



SECTION 2  
Cities

Cities, with their concentration of people, economic activity, and infrastructure, offer unique opportunities to reduce poverty, deliver greater prosperity, and tackle climate change. Today, 3.9 billion people live in urban areas, and the urban population is expected to grow by another 2.5 billion people by 2050.<sup>468</sup> By then, two-thirds of the world's population will be living with the infrastructure and planning decisions we make today. If done right, the cities of tomorrow can be places where people enjoy healthy, active, productive lives. More compact, connected, and coordinated cities are worth up to US\$17 trillion in economic savings to 2050.<sup>469</sup> Cities can be engines of economic growth, generating opportunity and wealth for the whole country. And their density and dynamism offer governments the possibility of achieving human development goals while reducing environmental impacts.

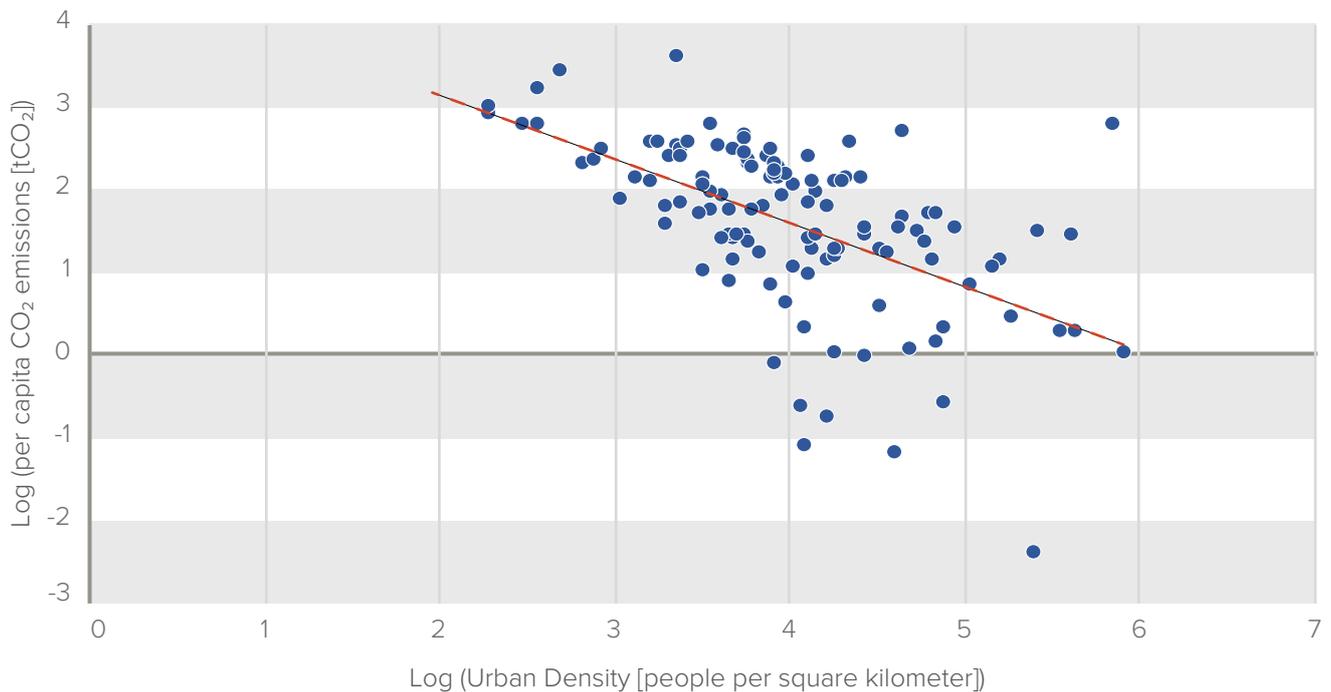
Yet urban areas are not fully realising their enormous potential to drive sustainable development. Nearly a billion urban residents live in informal settlements without access to decent housing, secure tenure, or improved water and sanitation.<sup>470</sup> Urbanisation is occurring in places with much lower average levels of income than historical averages, particularly in sub-Saharan Africa,<sup>471</sup> and new urban areas are emerging. Over 60% of the land projected to become urban by 2030 has yet to be developed,<sup>472</sup> and smaller cities are growing faster than mega-cities.<sup>473</sup> More mature cities are struggling with chronic congestion and toxic air pollution, yet private car ownership is projected to increase by as much as 60% in developed countries and up to 500% outside the OECD by 2050.<sup>474</sup> For cities to achieve their potential, it will be important to reduce the expected pressures resulting from the explosive rural-urban migration by balancing sustainable urban development alongside sustainable rural development.<sup>475</sup>

Tackling inequality alongside climate change and other environmental challenges is central to sustainable urban development. Soaring house prices are also contributing to growing inequality within cities and countries but there are also other drivers.<sup>476</sup> More extreme weather events—from extended heat waves to rising sea levels and flood risk—are exacerbating

inequalities and reshaping sustainable urban planning and development.<sup>477</sup> The higher population densities of urban areas increase the need for risk-reducing infrastructure and services, such as drains, sewers, piped water, and paved roads, to reduce vulnerability to climate change. Balancing urban and rural development and managing urbanisation well will also be essential for ensuring resilience. Generating positive momentum from in-migration for better growth is possible but it will require adequate capacity in housing, transportation and other infrastructure and social services as well as consultative mechanisms for including migrants and other marginalised communities in decision-making. Institutions for planning, provision of infrastructure and other services will need reforming to ensure that all city dwellers enjoy a high quality of life and can enhance their economic productivity.

Unlocking the power of cities to deliver economic development in a sustainable way requires ambitious action. At its core, this depends on compact, connected, and coordinated use of urban land. Promoting density is critical to avoid locking in sprawling, inefficient and climate-vulnerable modes of growth, but the kind of density matters. 'Good density' means functionally and socially mixed neighbourhoods with access to green spaces, comfortable, affordable, and climate-smart housing for all, and high-quality public transport networks.<sup>478</sup> When done right, compactness improves residents' access to jobs, services, and amenities and, compared to sprawl, could reduce infrastructure capital requirements by over US\$3 trillion between 2015 and 2030.<sup>479</sup> Densification is also more carbon efficient (see Figure 9) and resilient to climate change and disasters.<sup>480</sup> Promising examples of good density in action can be found all over the world today from Barcelona's car-lite Superblocks (see Box 25) to Singapore's green canopies (see Box 26), which are estimated to build resilience by reducing local peak temperatures by as much as 5°C, while also reducing energy costs associated with air conditioning.<sup>481</sup>

**Figure 9**  
**The Relationship between Population Density and Per Capita Carbon Emissions in Urban Areas.**



Note: A Pearson's correlation on a dataset of 127 cities found that  $r=-0.3383$ , with  $p<0.05$ . Source: Coalition for Urban Transitions. Data source: Oxford Economics, 2014.<sup>482</sup>

To achieve greater compactness, established cities will need to retrofit, repurpose, or replace much existing infrastructure, and in some cases relocate people settled in increasingly areas increasingly vulnerable to disasters (for example, coastal zones), while fast-growing cities need to steer investment to new infrastructure and housing stock (see also Section 1.C on building efficiency). In both cases, governments will need to reform spatial plans, building codes, and tax incentives that favour sprawl<sup>483</sup> and that might exacerbate vulnerability to climate change and disasters.<sup>484</sup>

The most important factor in increasing the resilience and adaptive capacity of the built urban environment is to guide development that is out of harm's way at the systems and planning phase. Urban sprawl is often accompanied by an increase in vulnerability particularly amongst the poorest, who may be located in areas prone to flooding or landslides, and who lack adequate housing and infrastructure services. Planning for the multipurpose use of assets, such as connectivity and flood protection, can reduce risks at low cost. When infrastructure is at the design phase, choice of materials and other design features can be guided by the need to increase resilience to extreme heat, flooding and storms.

At the same time, care should be taken to avoid the displacement of low-income or other marginalised urban residents as inner-city areas become more attractive. New York's High Line, an abandoned elevated train line spur converted into an aerial greenway, displaced residents by boosting nearby property values a staggering 103% in eight years, despite a recession.<sup>485</sup> Inclusive urban planning, as modelled by Thailand's Baan Mankong programme (see Box 27), will be key to increasing density while enhancing the resilience and well-being of the urban poor.

Efficient, clean transport systems are essential for good density. Cities must avoid being physically locked into car-based transport systems and prioritise active and shared transport. Making walking and cycling safe and convenient is a universal priority, with particularly large potential in smaller and lower-income cities. Public transport is more complex, but there are opportunities to learn from front-running examples. Since the successful experiments in Curitiba, Brazil, and Bogota, Colombia, for instance, 164 cities worldwide have built bus rapid transit (BRT) systems, carrying close to 33 million passengers a day (see Box 2).<sup>486</sup> There are also opportunities to harness exciting new innovations in urban mobility, such as ride-hailing

networks, car- and bicycle-sharing systems, mobile trip-planning, and ticketing apps.<sup>487</sup> Where cities already have substantive car-based infrastructure, electrification can reduce noise pollution, air pollution, and carbon emissions. China is already seeing many of these benefits (see Box 30).

Analysis undertaken for this Report using the E3ME model suggests that a global shift to EVs could create about 11 million jobs by 2040, compared with the baseline, and would increase GDP (see also Box 4 on modelling). This is a scenario whereby new EV sales would climb to just over 1 per 100 people globally by 2030, and to a level whereby almost one in ten people have EVs by 2050.<sup>488</sup> To maximise the climate-change mitigation benefits, electrification of transport needs to be accompanied by a growing share of renewables in the electricity mix (see Figure 9).<sup>489</sup>

Because cities are shaped by governments but often built and financed by private actors, ambitious, integrated, and accelerated action in cities will require collaboration and coordination among many different actors. (See Box 24 on finance for cities). Aligning actors' behaviour and incentives behind a shared vision can make it easier to achieve compact and connected cities. National urban policies can provide an overall framework to guide sustainable and inclusive urban development through coordinated policies across different sectors. This includes more traditional 'urban' sectors like housing and transport, but also others not necessarily considered as urban, such as tax policies.<sup>490</sup> National and local governments need to work together to further develop of such frameworks, and this in turn, can provide a foundation for building climate resilience and environmental sustainability.<sup>491</sup> Effective national-urban policy frameworks include: getting the

tax system right to maximise public fiscal capacity and create incentives for sustainable urban development; apportioning revenue collection and borrowing responsibilities and revenue allocations across different jurisdictions (including city governments); and implementing comprehensive, climate-smart national urban policies, including platforms and partnerships to finance the deficit in sustainable infrastructure in urban areas.<sup>492</sup>

