured expansion and conventional motorisation. Business-as-usual development may see the number of privately owned vehicles increase from 1 billion today to 2 billion in 2030.[22] Meanwhile, the area of urbanised land could triple globally from 2000 to 2030.[23] This is equivalent to adding an area bigger than Manhattan every day.

China illustrates this trend. Over the last 10 years, population densities in Chinese cities have declined on average by 25%, and are now lower relative to benchmarks in advanced countries.[24] Despite some signs of the inverse trend in Beijing over the last decade, the continuation of such a model of urban expansion would

require developing an area equivalent to the Netherlands over the next decade, and a tripling of urban land in China by 2030.[25]

Although this sprawled pattern of urban development has real and perceived benefits,[26] the Commission's analysis shows that on balance, the future costs will significantly outweigh the benefits.[27] Already today, this growth model is starting to break down. In China, Prime Minister Li Keqiang described the smog in Chinese cities as a warning "against the model of inefficient and blind development", with the rush to develop spreading into rural areas and leaving municipal governments with mounting debt.[28] In other emerging markets, informal settlements are growing as urbanisation increases, with the provision of infrastructure and services unable to keep pace with population growth.[29]

The challenges also apply to developed countries. In the United States, sprawling urban areas were hit hard by a speculative real estate market and high energy prices in the run-up to the financial crisis. Sprawling suburbs such as Victorville, outside Los Angeles, proved unviable when fuel prices rose from $2 early in the decade to $4 in 2008.[30] The significant increase in transport costs reduced the demand for housing, contributing to over 70% of new homes for sale being in foreclosure by July 2009.[31] In Europe, urban economies characterised by a pre-crisis real estate boom, for example in Spain, are still struggling to recover from the downturn.

The business-as-usual pattern of urbanisation is imposing a range of significant economic and social costs. These include:

1. **Greater required investment, leading to a funding gap and the failure of many cities to deliver basic urban infrastructure and services:** The Organisation for Economic Co-operation and Development (OECD) and the IEA estimate that around US$50 trillion is required for investment in transport, building energy efficiency, telecommunications, and water and waste infrastructure over the next 15 years.[32] The Boston Consulting Group, meanwhile, calculates an infrastructure investment shortfall of over US$1 trillion per year[33], a significant share of which is due to the additional investment required for roads and traffic management in sprawling cities. Urban sprawl significantly reduces the resources available for investment in basic urban infrastructure and services, as well as public transport. In India, the gap in urban infrastructure investment is estimated at US$827 billion over the next 20 years,[34] with two-thirds of this required for urban roads and traffic support. New analysis for the Commission shows urban sprawl in the United States adds costs of around US$400 billion per year, mostly as a result of greater infrastructure, public service delivery and transport costs (see Box 1). [35]
2. **Growing financial and welfare costs related to traffic congestion:** Congestion is already imposing costs as high as 3.4% of GDP in Buenos Aires and 2.6% in Mexico City.[36] Even in the higher-density European Union, congestion costs average 1% of GDP.[37]

In Beijing, the total social costs of motorised transport, including air pollution and congestion, are estimated at 7.5-15% of GDP.

3. **Escalating economic and social costs due to air pollution:** Urban air pollution is projected to become the top environmental cause of premature mortality by 2050.[38] In Beijing, the total social costs of motorised transport, including air pollution and congestion, are estimated at 7.5–15% of GDP.[39] Analysis for this report, covering 311 cities and close to a billion people, shows that the business-as-usual pattern of urban development is responsible for 86% of these cities exceeding World Health Organization (WHO) air quality guidelines for outdoor air pollution. By tipping air pollution above safer thresholds, this pattern of development has therefore contributed to an estimated 730,000 premature deaths, a significant proportion of which are related to motorised transport.[40] Other studies show that pollution-related health costs reach as high as 5% of GDP in some cities in developing countries, over 90% of which can be attributed to vehicle emissions.[41] The OECD estimates that the social costs of road transport in OECD countries, China and India combined are US$3.5 trillion per year, including the value of health impacts and lives lost.[42]
4. **Lock-in of inefficiently high levels of energy consumption:** A study of 50 cities worldwide estimates that almost 60% of growth in expected energy consumption is directly related to urban sprawl, surpassing the impact of GDP and population growth.[43] This leaves many cities vulnerable to volatility in energy prices.
5. **Increasing social exclusion:** The combined effects of urban sprawl and motorisation are linked to the growth of both slums and gated communities, which are creating socially divided cities.[44]
6. **A wide range of other economic and social costs:** These include costs related to road safety, divided communities, low levels of physical activity (with significant health implications), reduced ecosystem

Box 1
The global cost of urban sprawl [47]

Urban sprawl, defined here as the uncontrolled and excessive spatial expansion of cities, is one of the world's most significant – and least well documented – market failures, leading to inefficient use of land, capital and other resources.

As noted above, new analysis for this project puts the external costs of sprawl at about US$400 billion per year in the United States alone. Around 45% of those costs are due to the increased cost of providing public services such as water and waste; one-fifth is due to increased capital investment needs for infrastructure such as roads, and the rest is due to the costs of increased congestion, accidents and pollution not borne directly by private individuals. The total costs amount to about 2.6% of US GDP at current prices. If the United States followed an alternative growth pattern without urban sprawl, the savings could cover the country's entire funding gap in infrastructure investment.

Such cost estimates indicate the potential savings from pursuing smarter growth policies based on more compact, mixed, multi-modal, infill development. This is a lower bound estimate, as it excludes over US$323 billion in higher personal/household transport costs, climate change impacts, the impacts on agricultural productivity and ecosystems, and social costs related to the creation of more divided communities and degradation of urban centres – which can, for example, increase crime. Although the costs of urban sprawl may be lower in absolute value in developing countries, due to lower wages and property values, they are likely to be similar in magnitude as a proportion of the national economy.

Despite a range of real and perceived benefits of more sprawled development to private individuals and developers, such as larger house sizes and some cost efficiencies in house-building, a review of the evidence for the Commission report suggests inefficient sprawled development at least doubles land used per housing unit, increases the costs of providing utilities and public services by 10–30% and sometimes more, and increases the costs associated with travel by 20–50%.[48] These costs can be higher in fast-growing low- and middle-income countries, where sprawled patterns can double or triple many costs due to the increased costs of importing construction equipment, for instance.

Sprawl also tends to be unfair, since lower-income people, who rely more on walking, cycling and public transport, are less likely to benefit from the additional road infrastructure, for example, but still pick up the bill in higher utility and public service costs. Although there is some evidence to suggest that sprawl can increase housing affordability, this is typically more than offset by the increase in transportation and public service/infrastructure costs (e.g. water, waste and sewage).[49]

A degree of urban expansion is inevitable, particularly in Emerging Cities, driven by a range of factors, including income and population growth, the falling costs of private vehicle travel, and reductions in the value of rural land as economies undergo structural transformation. However, urban expansion often goes far beyond what is economically efficient.

At the heart of sprawl are a range of interlocking market failures, such as the failure to account for the higher costs of providing public infrastructure in sprawling cities; the failure to price the significant and rising costs of traffic congestion, vehicle-related accidents, carbon emissions and air pollution; and the failure to take into account the public infrastructure costs generated by more dispersed developments. Excessive spatial growth is also driven by a range of governance failures, strong vested interests, and weak revenue bases (which encourage the sale of land for new development). Chapter 5: Economics of Change provides detailed analysis of markets failure in the pricing of energy and carbon emissions.

services and risks to food security. Urban road accidents in developing-country cities alone can cost as much as 2% of GDP.[45] And Chinese urban expansion is already adversely affecting food security due to the impacts on land use.[46]

In addition to these economic and social costs, a business-as-usual pattern of urban expansion will lead to a significant increase in global carbon emissions.

First, urban infrastructure uses materials, including concrete and steel, which have significant embedded emissions as a result of their carbon-intensive manufacture. These materials are heavily used in the early phases of urbanization in particular. If developing countries expand their infrastructure to current average global levels, the production of infrastructure materials alone would generate around 470 billion tonnes of CO_2 emissions by 2050,[50] much of this in sprawled cities. The continued expansion of infrastructure could produce cumulative emissions of 2,986-7,402 billion tonnes of CO_2 over the remainder of this century.[51]

Second, poorly managed urban development could lock in higher operational emissions for decades and centuries to come. The IEA estimates, for example, that under business-as-usual patterns of urbanisation, carbon emissions from urban transport will almost double by 2050.[52]

4. A new wave of urban productivity

Cities can follow a different growth pathway to unlock a new wave of urban productivity. This alternative approach

Box 2
The rising costs of unmanaged, unstructured urban expansion in India [53]

India is on the brink of an urban revolution. Over the last two decades India's urban population increased from 217 million to 377 million, and this is expected to reach 600 million, or 40% of the population, by 2031. The current pattern of urbanisation is largely taking place on the fringe of cities, much of it unplanned and outside the purview of city codes and byelaws, and is already imposing high costs. Unprecedented growth is leaving municipal governments with critical infrastructure shortages and service gaps.

