

VALUING THE SDG PRIZE IN CITIES UNLOCKING BUSINESS OPPORTUNITIES TO ACCELERATE SUSTAINABLE AND INCLUSIVE GROWTH

**A paper from AlphaBeta commissioned by the Business and Sustainable
Development Commission**

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FOREWORD

Launched in 2015, the Sustainable Development Goals (SDGs), or Global Goals, as they are commonly known, are 17 goals for ending poverty and hunger, reducing inequality, and tackling urgent challenges such as climate change, by 2030. A year on, the focus now is on how to make meaningful progress on the ambitious targets outlined in this agenda.

The Business and Sustainable Development Commission (BSDC) was established in January 2016 to articulate and quantify a compelling business case for the private sector to help deliver the SDGs. The Commission's approach has been to start with the business perspective and ask a simple strategic question: what needs to be different in key sectors and value chains in order to achieve the SDG targets by 2030. We then look to identify the biggest, most attractive business opportunities that could emerge from the delivery of the SDGs. Finally, we assess what it will take to unlock that opportunity, including actions from government, investors and companies. Delivering the SDGs will require combining the best know-how from the public and private sectors, from civil society and from the investment community. Think of the Commission as creating a strategic roadmap of the fastest-growing markets that would result from delivery of the SDGs. We believe that the SDGs represent a huge opportunity for progressive businesses, willing to drive transformative change in their sectors.

Valuing the SDG Prize in Cities is part of a larger body of research that quantifies the value of business opportunities across four key systems: food and agriculture (released in October 2017); cities; energy and materials; and health and well-being. The findings for these systems will be revealed in the Business Commission's flagship report, to be launched in January 2017. The report will quantify the private sector opportunity across the four key systems, identify the new business models associated with them, and estimate the financing required to unlock these opportunities. The Business Commission would like to thank AlphaBeta for providing the analytical support for this project.

Many experts in academia, government and industry have offered invaluable guidance, suggestions and advice. Our particular thanks to Paul Polman, Jeff Seabright, Rianne Buter, Alison Cairns and Ella Mayhew (Unilever); James Gomme and Carina Larsfalten (World Business Council for Sustainable Development); Janez Potocnik (International Resource Panel and SystemIQ); Daniela Saltzman (Generation Investment Management); Jessica Alsford (Morgan Stanley); Jason Eis (Vivid Economics); Elizabeth Stuart (Overseas Development Institute); Miguel Veiga-Pestana (Bill and Melinda Gates Foundation); Nick Godfrey (New Climate Economy); Justin

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We are grateful for all of their input; the final report is ours, and any errors are our own.

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EXECUTIVE SUMMARY

Key messages

- Business opportunities in the implementation of the SDGs related to cities could be worth over \$3.7 trillion annually for the private sector by 2030. Investment required to achieve these opportunities is approximately \$2.5 trillion per year.
- These 16 opportunities could also generate almost 170 million jobs by 2030, which represents around 5 percent of the forecasted labour force.
- More than half of the value of the opportunities, and over 85 percent of the potential job creation, is located in developing countries. That includes roughly 49 million jobs in China, 32 million jobs in Africa and 22 million jobs in India.

Cities face significant challenges over the next two decades

Over the next two decades, nearly all of the world's net population growth is expected to occur in urban areas, with about 1.4 million people – close to the population of Stockholm – added each week. Urbanisation is a crucial driver of economic growth. In fact, no country has ever climbed from low-income to middle-income status without a significant population shift into cities. However, this urbanisation also poses a series of challenges to inclusiveness, the environment, economic efficiency, health and cultural heritage. By 2025, one-third of the urban population (or 440 million urban households) could lack access to affordable housing, undermining the inclusiveness of cities. The phenomenal growth of cities could also pose significant environmental challenges – urbanisation could consume an estimated two million hectares of land per year, with about three-quarters of that being agricultural land. The economic efficiency of cities is threatened by urban sprawl, which can double the land per housing unit, increase the costs of providing utilities and public services by 10–30 percent and increase motor travel and associated costs by 20–50 percent. Cities also create challenges for health. Urban air pollution is projected to become the top environmental cause of premature mortality by 2050. Access to clean water and sanitation remains challenging in the fast-growing cities of the developing world, with almost 20 percent of urban dwellers still lacking improved sanitation facilities. Finally, rapid urbanisation can risk the destruction of cultural heritage in cities unless the process is carefully managed.

The Sustainable Development Goals provide a new vision for cities

The SDG agenda proposes to meet these profound challenges by shifting cities onto a sustainable development pathway. This shift will transform the entire cities system, with major impacts throughout the value chain. Mapping these impacts provides a vision for sustainable urban development (Exhibit E1).

Exhibit E1

A sustainable development pathway could result in significant shifts in cities

Value Chain Area	Current Value \$ billions ¹	From...	To...
Mobility	4,000 (Automotive)	<ul style="list-style-type: none"> • Individual car ownership • Traditional ICE vehicles • Self-driven vehicles • Truck-based transportation • Low vehicle connectivity • Private vehicle ownership • Basic safety devices 	<ul style="list-style-type: none"> • Shared mobility options • EVs and hybrids • Autonomous vehicles • Multi-modal transport models • In-vehicle connectivity • Public transport • Active and advanced safety equipment
Transport infrastructure	1,500	<ul style="list-style-type: none"> • Free road usage • Road and freeway construction 	<ul style="list-style-type: none"> • Smart pricing for usage of road infrastructure • Growth in rail and metro construction
Non-residential buildings	2,497	<ul style="list-style-type: none"> • Using halogen and inefficient lighting solutions • Fuel-intensive methods for water and space heating • Vacant office space • Low resilience to climate-related weather events • Building-level heating and cooling systems 	<ul style="list-style-type: none"> • Energy-efficient lighting solutions in building • Using electricity/renewables for space and water heating • Office sharing • Climate-resilient buildings • District heating and cooling systems
Residential building	2,997	<ul style="list-style-type: none"> • Lack of low-cost housing • Resource-inefficient construction • Fuel-intensive methods for water and space heating • Energy inefficient appliances • Inefficient use of energy for consumers 	<ul style="list-style-type: none"> • Affordable housing models • Durable and modular design in buildings • Using electricity/renewables for space and water heating • Energy-efficient appliances • Smart metering
Water and sanitation infrastructure	565	<ul style="list-style-type: none"> • Poor infrastructure in developing countries • Lack of investment in managing water leakage rates 	<ul style="list-style-type: none"> • Universal access to quality infrastructure • Water efficiency/leakage prevention systems
Tourism infrastructure	1,245	<ul style="list-style-type: none"> • General tourism 	<ul style="list-style-type: none"> • Universal access to quality infrastructure

Source: McKinsey Global Institute; World Tourism Organization; IHS global construction outlook; AlphaBeta analysis

¹ Mobility includes revenue size of the automotive market from McKinsey Global Institute (MGI) disruptive technologies; transport includes the historical investment in roads, rail, airports and ports estimated by MGI; residential and non-residential data is from IHS on market size of global construction segment ; water infrastructure is the historical spend on infrastructure estimated by MGI; tourism is the international tourism receipts in 2014.