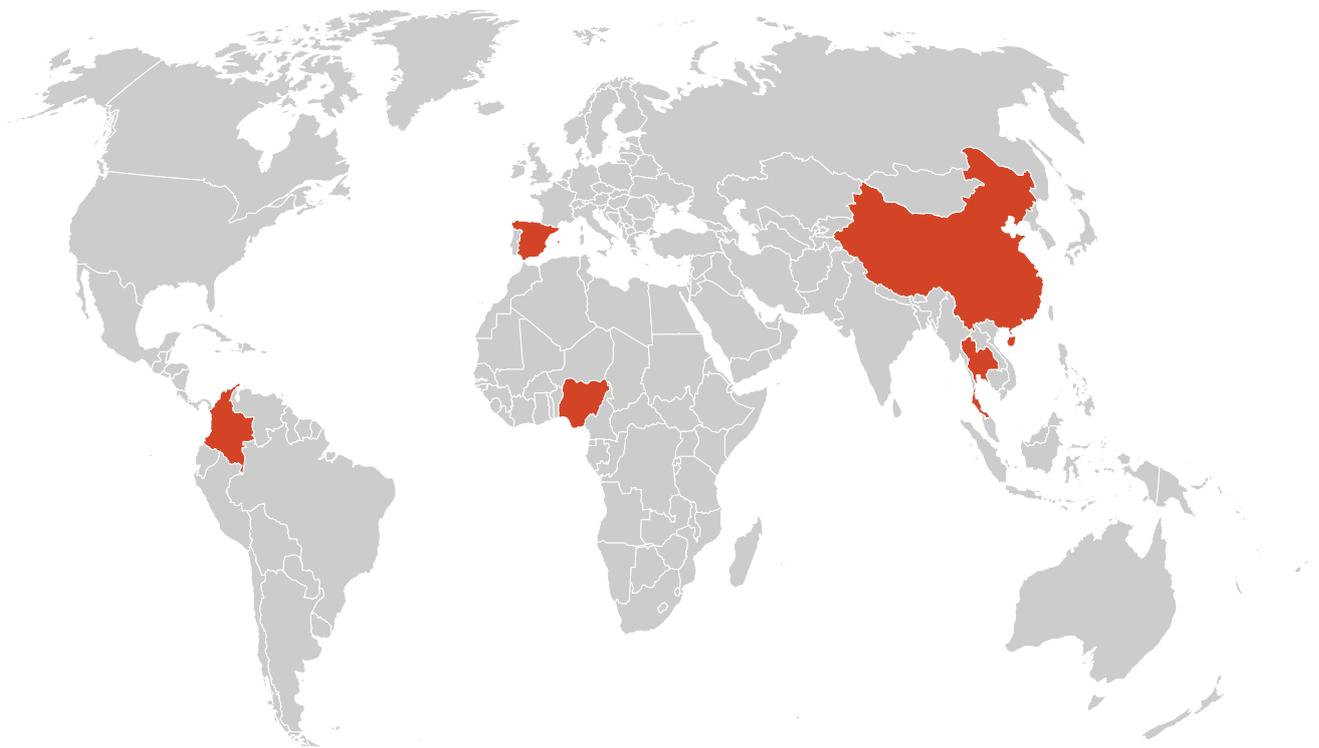
Within these national urban frameworks, effective, accountable governments and institutions can facilitate public participation and develop and implement spatial plans and policies. Civil society organisations can foster environmental citizenship and harness community capabilities, for example to define sustainability in local terms and prioritise actions to build resilience to natural disasters. Domestic financial institutions, such as commercial banks and asset management companies, can provide much of the necessary investment, perhaps working with ministries of finance and development banks to increase bankability of projects and lower the cost of capital. And property developers, engineering firms, and construction companies can bring important technical and management capabilities to infrastructure and service delivery. Partnerships among these diverse organisations will be key to realising the vast potential of cities to create jobs, foster innovation, and advance the national economic interest.

This chapter identifies three key priorities that can anchor compact urban form today and lay the foundation for thriving cities of the future: densification to revitalise sprawling cities; the provision of sustainable and affordable housing; and investment in shared, electric, and low-carbon transport.

Photo credit: Flickr: ruich\_whx



Figure 10  
Locations of Transformative Examples in Cities Highlighted in this Report.



## Box 24 Finance for Cities

NCE estimates that roughly US\$2–3 trillion per year will be required between 2015 and 2030 to fill the sustainable infrastructure financing gap.<sup>493</sup> Infrastructure related to sustainable urban development is estimated to account for between two-thirds and three-quarters of all infrastructure investment to 2030.<sup>494</sup> There is also scope to lower the total investment needs through safeguarding and enhancing natural infrastructure, both blue and green (see Section 3). Yet governance and market failures are driving a financing gap of roughly 50%.<sup>495</sup> Investing in sustainable urban infrastructure does not mean it has to be more expensive. Indeed, making cities more compact and connected will lower investment requirements by as much as 10%.<sup>496</sup> Yet there remains substantial need to mobilise new resources to fill the financing gap.

Public finance has traditionally been a significant source of urban infrastructure investment, but public budgets are often insufficient for larger or more complex projects (with the notable exception of China). This is particularly true in the context of austerity, limited ability to collect revenues, or competing priorities for public budgets. The financing gap is most evident in cities in low- and middle-income countries: While Freiburg (Germany) and Bristol (United Kingdom) have per capita budgets of US\$3,638 and US\$4,907 respectively, Iwo (Nigeria), Pekalongan (Indonesia), and Feira de Santana (Brazil) have per capita per year budgets of only US\$14, US\$101, and US\$399 respectively (see Figure 12).<sup>497</sup> Municipalities in developing countries typically have limited capacity or authority to raise revenues, but also the largest infrastructure deficits.

Although public budgets may be insufficient to meet investment needs, national governments have a critical role to play in raising and steering finance for sustainable urban infrastructure.<sup>498</sup> They have large opportunities to simultaneously increase the fiscal envelope and to create incentives for households and firms to behave in a sustainable manner through tax reform. This may be through urban-influencing policies, such as standards for weatherisation of built infrastructure, removing fossil fuel subsidies and introducing a carbon price, or urban-specific policies, such as eliminating subsidies for parking or reforming land and property taxes to favour densification.<sup>499</sup>

## Finance for Cities (continued)

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National governments also have responsibility for boosting revenue-generation capacities at the local level. One study suggested that only 42% of countries devolve fiscal or legislative powers to subnational governments,<sup>500</sup> which means that many cities are almost entirely dependent on financial transfers from national governments. Clear legal frameworks outlining what revenues local governments can use will help incentivise them to improve the efficiency of both revenue collection and expenditure, thereby growing public fiscal capacity at local level.

Cities also have substantial scope to improve the efficiency of revenue collection and expenditure. Kampala, Uganda, offers an extraordinary success story, tripling its revenue in a five-year period by improving administration and compliance. Kampala Capital City Authority invested in an electronic platform called eCite, which allows citizens to pay business licences, hotel taxes, property rates, ground rents, and other fees on their mobile phones. This increased people's willingness to pay, as they did not have to wait in long queues.<sup>501</sup> The platform eCite also helped to tackle corruption and tax avoidance, as city officials could more easily track payments. Kampala Capital City Authority is now undertaking an ambitious valuation programme in order to update land and property registries, which is expected to triple revenues from the business district.<sup>502</sup> Many cities around the world, including Kampala, are working to increase their creditworthiness in capital markets. Creditworthiness effectively serves as a useful proxy for the quality of public finance administration, as it encompasses multiple factors including own-source revenue collection, asset management, and reliability of debt repayments.

Even if both national and local governments optimise their tax systems, there is a need to find new sources of public revenue and mobilise private investment. Governments and DFIs can use public finance strategically to leverage private finance by ensuring that urban infrastructure projects are bankable (by improving returns or de-risking investments) and by ensuring government entities are creditworthy.<sup>503</sup> Governments can tap into a large array of instruments for this purpose, including bank lending, bond issuance, public-private partnerships, land value capture (LVC), guarantees, and insurance.<sup>504</sup>

Local governments in developing countries can deploy these finance instruments more effectively with enabling national policies and technical assistance from DFIs, and DFIs are increasingly able to support cities' to take infrastructure investment to scale. The World Bank, for example, launched the "City Resilience Program" to work with cities on a pipeline of well-prepared and bankable investments to enhance urban resilience; it also acts as the banker for the city, improving access for private and institutional investors and facilitating strategic investments to build resilience.<sup>505</sup>

The case of bonds is also illustrative to attract private investment. Before cities can issue bonds, they need national legislation to clearly articulate whether they can borrow and under what conditions, including from which institutions, how much, in what currencies, and using what collateral. South Africa is a notable success story, explicitly and constitutionally enshrining the rights of municipalities to borrow. This has enabled both Johannesburg and Cape Town to issue municipal green bonds.<sup>506</sup> For example, Johannesburg's 10-year, 10.18% note raised more than US\$125 million for investments in renewable energy, landfill methane capture, and hybrid-fuel buses.<sup>507</sup>

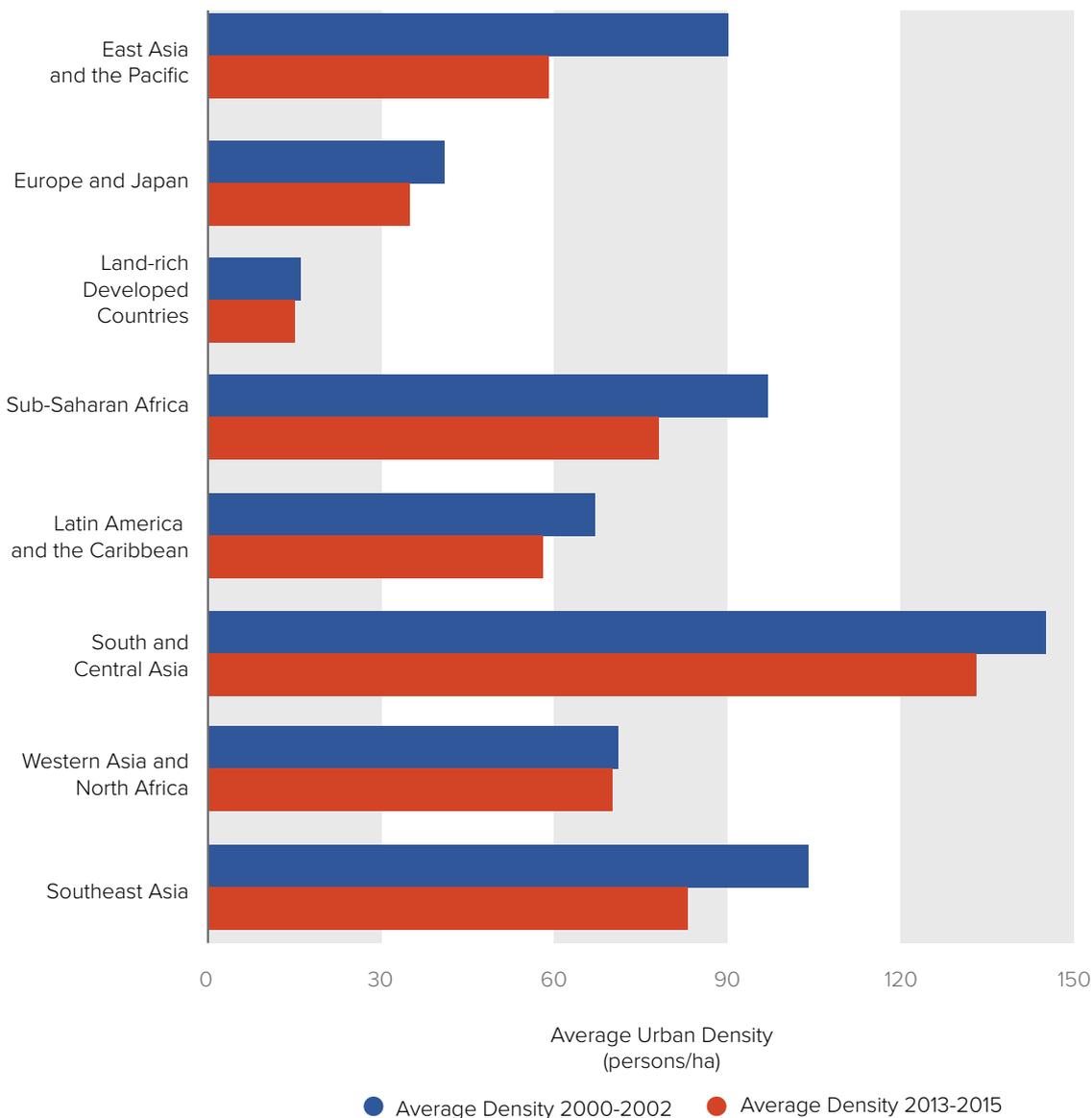
LVC instruments allow the state to secure a proportion of the uplift in land prices associated with sustainable infrastructure investment. These are much more effective when integrated into an effective revenue system as well as when there are transparent land and real estate markets and robust legal frameworks to guide the appraisal, appropriation and sale of land before and after public improvements. LVC is being deployed in an increasingly diverse range of contexts, including Addis Ababa, Harare, London, Portland, Quito, Shenzhen, and Tokyo.<sup>508</sup> Notably, almost half of the new Hyderabad Metro in India was funded through LVC instruments, primarily through issuing property development rights around the planned metro stations.<sup>509</sup> In a city where one in four people lives in informal settlements without clean drinking water, safe sanitation, or decent housing, LVC instruments offered an ingenious way to mobilise private investment in urban infrastructure. (See also Box 46 on LVC in Morocco). Infrastructure that meets sustainability standards by delivering low-carbon and resilient transport, water or flood protection services, will have higher value added over the medium to long-term, and thus provide a more stable revenue source for cities.<sup>510</sup>