Urban pollution caused 620,000 premature deaths in 2010, up more than sixfold from 2001, and a recent survey of 148 Indian cities by the Indian Central Pollution Control Board found onlty two cities with passable air quality. Recent estimates show that the cost of environmental degradation, largely driven by sprawling cities, is enormous, reducing India's GDP by 5.7%, or about US$80 billion annually. Some 44% of India's rapidly growing carbon emissions have urban origins, emanating from transport, industry, buildings and waste. This highlights the potential benefit of a new model of urban development.

should be based on boosting resource productivity, to improve the efficiency of energy use and resilience to energy price volatility. And it would involve a broader shift to more compact, connected and coordinated urban growth.

4.1 Boosting resource productivity

Even under a business-as-usual pattern of urbanisation, all groups of cities have significant short- to medium-term opportunities to save energy and reduce inefficiencies associated with unstructured, poorly managed urbanisation. New analysis reviewed by the Commission shows significant economic opportunities in the next 5–10 years for all cities to improve resource efficiency, generate wider economic benefits, and reduce carbon emissions. Potential measures include smarter buildings and transport, efficient waste management, and investments at the district level. These are outlined in further detail in Box 3.

These relatively accessible, "no-regrets" options could play a critical role in helping cities overcome some of the key barriers to change, and so avoid becoming locked into higher-cost, higher-carbon development trajectories.

They could help secure commitment to creating cleaner cities, and could build capacities, stimulate investment, build momentum for change, and create opportunities for learning. All of these could be critically important benefits, as many cities, and particularly those in the developing world, may not yet have the technical, financial and institutional capacities needed for fundamental shifts to more energy-efficient and low-carbon development paths.[59]

However, it is also clear that the economic and climate benefits of measures to boost urban resource productivity can be quickly overwhelmed by continued economic and population growth under business-as-usual patterns, unless they are accompanied by broader structural shifts in urban form and public transport infrastructure. That was a key finding of the five city studies described in Box 3, and is especially the case in rapidly growing, Emerging Cities. The study calculated that it took only a few years for energy consumption and carbon emissions to reach business-as-usual levels (dubbed energy or emissions "TREBLE points"),[60] after exploiting all cost-effective energy efficiency and carbon reduction options. For example, GHG emissions returned to levels expected without the green technology investments in less than seven years in Kolkata, Lima, Palembang, and Johor Bahru, as a result of economic and population growth.

These findings highlight the importance of combining investments in efficiency with deeper structural changes in urban form and transport infrastructure. Another priority is to decarbonise the energy supply – a topic discussed in depth in Chapter 4: Energy. While sector- or district-level investments that boost resource productivity can help improve urban efficiency and build capacity for further change, they are not sufficient to ensure long-term resource efficiency, sustained emission reductions, and wider social and economic benefits. Cities operate like networks. Fixing one node at a time, on a patchwork basis, can create strong positive local effects at the node, but it does not systematically boost productivity across the whole urban network. A more coordinated approach is essential.

4.2 Compact, connected, coordinated urban development

To unlock a new wave of sustained, long-term urban productivity improvements, cities will need to shift to compact, connected and coordinated urban development, termed the "3C" model of urban development. This alternative model is briefly defined.

- **Compact urban growth** refers to managed expansion which encourages higher-density, contiguous development, with functionally and socially mixed neighbourhoods, and walkable, human-scale local urban environments.[61] Denser development is complemented by public green spaces to maintain liveability.[62] In rapidly expanding cities, compact urban development is achieved through planned accommodation of population expansion and

Box 3
Economic returns from boosting resource productivity

A synthesis of studies examining the economic case for investment in low-carbon development strategies in five cities – Leeds, UK; Kolkata, India; Lima, Peru; Johor Bahru, Malaysia, and Palembang, Indonesia – identifies numerous opportunities for cost-effective investments, for more efficient vehicles, transport systems and buildings, and for small-scale renewables.[54] The review shows that savings in the range of 13–26% in energy use and GHG emissions are possible relative to business-as-usual trends in the next 10 years through investments, with payback periods of less than five years, assessed on commercial terms.

In the buildings sector, opportunities include improved building design practices; insulation; more efficient heating/cooling, lighting technologies and appliances, and the adoption of small-scale renewables. For residential buildings in the Leeds City Region, it was calculated that £1.1 billion (US$1.7 billion) could be profitably invested in domestic energy efficiency measures, generating annual savings of £400 million (US$626 million), paying back the investment in less than three years and reducing total emissions from the domestic sector by 16% relative to business-as-usual trends. These investments could also achieve multiple other benefits, including reduced fuel poverty and improved public health.

In the transport sector, the studies emphasise the potential for cost-effective investments in more efficient vehicles, cleaner fuels and a range of public transport initiatives. In the Lima-Callao region, for example, it was projected that cost-effective investments could reduce transport-related GHG emissions by 26% by 2025 relative to business as usual. An investment of PEN7.4 billion (US$2.8 billion) would generate annual energy savings of PEN2.9 billion (US$1.1 billion) – meaning a payback in 2.6 years. These investments would also have other benefits – particularly relating to urban air quality and public health.

In the waste sector, the studies found that cities could make significant cost-effective investments in waste-related GHG emissions through measures such as improved recycling, landfill gas capture and enhanced composting of waste. In Kolkata, for example, waste-related greenhouse gas emissions could be cut by 41% by 2025, relative to business as usual, through investments of INR13.1 billion (US$224 million) that would generate annual savings of INR1.1 billion (US$18.8 million), paying back the investment in 11.8 years. Again, these investments could achieve multiple other benefits.

These findings are supported by other studies and assessments:

- The Intergovernmental Panel on Climate Change (IPCC) found that recent developments in technology and know-how made it possible to build or retrofit very low- and zero-energy buildings, often at little marginal investment cost.[55] Efficiency measures typically paid back well within the building's lifetime, and generated significant energy savings in both new (50–90% savings) and existing buildings (50–75%). The IPCC found that well-designed building codes and appliance standards were the most cost-effective ways to unlock these benefits, although numerous market and non-market barriers often hinder market uptake.

- Siemens identified 30 market-ready low-carbon technologies such as light-emitting diode (LED) street lighting, new building technologies and electric buses. Adopting these across 30 of the world's megacities could create more than 2 million jobs,[56] and avoid 3 billion tonnes of cumulative GHG emissions and 3 million tonnes of local air pollution between 2014 and 2025, with an investment value of US$2.5 trillion.[57]

- McKinsey & Company examined the economic benefits of developing new green technology districts in the United States, China and the Middle East.[58] Technologies included efficient building design and lighting, energy-efficient street lighting, efficient waste management, rooftop solar power, and combined heat and power. McKinsey estimated annual operating savings of US$7–21 million, or US$250–1,200 per resident, for incremental capital costs of US$35–70 million per square kilometre. The investment could break even after three to five years, and generate an internal rate of return of 18–30%. The green technologies could reduce annual energy costs by 24–36% and reduce GHG emissions by 28–49%. Extending the same technologies (analysed here for greenfield development) to brownfield sites would have higher costs associated with remediation, but likely still drive net savings.

anticipation of infrastructure needs. Compact urban growth can also be achieved through redevelopment of brownfield sites.[63]

- **Connected infrastructure** refers to investment in innovative urban infrastructure and technology, with a focus on smarter transport systems to connect and capture the economic benefits of more compact urban forms. These transport systems would connect mixed-use, employment, housing and commercial clusters. They include bus rapid transit (BRT), bicycle "superhighways", car- and bicycle-sharing, smarter traffic information systems, and electric vehicles with charging point networks using renewable energy sources. Transport systems can be complemented by smarter urban utilities to deliver more connected, resource-efficient public services such as efficient energy, waste and water systems, street lighting technology, and smart grids. Smarter, more efficient buildings (both via retrofits and new builds) complete the fabric of the urban system.
- **Coordinated governance** refers to effective and accountable institutions to support coordinated planning and implementation across the public and private sectors and civil society, particularly for land use change and transport. The existence of organisations dedicated to coordinating policies within entire urban agglomerations, for example, has especially positive effects, ranging from lower levels of particulate matter air pollution to a reduction in urban sprawl.[64]

4.3 The benefits of compact, connected, coordinated urban pathways

Encouraging more compact, connected and coordinated cities is ultimately about harnessing cities' growth potential by reinforcing a central function, facilitating access to people, goods and services, and ideas. Throughout history, cities have been dynamic centres of economic specialisation and cultural expression. By enabling density – the concentration of people and economic activities in a small geographic space – these economic and social interactions create a vibrant market and fertile environment for innovation in ideas, technologies and processes, spurring innovation and productivity.[65]

More compact urban growth can significantly reduce the cost of providing services and infrastructure, and the rate of development of new land. It also significantly increases the viability of public transport and other urban infrastructure, by attracting more intensive use, and creates a deeper labour market that can achieve faster and better job matches. Moreover, the components of this system are self-reinforcing, generating a virtuous circle: more compact urban centres concentrate urban innovation and job creation, helping to attract talent and capital for investment in smarter infrastructure and technology, and widening the skilled labour pool.