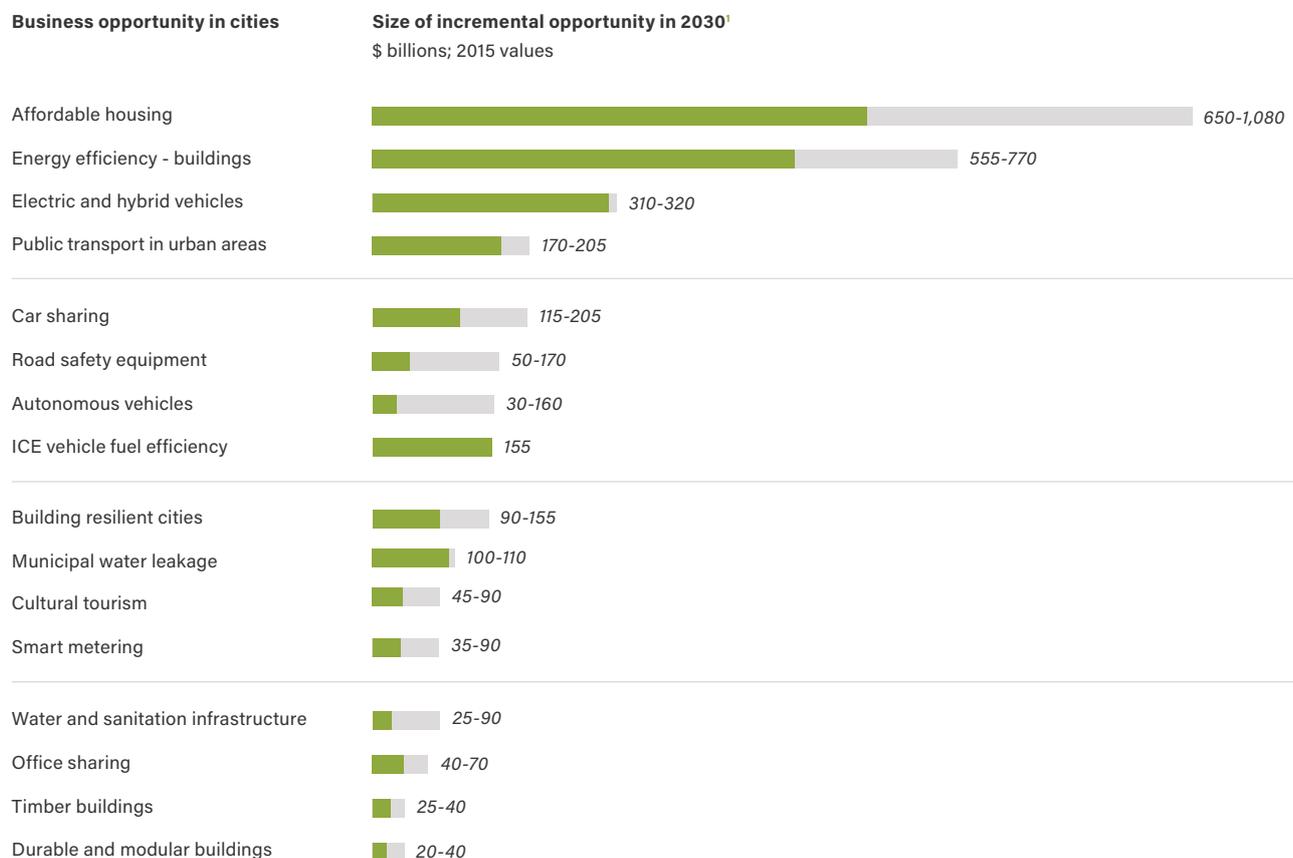
The private sector will be crucial to delivering the SDGs and there are potentially over \$3.7 trillion of business opportunities

The public sector will play a critical part in creating the enabling environment for the implementation of the SDGs, but business will be needed to do much of the 'heavy lifting'. In fact, in cities alone, businesses can play a key role in delivering more than a quarter of the 169 SDG targets. The participation of the private sector in the implementation of the SDGs can also lead to the development of specific business opportunities. We find that 16 opportunities in cities could be worth collectively over \$3.7 trillion annually by 2030 (Exhibit E2). More than half of the value of identified opportunities is concentrated in developing countries, reflecting both their share of urban population growth and the larger capacity for improvement in urban infrastructure.

Our sizing of opportunities is based on current prices. However, these largely do not reflect the cost of a range of externalities, in particular greenhouse gas (GHG) emissions, and they incorporate various subsidised and unpriced resources, including water, fossil fuels and food. To understand the impact of removing subsidies and properly pricing resources, we repriced a subset of our top opportunities for two relevant factors for which reliable data is available: carbon and water. This increases the overall value of opportunities by almost 30 percent in the case of some opportunities, such as energy efficiency in buildings.

Exhibit E2

The largest opportunities in cities could be worth more than \$3.7 trillion in 2030



Source: Literature search; AlphaBeta analysis

¹ Based on estimated savings or project market sizings in each area. Where available, the range is estimated based on analysis of multiple sources. Rounded to nearest \$5 billion.

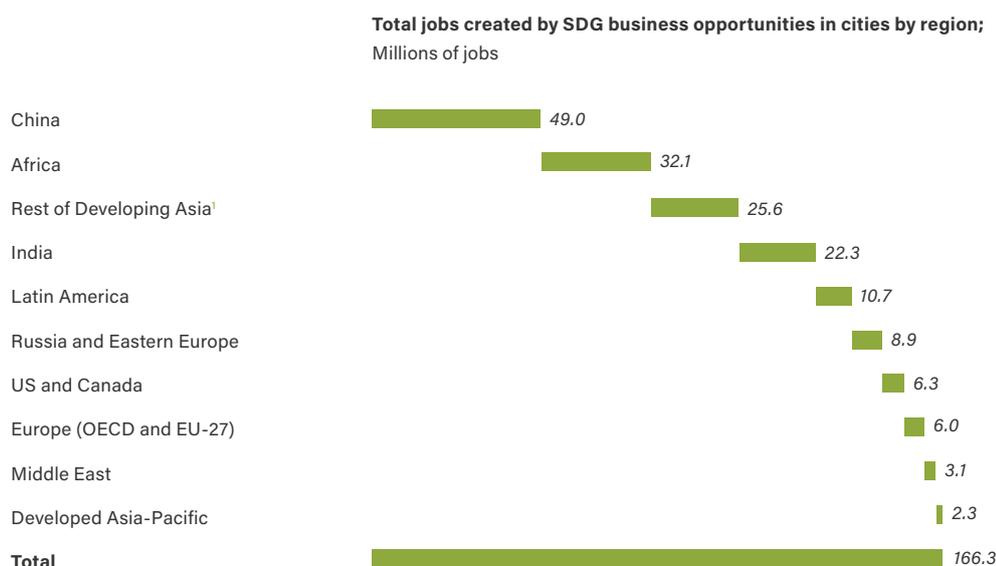
These opportunities could create almost 170 million jobs, as well as a host of benefits to economic development, access to housing, climate change mitigation, waste reduction and health outcomes

The identified SDG-related business opportunities could create almost 170 million jobs by 2030 (Exhibit E3). Over 85 percent of the potential job creation is located in developing countries. That includes roughly 49 million jobs in China, 32 million jobs in Africa, 26 million jobs in the rest of developing Asia and 22 million jobs in India. Given substitution effects, not all of these jobs will translate to net increases in employment.

There are also significant potential benefits to economic development, access to housing, climate change mitigation, waste reduction and health outcomes. For example, investment in affordable housing could expand the housing stock, upgrade slums and provide approximately 1.6 billion people with adequate and safe housing. Improvements to the energy efficiency of buildings could reduce total final energy consumption by 4.6 percent by 2030. The growth of the sharing economy and more durable and modular building systems could significantly improve the efficiency and sustainability of resource use in cities. Increased use of public transport and electric vehicles could reduce ambient air pollution, including NOx and other emissions, which caused 2.9 million deaths in 2013, most of them in cities.

Exhibit E3

Almost 170 million jobs could be created by SDG business opportunities in cities



Source: Literature search; AlphaBeta analysis

¹ Rest of developing Asia includes Central Asia (e.g., Uzbekistan), South Asia (e.g., Bangladesh), Southeast Asia (e.g., Laos), and North Korea.

Achieving the SDGs will require significant investment and a new approach from business

Substantial investment will be needed to capture the SDG opportunities related to cities. We forecast the total annual investment required for the 16 major opportunities identified in the cities system to be roughly \$2.5 trillion. To understand the scale of the challenge, it is useful to compare these incremental investment requirements with current global expenditure on major infrastructure classes, which we estimate to be around \$2.2 trillion. While some SDG-related investment will substitute for existing infrastructure investment, much of this investment will be additional. Given that much of the investment will need to be delivered by local governments in partnership with the private sector, the ability of cities to borrow will also be a critical issue. Analysis by the World Bank has found that only 4 percent of the 500 largest cities in developing countries are deemed creditworthy in international financial markets.

Beyond capital investment, there will need to be additional radical departures from current approaches to unlock the SDG opportunities. The largest shifts required from business are in product innovation and engaging with public policy (particularly on topics related to subsidy reform, building codes and regulatory frameworks on mobility). Driving sustainability through the supply chain is also critical.