## 2.A. Dynamic Downtowns: Well-Managed Densification to Revitalise Cities

Millions of urban residents live in private houses with their own gardens, and many more aspire to this type of suburban lifestyle. This cultural norm is reinforced by economic drivers, such as the lower cost of land around the urban periphery or tax policies that favour single-family dwellings. The result is a global decline in average urban population densities (Figure 11). While attractive to individual families, this kind of urban development creates substantial costs for the city as

a whole. People have to travel farther to reach their workplace or public amenities, they face greater traffic congestion and air pollution, and it is more expensive to construct and operate the infrastructure needed to service sprawling communities.<sup>511</sup> In Sao Paolo and Rio de Janeiro, sprawl costs the cities 8% of GDP.<sup>512</sup> In the United States, sprawl is conservatively estimated to around 7% of national GDP.<sup>513</sup> Increasing urban density in ways that enhance residents' quality of life—providing green space, locating employment and services within walking distance of people's homes, and regenerating vacant and degraded inner-city areas—should therefore be a priority for cities around the world.

Figure 11  
Average Density of Cities by Region in 2000–2002 and 2013–2015.



Source: Coalition for Urban Transitions. Data source: Lincoln Institute of Land Policy.<sup>514</sup>

## Evidence of the Benefits

The clustering of people and firms in cities yields a wide range of benefits, and these benefits are larger with greater population and economic density. Densification can help to avoid the high costs of sprawl, including congestion, CO<sub>2</sub> emissions, air pollution, traffic accidents, and the increased investments needed to extend critical infrastructure to more dispersed populations. China alone could reduce infrastructure spending by up to US\$1.4 trillion by pursuing more compact, connected urban growth.<sup>515</sup> Recent IMF estimates suggest congestion costs exceed US\$350 billion per year, based on lost productivity and health impacts.<sup>516</sup> Many of these savings from densification will accrue to public budgets.

Beyond this, densification yields notable productivity benefits. A larger pool of employers creates incentives for workers to specialise, and a larger pool of workers allows employers to find the best fit with their team, enhancing the economic productivity of both individuals and firms.<sup>517</sup> Proximity encourages interactions whereby people can learn from each other and exchange ideas, thereby stimulating innovation. Evidence from Germany, Mexico, Spain, the United Kingdom, and the United States suggests that doubling a city's population is associated with roughly a 2-5% improvement in productivity.<sup>518</sup> This translates into significant increases in taxable incomes and assets, with commensurate scope to expand public fiscal capacity. In monetary terms, increasing economic density by 10% in urban areas is worth approximately US\$71 per person per year due to higher productivity, US\$62 due to higher job accessibility, and US\$49 due to better access to services.<sup>519</sup> Higher population density also corresponds to lower per capita emissions (see Figure 9): One analysis suggests that low-density suburban development produces 2.0–2.5 times as many emissions per person as high-density urban core development.<sup>520</sup>

## Challenges

Governments need to take immediate action to avoid further lock-in to inefficient, climate-vulnerable, and sprawling urban forms.<sup>521</sup> This will require retrofitting, repurposing, or replacing existing infrastructure. Neighbourhoods with single-family houses will need to be rezoned in order to increase the share of medium- and high-rise buildings, and public transport systems may need to be improved or extended to serve these hubs and improve connectivity.<sup>522</sup> This transformation will require mobilising substantial new

flows of investment, as well as sophisticated planning capabilities and extensive consultations to design or refurbish infrastructure in a way that is climate-smart and meets the needs of affected communities. These consultations must involve local residents, as a lack of public support for densification or deep-seated preferences for existing urban forms can hinder government efforts to improve densification.

Efforts to densify can also be inhibited by zoning requirements that mandate minimum lot sizes, parking requirements, and single land uses; building codes that stipulate low floor-to-area ratios or building heights;<sup>523</sup> or government mortgage programmes that preferentially support single-family dwellings.<sup>524</sup> These policies may also reduce the supply of affordable housing within cities. For example, requirements that mandate two parking spaces per housing unit increase housing development costs by as much as 25%.<sup>525</sup> Governments will need to dismantle the legislation that incentivises sprawl and introduce new frameworks that steer investment into denser and more resilient urban development.

Densification must be carefully managed to avoid negative spillover effects, such as rising housing costs. Without appropriate safeguards, increasing the density of people living and working in a city by 10% could drive up rents by US\$240 per person with the burden borne disproportionately by the poor and the young.<sup>526</sup> Densification must therefore be accompanied by programmes to expand the supply of genuinely affordable housing (see Section 2.B), ensuring that compactness does not improve urban life for more prosperous groups at the expense of lower-income residents. In addition, built-up areas are typically hotter, so there is a need to maintain urban green space to build resilience by tackling heat island effects.<sup>527</sup> Benefits of urban forests, parkland, and canopy cover include improved air quality, improved urban water management, and reduced runoff, which also enhance climate resilience.<sup>528</sup>

## Accelerators

- **National and local governments can reform zoning ordinances, building codes, and tax incentives that favour urban sprawl.** Depending on the particular context, this might involve relaxing floor-to-area ratios and building height limitations; easing restrictions for government-backed mortgages; taxing unused property and parking lots; and offering density bonuses.<sup>529</sup> For example, Toronto

has raised US\$309 million for public facilities through 'density-for-benefit' agreements whereby developers can offer cash or in-kind contributions in return for rights to exceed existing height and density restrictions.<sup>530</sup> Sao Paulo has eliminated parking minimums in favour of parking maximums, allowing only one space per residential unit along transit corridors to address crippling and costly congestion.<sup>531</sup>

- **Local governments can establish urban plans and programmes that promote connected parks, enhance natural ecosystems, and mainstream urban greenery.** The conservation of high-quality, accessible, and communal green space is essential for equitable and liveable urban density (see Box 26). 'Nature-based solutions', such as urban wetlands and forests, can absorb GHG emissions while building resilience to climate change and providing valuable ecosystem services, including services such as water filtration, flood buffering, biodiversity habitat, and temperature regulation.<sup>532</sup> For example, Colombo, Sri Lanka, is enhancing climate resilience and reducing flood risk by restoring wetlands,<sup>533</sup> without which the city would face losses from flooding amounting to about 1% of GDP.<sup>534</sup> Increasing efforts to green low-income neighbourhoods, while welcome, should be carefully managed to avoid pricing out and displacing residents.<sup>535</sup>
- **Local governments should work with developers and civil society to ensure that densification is accompanied by a sufficient supply of climate-smart, affordable housing.** Proven strategies include fiscal support for public housing programmes, comprehensive protection for renters, legal requirements that new residential developments include affordable housing, and the formation of public land banks and community land trusts to acquire properties for redevelopment. Since the 1990s, Japan made it easier to re-zone urban land, re-purpose office sites for housing and construct taller apartment buildings. The expanding housing supply has meant that rents and house prices have risen at much slower rates than in many Western cities. Denver, Colorado, has been one of the most proactive cities in the United States, creating the Affordable Housing Trust Fund in 2015, a revolving fund that offers finance to low-income housing developers that is anticipated to grow to US\$150 million over the next 10 years.<sup>536</sup> A

suitable regulatory environment can also ensure that residential construction is climate-smart and keeps pace with demand, including in smaller, high growth and newly urbanising areas.<sup>537</sup>

## Box 25

### People-focused Superblocks in Barcelona

Barcelona is among Western Europe's densest cities.<sup>538</sup> Although known for its rich culture and pleasant cityscape, Barcelona struggles with air pollution, noise, limited green space, social isolation and—increasingly—climate impacts.<sup>539</sup> Up to 85% of the city's area is dedicated to private vehicles (including parking spaces).<sup>540</sup>

Local authorities in Barcelona are tackling these challenges with an innovative Superblock model, piloted in the central neighbourhood of Eixample.<sup>541</sup> Eixample's widened, octagonal intersections were meant as meeting squares, but many are now utilitarian, unfriendly intersections dominated by traffic. Barcelona seeks to revitalise these public spaces. Superblocks will form mini-neighbourhoods, typically comprising 12 blocks (400x400 metres) that house 5,000–6,000 residents.<sup>542</sup> The Superblocks' surrounding roads serve through traffic, but internal roads are reserved for residents' vehicles travelling below 10 km/hr. This improves access and safety for pedestrians and cyclists, as well as the quality of public and green space.

Initial interventions in Eixample require minimal infrastructure—mostly signage, road markings, and street furniture. Future plans include permanent installations like playgrounds, 300 km of new cycling lanes (from today's 100 km) and 23 new ha of car-free space.<sup>543</sup> In September 2017, Barcelona created the newest Superblock on 40 acres in the El Poblenou neighbourhood, and another five are planned by 2018.<sup>544</sup> In addition to decreasing traffic by 21%, the effort could also reduce emissions by as much as 75%.<sup>545</sup>

## Green Spaces in Dense Singapore

Typically, the ranks of the world's most liveable cities are topped by larger low-density cities, such as Sydney and Vancouver, or smaller established cities, such as Vienna and Zürich.<sup>546</sup> A common exception is Singapore, which squeezes 8,155 people into every square kilometre.