In the medium to long term, the economic and social benefits of a large-scale shift to a compact, connected and coordinated urban pathway include:

1. **Unleashing productivity and growth through agglomeration effects:** Firms and workers in dense urban agglomerations are more productive. The World Bank estimates that in China, for example, a compact urban development pathway would lead to higher economic growth, greater productivity, and a larger share of the high-value services sector by 2030.[66] There are also productivity benefits from policy coordination. Empirical evidence suggests that productivity is lower in cities with a high degree of administrative fragmentation, a cost that is almost halved by the presence of a well-functioning governance body.[67]

2. **Improving the efficiency of capital deployment and closing the infrastructure gap:** New analysis for the Commission suggests that the United States could save $200 billion per year if it pursued smarter, more compact growth policies, primarily due to savings in the cost of providing public services and capital investments such as roads.[68] According to the World Bank, China could save up to US$1.4 trillion in infrastructure spending up to 2030 if it pursued a more compact, transit-oriented urban model – equivalent to around 15% of China's GDP in 2013.[69] Analysis for the Commission suggests that more compact, connected urban development could reduce global urban infrastructure requirements by more than US$3 trillion over the next 15 years (2015–2030).[70]

More compact, connected urban development could reduce global urban infrastructure requirements by more than US$3 trillion over the next 15 years (2015–2030).

3. **Delivering substantial cost savings in the transport sector:** Estimates for the United States suggest that transit-oriented urban development could reduce per capita car use by 50%, reducing household expenditures by 20%.[71] In 1995, transport costs in transit-oriented Singapore were US$10 billion less than in car-oriented Houston, a city of similar population size and wealth.[72] At significantly lower

fuel prices, sprawling Houston spends about 14% of its GDP on transport, compared with 4% in relatively compact Copenhagen and about 7% typically in many Western European cities.[73] In New York, density-related transport cost savings amount to about US$19 billion per year.[74]

4. **Delivering a wide range of benefits related to public-transport, walking and cycling infrastructure:** These benefits include greater access to jobs and low-cost transport, reduced congestion, improved public health and safety, and greater energy security[75] – all of which are particularly valuable to low-income urban residents. Regarding health, substantial benefits arise from improved air quality and physical activity. A study of Ho Chi Minh City, for example, found that a compact urban model would reduce transport-sector fine particulate matter (PM2.5) emissions by 44%, as well as indirect PM emissions by 16% as a result of reduced electricity use.[76]

In addition to the economic and social benefits, more compact, connected and coordinated urban development will also have significant climate benefits, by lowering GHG emissions from transport, buildings and other operations. New analysis for this report using a global database of city-level carbon emissions estimates that adoption of more compact, connected development models by the world's largest 724 cities could reduce global GHG emissions by 800 million to 1.5 billion tonnes of CO_2e per year by 2030. Those savings are achieved primarily through transformative changes in transport, reducing personal vehicle use in favour of mass transit.[77]

Another analysis for the Commission found that compact, transit-oriented cities could reduce annual GHG emissions by about 0.6 billion tonnes of CO_2e in 2030, rising to 1.8 billion tonnes CO_2e by 2050.[78] The savings would be achieved through reductions in personal vehicle use (shifting to public transport) and smaller housing units with lower energy demand. Further research is needed, however, to fully assess the potential impact on emissions of these and other compact, transit-oriented urban development strategies.

Measures to improve compactness and connectivity at the city level can also significantly improve the effectiveness of national policies to reduce carbon emissions. A recent study of Paris, for example, found that the presence of dense public transport infrastructure significantly increases residents' willingness to pay carbon or fuel taxes.[79]

Box 4

Urban resilience: compact, connected and coordinated cities

With the rising incidence of climate-related hazards impacting urban areas, it is crucial that cities invest in enhancing their resilience to ensure they can withstand the shocks of future extreme events, minimise the damages, and recover quickly. A great deal is at stake: Hurricane Sandy in 2012 caused about US$19 billion in damages in New York City alone, left almost 2 million people without power, and flooded nearly 90,000 buildings.[80]

Coastal cities are at particularly great risk. The OECD analysed the climate risks faced by the 136 port cities globally with more than a million residents in 2005, and found they had about US$3 trillion worth of assets at risk in 2005, or about 5% of global GDP that year; by the 2070s, that is expected to rise to US$35 trillion, or 9% of projected global GDP.[81] The most exposed cities as of 2005, the study found, were Mumbai and Kolkata in India; Guangzhou and Shanghai in China; Miami, Greater New York and New Orleans in the US; Ho Chi Minh City in Vietnam; Osaka-Kobe in Japan; and Alexandria in Egypt.

Sound urban management can reduce vulnerability to climate hazards – for example, through better planning to restrict development in the most exposed locations.[82] Transport systems, utilities (e.g. energy, water) and buildings also need to be made more resilient, and basic infrastructure such as sewers needs to be well maintained. Some measures can enhance resilience, reduce emissions, and boost jobs and growth at the same time. For example, investment in green space and efficient waste management bolsters climate resilience, absorbs carbon, and enhances the attractiveness of cities to global talent and capital.

While the benefits of economic density have to be balanced against the potential risks of increased exposure to shocks such as climate hazards, there is evidence that more compact, connected and coordinated cities can also be more resilient:

- They are more energy- and resource-efficient, providing resilience to resource price shocks.
- They may be more able to raise finance for investing in climate-resilient infrastructure and public services.
- They provide economies of scale in the provision of risk control measures.
- Dense, well-functioning urban centres can draw residents in from areas exposed to climate hazards.
- Strong, coordinated land management can prevent settlement in hazardous areas.

Table 1

Different cities, different choices

	EMERGING CITIES	GLOBAL MEGACITIES	MATURE CITIES
Compact	Design in compact city features from the start, including integration of industrial and residential areas e.g Chenggong (China)	Re-densification through regeneration of existing city cores and multiple hubs, brownfield re-development, and urban retrofitting e.g Beijing (China)	Re-densification through regeneration of existing city cores and supporting hubs, brownfield re-development, and urban retrofitting e.g. Hamburg (Germany)
Connected	Introduce surface-based public transport based on Bus and BRT systems and rapid rail where appropriate e.g. Bogota (Colombia)	Further expand existing public transport systems and increase share of public and non-motorised travel e.g Mumbai (India)	Major opportunities for introducing cycling and non-motorised travel e.g. Amsterdam (Netherlands)
Coordinated	Build capacity for integrated land use and transport planning e.g. Curitiba (Brazil)	Integrated land use and transport planning, including accessing international finance for smarter infrastructure, road pricing and land value capture mechanisms e.g. London (United Kingdom)	Integrated land use and transport planning, including use of regulations e.g. Barcelona (Spain)

4.4 Different cities, different choices

The concept of supporting more compact, connected and coordinated urban development is relevant to all types of cities, but the strategies for achieving this will vary significantly.

In Emerging Cities and many Small Urban Areas, there will inevitably be some urban expansion. There is thus a unique opportunity to managing urban growth so it includes compact city features and smarter urban infrastructure from the start.[83] Emerging Cities can become real leaders in driving forward a compact, connected development model, given that much of their infrastructure is yet to be built, and essential aspects of urban form have yet to be locked in.

In Global Megacities, there is a growing imperative to retain and enhance attractiveness for talent and capital. This can be achieved through vibrant urban cores and world-class transit systems. Transit-oriented development at the periphery can complement the redevelopment of city centres, neighbourhoods and former industrial land. Road space and parking areas can also be reallocated to achieve a greater mix of alternative transport and non-transport uses. Many Global Megacities have a central core with multiple hubs, with opportunities for a two-track strategy to revitalise and improve connectivity within and between the urban core and multiple hubs.

Mature Cities may already be locked into substantial sprawl, as is the case in Sydney and Johannesburg. Concentrating new development in denser urban blocks can enable compact city pockets supported by mass transit, to create more efficient and connected urban networks, and diversification of their economies. This can be complemented by the regeneration and revitalisation of brownfield sites in urban cores. Existing development can also be retrofitted, and connectivity between the urban core and supporting hubs can be improved. As with many megacities, this type of strategy will become ever more important as many Mature Cities look to retain and enhance their attractiveness for talent and capital in increasingly globalised labour and capital markets (see Box 7).

In summary, every city has a unique economy, demographic and geography, so the strategy for achieving more compact, connected and coordinated urban development must be flexible and responsive to diverse demands: one size does not fit all.