1. THE CHALLENGES IN CITIES

By 2030, 60 percent of the world's population will live in cities, up from about 54 percent today – adding over 1 billion people to cities over the next 15 years.¹ Over the next two decades, nearly all of the world's net population growth is expected to occur in urban areas, with about 1.4 million people – close to the population of Stockholm – added each week.²

Urbanisation is a crucial driver of economic growth. In fact, no country has ever climbed from low-income to middle-income status without a significant population shift into cities.³ The underlying causes of this include the scale benefits to economies from larger cities, as well as the higher wages that people typically receive as they shift from farming to urban manufacturing and services. However, this urbanisation also poses a series of challenges to inclusiveness, the environment, economic efficiency, health and cultural heritage:

- **Inclusiveness.** The growth of cities can lead to inclusiveness challenges, particularly as housing becomes increasingly expensive. By 2025, one-third of the urban population (or 440 million urban households) could lack access to affordable housing.⁴
- **Environment.** While the environmental footprint of individuals tends to be significantly lower in cities than in rural areas, the phenomenal growth of cities could still pose significant environmental challenges. Urbanisation could consume an estimated two million hectares of land per year, with about three-quarters of that being agricultural land.⁵ In addition, cities are responsible for around 70 percent of global energy use and energy-related GHG emissions.⁶ Many cities are also highly exposed to natural disasters and environmental concerns, particularly rising sea levels. A UN assessment found that more than 70 percent of the world's major cities are already highly vulnerable to flood-related mortality and economic losses.⁷

¹ Based on UN global population forecast of 8.5 billion in 2030

² *World Urbanization Prospects, the 2014 revision*, UN Department of Economic and Social Affairs, Population Division, 2014.

³ Michael Spence, preface to *Urbanization and growth*, Michael Spence, Patricia Clarke Annez, and Robert M. Buckley, eds., Commission on Growth and Development, 2009.

⁴ *Tackling the world's affordable housing challenge*, McKinsey Global Institute, October 2014.

⁵ Shlomo Angel, Stephen C. Sheppard, and Daniel L. Civco, *The dynamics of global urban expansion*, World Bank, September 2005.

⁶ *Better Growth Better Climate: Synthesis report*, New Climate Economy, September 2014.

⁷ *Risk of Exposure and Vulnerability to Natural Disasters at the City Level: A Global Overview*, UN Population Division, 2015.

- **Economic efficiency.** A large share of urban growth around the world involves unplanned, unstructured urban expansion, with low densities and high rates of car use. This not only increases the land requirements of cities, but also adds to congestion. The number of cars could almost double, from 1.2 billion today to 2 billion by 2035.⁸ Congestion is already close to unbearable in many cities and can cost as much as 5 percent of national gross domestic product (GDP), by measures such as lost time, wasted fuel and the increased cost of doing business.⁹ Urban sprawl could further increase these costs. This can double the land per housing unit, increase the costs of providing utilities and public services by 10–30 percent or more, and increase motor travel and associated costs by 20–50 percent.¹⁰
- **Health.** Almost 3 million premature deaths each year are attributable to ambient air pollution.¹¹ Urban air pollution is projected to become the top environmental cause of premature mortality by 2050. Access to clean water and sanitation remains challenging in the fast-growing cities of the developing world, with almost 20 percent of urban dwellers still lacking improved sanitation facilities.¹² In addition, the incidence of non-communicable diseases could also be impacted by poor urban planning. Obesity is three to four times more prevalent in cities than in rural areas, linked to changes in diets and lack of exercise.¹³
- **Cultural heritage.** Rapid urbanisation can risk the destruction of cultural heritage in cities unless the process is carefully managed. In a speech in 1995, Singapore’s founding father, Lee Kuan Yew, reflected: “We made our share of mistakes in Singapore [...] In our rush to rebuild Singapore, we knocked down many old and quaint Singapore buildings. Then we realised we were destroying a valuable part of our cultural heritage.”¹⁴ Many other cities, particularly in Asia, have also lost significant cultural heritage due to rapid urbanisation.

⁸ *Transportation Forecast: Light Duty Vehicles 2015-2035*, Navigant Research, 2014.

⁹ *Transport in Asia and the Pacific: 12 Things to Know*, Asian Development Bank, March 2012.

¹⁰ *Better Growth Better Climate: Synthesis report*, New Climate Economy, September 2014.

¹¹ *Global Burden of Air Pollution: Deaths from air pollution in 2013*, Institute for Health Metrics and Evaluation et al., 2016.

¹² *Progress on sanitation and drinking water – 2015 update and MDG assessment*, UNICEF and WHO, 2015.

¹³ *How the world could better fight obesity*, McKinsey Global Institute, November 2014.

¹⁴ Heng Chye Kiang, *From architectural heritage to identity in Singapore*, paper presented at ‘The conservation of urban heritage: Macao Vision’ conference in Macao, China, 2002.

2. A VISION FOR SUSTAINABLE CITIES

The SDG agenda proposes to meet these serious challenges by shifting cities onto a sustainable development pathway. This shift will transform the whole cities system, with major impacts across the value chain. By mapping these impacts, a vision for a new, SDG-compatible cities system becomes clear (Exhibit 1).

Exhibit 1

A sustainable development pathway could result in significant shifts in cities

Value Chain Area	Current Value \$ billions ¹	From...	To...
Mobility	4,000 (Automotive)	<ul style="list-style-type: none"> Individual car ownership Traditional ICE vehicles Self-driven vehicles Truck-based transportation Low vehicle connectivity Private vehicle ownership Basic safety devices 	<ul style="list-style-type: none"> Shared mobility options EVs and hybrids Autonomous vehicles Multi-modal transport models In-vehicle connectivity Public transport Active and advanced safety equipment
Transport infrastructure	1,500	<ul style="list-style-type: none"> Free road usage Road and freeway construction 	<ul style="list-style-type: none"> Smart pricing for usage of road infrastructure Growth in rail and metro construction
Non-residential buildings	2,497	<ul style="list-style-type: none"> Using halogen and inefficient lighting solutions Fuel-intensive methods for water and space heating Vacant office space Low resilience to climate-related weather events Building-level heating and cooling systems 	<ul style="list-style-type: none"> Energy-efficient lighting solutions in building Using electricity/renewables for space and water heating Office sharing Climate-resilient buildings District heating and cooling systems
Residential building	2,997	<ul style="list-style-type: none"> Lack of low-cost housing Resource-inefficient construction Fuel-intensive methods for water and space heating Energy inefficient appliances Inefficient use of energy for consumers 	<ul style="list-style-type: none"> Affordable housing models Durable and modular design in buildings Using electricity/renewables for space and water heating Energy-efficient appliances Smart metering
Water and sanitation infrastructure	565	<ul style="list-style-type: none"> Poor infrastructure in developing countries Lack of investment in managing water leakage rates 	<ul style="list-style-type: none"> Universal access to quality infrastructure Water efficiency/leakage prevention systems
Tourism infrastructure	1,245	<ul style="list-style-type: none"> General tourism 	<ul style="list-style-type: none"> Universal access to quality infrastructure

Source: McKinsey Global Institute; World Tourism Organization; IHS global construction outlook; AlphaBeta analysis

¹ Mobility includes revenue size of the automotive market from McKinsey Global Institute (MGI) disruptive technologies; transport includes the historical investment in roads, rail, airports and ports estimated by MGI; residential and non-residential data is from IHS on market size of global construction segment; water infrastructure is the historical spend on infrastructure estimated by MGI; tourism is the international tourism receipts in 2014.

¹⁵ *Urban mobility at a tipping point*, McKinsey & Company, September 2015.