One of the reasons for Singapore's liveability is the provision of high-quality urban greenery throughout the city, thanks to policies such as mandatory roadside plantings, which have ensured that trees have been introduced systematically with enough growing space to provide substantial canopy cover. This creates a pleasant urban environment: Trees, parks, and other green infrastructure help to reduce temperatures, filter air pollution, and mute street noise.<sup>547</sup> Where permeable, these surfaces can support storm water management as well as prevent overflow from combined sewers handling both rainwater and sewage. Importantly, Singapore has focused on the distribution and connectivity of parks, not just on the total area of parkland. Hundreds of kilometres of green, pedestrian park connectors mean that people have easy access to green space despite higher density living.

Between 1986 and 2007, green cover in Singapore grew from 36% to 47%, despite a 68% increase in population,<sup>548</sup> and reduced average temperatures by between 0.5 and 5°C.<sup>549</sup> This builds resilience to climate change while also mitigating GHG emissions as a drop of 1°C in air temperature lowers peak electricity demand by as much as 4%, which translates into reduced energy consumption and emissions.<sup>550</sup> The government now requires property developers to replace any greenery lost during construction and covers 50% of the costs of installing green roofs and walls on existing buildings, spurring innovations to develop lighter and more robust rooftop and vertical greening systems. These systems are also cheaper: The cost of greening fell from S\$150/m<sup>2</sup> to S\$100/m<sup>2</sup> in a two-year period.<sup>551</sup>

## 2.B. House Proud: Provide Sustainable and Affordable Housing for the Urban Poor

Today, 330 million urban households currently lack access to affordable, safe, secure housing—a number that is projected to grow to 440 million households by 2025.<sup>552</sup> Whether, where, and how housing for these people is built will determine the health and employment opportunities of one in five urban dwellers. These factors will also shape urban form and function for decades to come, influencing emission intensity and vulnerability to climate change and disasters. Smaller, fast-growing cities in particular have the opportunity to avoid sprawling, incremental, inefficient and disaster-prone development in peri-urban areas. Instead, governments can establish policies and plans that will provide low-income urban residents with climate-smart, affordable, efficient, and well-located housing, served by basic infrastructure such as piped water and sanitation (see also, Section 4.A). The challenge is to meet demand for housing and services today while establishing spatial forms that can underpin sustained economic development and maximise resource efficiency in the longer-term while also limiting the risks of climate change. (See also Section 1.B on energy and building efficiency).

## Evidence of the Benefits

Housing is an important asset to increase economic security, especially for lower-income groups.<sup>553</sup> Improving the quality of housing can improve the productivity of home-based workers, who account for a significant share of urban employment (14% in India and 6% in South Africa) and are mostly women.<sup>554</sup> Safe and affordable housing could also dramatically improve health outcomes for urban dwellers by reducing the health costs associated with everyday risks and catastrophic events. Flooding, disease, pollution, and fire all impose a heavy health burden that is disproportionately felt by low-income urban residents;<sup>555</sup> further, life expectancy for the poorest 20% of urban residents hovers at around 55 years, compared to over 70 years for the richest 40%.<sup>556</sup> Experience in Ahmedabad, India, illustrates such health benefits as slum upgrading as more than halving the incidence of severe water-borne disease.<sup>557</sup> Increasing the supply of climate-smart, affordable housing would especially climate urban women, who are twice as likely as men to face violence<sup>558</sup> and have fewer capacities and resources to respond to shocks and stresses.<sup>559</sup>

There are significant opportunities to steer planned investment in shelter and related infrastructure and services towards low-carbon and climate-resilient options. For example, in waste management, recycling and composting require substantially less capital expenditure than landfill or incineration infrastructure. Using renewable energy and passive design to improve the energy efficiency of urban housing can enhance resilience to climate change. Distributed renewable energy generation (particularly photovoltaic solar or biogas) can be more economically attractive than connecting to the grid and may also allow the state to defer capital investments to maintain and upgrade grids.<sup>560</sup> For the very poorest, there is scope to improve the availability and cost of low-carbon, local building materials (such as bamboo or compressed earth blocks) that could also enhance the durability and resilience of self-build housing.

It is important that new housing stock is constructed in places that help cities to achieve good density and resilient development, particularly by aligning spatial and infrastructure planning in a sustainable way. This could yield immediate fiscal savings: Higher population densities offer economies of scale for infrastructure<sup>561</sup> and service provision,<sup>562</sup> enabling governments to reach more residents at lower cost (see also, Section 2.A). To realise these gains, governments will need to align land-use, housing, and transport policies.<sup>563</sup> Complementary investments in mass transit can effectively expand the supply of urban land, thereby driving down housing costs while cutting demand for transport energy. In Mumbai, for example, the construction of feeder BRT systems would make new housing settlements on the urban periphery more financially viable to low-income residents.<sup>564</sup> In some cases relocation or retreat of existing settlements will be required to move them out of harms' way.<sup>565</sup> However, care must be taken not to exclude or push poor residents to the peripheries of cities. Strong public institutions are needed to achieve this. Ultimately, building housing and infrastructure in a coherent way today will be much more cost-effective in the long-run, enabling cities to avoid retrofitting, relocating, and re-densifying in the future.

## Challenges

About 881 million people live in slum conditions, primarily in sub-Saharan Africa and Asia, according to UN Habitat (see Figure 13).<sup>566</sup> These estimates, however, understate the scale of the shelter deficit. In Indonesia, for example, UN Habitat calculates that 27 million people live in slums. This excludes residents

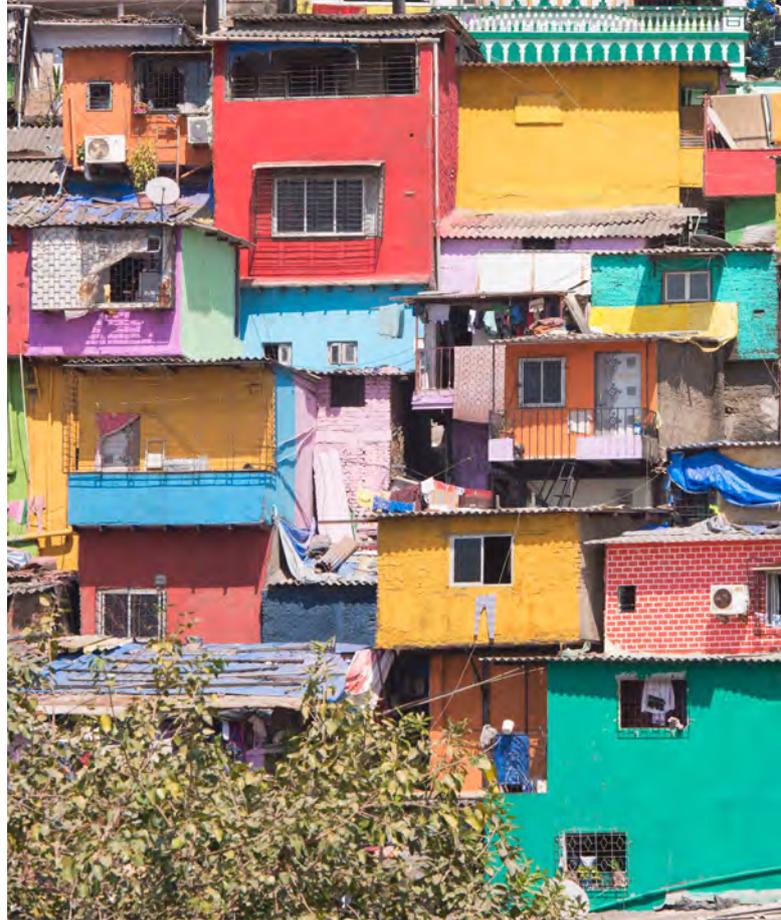


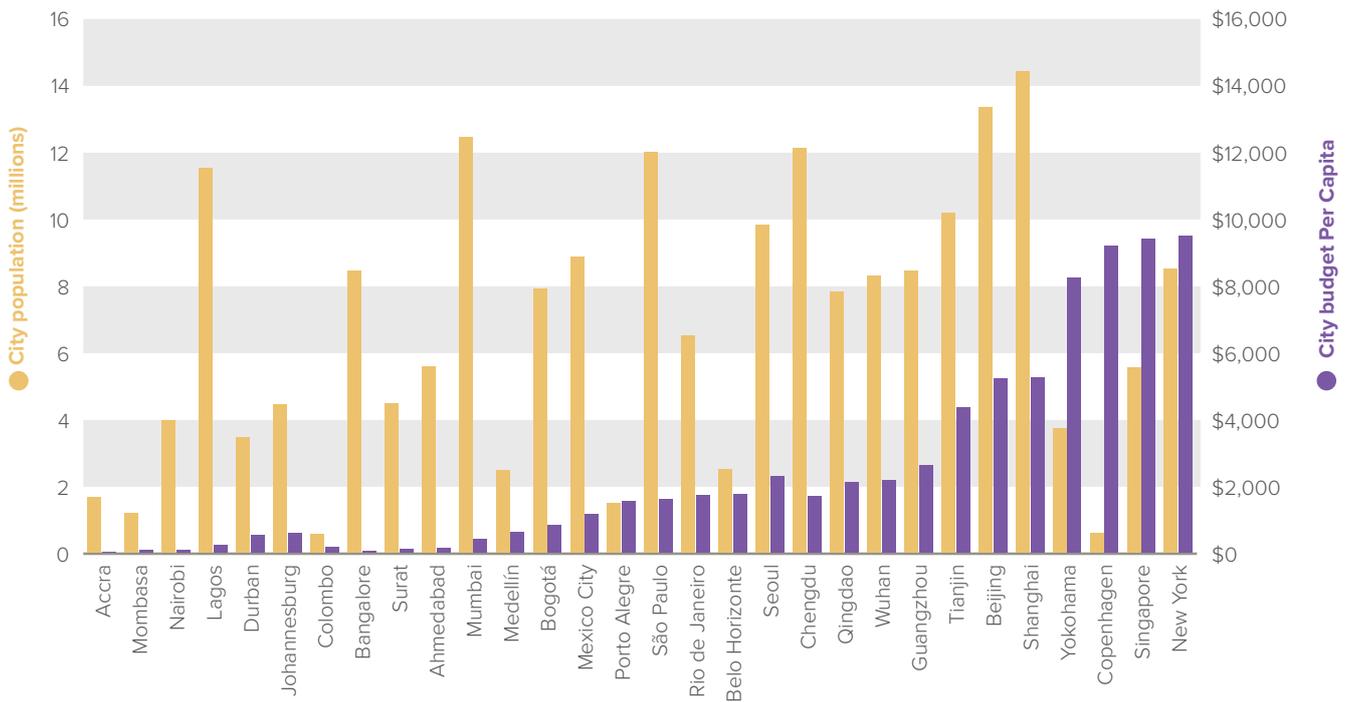
Photo credit: Flickr: Visty Banaj

with access to so-called improved water, namely from public taps, boreholes, protected springs, or other sources that do not necessarily provide safe or reliable drinking water in crowded urban contexts.<sup>567</sup> By applying a stricter classification that would more reliably indicate a safe water supply (such as water piped to a dwelling, yard plot, or neighbour), an additional 80 million urban Indonesians would be designated as slum dwellers. Applying more rigorous standards to 10 of the most rapidly urbanising countries suggests that official figures may understate the number of people living in slum conditions by at least 190 million (Figure 14)—nearly equivalent to the populations of Germany, France, and Spain combined.