4.5 New urban development models in action

The Commission found remarkable consensus amongst urban development practitioners and prominent international organisations such as the World Bank, the OECD, the United Nations Human Settlements Programme (UN-Habitat), and the United Nations

Box 5
Innovation: a potential tipping point in urban transport? [87]

Few sectors are as inefficient as road transport. Roads can cover more than 20% of a city's surface, but operate at capacity only 5% of the time. Cars are in use only about 4% of the time, and much of that time is spent stuck in traffic or searching for parking.[88] Despite this, there remains a global trend towards increasing motorisation, with the number of privately owned motorcars potentially doubling from 1 billion today to 2 billion by 2030.[89]

However, new and alternative patterns of urban transport are emerging in cities around the world, driven largely by innovative use of existing technologies, which could start to reverse this trend.

Figure 3 below shows the explosion in new forms of urban mobility, as more and more cities adopt these solutions to enhance their efficiency, competitiveness, social equity and quality of life. BRT is a notable phenomenon, which redistributes road space in favour of buses through dedicated bus lanes, pre-boarding ticketing and custom-designed stations. But there has also been an explosion in other areas such as car- and bike-sharing and the use of car-free zones.

In 2000, five cities had bike-sharing schemes, with only 4,000 bikes between them.[90] There are now bike-sharing schemes in 678 cities in both developed and developing countries, with 700,000 bikes.[91] Some 186 municipalities around the world were building, planning or actively studying bike-sharing as of the end of 2013. The number of car-sharing members in North America has increased from 16,000 in 2002 to 1 million in January 2013.[92]

While the number of electric vehicles (EV) introduced in cities has been slower than anticipated, EV sales increased from 45,000 cars in 2011 to nearly 200,000 in 2012, and more than 400,000 EVs were registered in cities worldwide at the beginning of 2014. This is likely to rise markedly with further technological improvements, helping to reduce local air pollution and noise in cities. Digitisation, information and communications technology (ICT), and use of "big data" are also opening up possibilities for improving public transport efficiency and reducing the need for travel. Chapter 7: Innovation discusses these issues.

There are several reasons for this diversification of urban mobility, including increased congestion and the costs of maintaining a car, which are shifting new generations of urban dwellers to alternative transport options. A study of 23,000 respondents in 19 countries found that younger urban dwellers (the so-called Generation Y) are more likely to live in areas where amenities are within walking distance; to relocate to reduce their daily commuting time; and to use car-share or car-pool technologies.[93]

Urban transport in the next decades is thus likely to be marked by greater use of public options; smarter, cleaner vehicles, and digitally enabled car-sharing. However, it is unlikely that in the foreseeable future, technological innovation will change the co-dependence of compact urban form and public transport in enhancing productivity and accessibility in cities.

Environment Programme (UNEP) supporting the development of more compact, connected and coordinated cities. There is strong evidence that such cities are more productive, socially inclusive, resilient, cleaner, quieter, safer and lower-carbon.

There is less consensus on whether it is possible to develop cities in ways which arrest what some see as an inevitable expansion of existing patterns of urbanisation. Case study evidence suggests, however, that we are already seeing tipping points towards more compact, connected and coordinated urban pathways. The development of more compact urban forms and re-densification is an emerging trend in some leading, better planned cities, and in other cities as well.

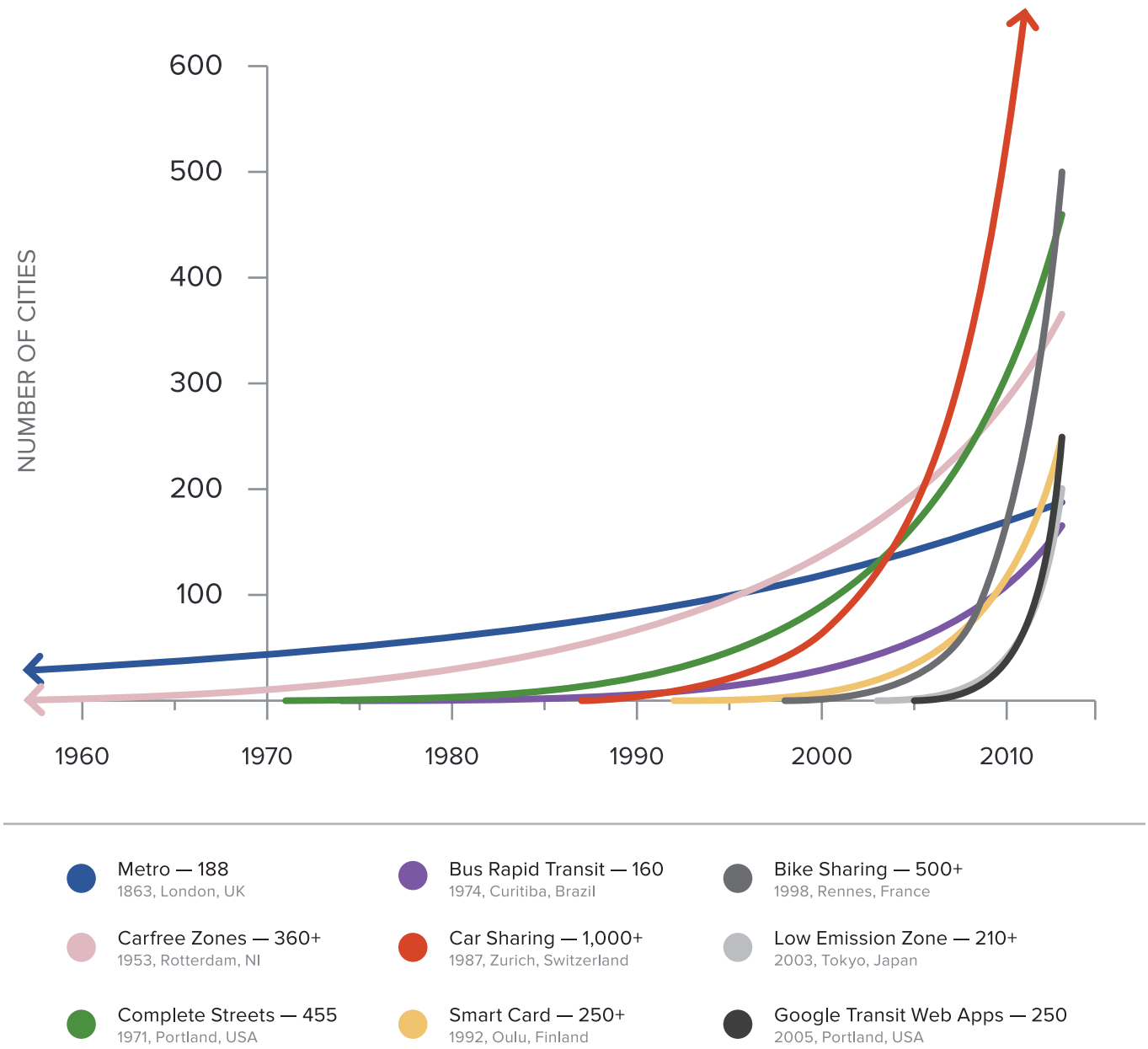
Over the last decade, re-densification has been taking place in a range of Global Megacities and Mature Cities,[84] including London, Brussels, Tokyo, Hamburg and Nagoya. These cities have moved back towards more concentrated forms partly as a result of land use regulations and investment in public transport. Beijing is going against the trend of sprawling cities in China: population density in Beijing's core increased by 50% between 2000 and 2010.[85] The Sacramento region in California demonstrates how an urban area can swiftly reverse a trend towards urban sprawl, through land use and transport planning. Two years after a growth management plan was implemented, two-thirds of the housing growth in the region was achieved through infill in attached or small-lot detached housing, resulting in a significant rise in density for the region.[86]

The world is also seeing the seeds of a revolution in urban connectivity, through smarter urban infrastructure and new technology, particularly in transport, with the potential for transformative effects (see Box 5).

BRT is transforming cities in many developing countries, increasing productivity and land value, while reducing traffic congestion, carbon emissions and air pollution. More than 160 cities have implemented BRT systems, which can carry large numbers of passengers per day at less than 15% of the cost of a metro.[95]

Bogota has been a trailblazer in BRT. The city is a globally recognised leader in transit-oriented urban planning and transport innovation, with strong leadership from

Figure 3
A range of smart transport systems have taken off in numerous cities worldwide since 2000



Source: Embarq, 2013[94]

successive city administrations and the embrace of integrated planning. Its headline project has been the TransMilenio BRT system, which has been replicated in several other cities, including Guangzhou (China) and Ahmedabad (India).[96] The BRT carries 2.1 million passengers per day and operates at a profit.[97] The city has complemented the BRT with a citywide network of bicycle paths that connect residents to public transport, community spaces and parks. Further innovations in the pipeline include the piloting of electric and hybrid buses, and an electric taxi fleet.