- **Mobility.** Some of the most fundamental shifts in cities through the implementation of SDGs will occur in mobility. The SDGs aim to improve access to transport systems and reduce adverse environmental impacts of cities, including air pollution. In the transition required to meet these challenges, the traditional, low-efficiency vehicles with internal combustion engines that are most commonly used for private transport will experience slow decline in favour of public transport, cycling, walking, and electric and hybrid vehicles. One of the biggest winners will be software companies. Consumers can already use apps on their electronic devices to find out about real-time traffic conditions and reroute journeys away from heavy traffic; access car sharing, e-hailing and on-demand private shuttles; find appropriate routes for cycling and walking; and enable public transit agencies to analyse and improve network performance.¹⁵ Transport systems will increasingly become more multimodal, on-demand and shared, increasing consumer choice and convenience.
- **Transport infrastructure.** Transport infrastructure will also need to evolve to sustainably manage access and respond to changing mobility systems. Smart pricing for the use of road infrastructure is one likely option to manage congestion and vehicle traffic in cities. As improving access to public transport becomes a priority, the construction of roads for private vehicles will slow in favour of bus rapid transit systems, rail and metro.
- **Non-residential buildings.** Improving energy efficiency is an important objective of the SDGs. In non-residential buildings, energy efficiency interventions will become mainstream, including more energy efficient heating and cooling systems, and better lighting technology, and will be incorporated into building design processes. New approaches will develop to improve the utilisation of existing office and non-residential buildings, including office sharing and telecommuting.
- **Residential buildings.** Various aspects of residential buildings will be transformed in the implementation of the SDGs, with a focus on increasing the supply of affordable housing, less wasteful construction and design techniques, and more efficient energy use. Construction will shift towards more modular and durable designs and materials. Energy savings will be achieved by using more energy efficient cooking, cooling, heating and lighting appliances. Increasing penetration of smart meters will also help consumers manage their energy use. District energy systems will be deployed at scale, enabling the use of low-grade waste heat from electricity generation and free cooling sources such as sea water.

- **Water and sanitation infrastructure.** Water and sanitation infrastructure will need to rapidly expand to ensure universal access to clean water and sanitation in the world's cities. Utilities will also focus on actively monitoring and addressing water leakage to improve efficiency, and using technology to better match wastewater generators with potential users.
- **Tourism.** The SDGs aim to improve the protection of cities' cultural heritage, while growing opportunities for sustainable tourism. This creates an opportunity to enhance the focus on heritage-linked tourism, especially given the strong forecast growth in tourism. Cities – particularly those expanding quickly – will need to shift from current attitudes of indifference to their existing heritage to ensure they take advantage of this growth.

3. BUSINESS OPPORTUNITIES IN AN SDG-COMPATIBLE WORLD

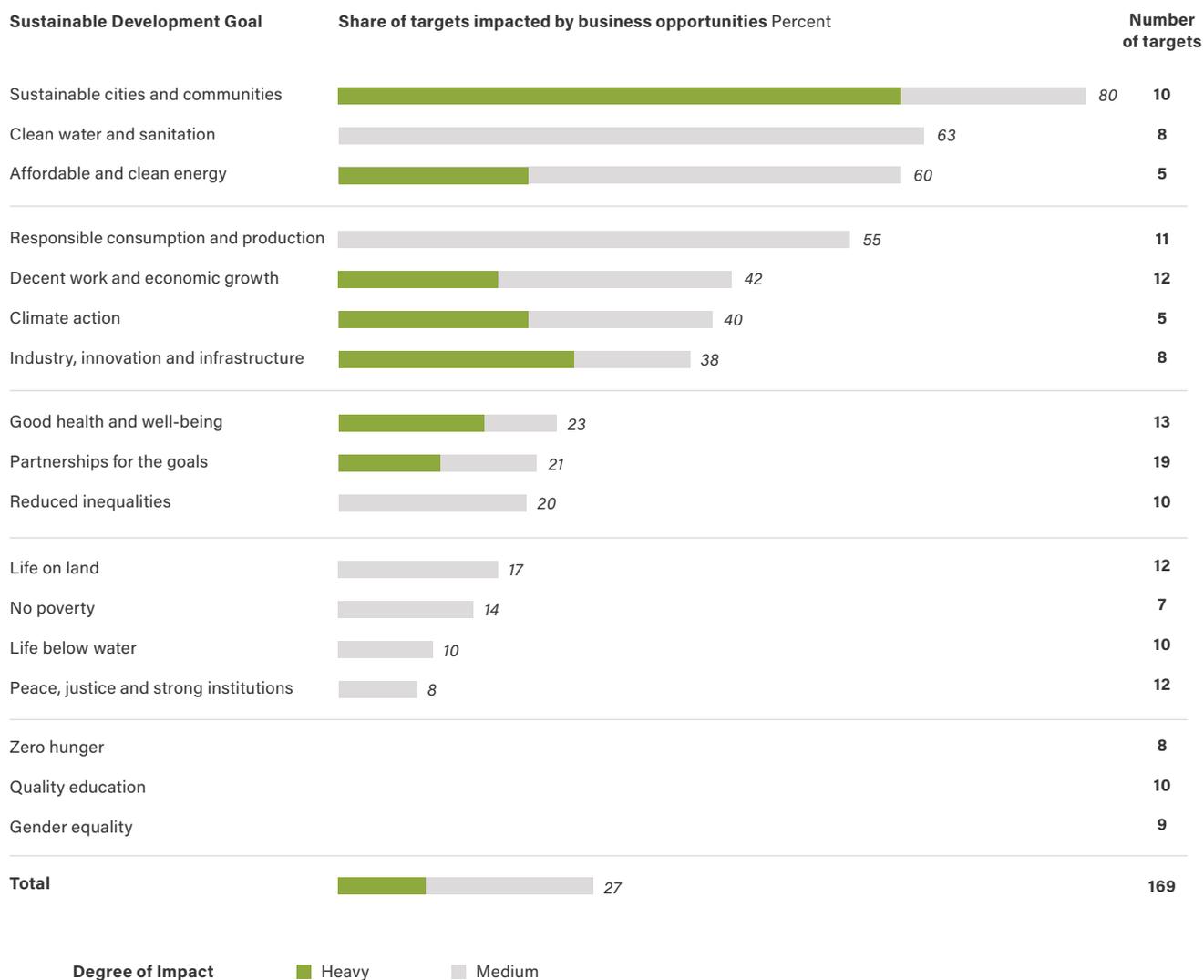
Businesses, for the most part, did not focus on the Millennium Development Goals (MDGs) as they were largely aimed at developing countries. The 17 SDGs are very different however, given they have a truly global focus and are far broader than the MDGs – they aim to fundamentally transform the economic growth model.

If business chooses not to engage with the SDGs, this is likely to lead to two undesirable consequences. Firstly, the costs of global burdens outlined in chapter one will only increase, resulting in less stable and equitable societies, an irreversibly damaged environment, and poorer governance. Increased volatility will weaken business conditions and further curtail growth. Secondly, as the private sector resists cooperation to develop a new growth model, governments will be forced to enact strong regulations to attempt to avert the worse impacts of the challenges we face.

While the private sector can't afford to ignore the SDGs, it is also true that the world cannot afford the private sector to ignore them. We find that the private sector can play a crucial role in more than a quarter of the 169 SDG targets by focusing on business opportunities related to cities (see Exhibit 2).

Exhibit 2

The business opportunities in cities impact more than a quarter of the SDG targets



Source: AlphaBeta analysis

The SDGs will also reshape the business landscape through three main channels:

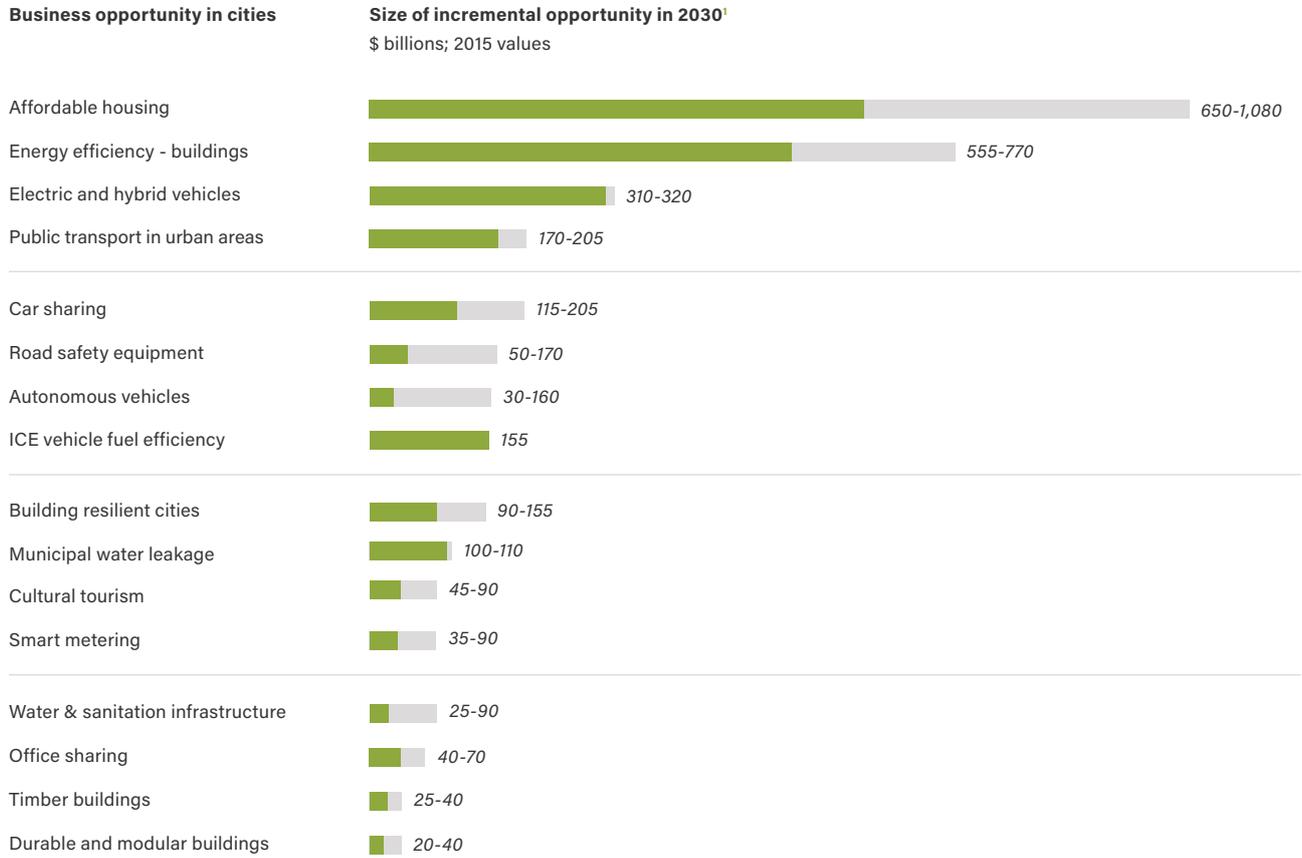
- **Providing new growth markets.** The SDGs offer a pathway to create new markets or accelerate the growth of existing markets. These include the impact on existing product ranges (e.g., increasing the supply of affordable housing); growth of a new consuming class (through the transition of people out of poverty); changing incomes within the consuming class (e.g., through reductions in inequality); and enhancements to existing products to achieve price premium (e.g., road safety equipment).
- **Production and supply chain improvements.** This relates to shifts in production systems and supply chains that are called for in the SDGs agenda. These include reducing waste (e.g., increasing the energy efficiency of buildings) and improving productivity (e.g., car sharing).
- **Initiating regulatory changes.** The SDGs could engender a range of regulatory interventions, which would require business to respond. These include environmental regulations to address GHG emissions and encourage resource efficiency; measures to protect labour rights and address discrimination in employment; regulations to tackle negative social externalities (e.g., congestion charging to reduce private vehicle use); and measures aiming to strengthen governance (e.g., tackling corruption and land rights).

The delivery of the SDGs could create specific business opportunities worth over \$3.7 trillion in cities by 2030

The participation of the private sector in the implementation of the SDGs can also lead to the development of specific business opportunities. Based on an extensive literature scan and deep engagement with experts across the cities system, we have identified the 16 largest business opportunities (Exhibit 3, see Box 1 and the Appendix for further details on the methodology).

Exhibit 3

The largest opportunities in cities could be worth more than \$3.7 trillion in 2030



Source: Literature search; AlphaBeta analysis

¹ Based on estimated savings or project market sizings in each area. Where available, the range is estimated based on analysis of multiple sources. Rounded to nearest \$5 billion.

Box 1. Quantifying the business opportunities related to the SDGs

In the cities system, the team engaged extensively with industry and academic experts, industry reports and the academic literature, to identify and size the major opportunities (worth at least \$25 billion in 2030) for the private sector. Some of the benefits of implementation of the SDGs are diffuse across the economy, such as increased workforce participation through gender equality. We focused instead on concentrated shifts in profit pools, generating specific opportunities for business. The opportunities that we selected are based on existing, commercialised technology, though we note that many important opportunities in the implementation of the SDGs will arise from technologies as yet unknown or embryonic in their development.

The sizing reflects the annual opportunity in 2030 (calculated in 2015 US dollars and rounded to the nearest US\$5 billion), based on the estimated savings (e.g., reduced energy use from energy efficiency measures in buildings) or market size (e.g., size of market for road safety equipment). In each case, we have measured the incremental size of the opportunity in a SDG versus a 'business-as-usual' (BAU) scenario. For example, the electric and hybrid vehicles opportunity is the additional market opportunity from implementation of the SDGs, above that expected in a BAU scenario. The SDG scenarios are based on achieving all relevant SDG targets and a 2-degree climate pathway, but do not build in pricing of carbon or other externalities. The BAU scenarios are derived from existing policies and policy announcements. Where possible, we have used multiple sources for each opportunity to generate a range. The sizings are a 'bottom-up' microeconomic perspective and do not take into account interaction and general equilibrium effects.

The major opportunities in cities include:

- **Affordable housing (\$650–1,080 billion).** As of 2012, there were 330 million urban households living in inadequate housing, which is expected to increase to 440 million by 2025. To replace today's inadequate housing and build the additional units needed by 2025 would require \$9 trillion to \$11 trillion in construction spending alone. With land, the total cost could be \$16 trillion.¹⁶ The current housing affordability gap is \$650 billion, which is the difference between the income available for housing and the annualised market price of a standard unit.¹⁷ This affordability gap is set to grow as the number of households needing affordable and adequate housing will increase by 2030. Realising this opportunity will require efforts to unlock new

¹⁶ *Tackling the world's affordable housing challenge*, McKinsey Global Institute, October 2014.

¹⁷ *Tackling the world's affordable housing challenge*, McKinsey Global Institute, October 2014.

land through innovative mechanisms (e.g., providing density bonuses to developers that permit them to increase the floor space on a plot of land in return for providing land for affordable units); employing available efficiency techniques to reduce costs by up to 30 percent; reducing operations and maintenance costs through energy efficiency retrofits and consolidated supply purchasing; and supporting access to lower-cost financing options for developers and purchasers.¹⁸

- **Energy efficiency – buildings (\$555–770 billion).** The building sector currently accounts for around one-third of total final energy consumption and more than half of all electricity demand.¹⁹ There are large opportunities to improve building energy efficiency through two main channels. Firstly, the heating and cooling performance of buildings can be improved by retrofitting existing buildings and installing more efficient technology in new buildings. An alternative approach is to shift from building-level installations towards the expansion of district heating and cooling, which can deliver operational efficiency gains of up to 90 percent by linking electricity and heating sectors through cogeneration.²⁰ Secondly, switching to efficient lighting, appliances and electronics can reduce demand. There are, however, challenges in implementing these reforms in existing buildings, since significant capital and product innovation are required to replace existing heating, cooling and lighting appliances in buildings. The key to achieving substantial reductions in building energy use is to analyse the building as an entire integrated system, rather than focusing on incremental improvements to individual energy-using devices.²¹ A range of levers could be applied to help tackle these barriers, including enacting energy efficiency standards in new construction and developing innovative financing mechanisms to help overcome capital constraints.
- **Electric and hybrid vehicles (\$310–320 billion).** Market research predicts that annual sales of battery-powered electric vehicles (EVs) and hybrid vehicles will increase from about 2.3 million units in 2014 to 11.5 million by 2022, or 11 percent of the global market.²² Assuming an average lifespan of 15 years, the total global passenger vehicle fleet will turn over completely by 2030, leaving ample opportunity for a huge increase in EV and plug-in hybrid electric vehicle (PHEV) penetration. It is estimated that electric and hybrid vehicles could comprise 62 percent of new light-duty vehicle sales in 2030, though that is dependent on significant and continued falls in the cost of batteries.²³ Along with innovation in battery technology to improve range and reduce cost, investment would also be required for the development of charging infrastructure to facilitate the smooth running of these vehicles.

¹⁸ *Tackling the world's affordable housing challenge*, McKinsey Global Institute, October 2014.

¹⁹ *World Energy Outlook*, IEA, 2015.