The urban infrastructure deficit is likely to increase with rapid urban population growth. Most of the projected growth to 2050 is expected in smaller cities, many of which are the least prepared to manage such growth.<sup>568</sup> Municipal authorities in the most rapidly urbanising regions typically also have the smallest per capita budgets (for example, see Figure 12) and limited technical or institutional capacities.<sup>569</sup> These constraints make it difficult for governments to address pressing development needs, let alone shape urbanisation towards resilient, compact, and connected forms.

Figure 12

**Cities in the Global North Typically Have Much Larger Budgets Per Capita Than Cities in the Global South, Irrespective of Population Size.**



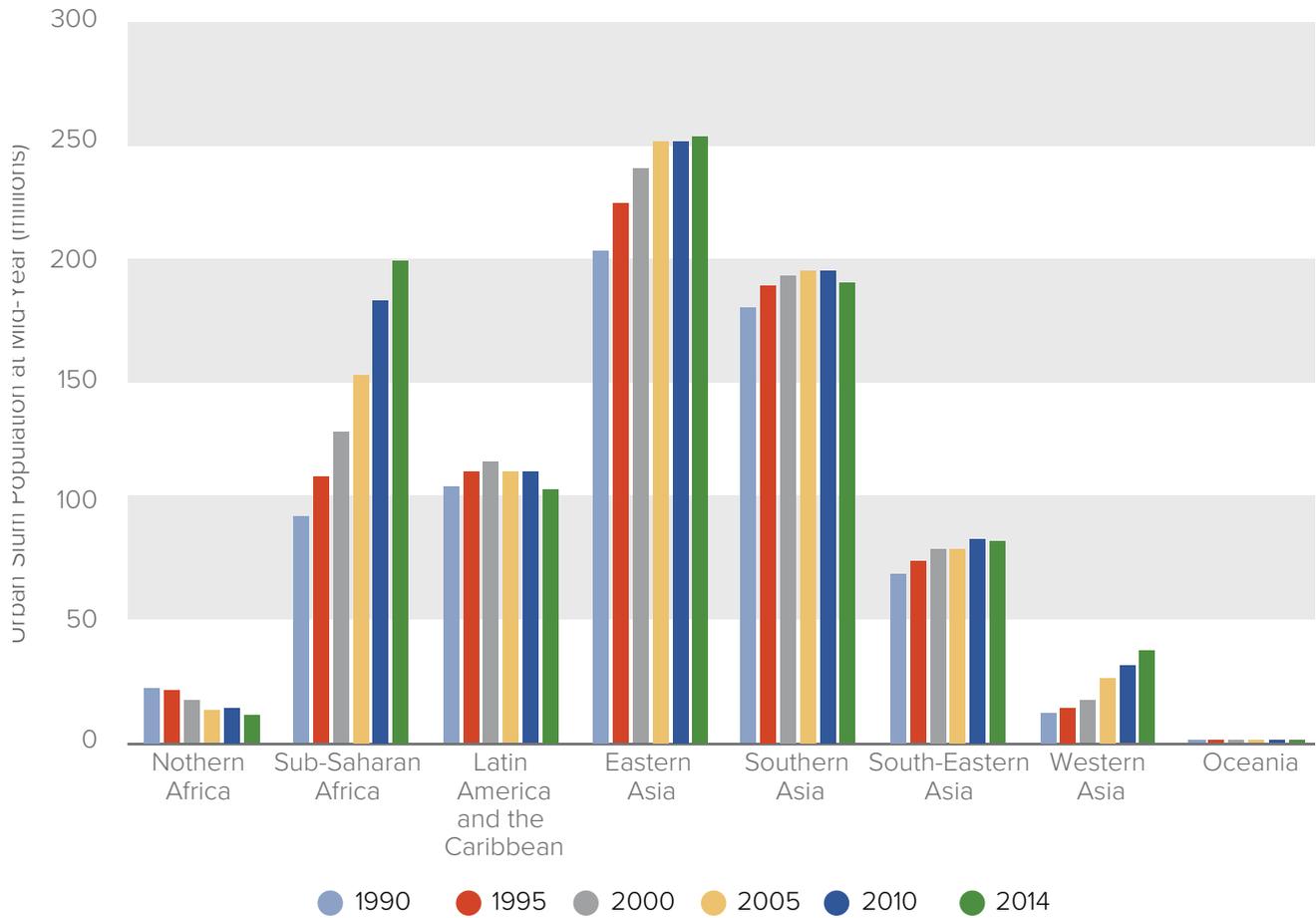
Note: Budget data represent years 2010–2016. Source: Beard et al. (2016).<sup>570</sup>

Policy distortions can further reduce the supply of urban land and housing and therefore increase their costs. Combined with low per capita incomes, increased costs keep many urban dwellers from participating in formal property markets. However, it is not solely economic factors that contribute to the chronic shortage in affordable, decent, formal housing. Discrimination in labour and land markets and a lack of legal or political rights means that the urban poor are vulnerable to abuse and exploitation.<sup>571</sup> As a result, informal shelter

markets have developed in many cities.<sup>572</sup> In sub-Saharan Africa, for instance, over 75% of all housing stock is constructed informally.<sup>573</sup> Conventional urban planning, meanwhile, is often used to justify the eviction of low-income urban residents from well-located land.<sup>574</sup> This perpetuates poverty by reducing access to jobs, services, and amenities and contributes to sprawling urban forms with all their concomitant externalities, including increased vulnerability of the poor to climate change and disasters.

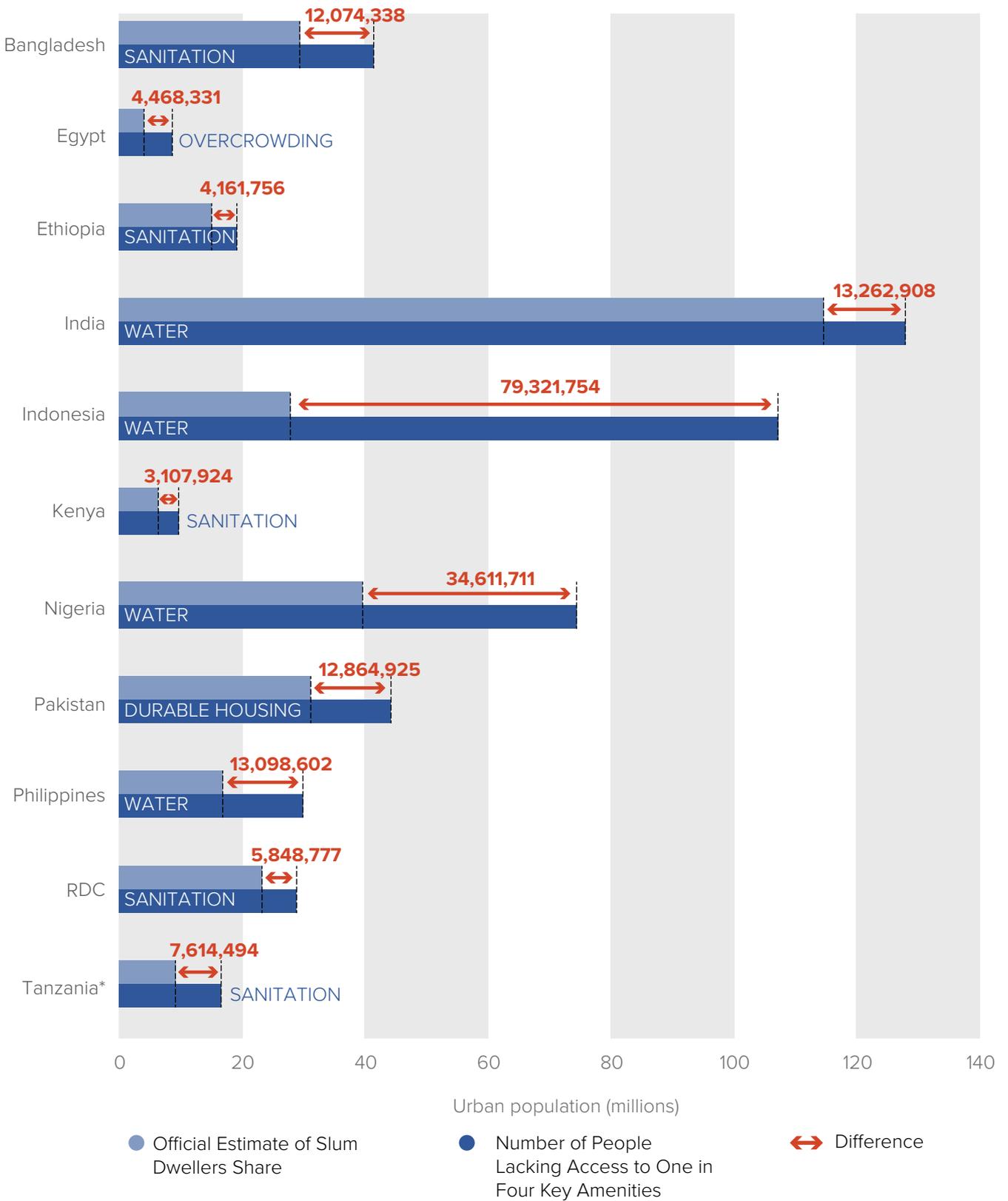
Figure 13

**Official Estimates of the Proportion of the Urban Population Living in Slums are Based on the Number of Households Lacking Access to (i) Improved Drinking Water Sources; (ii) Improved Sanitation Facilities; (iii) Durable Housing; and (iv) Sufficient Living Space.<sup>575</sup>**



Source: Coalition for Urban Transitions. Data source: UN Habitat.<sup>576</sup>

**Figure 14**  
**Underestimations of the Slum Population in Ten Rapidly Urbanising Countries.**



Source: Coalition for Urban Transitions. Data source: UN Habitat<sup>577</sup> and national demographic and health surveys.<sup>578</sup>

Note: This figure shows official estimates of the urban population living in slums contrasted to the number of people lacking access to decent housing and basic services using more rigorous metrics: a piped water supply, a flush/pour latrine, durable housing and no more than three people to a room.