There are other signs of change around the world. In China, urban rail networks will total 3,000 km in length in 2015 and double that by 2020.[98] Bicycle infrastructure is also being upgraded in many cities, including citywide upgrades in Copenhagen, cycle superhighways in London, and hundreds of bike-sharing schemes that showcase the benefits of cycling for local economies, the environment and individual health. A range of smarter transport systems, such as car-sharing and electric vehicles, have also taken off in cities worldwide.[99]

The coordination of land use and transport planning is also improving in some countries and cities, with strengthened urban institutions. More than two-thirds of OECD cities now have a municipal body to coordinate programmes of public investment in urban infrastructure. These

Box 6
China's urban revolution [103]

Joseph Stiglitz, a Nobel laureate in economics, has said that technological innovation in America and urbanisation in China will be the "two keys" to human development in the 21st century.

China's urbanisation represents the biggest and fastest social movement in human history, with nearly 500 million people moving into cities in the past 30 years.[104] However, the dominant, business-as-usual model of rapid urbanisation has given rise to a growing range of economic, social and environmental costs. Urban forms developed over the past 10 to 15 years are starting to lock in dependency on private cars, resulting in more carbon-intensive, polluting and congested development. Urban sprawl has reduced productivity gains from agglomeration and specialisation and has led to much higher levels of capital accumulation than is necessary to sustain growth. Research from 261 Chinese cities in 2004, for example, suggested that labour productivity would rise by 8.8% if employment density doubled.[105]

China's leaders recognise that building better cities will help China to keep growing strongly for years to come.[106] Going in the wrong direction with cities will undermine growth, increase social inequality, and accelerate global climate change. Traffic congestion and air pollution are the top complaints by China's citizens. As a result, China is undergoing a potentially radical policy shift. In December 2013, for the first time in China's history, the Central Government held a national urbanisation conference, attended by President Xi Jinping and Prime Minister Li, which emphasised the need to shift towards more compact and mixed-use land development patterns to contain urban sprawl, maximise resource efficiency and curtail the negative externalities of pollution, congestion and CO_2 emissions.

China's New National Urbanisation Plan for 2014-2020 – overseen by the prime minister and published in March 2014 – places urban policy at the heart of Chinese decision-making and signals a strong shift towards an alternative urban pathway, highlighting the need to address urban sprawl, congestion and worsening pollution. This shift in direction is embedded in a new joint report by the World Bank and the Development Research Center of China's State Council recommending that China curbs rapid urban sprawl, with a focus on reforms to urban planning, urban finance and municipal governance.[107]

cities tend to be denser, have higher GDP per capita, and attract more skilled people.[100] Cities such as London are providing strong, replicable models for coordinating public transport investment. Transport for London, for example, is a single agency that oversees all urban transport modes, including non-motorised transport, public transport and road traffic, with the authority to take decisions across local administrative boundaries.[101] India and South Africa have also developed plans to help coordinate land use and transport decisions between the local, regional and national levels.

City policies supporting a shift towards compact, connected and coordinated pathways are being adopted in a growing number of developed countries, including France, Japan, the Czech Republic and Austria. Among emerging economies, China is shifting towards a similar pathway to boost urban productivity and reduce the escalating costs of urbanisation. China has established a programme of 100 low-carbon demonstration cities embedded in all major departmental plans. Cities such as Chenggong district in Kunming typify radical shifts towards higher-density, mixed-use, transit-oriented development.[102]

A broad range of cities are demonstrating that more compact, connected and coordinated urban pathways can strengthen the economy and deliver multiple other benefits:[108]

- Emerging Cities are demonstrating the economic, social, and broader benefits of investing in more compact, connected urban pathways. Sustained investment by Curitiba in its BRT system, bike paths, pedestrian ways and zoning policies has resulted in the city having one of the lowest accident rates in Brazil. Per capita GHG emissions are also 25% lower than the Brazilian urban average; gasoline consumption is 30% lower than the national average; and citizens spend only 10% of their income on transport, one of the lowest rates in the country. Curitiba has achieved this while seeing a threefold increase in population since the 1960s.[109] It is now one of the most affluent cities in Brazil, and its experience has been replicated in other cities, such as Bogota.
- Global Megacities are demonstrating how to remain competitive through more compact, connected and coordinated urban development. London, for example, remains one of the world's most dynamic cities, yet since 2000, population growth in London has been concentrated within a 10 km radius of the city centre, and 53% of all newly constructed floor area between 2004 and 2011 was within 500 metres of a rail or underground station.[110] Car ownership in London decreased 6% from 1995 to 2011, while the city's economy grew around 40%.[111] And the city has reduced air pollution to close to WHO guidelines,

Box 7

Houston: Overcoming sprawl through urban renewal and connectivity [117]

Even cities with significant lock-in to sprawled development patterns can start to forge alternative urban pathways. A striking example is Houston, one of the most sprawling, low-density, car-dependent cities in the United States, and the largest US city to lack zoning policies to manage private development. By 2035, if present trends continue, Houstonians are forecast to be spending 145% more time in their cars than they do today.

City leaders are making ambitious attempts to overcome the legacy of sprawl through urban renewal and sustained investment in transport systems. One programme, for example, offers developers up to $15,000 per unit for building multi-family housing in and around the city's core. Houston also launched a light rail system in 2004, and will be adding three new lines in 2014. Plans are in progress for a BRT line.

In addition, a third of Houston's bus fleet is now hybrid buses, and the city has created an online hybrid and electric car-sharing programme for municipal vehicles, enabling a 34% reduction in the municipal car fleet; more than half of its light-duty vehicles are hybrid or electric. Bike-sharing and car-sharing programmes are now up and running. The city and the private sector have also committed more than $200 million to a signature new Bayou Greenways initiative, adding 150 miles of new hiking and biking trails. These initiatives mark a potential shift towards planning Houston's future in a way that values improved transport connectivity as a viable alternative development model. (In addition, the city is converting traffic lights at 2,450 intersections to LEDs, as well as 165,000 streetlights.)

The case for action has been a simple economic one: Houston's leaders recognise that their firms are struggling to draw talent from leading US universities, because prospective employees want a city with an attractive, vibrant urban core and strong multi-modal transport networks. Recent survey evidence from the Rice University's Kinder Institute for Urban Research already suggests that more than half the residents of Harris County, of which Houston is part, would prefer to live in an area with mixed-use development, including homes, shops, and restaurants as opposed to single-family residential areas.

"At some point, it's not enough to keep grabbing the suburbs and roping them in," Houston Mayor Annise Parker has said, recognising the need for change. "You've got to make the system as a whole function, and you do things to bring people back to the inner core."

Houston's leaders have had to demonstrate leadership to make these investments and reforms. Stephen Klineberg of the Kinder Institute says: "The great Catch-22 for Houston is we want density, but you can't have density with a car and there's no density to support light rail. You build light rail on the faith that if you build it, they will come."

with a particular emphasis on reducing emissions from private vehicles through policy measures such as congestion charges and low-emissions zones.[112] More broadly, the members of C40, a global network of megacities committed to reducing GHG emissions, are collectively taking more than 8,000 actions, primarily in their economic self-interest. A significant share of these investments could be transformational, with a rising number of megacities reporting implementation of BRT systems, for example.[113]

- Mature Cities such as Stockholm, Copenhagen, Portland, Hong Kong, Hanover and Singapore have all shown, through efficient land use and sustained investments in public transport, that it is possible to grow prosperous economies while dramatically reducing externalities such as GHG emissions and air pollution. For example, Stockholm reduced emissions by 35% from 1993 to 2010, but grew its economy by 41%, one of the highest growth rates in Europe.[114] The city is now considering new measures, such as making the Stockholm Royal Seaport fossil fuel-free by 2030, to drive further economic and carbon benefits. Since 1990, Copenhagen has reduced its carbon emissions by more than 40%, while experiencing real growth of around 50%.[115] All of these cities consistently rate high in rankings of the world's most competitive cities.