²⁰ *District Energy in Cities: Unlocking the Potential of Energy Efficiency and Renewable Energy*, UNEP, 2015. District energy enables low-grade waste heat from electricity generation, or free cooling sources such as sea water, to be utilised. Investments in district energy may be more economical than further retrofits where buildings are already relatively efficient. District energy has not been separately sized as it is difficult to accurately estimate how it would substitute for building-level investments in energy efficiency. However, its potential contribution is significant.

²¹ *Global Energy Assessment*, IIASA, 2012.

²² *Urban mobility at a tipping point*, McKinsey & Co, September 2015.

²³ *Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November 2011.

- **Public transport in urban areas (\$170–205 billion).** In modern, denser cities with medium- and high-density housing, public transport is the most effective solution to urban mobility needs. Jeffrey Zupan of the New York Planning Association has suggested that public transport becomes viable at a threshold of around seven dwellings per acre.²⁴ If a quarter of passenger kilometres were shifted from light-duty vehicles to a mix of public transport modes, it could reduce energy consumption by 5 QBTU in 2030.²⁵ Investment in public transport has also been shown to cut congestion costs, and reduce household transport expenditure by 20 percent.²⁶ The spread of bus rapid transit (BRT) to over 160 cities since the first system was introduced in 1974 indicates the potential of lower-cost systems in enabling greater access to public transport, particularly in developing countries where cities' fiscal capacities are more limited.²⁷ There is an opportunity for the private sector to both build and operate public transport systems, in close partnership with government.
- **Car sharing (\$115–205 billion).** Evolving mobility options are set to change the landscape of the current automotive industry and private-vehicle ownership patterns. According to a study by McKinsey, most cars sit idle 90 percent of the time or more.²⁸ It is expected that car sharing could improve vehicle usage significantly, and may also reduce the number of cars on the roads at the same time. Widespread car sharing would also mean more-intensive use of each vehicle, increasing average annual mileage from 11,700 to 20,400. Car sharing services have grown at roughly 35 percent a year in the United States alone, reaching 1.6 million members in 2014. The future pace of growth for this opportunity will depend on how the technology and product evolve to facilitate 'ease of use' for customers, together with capital investment to ensure that the infrastructure (e.g., car fleets) is in place.
- **Road safety equipment (\$50–170 billion).** Road accidents are the leading cause of death among people aged 15 to 29 years old, and in developing countries are responsible for economic losses of up to 5 percent of GDP.²⁹ The SDGs have an ambitious target of halving the number of deaths and injuries from road accidents; increasing the penetration of new road safety devices will be critical to reaching that goal. Safety control devices in cars will constitute 32 percent of global auto electronics sales in 2016, and there remains significant further opportunity for investment in new technologies.³⁰ The introduction of Car2X, which enables cars to communicate with their surroundings, could prevent up to 60 percent of road traffic accidents and related fatalities and injuries from happening.³¹ Continuous innovation and talent development will be needed to ensure that road safety devices and equipment are seamlessly integrated into vehicles, and hence accepted by consumers.

²⁴ David Owen, *Green metropolis: Why living smaller, living closer, and driving less are the keys to sustainability* (New York: Riverhead Books, 2009).

²⁵ *Resource Revolution: Meeting the world's energy, material, food and water needs*, McKinsey Global Institute, November 2011.

²⁶ *Accessibility in Cities: Transport and Urban Form*, NCE Cities Paper 03, LSE Cities, London School of Economics and Political Science, 2014.

²⁷ *Better Growth, Better Climate: Cities*, New Climate Economy, September 2014. The cost of BRT is estimated to be less than 15 percent of the cost of a metro system with comparable capacity.

²⁸ *Urban mobility at a tipping point*, McKinsey & Co, September 2015.

²⁹ *Global Status Report on Road Safety*, WHO, 2015.

³⁰ *Trends and outlook of the auto electronics industry*, Deloitte, October 2013.

³¹ "Intelligent Safety Warning and Alert System for Car Driving", *Tamkang Journal of Science and Engineering*, 2010.

- **Autonomous vehicles (\$30–160 billion).** The use of autonomous vehicle is expected to grow significantly over the next two decades, with some estimating that 12 million fully autonomous vehicles will be sold globally by 2035.³² There are various benefits of autonomous vehicles, including less road accidents, reduced need for parking spaces and also less congestion in cities. By reducing the human error factor in driving, it is estimated that autonomous vehicles could cut accidents by as much as 90 percent.³³ To realise this opportunity, the private sector would need to invest significantly in developing the technology, reorganising supply chains and training personnel.
- **ICE vehicle fuel efficiency (\$155 billion).** Continued improvement in the fuel efficiency of internal combustion engines (ICE) will be particularly important for cities, not only because of the fuel savings for drivers but also because of the impact on air pollution. By 2030, vehicle manufacturers could potentially reduce fuel consumption by an additional 0.6 litres per 100 kilometres, resulting in a final consumption rate of 4.3 litres per 100 kilometres, or nearly 40 percent below today's levels. Light-duty vehicles could therefore travel the same distance as a car from 1975 with only one-quarter of the fuel. Medium-duty trucks have the potential to improve their fuel efficiency by 11 percent and heavy-duty trucks by 13 percent.³⁴ Capturing these opportunities will require strong regulatory frameworks from government and coordinated investment in research and development.
- **Building resilient cities (\$90–155 billion).** Urban resilience is defined as the capacity of individuals, communities, institutions, businesses and systems within a city to survive, adapt and grow no matter what kinds of chronic stresses and acute shocks they experience.³⁵ While the chronic stresses are mostly due to growing urbanisation rates, the acute shocks are mostly likely to come through events caused or exacerbated by climate change. Previous global estimates of the costs of adaptation have been placed at \$70–\$100 billion annually for the period 2010–2050. However, in its latest report, the United Nations Environment Programme (UNEP) indicates that the annual costs of adaptation in developing countries alone could range from \$140 billion to \$300 billion by 2030.³⁶ The World Bank has estimated that up to 80 percent of these costs could be concentrated in cities. The private sector has the opportunity to participate in the adaptation process in cities by innovating technical solutions to climate challenges and building climate-resilient infrastructure. Barriers include large capital investments and the need for strong coordination with the public sector to achieve this opportunity.

³² *Autonomous Vehicle Adoption Study*, Boston Consulting Group, 2015.

³³ *Urban mobility at a tipping point*, McKinsey & Co, September 2015.

³⁴ *Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November 2011.

³⁵ *100 Resilient Cities*, Rockefeller Foundation.

³⁶ *The Adaptation Finance Gap Report*, UNEP, 2016.

- **Municipal water leakage (\$100–110 billion).** The rate of leakage in municipal water systems varies widely, even among developed economies. While Germany has a leakage rate of just 5 percent, the United Kingdom's rate is 25 percent. The McKinsey Global Institute (MGI) estimates that between 100 billion and 120 billion cubic metres of water could be saved annually by 2030 through reducing leaks in the supply of bulk water in commercial, residential and public premises. While returns from water efficiency investments are often attractive (at above 20 percent), the high capital costs and a lack of awareness among utilities about the benefits of reducing leaks can act as barriers to change.

- **Cultural tourism (\$45–90 billion).** Cultural tourism is estimated to account for 40 percent of total international tourism, according to the World Tourism Organization, and could grow to a \$90 billion opportunity by 2030.³⁷ It also has a number of important advantages for countries. It is a labour-intensive sector that can provide significant opportunities for low-skilled workers. It can also engender the development of a more liveable city that can also become a comparative advantage in attracting a highly mobile and skilled workforce. Cities such as Agra in India and George Town in Malaysia have generated significant growth from cultural tourism. A key challenge for cities is to put in place a balanced blend of regulation and incentives to preserve urban heritage and to support coordination of tourism providers along the supply chain.

- **Smart metering (\$35–90 billion).** Smart meters are electronic measurement devices that maintain two-way communication between the consumer and the utility and also manage the electrical system of the consumer. By 2014, there were close to 45 million smart meters already installed in Finland, Italy and Sweden³⁸, while 50 million smart meters had been deployed in the United States, covering more than 43 percent of homes.³⁹ The advantages associated with smart metering include improved accuracy in meter reading, advanced data recording and energy consumption tracking. By providing consumers with real-time feedback on their energy usage, it helps them to reduce and 'time shift' their consumption to off-peak periods when prices are lower. Switching to smart meters requires considerable upfront investment to replace conventional meters, and education of consumers to use the tool effectively.