Photo credit: Flickr: Kzoop

## Accelerators

- **Local governments can make serviced land available to low-income households at affordable prices and with occupancy rights.**

This may need innovative titling arrangements to manage the risk of sale and gentrification, for instance, supporting collective tenure as the Baan Mankong programme did in Thailand (see Box 27). Local authorities and utilities should preferentially extend trunk climate-smart infrastructure to low-income neighbourhoods, as the per capita costs of networked solutions (such as sewers) are much cheaper than for individual solutions (such as septic tanks). (See also Sections 4.A and 4.B on water and resilient infrastructure). Involving local residents in planning and implementation can also dramatically reduce the costs of sustainable infrastructure development. In Karachi, Pakistan, for example, the cost of community-financed and managed infrastructure came in at a quarter of the cost of government-developed sewage systems.<sup>579</sup>

- **National and local governments should relax restrictions that constrain the supply of low- and middle-income housing and put in place enabling policies, that can unlock investment.** Building codes should be reformed to permit smaller plot sizes, higher floor area ratios, and support for incremental construction to enable self-build housing, while also ensuring it is climate-smart.<sup>580</sup> In Windhoek, Namibia, for example, this approach enabled the creation of affordable, formal housing units by low-income urban residents.<sup>581</sup> Financial organisations can also be created, supported, or mandated by governments to provide low-cost microloans to formal and informal households or communities. In Kenya, for instance, the Akiba Mashinani Trust provides loans

with an annual interest rate of 10%, compared to 16% from commercial banks and 22.6% charged by microfinance institutions, to pay for land acquisition, greenfield housing development, and in-situ slum upgrading.<sup>582</sup>

- **MDBs should collaborate with grassroots organisations of the urban poor to ensure that marginalised groups have avenues to shape policy and programming.** Ensuring that connectivity, inclusivity, and resilience are at the heart of urban planning processes will be essential for resilient, prosperous cities. Community-based organisations, such as those federated within Shack/Slum Dwellers International and the Asian Coalition for Housing Rights, can construct housing, co-produce infrastructure, and shape urban land use in an inclusive and environmentally efficient way.<sup>583</sup> MDBs and development agencies can empower these organisations by providing bridging capital and project management expertise and by fostering relationships with commercial banks and other private investors.<sup>584</sup> This assistance can unlock substantial public and private capital, including mortgage finance, to scale affordable housing projects. For example, community engagement is key in a number of ADB projects supporting urban redevelopment and services in Ulaanbaatar, Mongolia, including a pilot on green, affordable housing which is co-financed by the Green Climate Fund and will be driven in part by private investment. These projects are using community development councils to advise on project implementation and increase community-based monitoring and control over service provision.<sup>585</sup> Engaging early with public and private stakeholders, from governments to local businesses, potential investors and community-based organisations, will help to ensure projects are bankable.<sup>586</sup>

## Box 27

### Improving Housing Conditions in Urban Thailand

Between 2003 and 2010, the Baan Mankong programme in Thailand improved the housing security and conditions of over 80,000 households across 249 urban areas.<sup>587</sup> The programme channels government funds, in the form of infrastructure subsidies and soft housing and land loans, directly to poor communities, which plan and carry out improvements to their housing, environment, and basic services themselves. In most cases, communities pursued in situ upgrading, secured legal tenure and connected to water and sewage systems. The programme also enabled communities to relocate to reduce their exposure to environmental hazards, which was critical, given the 13 million people affected by the 2011 floods in Bangkok.

The Baan Mankong programme was introduced and coordinated by the national government, which established a revolving fund to provide housing loans with subsidised interest rates and long repayment periods, as well as infrastructure subsidies to low-income residents living in informal settlements.<sup>588</sup>

The programme established a unique city-scale approach to slum upgrading, integrating low-income households into the social and physical fabric of the city. Local governments worked with low-income communities to secure legal tenure in their existing settlements or nearby parts of the city, using a combination of new planning permissions, leasing arrangements, land-sharing with formal land owners, and cooperative land titles.<sup>589</sup> The programme emphasised collective approaches to planning and upgrading, which helped build social capital and capabilities within low-income neighbourhoods.

The fund was initially capitalised with public capital but is now substantially resourced through private banks and loan repayments.<sup>590</sup> The total public investment of less than US\$100 million,<sup>591</sup> translated to less than US\$1,250 per household, further reinforcing the cost-effectiveness of community-driven upgrading, compared to conventional approaches.

The programme is still running in Thailand, and key features, such as the revolving fund and community-led upgrading processes, have been adopted in over 200 urban areas across Cambodia, Nepal, the Philippines, and Sri Lanka.<sup>592</sup>

## 2.C All Aboard: Shared, Electric, Low-Carbon Transport

Urban dwellers need transport to access jobs, services, and amenities. However, urban transport networks are often not convenient, flexible or affordable. Where they already exist, many struggle to keep up with increased ridership or maintain aging infrastructure. Existing urban transport systems are also responsible for over 11% of total global energy use—equivalent to about double the entire energy consumption of Africa<sup>593</sup>—and about 18% of global CO<sub>2</sub> emissions.<sup>594</sup> Where urban areas and transport systems are yet to be built, planning needs to embrace public and non-motorised transport.<sup>595</sup>

The more private cars there are on city roads, the greater the costs associated with air pollution, noise pollution, congestion, traffic accidents, and sprawl. In 2010, OECD countries incurred health costs of US\$1.7 trillion from transport-related air pollution.<sup>596</sup>

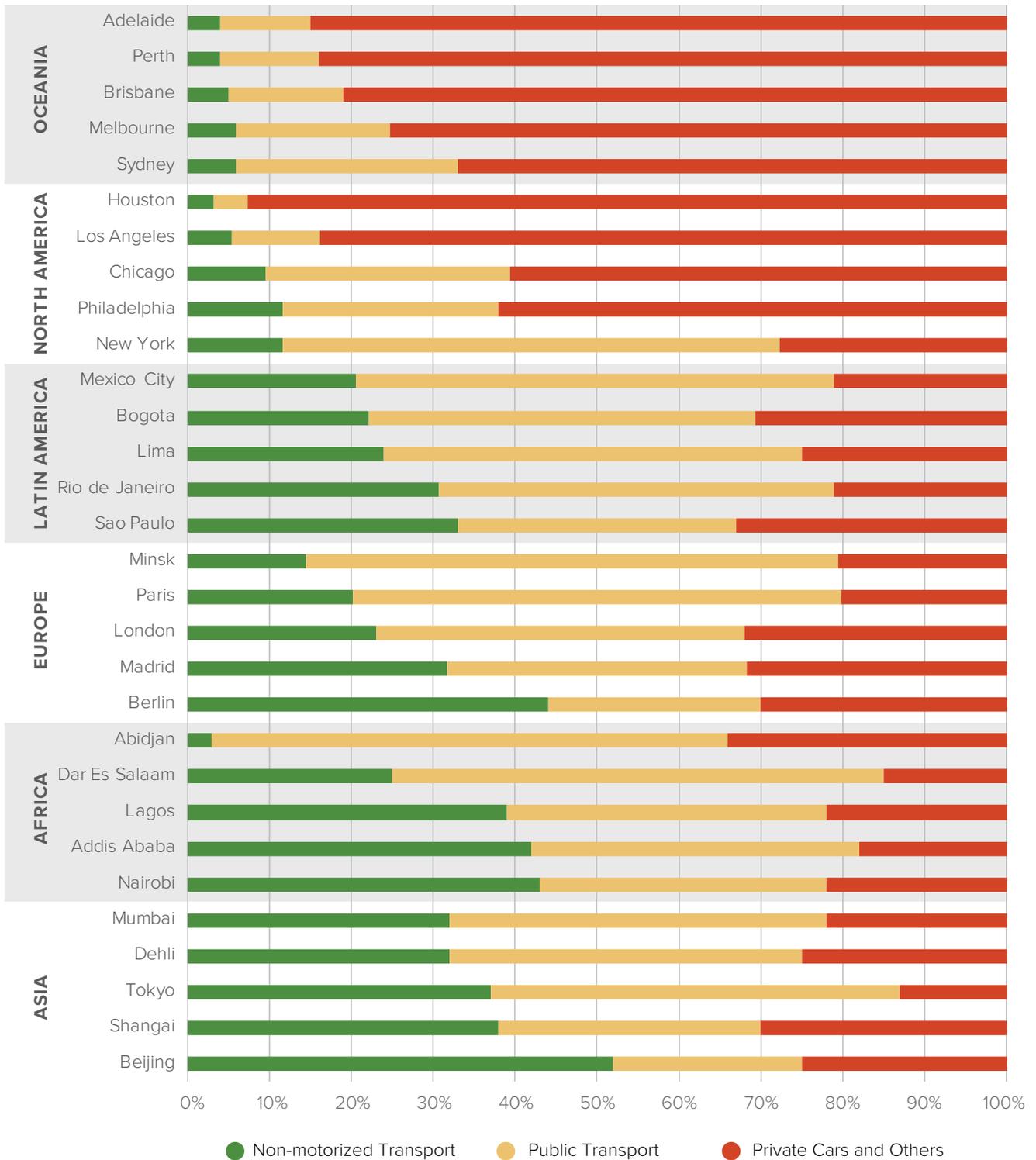
Air quality is even worse in cities of the global South, where as much as 90% of air pollution can be attributed to cars in some cities.<sup>597</sup> Dependence on private cars also leads to more road crashes (which costs up to 5% of GDP in developing countries)<sup>598</sup> and more congestion (which costs 5% of GDP in Beijing, Sao Paulo, and Bangkok).<sup>599</sup>

Urban form and transport modes must shift for cities to meet 21st century challenges. Larger cities in North America and Oceania have typically invested heavily in car-based transport systems, with much urban land used for roads and car parks. Counterparts in Europe and Latin America are more likely to have well-developed public transport systems and cycling networks. In urban Africa, widespread poverty means that a large share of trips continue to be made on foot. Asian cities are more varied, but the trend is towards increasing dependence on private cars and commensurate urban sprawl. Historical patterns of and behavioural preferences for different types of urban transit continue to determine how people move

around cities today, as well as the strategies available to cities to enhance accessibility and decarbonise transport. However, rapid population growth means

that swaths of new urban infrastructure will soon be built, particularly in the developing world, offering opportunities to leapfrog directly to active and shared transport modes.

### Modal Share for Five of the Ten Largest Cities in Each Region, Divided into Non-motorised Transport (Walking and Cycling), Public Transport, and Private Motorised Options.



Source: Coalition for Urban Transitions.<sup>600</sup>

## Evidence of the Benefits

In the near-term, investing in low-carbon transport infrastructure creates more jobs than those in car-based systems. A review across 11 American cities found that about 50% more jobs were generated by investments in cycling projects than road projects, with pedestrian projects averaging between the two.<sup>601</sup> In the longer term, net economic savings from reduced transport-related energy expenditure are estimated at US\$10.5 trillion between 2015 and 2050.<sup>602</sup> These gains would be largely enjoyed by the urban poor: The average urban resident spends as much as 16% of household income on transport, while the underserved resident spends up to twice that share of income.<sup>603</sup> Results from the E3ME modelling analysis undertaken for this Report indicate that under a scenario of accelerated EV uptake, there would be an increase in employment in the motor vehicle sector engaged in EV production of half a million people globally by 2030 relative to baseline. This is associated

with a larger value of the sector's GDP from higher sales relative to the base case. Under this scenario, reductions in air pollution could save 385,000 lives globally in 2030.<sup>604</sup>

Overall health and energy benefits from improved pedestrian and cycling amenities could recoup more than five times the initial investment cost.<sup>605</sup> The transition to walking, cycling, and public transport would particularly benefit low-income groups (see, for instance, the example of Medellin, Box 28), who are less likely to own cars but are more likely to be the victims of traffic accidents and to live and work in polluted areas.<sup>606</sup> It is important that new transit infrastructure is designed in ways that ensure the safety of women and other potentially vulnerable groups.<sup>607</sup> Harassment and physical abuse on public transport<sup>608</sup> has meant that poorer women lose out on economic or educational opportunities, while those who can afford to, switch to private car options.