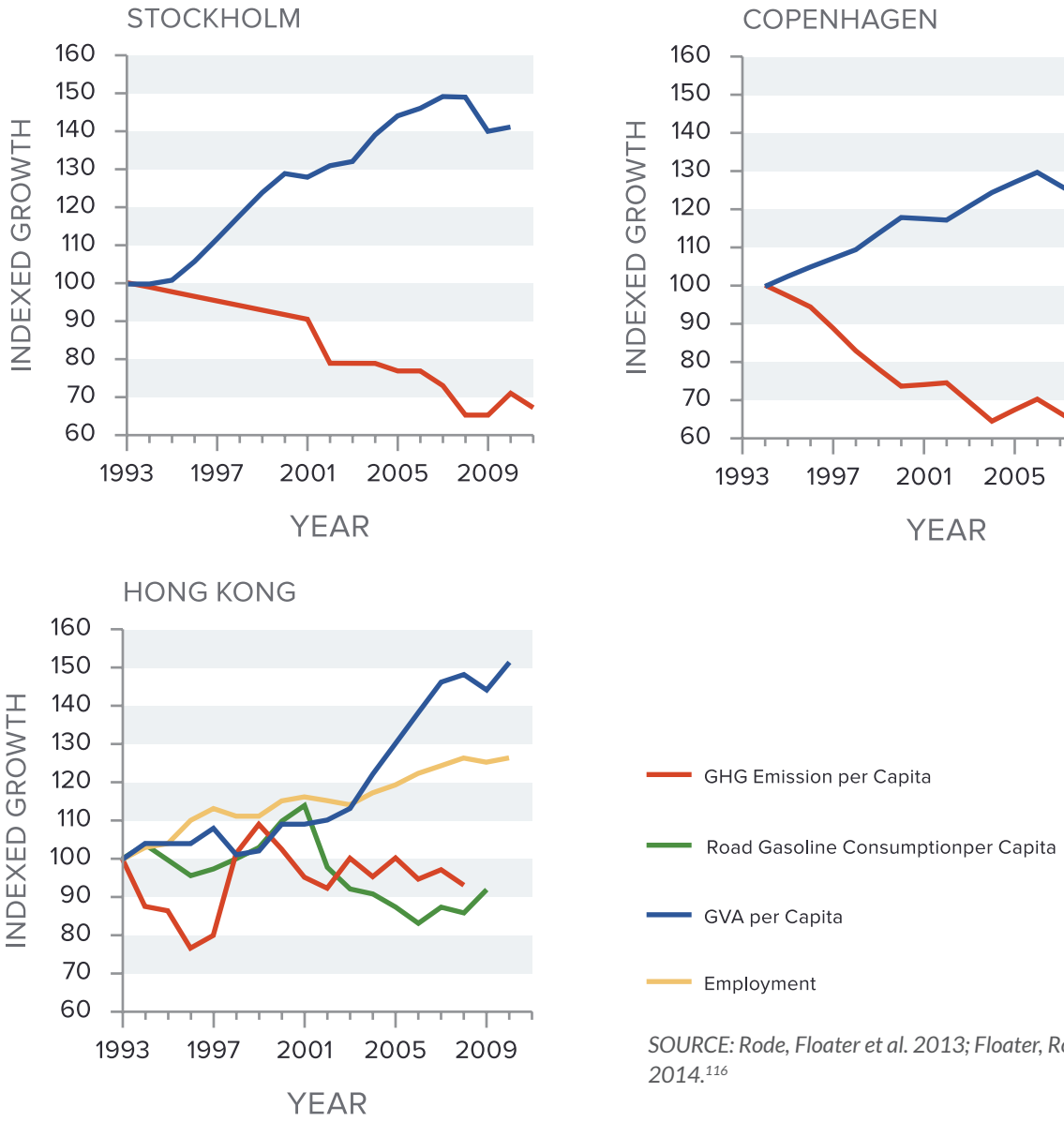
5. Scaling and accelerating change

If the global economy is to capture the productivity benefits of more compact, connected and coordinated cities, analysis for the Commission suggests that policy-makers should prioritise four mutually reinforcing areas:

- Strengthen the role of strategic planning and land use regulation at the national and city level, to provide the framework for more efficient and effective planning of land use, transport and urban infrastructure.
- Reform subsidies and introduce pricing to reflect the full costs associated with unstructured urban expansion, including inappropriate pricing of land, new development, carbon emissions and conventional motorisation.[118]
- Unlock financing for smarter, more resilient urban infrastructure and technology, to allow cities to redirect and invest capital in infrastructure which dramatically improves connectivity.[119]

Figure 4

Some cities have shown that compact and connected urban pathways can go hand in hand with economic growth: Stockholm, Copenhagen, Hong Kong



SOURCE: Rode, Floater et al. 2013; Floater, Rode et al. 2013, 2014.[116]

- Build effective and accountable institutions to support the implementation and delivery of coordinated programmes and investment, particularly in relation to land use change and transport.

The importance of these issues to each city will differ. Cities will need to structure a mutually reinforcing package of reforms and investments suited to their own political, economic and social contexts, and their capacity for implementation. Moreover, the balance of responsibility between actions at the city, regional and national level will depend on the level of autonomy provided to urban areas.

The most significant opportunities for shifting the course of urbanisation are likely to be in fast-growing, mid-sized Emerging Cities and in Small Urban Areas, where administrative and technical capacities can be limited or weak. These cities can start by identifying relatively accessible, economically attractive options in the short- to medium term to boost resource productivity and build commitment and capacities for change. They can combine this with planning an adequate public transport network and basic public services. However, capacity constraints should not prevent cities from being ambitious and focusing on more challenging interventions. Consultations for this report have demonstrated that policy-makers are considering ambitious reforms even in some of the most capacity-constrained environments. Moreover, capacity is often best built through action-based learning in the process of policy implementation.

Table 2
Traditional vs. new citywide planning systems

Traditional approaches to planning	New approaches to planning
• Little integration with transport planning • Lack of thought for relationships with wider city region • Little attention paid to wider, social, environmental or economic factors associated with land use • Strict division of land uses with little mixed use • Low development densities to restrict pressure on existing infrastructure • Focus on neighbourhood-scale physical development rather than city-level spatial planning	• High degree of integration of land use, transport policy, and infrastructure investment with wider economic, social, and environmental objectives • Plan grounded in robust analysis of functional relationship with wider region • Plan fully costed and responsibilities for delivery clearly stated • Plans recognise that mixed use is part of a wider strategy for efficient land use, but not prescriptive on exact mix of uses • Flexibility built in to neighbourhood-level objectives, with high frequency of review

Source: Adapted from Atkins, 2014[126]

5.1 Strategic planning and regulatory reform

Spatial and infrastructure planning needs to be significantly strengthened at both the national and city levels.[120] According to the World Bank, only about 20% of the world's 150 largest cities have even the basic analytics needed for low-carbon planning.[121] A significant number of the world's most rapidly urbanising countries do not have national plans for managing urban expansion to achieve economic, social and environmental objectives. Traditional approaches to planning in countries such as India are proving ineffective at influencing the sheer scale and shape of urbanisation and infrastructure. Land use planning at the national and city levels is often conducted as separate exercises, leading to urban sprawl, social marginalisation and high demand for conventional motorisation (see Table 2).

Reforms to national- and city-level planning systems need to go hand-in-hand with regulatory reform. Such reform will include shifting from maximum to minimum density standards, and minimum to maximum parking requirements. It will also include introducing mixed-use regulation and density bonuses for developers in order to support compact city development with a hierarchy of higher-density, mixed-use clusters around public transport nodes. For example, Denmark's Planning Act on the "Station Proximity Principle" requires new offices over 1,500 m^2 to be located within 600 metres of a rail station, reinforcing Copenhagen's efficient, compact urban form.[122]

Careful introduction of urban growth boundaries (or selective protection of non-urban land) can foster urban compaction and incentivise the development of brownfield over greenfield land, while avoiding house cost inflation.[123] Here it is important to identify where there is scope for expansion and plan ahead for essential infrastructure, rather than simply try to contain sprawl, which can lead to unintended outcomes such as "leapfrog sprawl".[124] Complementary measures to boost development density, reduce parking requirements and promote more mixed-use development can offset the inflationary impact of growth boundaries on housing affordability, by reducing unit land costs and land requirements.[125]

5.2 Subsidy reform and new pricing mechanisms

Subsidy reforms and new pricing mechanisms can help reduce and reverse the perverse incentives supporting unstructured urban expansion and conventional motorisation. This would not only reduce negative externalities, but also strengthen the fiscal revenue base at the national and city levels, and provide revenue to reinvest in sustainable urban infrastructure. Nations and cities can develop different strategies according to their

unique political, institutional, and cultural landscapes. Three types of instruments are of particular importance: fuel subsidies, congestion charges and land development taxes.[127]

Fuel subsidies and other pricing policies drive urban sprawl in many countries, directly against other national policy goals, such as addressing air pollution and congestion and promoting responsible macroeconomic policy management.[128] The under-pricing of transport fuels and motorised travel has locked-in inflated levels of automobile use in many urban areas. For example, commuters in the Netherlands are able to reduce their taxable income by up to €0.19 per kilometre of commute, resulting in 25% more commuting trips and 16% more car trips.[129] Research from US cities shows that a 10% increase in fuel prices leads to a 10% decrease in urban fringe developments with high commute times.[130]

Congestion charges and parking fees can steer commuters to public transport if viable options exist, and cities typically have the power to introduce such measures. Stockholm's congestion tax reduced traffic delays by a third, decreased traffic demand by more than a fifth,[131] and generated a net budget surplus of US$90 million per year.[132] A study in Paris showed that congestion charges would reduce the radius of the metro area by 34% and average travel distance by 15%.[133] Charging for on- and off-street parking based on market prices also reduce parking demand and release space for higher-value usage.