³⁷ *Tourism trends: The convergence of culture and tourism*, NHTV University of Applied sciences, November 2014.

³⁸ *Benchmarking smart metering deployment in the EU-27 with a focus on electricity*, European Commission, 2014.

³⁹ *Utility-scale smart meter deployments: Building block of the evolving power grid*, IEI Report, September 2014.

- **Water and sanitation infrastructure (\$25–90 billion).** Increasing urbanisation has created additional pressures on already lacking water and sanitation infrastructure, especially in the developing world. Currently, 828 million people live in slums or informal settlements that are scattered around the world’s cities – providing adequate water and sanitation facilities for these people is a major challenge and an important effort in improving public health.⁴⁰ There is a significant opportunity for the private sector to collaborate with governments in building and maintaining this infrastructure. However, it will require large and long-term capital investments to provide adequate water and sanitation facilities to match the growing urban population. A major barrier to these investments is the subsidised prices of both water and wastewater treatment in many countries, which do not reflect the societal cost of managing this important resource.
- **Office sharing (\$40–70 billion).** It is estimated that approximately 40 billion square metres of floor space globally remains under-utilised during office hours.⁴¹ This points to a significant opportunity to better utilise the existing office and commercial space in cities to meet emerging demand. This will reduce the need for new office space to be constructed and improve the productivity of precious urban land. New shared office and co-working models provide tenants with greater flexibility, reduce upfront costs and foster new forms of collaboration. Further development of technology platforms (e.g., applications, websites) will be necessary to make office sharing easily accessible to customers, and tenants may need to be educated to accept a different style of office environment with reduced privacy and less customised facilities.
- **Timber buildings (\$25–40 billion).** Increasing the supply of affordable housing and other urban infrastructure will generate greater demand for construction materials. However, the production of concrete and steel – the most commonly used materials – is highly carbon intensive and is collectively responsible for almost one-tenth of global GHG emissions.⁴² Wood-based building materials, in contrast, can be produced with fewer emissions and are able to store carbon dioxide during the life of the building. Life cycle analysis indicates that substituting 1 kg of timber leads to average savings of 3.9 kg of carbon dioxide (CO₂).⁴³ The development of composite timber building products, such as glulam and cross-laminated timber, has widened wood’s ability to replace steel and concrete by enabling the

⁴⁰ *Water and Cities: Facts and Figures*, UN-Water Decade Programme on Advocacy and Communication (UNW-DPAC).

⁴¹ Estimated based on European floor space numbers and vacancy assumptions, which have been scaled globally based on GDP; *Growth within: A circular economy vision for competitive Europe*, Ellen MacArthur Foundation, 2015.

⁴² *World Greenhouse Gas Emissions in 2005*, Tim Herzog, World Resources Institute, July 2009.

⁴³ “Carbon, Fossil Fuel, and Biodiversity Mitigation With Wood and Forests”, Chadwick Oliver et al, *Journal of Sustainable Forestry*, Vol 33, 2014.

production of larger structural members.⁴⁴ The greater application of timber in construction may also provide a business model to stimulate investment in reforestation. In this regard, it is preferable to other wood uses, such as paper, that capture carbon for shorter time periods and are more likely to experience structural decline in demand.⁴⁵ To achieve this opportunity, further investments in product innovation will be needed to develop a wider range of wood construction products.⁴⁶ Governments and the private sector will also have to ensure that additional timber is sustainably supplied from plantations and reforested areas, and does not lead to increased pressure on existing natural forests.

- **Durable and modular buildings (\$20–40 billion).** Better modularity and durability of buildings could help address traditional factors in housing obsolescence, such as changing lifestyles, shifting demographics, an aging population and poor construction quality. Modularity and durability go hand in hand: modular design enables about 80 percent of the components in the envelope of a building to be re-used and refurbished, which makes investment in more durable components cost-effective.⁴⁷ Modularity can also reduce material use through more efficient construction processes. It is estimated that 10–15 percent of building material is wasted during traditional construction methods. Capturing this opportunity would require moving away from traditional construction materials and methods, and innovating in techniques as well as materials. Some reorientation of the existing supply chain would also be necessary.

Some opportunities haven't been included, or have been incorporated within other opportunities. Urban densification, for instance, has been considered as an overarching process affected by public transport, the energy efficiency of buildings and affordable housing. Air pollution is a major challenge for cities, a large social cost and a key goal in the SDGs. Addressing this challenge generates a number of separate opportunities that have been included, such as affordable housing, public transport, electric and hybrid vehicles, and ICE vehicle efficiency. Other related opportunities, including retrofitting factories and air purification, were found not to be individually significant. Residential sharing was also assessed, but the incremental opportunity (in a SDG versus a BAU scenario) is estimated to be relatively small.

⁴⁴ *Timber City: Prospectus*, Gray Organschi Architecture, 2016.

⁴⁵ *Outlook to 2060 for World Forests and Forest Industries: A Technical Document Supporting the Forest Service 2010 RPA Assessment*, Joseph Buongiorno et al, Southern Research Station, April 2012.

⁴⁶ Composite timber building products add substantial value to wood that has not been fully incorporated in the estimate of the size of this opportunity. Glulam, for example, has a price up to five times that of industrial roundwood (*Forest Products Annual Market Review 2011-2012*, FAO and UNECE, 2012).

⁴⁷ *Growth within: A circular economy vision for a competitive Europe*. Ellen MacArthur Foundation, 2015.

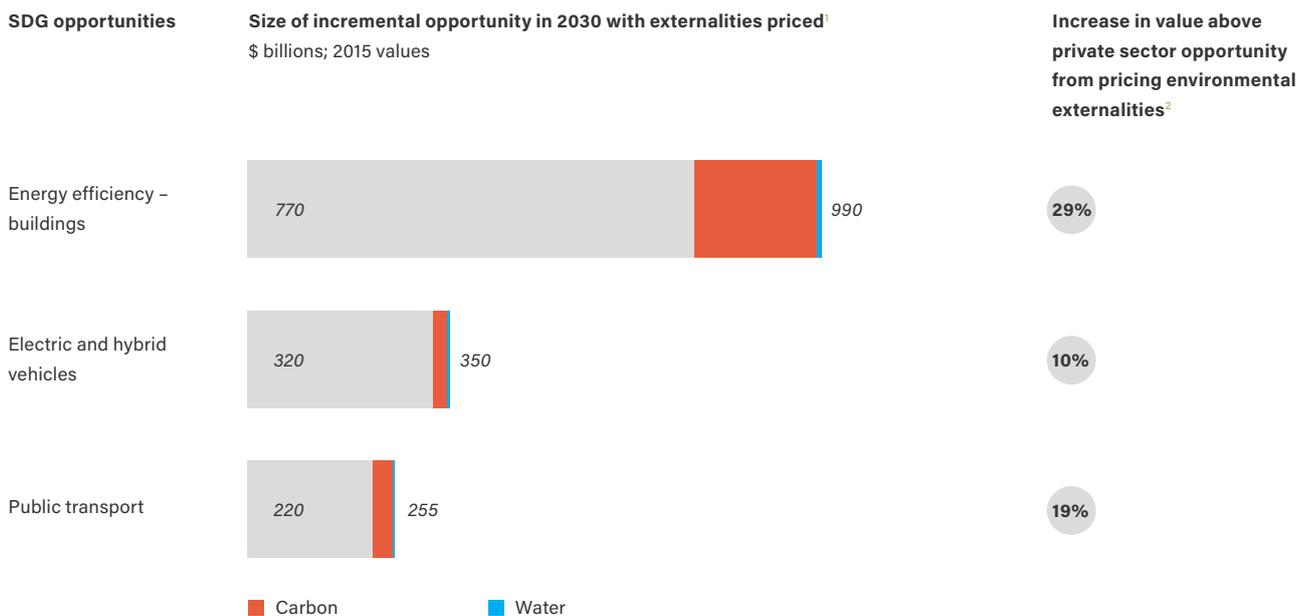
Pricing of externalities could increase the value of opportunities

Our sizing of opportunities is based on current prices. However, these largely do not reflect the cost of a range of externalities, in particular GHG emissions, and they include various subsidised and unpriced resources, including water, fossil fuels and food. The value of these resource subsidies globally is estimated to be over \$1 trillion annually.⁴⁸ To understand the impact of removing subsidies and properly pricing resources, we repriced a subset of our top opportunities for two relevant factors for which reliable data is available: carbon and water. This increases the overall value of some opportunities by almost 30 percent, such as energy efficiency in buildings (Exhibit 4).