### Box 28

#### Medellin's Cable Car

Medellin, Colombia, sits in a valley, bordered by steep mountainsides that hold the *favelas*. These informal settlements were notoriously violent during Colombia's drug wars in the 1990s and are still among the city's poorest neighbourhoods. Traveling to the city centre took several treacherous hours on foot or depended on infrequent and unreliable buses.<sup>609</sup> This made it difficult for residents to access jobs, education, and other services.

Since the mid-2000s, Medellin's *favelas* have seen a transformation, much of which is credited to the installation of a cable car system. Opened in 2004, a network of nine cable car lines brings *favela* residents down the hillsides in 25 minutes for US\$0.60.<sup>610</sup> About 30,000 *favela* residents use the system daily,<sup>611</sup> doubling residents' access to employment opportunities.<sup>612</sup> Strikingly, neighbourhoods with cable cars experienced 66% fewer homicides in 2012 than comparable neighbourhoods without them.<sup>613</sup>

Challenges remain, including improving the accessibility of the cable cars to all *favela* areas (walking and queuing times can exceed one hour at peak); their vulnerability to electricity outages; and their limited usage by women, children, and the elderly or infirm.<sup>614</sup>

Given their ability to connect hilltop areas to lower central zones cheaply and with less disruption to existing land uses, cable cars are growing in popularity.<sup>615</sup> Several other urban cable cars projects are operating in Latin America (Rio de Janeiro, Caracas, Guayaquil, Santo Domingo, La Paz, and Medellin), Asia (Yeosu, South Korea, Taiwan, Hong Kong), Africa (Lagos, Constantine), and Europe (London, Koblenz, Bolzano). The World Bank estimates that they cost US\$10-25 million per km and can carry 1,000–2,000 passengers per hour in each direction, which compares favourably to BRT systems.<sup>616</sup>

At the same time, improving cycling and walking infrastructure through low-cost interventions—such as investing in street lighting, segregating cycle lanes and bike parking, and separating sidewalks and pedestrian crossings—can quickly recover public investments through health savings. For instance, if a quarter of all trips in European cities were by bike, the region could prevent 10,000 premature deaths each year.<sup>617</sup> More than 500 cities have constructed bicycle share schemes in the last 20 years.<sup>618</sup> Cities could draw from the experience of Rwanda’s capital, Kigali, which has constructed an elaborate network for pedestrians including car-free streets—or Vienna, Austria, which has installed additional lighting to make walking at night safer for women.<sup>619</sup>

## Challenges

Public transport infrastructure comes with significant challenges at both institutional and financial levels. Mass transit typically requires substantial capital expenditure, and cities in the developing world tend to have limited fiscal autonomy and a narrow resource base, and are often dependent on sale of publicly owned land to developers to raise revenue.<sup>620</sup> Additionally, governments may adopt high discount rates or use narrow cost-benefit analyses, which means that they do not always account for the long-term economic returns associated with transport investments, such as reduced expenditure on fuel and improved access to opportunities or agglomeration economies.

Effective land-use and transport planning are essential to construct compact and connected cities. However, many governments lack the technical or institutional capacities to design, construct, and operate public transport systems or to integrate transport with land-use planning.<sup>621</sup> Acquiring land for transport routes is typically expensive and complicated, especially in more established cities. If not managed carefully, land acquisition can lead to the displacement of informal settlers along proposed transport corridors.

Electrification of the transport sector has the potential to reduce GHG emissions and local pollutants<sup>622</sup> and would likely require less radical changes to the built environment than a modal shift away from private cars to public or non-motorised transport. However, a transition to EVs will require substantial investment in grid capacity and charging infrastructure (see, for instance, China’s example in Box 30). Achieving the full mitigation potential of GHG emissions and other air pollutants from electrification will also depend on shifting rapidly to renewable electricity sources to avoid trade-offs (Figure 15),<sup>623</sup> and this effort will require transit agencies to coordinate effectively with utilities and energy agencies.

In addition to the institutional and financial challenges, modal shifts and the electrification of the transport sector require behavioural changes from city dwellers themselves. Given historical patterns of transport, costs, and the private benefits that can come with urban sprawl (increased privacy, space, access to amenities, etc.), transport preferences can be difficult to change rapidly.

Photo credit: Flickr: New York City Department of Transportation

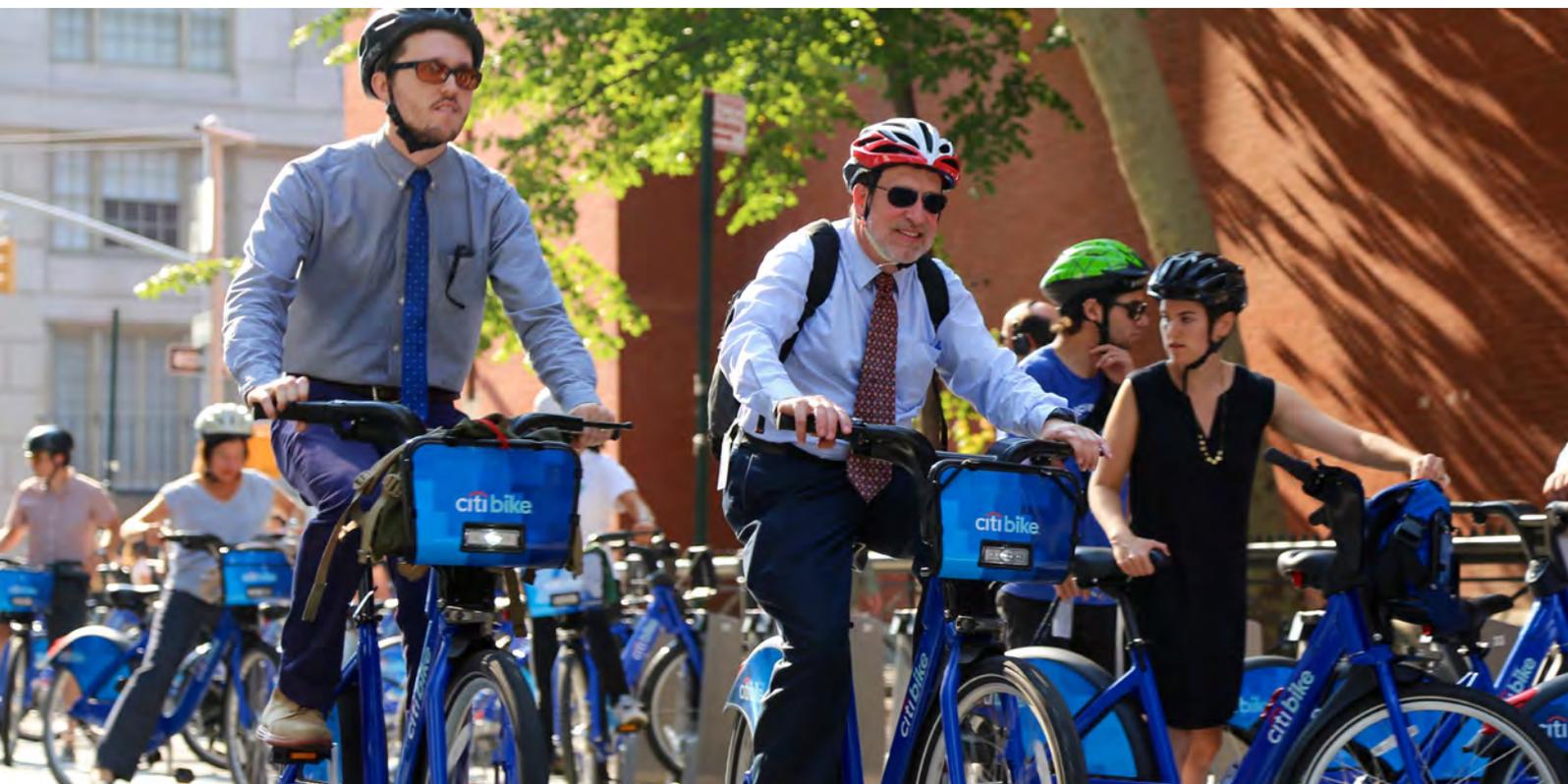
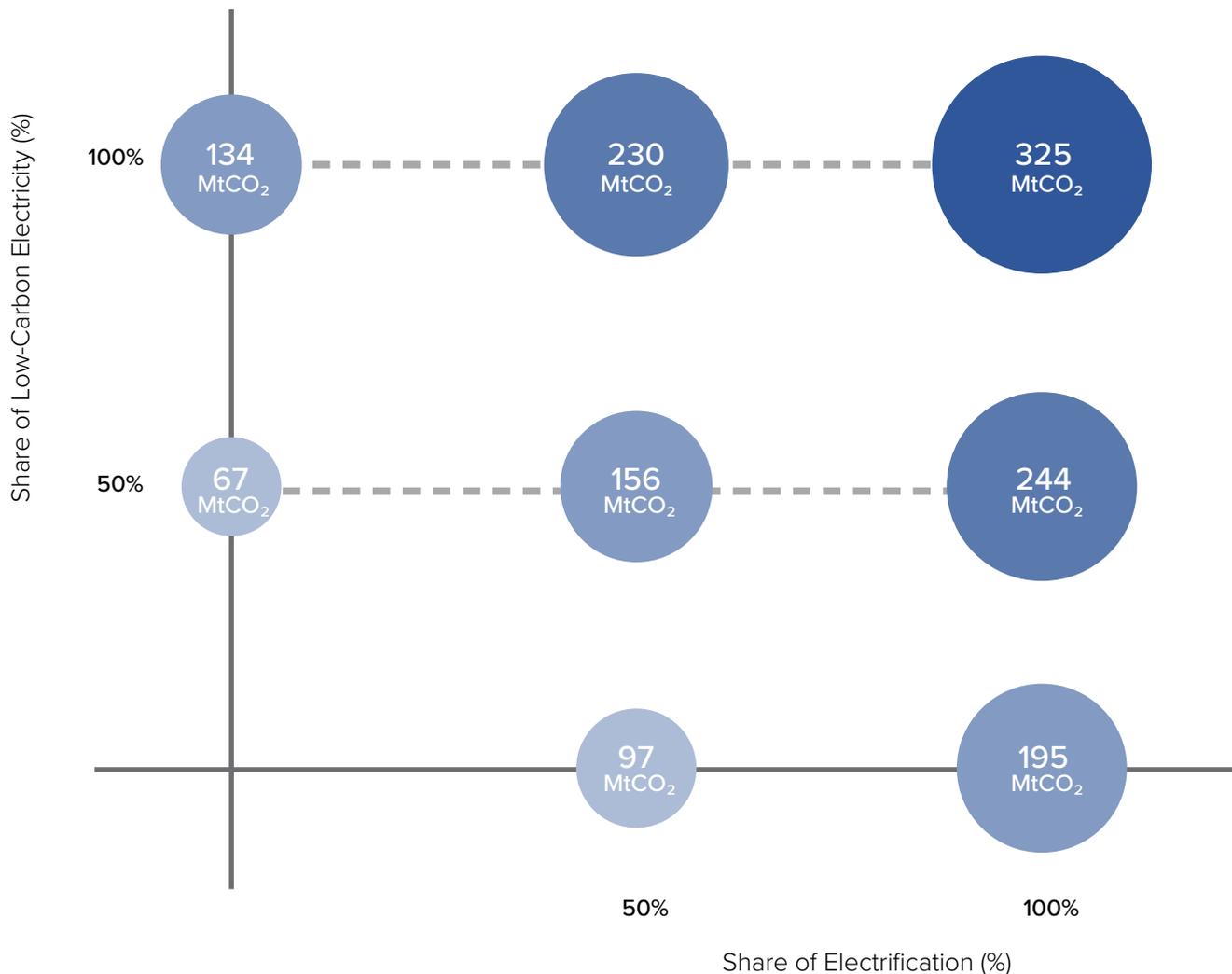