Land and development taxes are usually under the control of city authorities, and their greater use has recently been suggested by influential bodies such as the OECD and International Monetary Fund (IMF). Property taxes are typically the largest source of revenue for many cities, but often favour greenfield over infill development. Variants of property taxes include land taxes or split-rate taxes. These are underused and could be scaled up to promote compact urban form by levying a higher tax rate on the value of urban land, and a lower or zero rate on the value of buildings and other improvements. Such alternative taxes can increase the capital-to-land ratio – i.e. the intensity of development, with efficiency and equity benefits.[134] This type of taxation has been successfully used in countries such as Singapore, Japan and Korea, and parts of the United States, South Africa and Canada. Perverse incentives which favour single-family homes over multi-household developments should also be reconsidered. Development taxes can help to control urban sprawl at relatively low economic cost, and are the most direct way to price the externalities associated with new development beyond city boundaries.[135]

5.3 Finance mechanisms

An overwhelming body of evidence suggests that cities need greater access to financing for smarter urban infrastructure and new technology. A lack of financing can be the most significant hurdle of all.

As a first principle, national, regional and city-level funding needs to be redirected away from business-as-usual urban infrastructure development, such as road-building. This would significantly reduce the investment gap and release funds for mass transit infrastructure, and is particularly important for countries with more limited budgets. China, for example, invested nearly US$200 billion in highway construction nationwide in 2012, with over US$1 trillion to accelerate the construction of urban public facilities during its 12th Five-Year Plan from 2011 to 2015.[136] India's main urban development fund – the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) – is skewed towards the construction of bridges and flyovers to support conventional motorisation.[137] Redirecting investment can be particularly effective for urban transport infrastructure.[138] Bogota's BRT system was partially financed by redirecting funds away from urban highway programmes.

Only 4% of the 500 largest cities in developing countries are deemed creditworthy in international financial markets, rising to 20% in local markets.

Other steps for increasing city financing include greater budgetary control, enhanced creditworthiness, the use of land value capture, municipal bonds, reform of multilateral funding, and support for project preparation.[139] These are discussed in turn below.

A narrow revenue base induces many cities to convert publicly owned agricultural land to urban land for revenue generation. Providing cities with greater fiscal autonomy – backed up by appropriate fiduciary safeguards – would help them to leverage the significant co-financing often required for large-scale urban infrastructure investment, such as mass transit systems, rather than simply converting land to pay for basic public services.

Enhancing creditworthiness is one way to boost city finances. An inability to source financing for large-scale urban infrastructure projects is closely related to poor credit ratings. According to the World Bank, only 4% of the 500 largest cities in developing countries are deemed creditworthy in international financial markets, rising to 20% in local markets. Investing US$1 in raising the creditworthiness of cities can leverage more than US$100

in private-sector financing for smart infrastructure.[140] The World Bank's City Creditworthiness Initiative is demonstrating how cities can improve their credit ratings through an array of measures, such as increasing locally generated sources of revenue, better debt management, and developing multi-year capital investment plans.

Such higher creditworthiness can unlock financing for low-carbon, climate-resilient infrastructure. Lima provides a good example of a city working with a range of international institutions, including the Public Private Infrastructure Advisory Facility (PPIAF), to gain a credit rating. This helped to unlock funding for its BRT project. In another example, Kampala in the space of one year managed to boost its locally generated revenue by 86%. With borrowing limits pegged to own revenue, this has almost doubled what the city can borrow for large-scale urban infrastructure.

Johannesburg recently issued a US$136 million green bond to finance a diverse range of investments, from hybrid buses to biogas energy and rooftop solar water heaters.

Greater use of land value capture can also help finance large-scale urban infrastructure, while also driving more compact urban forms. Land value capture involves financing the construction of new transit infrastructure with the profits generated by the increase in land value stimulated by the presence of that infrastructure. For example, in Hong Kong, the government's "Rail plus Property" model captures the uplift in property values along new transit routes, ensuring efficient urban form while delivering US$940 million in profits in 2009 for the 76% government-owned MTR Corporation.[141] Saõ Paulo has raised over US$1.2 billion in six years using related instruments, and Curitiba is funding the conversion of a highway into a BRT corridor, complemented by higher-density, mixed-use spaces and green areas – an investment of US$600 million.[142] Variations of land value capture include development impact fees, tax incremental financing, public land leasing and development right sales, land readjustment programmes, connection fees, joint developments, and cost/benefit-sharing. Cities such as Houston have created special Tax Increment Reinvestment Zones to help finance the cost of urban infrastructure.[144]

Cities can use municipal bonds to finance a group of infrastructure projects, whose collective assets underwrite the bond. Such bonds allow cities to attract large institutional investors which typically prefer not to invest in small, individual projects. For example, Johannesburg recently issued a US$136 million green bond to finance a diverse range of investments, from hybrid buses to biogas energy and rooftop solar water heaters. The bond was 1.5 times oversubscribed and will earn investors a return of 185 basis points above sovereign bonds.

The global climate-related bond market is currently estimated at US$503 billion.[145] Municipal bonds are a small share of this, less than US$2 billion, indicating significant potential for scaling up. Models such as the Qualified Energy Conservation Bond (QECB) used in the United States to allow local governments to borrow money to fund energy conservation projects could also be translated into other sectors to fund projects which generate economic returns and carbon savings. With public infrastructure investment falling in many countries, attracting private capital into smarter infrastructure is even more urgent. Institutional investors in the OECD alone have more than US$70 trillion in assets under management but face significant investment barriers related to the complexity of investments and transactions costs associated with smaller infrastructure projects.[146] To overcome these barriers, cities can set up exchanges or dedicated vehicles to match infrastructure projects with financial backers. For example, the mayor of Chicago set up the Chicago Infrastructure Trust in April 2012 to invest in transformative infrastructure projects. Smaller cities could set up pooled financing mechanisms between cities to aggregate the packaging, standardising, marketing and selling of urban infrastructure investments for the private sector.[147]

Existing multilateral development bank (MDB) funding in middle- and low-income countries could go further to support the development of more compact, connected and coordinated cities. The eight largest MDBs have committed to investing US$175 billion over the next decade for more sustainable transport. However, according to the MDBs' self-reported breakdown, only about 25% of current MDB financing for transport supports sustainable transport.[148] Less than a fifth of projects reported in 2012 focused on urban transport projects, except for road and urban highway construction.[149] This suggests that, for the foreseeable future, MDB financing will continue to provide incentives for business-as-usual urban growth rather than compact urban growth and connected infrastructure. Institutions such as the World Bank have established a set of tools to assess the carbon impacts of investment decisions. However, MDBs provide support to cities on a sector-by-sector basis rather than via holistic packages aligned to a strategic approach to managing urban growth. MDB funding could be reformed to ensure a more strategic, coordinated approach. Greater consideration should also

be given to improving cities' access to MDB financing, in partnership with national governments.

Finally, cities need support to prepare infrastructure projects and financing deals, especially rapidly expanding mid-sized cities in emerging and developing countries. Many cities have good ideas and plans for smarter urban infrastructure, but often lack the necessary expertise to prepare and package these into bankable projects that can attract private-sector capital. While dedicated financing vehicles designed for this purpose can help (see municipal bonds above), international support is also valuable. For example, the Cities Development Initiative for Asia (CDIA)[150] provides assistance to mid-sized Asian cities to bridge the gap between their development plans and implementation. More than US$5 billion in large-scale urban infrastructure investments are under development due to CDIA's catalytic input, delivered at a cost of around 0.25% of the investments under preparation.[151]

5.4 Building effective and accountable institutions

Cities need to build effective and accountable institutions, to achieve the collective decision-making and integrated policy interventions required for efficient urban infrastructure development and spatial planning. While many megacities have the skills and resources to implement the shift towards a new urban development model, many other cities lack such capacity.

Institutional strengthening is particularly important in small and mid-sized cities in developing countries.[152] To underpin the institutions required to plan and finance a more compact and connected development model, five elements of urban governance should be given greater prominence:[153]

1. **Integrated transport and land use authorities:** Many urban agglomerations include multiple administrative levels, which can prove challenging to coordinate. To integrate policy programmes at the metropolitan level ("horizontal governance"), many countries have set up sector-specific, metropolitan-level agencies,[154] such as Transport for London, discussed earlier. Another option is to set up integrated multi-modal transport and land use authorities. Curitiba pioneered this approach through the Instituto de Pesquisa e Planejamento Urbano de Curitiba (IPPUC), which aimed to integrate all elements of urban growth.[155] The IPPUC prioritised mixed-use development and dedicated high-capacity bus lanes, the backbone of the city's successful BRT system. Key factors in IPPUC's success included an ability to leverage dedicated funding sources and a long-term vision which was followed by a succession of civic leaders.[156]

2. **Institutional structures for coordinating land use and transport planning:** Fragmented governance and a lack of coordination between national and local policy frameworks for urban planning and transport are common in many countries. Coordination between city departments and between city, regional, and national policy frameworks ("vertical" governance) is fundamental to effective strategic land use and transport planning. India, for example, has recently developed a National Urban Transport Policy, integrating transport and land use planning as a single strategic goal. The central government covers half the costs of preparing integrated transport and land use plans.[157] South Africa has used national legislation to create an Integrated Development Plan that coordinates national, provincial and local government policy.

The next 10 to 20 years will be pivotal in the world's urbanisation journey

3. **Information communication technology (ICT) and e-governance systems:** More advanced ICT systems can improve urban planning, revenue-raising, and transparency and accountability in government practices. Poor transparency and accountability have historically contributed to the unplanned conversion of undeveloped land into industrial or residential use in many cities, exacerbating sprawl.[158] Cities can now make use of new ICT and e-governance systems to improve urban planning, and protect a revenue base for infrastructure investments. On the "demand side", these systems can empower citizens to provide feedback on the quality of municipal service delivery and boost citizen participation in shaping land use planning processes. City governments in India, for example, are starting to use geographic information system (GIS) mapping to develop spatial planning strategies and to ensure more effective revenue collection.

4. **Development of sound municipal accounts and data:** A crucial step in unlocking financing for urban infrastructure and new technology is to develop a coherent, consistent and integrated set of macroeconomic accounts, based on common standards similar to the Standard National Accounting system.[159] This helps private-sector financiers to assess creditworthiness and municipalities to identify and track performance improvements. If they face significant deficiencies in city-level economic, social and environmental performance data, cities can use ICT and social media to build effective metrics at

low cost, and even use real-time data to monitor and improve the efficiency of service delivery. City-level GHG emissions data are particularly inconsistent, of poor quality and with no common baseline.[160] The Global Protocol for Community Scale GHG Emissions (GPC), an initiative to move towards a standard for city-level GHG accounting developed by ICLEI (Local Governments for Sustainability), the World Resources Institute and C40, and supported by the World Bank, UN-Habitat and UNEP, is helping to address this problem.[161]

5. **Building capacity to scale public-private partnerships:** Many city authorities do not have sufficient capacity or skills to identify and structure the right kinds of public-private partnerships required to plan, design, finance and deliver large-scale urban infrastructure. New models of engagement with the private sector can help cities to build that capacity. Examples include the 2030 Districts model in the US and Canada, and those spearheaded by the World Business Council for Sustainable Development through its Urban Infrastructure Initiative (UII). The 2030 Districts are urban public-private partnerships that bring together property owners, municipal governments and community stakeholders to ensure significant district energy, water and transportation emissions reductions and resiliency upgrades. There are six established Districts in major US cities (Seattle, Denver, Los Angeles, Pittsburgh, San Antonio and Cleveland), with 12 additional Districts in various advanced stages of development. The UII initiative brought together 14 world-leading companies in partnership with ICLEI and the Urban Land Institute to support 12 developed- and developing-world cities with new urban solutions. In Yixing (China), for example, UII recommended approaches for tackling urban sprawl, and the development of a citywide tram network is now being fast-tracked.

The next 10 to 20 years will be pivotal in the world's urbanisation journey. Building better, more productive cities could make all the difference for middle-income countries looking to become high-income, and for low-income countries looking to graduate to middle-income. Building better, more productive cities will also be crucial for the global climate. The measures identified in this chapter can support significant improvements in the economic and climate performance of cities and sow the seeds for unleashing a new wave of long-term urban productivity improvements by encouraging more compact, connected and coordinated urban development.

6. Recommendations

A strategic approach to managing urban growth at the national level

Countries need to prioritise better planned urban development and increased urban productivity as key drivers of growth and climate goals. This is especially the case for countries with rapidly urbanising populations. Current institutional arrangements often result in urban development being driven by other national priorities. Here, coordination and cooperation between national and regional governments and city leaders is essential. The Commission urges countries to:

- **Develop national urbanisation strategies in conjunction with city governments, with cross-departmental representation and assigned budgets, overseen by the centre of government and/or Ministry of Finance.**
- **Provide greater fiscal autonomy for cities, potentially linked to economic, social and environmental performance benchmarks.**
- **Consider setting up a special-purpose financing vehicle at the national level to support cities to become more compact, connected and coordinated, with appropriate private-sector participation.**
- **Redirect existing infrastructure funding towards more compact, connected and coordinated urban infrastructure development, including existing national urban infrastructure funds and other relevant funding vehicles.**

Stronger policies and institutions to drive compact, connected and coordinated urban development

Building better, more productive cities is a long-term journey. It requires persistence in several key areas to shift away from business-as-usual urban expansion, with countries, regions and cities working together. In addition to short-term measures and investments to boost resource productivity in sectors as diverse as buildings, transport and efficient waste management, priority areas for structural transformation include:

- **Strengthen strategic planning at the city, regional and national levels, with a focus on improved land use and integrated multi-modal transport infrastructure.** These efforts should be supported by regulatory reform to promote higher-density, mixed-use, infill development, and new measures such as efficient parking practices.

- **Reform fuel subsidies and introduce new pricing mechanisms such as road user charges to reduce and eventually eliminate incentives to fossil-fuelled vehicle use.** Also consider charges on land conversion and dispersed development, and measures that place a higher price on land than on buildings such as land taxes and development taxes. These reforms can raise revenue to invest in public transport and transit-oriented development.

- **Introduce new mechanisms to finance upfront investments in smarter urban infrastructure and new technology.** These may include greater use of land value capture mechanisms, municipal bonds, and the creation of dedicated national, regional, or city-level investment platforms to prepare and package investments to attract private-sector capital.

- **Build more effective and accountable city-level institutions.** Key measures include: (i) setting up integrated transport and land use authorities to plan urban growth and scale public transport, cycling, walking and spatially efficient use of low-carbon vehicles; (ii) working with the private sector to plan, finance and deliver smarter infrastructure and integrated technology solutions; and (iii) making enhanced use of ICT and e-government practices.

The role of the international community

The international community also has a key role to play in fostering better-managed urban growth. The Commission urges the international community to:

- **Develop a Global Urban Productivity Initiative to promote and assist in the development of best practices in boosting urban productivity and support countries' and cities' own efforts.** The initiative should:
  - Build on the existing work of the OECD, UN-HABITAT, the World Bank, Regional Development Banks, and city networks such as the C40 and ICLEI;
  - Involve rapidly urbanising countries and mayors of leading cities;
  - Include a global leadership group of CEOs of leading businesses already helping cities to plan, finance and deliver smarter urban infrastructure and integrated technology solutions.

  This initiative should review institutional options for systematic collection of city-level data; develop urbanisation scenarios and best practice guidance; create an international standard for integrated municipal accounting, and provide targeted capacity-building. It should also give priority to educating the next generation of urban planners and designers – as well as economists in key ministries – about the benefits of compact, connected and coordinated urban development.

- **Set up a global city creditworthiness facility to help cities develop strategies to improve their "own source" revenues and, where sovereign governments allow it, increase their access to private capital markets.** This should build on and scale-up the existing programme of the World Bank, and assist cities in both developing and developed countries.

- **Effective immediately, ensure that the multilateral development banks (MDBs) work with client and donor countries to redirect overseas development assistance and concessional finance away from investments which lock in unstructured, unconnected urban expansion.** Investment should support integrated citywide urban strategies and investment in smarter infrastructure and new technology. Greater consideration should also be given to redirecting overall MDB funding to account for the growing importance of cities in economic development in rapidly urbanising countries, as well as the scaling-up of support to help cities prepare and package urban infrastructure investments.

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Analysis of emissions under this alternative pathway aimed to explore the potential impact on GHG emissions of two key changes: more efficient urban land use (using reduced rates of physical urban expansion as an indicator), and a shift away from personal vehicle use in favour of more energy-efficient forms of transport (using lower rates of fossil-fuelled car ownership as an indicator). The analysis assumes that car ownership is brought down to the level of a leading benchmark city in each world region (e.g. New York for North America), which reduces GHG emissions by 1.4 billion tonnes of CO_2e in 2030. The lower-end estimate of 0.7 billion tonnes of CO_2e assumes cities lower car ownership halfway towards that of the leading benchmark city, based on NCE staff assumptions. Urban land area is assumed to grow, at most, in proportion to population growth; this reduces GHG emissions by another 0.1 billion tonnes of CO_2e in 2030, which should be considered conservative. Further research and analysis to provide more robust estimates.

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is essential. Efforts to contain the outward expansion of cities without taking into account projected population growth run the risk that population growth will outpace housing provision, which can drive up housing prices and result in more people living in informal settlements. This report does not argue for strict urban containment but for managing uncontrolled, inefficient urban expansion given its detrimental economic, social, and environmental consequences.

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