Figure 16

**The Mitigation Potential (MtCO<sub>2</sub>e) Associated with Varying (1) the Share of Low-carbon Sources in the Electricity Mix and (2) the Levels of Electrification of Transport Modes in 21 Megacities.**



Source: Westphal and Kennedy (forthcoming).<sup>624</sup>

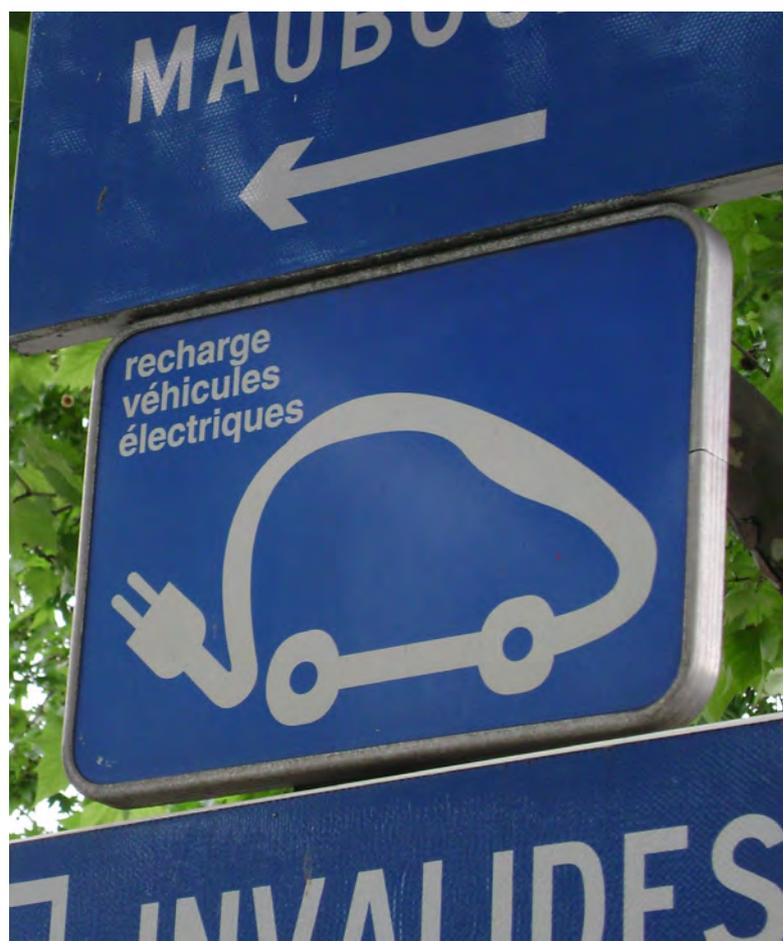
**Accelerators**

- Local governments should prioritise investments in active, non-motorised, and shared transport and disincentivise the use of private vehicles.** This will help avoid 'green congestion' or 'electrification of congestion' and favour the expansion of pro-poor mobility networks. Low-cost interventions, such as street lighting, segregated cycle lanes, bike parking, separated sidewalks, and pedestrian crossings,

can make walking and cycling more attractive and safer, especially for women. Bicycle share schemes have proliferated over recent decades. Kigali<sup>625</sup> and Vienna<sup>626</sup> are exemplars in terms of pedestrianising and making walking at night safer for women. Complementary policies can be adopted to deter car use. Stockholm, Singapore, Milan, and London have adopted congestion pricing,<sup>627</sup> while Nanjing Road in Shanghai, Broadway in New York, and Jalan Sudirman in Jakarta are car-free spaces. Reducing the availability and increasing the cost of parking spaces has proven highly effective in many European cities in incentivising non-motorised transport use.<sup>628</sup>

- State and local governments should accelerate the deployment of land value capture (LVC) instruments to finance new transit-oriented infrastructure, enabled by national governments.** LVC instruments allow governments to capture a proportion of the uplift in land and property values associated with public investments. The use of LVC instruments at the local or regional level typically needs to be enabled by constitutional, statutory, and policy frameworks created by the national government.<sup>629</sup> LVC instruments have been used in such diverse cities as Bogota, Hong Kong, Hyderabad, and Tokyo,<sup>630</sup> but they remain under-utilized in the developing world (see Box 46 on LVC in Morocco). In Hong Kong, the “Rail Plus Property” LVC model has allowed the Mass Transit Railway (MTR) operator to capture the increase in property values along transit routes to fund railway maintenance and expansion. The government grants development rights around railway stations and depots to the MTR operator, which then builds properties in partnership with private developers. MTR receives a share of the profits from these properties, which it uses to cover their capital and operating costs. MTR is 77% owned by the government, which received a financial return of about US\$18 billion on its investment between 1980 and 2005.<sup>631</sup>
- Central governments should coordinate with national and local planning, energy and transport agencies in order to support the electrification of transport.** This might entail planning, procuring battery electric public transport, and financing in charging infrastructure, as China has done through its New Energy Vehicle programme (Box 30) or incentivising EVs through subsidies or low-emissions zones in cities like in Norway and the Netherlands.<sup>632</sup> This should be accompanied by city-led pilots and targets for electrifying public fleets, as Bogota has done by replacing diesel buses with electric or hybrid buses. To deliver the full climate and air quality benefits, governments and utilities must increase the capacity and reduce the carbon intensity of the electricity grid. At scale, electrifying the transport sector could mitigate 7% of global GHG emissions,<sup>633</sup> roughly equivalent to India’s share of global emissions.<sup>634</sup>
- MDBs and development agencies should support governments, particularly in low-income and lower middle-income countries, to maximise financing and increase technical assistance to accelerate the development of public transport in cities.** Mass transit must be tailored to local contexts and constraints, as with Nigeria’s Lagos BRT-Lite system (Box 29) and Colombia’s Medellín Metrocable (Box 28). While eight MDBs have committed to provide more than US\$175 billion in finance for sustainable transport over this decade (2012–2022), road projects still dominate their investments.<sup>635</sup> The MDBs need to shift more investment to sustainable urban transport and planning. An example is the ADB’s US\$35 million loan to co-finance a bus rapid transit system and other transport innovations—from paid parking to better pavement for improved walkability—in Vientiane, Lao PDR.<sup>636</sup> MDBs and development agencies also bring substantive expertise in context-specific planning and construction in ensuring gender-sensitive and climate-resilient transport provisioning and in helping local agencies to procure equipment, operators, and digital technologies. DFIs can also play a key role in working with governments to manage early project risk to crowd in finance from private sources.<sup>637</sup>

Photo credit: Flickr: David Megginson



## Box 29

### Lagos BRT “Lite”

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With a population of 21 million, Lagos in Nigeria is the largest city in Africa and the seventh fastest growing city in the world. Like many rapidly growing cities, Lagos' economic growth and development has been hampered by its transport system. Chaotic, slow, and unreliable, transit in Lagos has been dominated by thousands of yellow mini-buses called Danfos. In 2008, Lagos became the first African city with a BRT.

Lagos's 'BRT-Lite' opened on a 22 km,<sup>638</sup> 65%-segregated route with three terminals.<sup>639</sup> At just US\$1.7 million per km, it cost a fraction of the US\$6 million per km average of premium BRTs. The public transport operator, LAMATA, dropped features like level loading and fancy stations that did not fit Lagos's budget, enabling them to recoup their investment in just 18 months.<sup>640</sup> LAMATA was also able to secure substantial private investment: Private operators directly procured 100 new buses and leased a further 120 buses from a state-owned company.<sup>641</sup>

As of 2017, the Lagos BRT-Lite's 300 buses carry 200,000 passengers daily, with an average journey of 30–55 minutes. This is a time saving of 30% on average,<sup>642</sup> complemented by reduced transport expenditures of as much as 31% for low-income households along its route. Along its corridor, the Lagos BRT-Lite carries 25% of commuters while accounting for only 4% of vehicle traffic. Road accidents have decreased significantly since its construction,<sup>643</sup> and the project generated 2,000 jobs. A final benefit: Carbon emissions are down by as much as 13% along the corridor, and particulate matter reduced by 48%.<sup>644</sup>

## Box 30

### EVs Taking Hold in Chinese Cities

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Chinese cities are at the forefront of transport electrification, thanks to clear policies and generous subsidies provided by the national government. China's ambitious efforts have, in part, been motivated by severe air pollution—up to 70% of Beijing's emissions come from transport, and some cities experience up to 129 days of emergency-level smog each year—as well as by climate mitigation targets and the opportunity to benefit the economy by capturing a growing share of a valuable new manufacturing sector.<sup>645</sup>

The national government invested over US\$7 billion across every stage of the EV lifecycle.<sup>646</sup> This effort started in 2009 with the “10 cities, 1000 vehicles” programme, involving large-scale pilot projects electrifying public fleets with predictable driving patterns (such as buses, garbage trucks, and taxis). The up-front costs of the large lithium-ion batteries proved too high for commercial vehicles but are compatible with the investment abilities and long investment horizons of China's public agencies. This public procurement policy helped manufacturers achieve economies of scale and knowledge spillovers for the production of private electric passenger vehicles. The national government also helped local authorities to install chargers necessary for private ownership of EVs.

In 2015, China became the world's largest market for electric private passenger cars,<sup>647</sup> and the New Energy Vehicles Programme has a target of reaching 20% of the total vehicle market demand by 2025. As of 2017, the country had a total of 632,371 private electric cars on the road and an additional 200 million electric two-wheelers, 300,000 electric buses, and up to 4 million low-speed, two seater EVs.<sup>648</sup> Shenzhen alone has 16,359 electric buses and 12,518 electric taxis.<sup>649</sup>

E3ME modelling results for this Report show gains in employment, health improvements, and value addition from a scenario of global accelerated uptake in EVs. In China, EV ownership could increase to about 3 vehicles per 100 people by 2030, leading to an increase in total employment in the motor vehicle sector of more than 126,000 people and value-added gains in the same sector of more than 6% relative to the baseline. Under this scenario, in 2030, more than 110,000 deaths due to air pollution could be averted.<sup>650</sup>