⁴⁸ *Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November 2011.

Exhibit 4

Pricing externalities could add more than 30 percent to the value of some of the cities opportunities



Source: Literature search; AlphaBeta analysis

¹ Based on estimated savings or projected market sizings in each area. Only the high case opportunity is shown here.

² Externality sizing assumptions: carbon price of \$50 tCO₂e; average water price increased by US\$0.08 for agricultural water and \$0.40 for industrial use (based on removal of subsidies).

Unlike the Millennium Development Goals, the potential impact of the SDGs is truly global

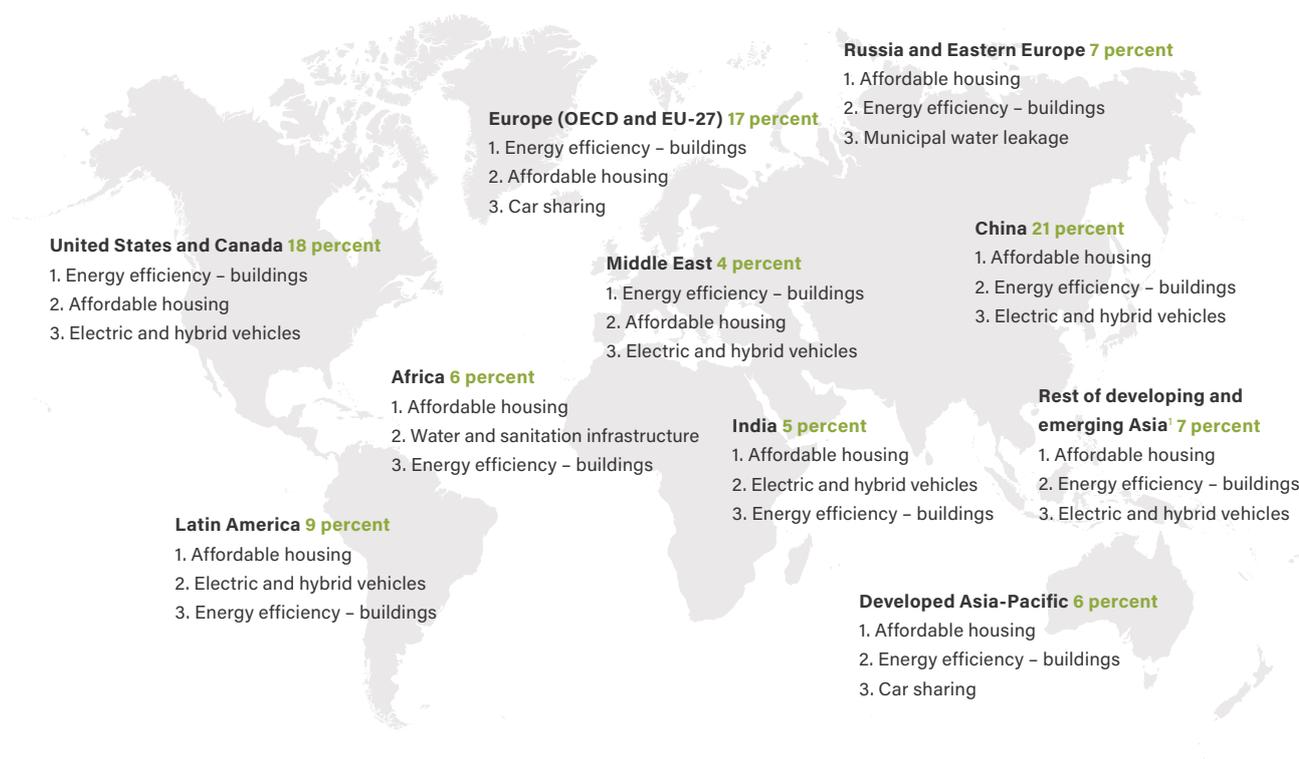
More than half of the value of the identified opportunities is concentrated in developing countries, reflecting both their share of urban population growth and the greater capacity for improvement in urban infrastructure (Exhibit 5). The importance of individual opportunities also varies by region, with stark differences between developed and developing countries. In all developing regions, the largest opportunity is in expanding access to affordable housing. In Europe, the Middle East, and the United States and Canada, energy efficiency in buildings is the most significant opportunity, reflecting their higher energy consumption per capita.

Exhibit 5

The main SDG business opportunities in cities vary somewhat by region

Top business opportunities by region

Share of value of SDG business opportunities in cities by region; Percent



Source: Literature search; AlphaBeta analysis

¹ Rest of developing Asia includes Central Asia (e.g., Uzbekistan), South Asia (e.g., Bangladesh), Southeast Asia (e.g., Lao PDR), and North Korea.

4. BENEFITS OF MORE SUSTAINABLE CITIES

⁴⁹ *The world at work: Jobs, pay and skills for 3.5 billion people*, McKinsey Global Institute, June 2012.

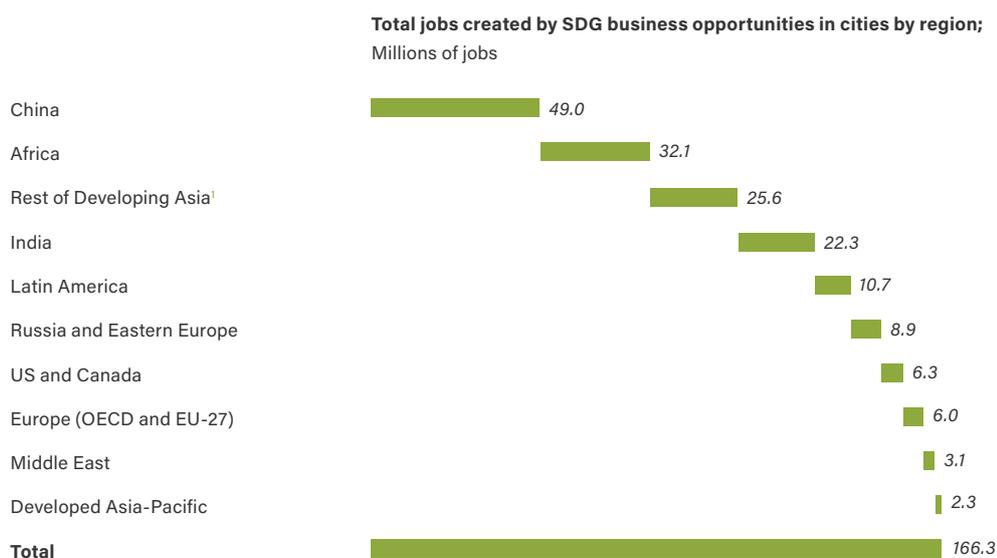
Realising these business opportunities in cities could also help deliver a wide range of societal benefits, including job creation, economic development, access to housing, climate change mitigation, waste reduction and improved health outcomes.

These business opportunities could create almost 170 million jobs

The SDG opportunities could make a substantial contribution to job creation over the next 15 years. We estimate that the 16 opportunities could collectively generate almost 170 million new jobs by 2030, which is around 5 percent of the forecasted 2030 labour force.⁴⁹ For most of the opportunities in cities, such as affordable housing and building resilient cities, this additional employment will be primarily associated with the investment needed. Other opportunities will create jobs through the ongoing operation of new businesses and value chains. The expansion of cultural tourism, for example, will lead to increased employment in the heritage sector, as well as in transportation and hospitality. The job creation potential of the SDG business opportunities is primarily located in the developing world (Exhibit 6). That includes roughly 49 million jobs in China, 32 million jobs in Africa, 26 million jobs in the rest of developing Asia and 22 million jobs in India. Given substitution effects, not all of these jobs will translate to net increases in employment.

Exhibit 6

Almost 170 million jobs could be created by SDG business opportunities in cities



Source: Literature search; AlphaBeta analysis

¹ Rest of developing Asia includes Central Asia (e.g., Uzbekistan), South Asia (e.g., Bangladesh), Southeast Asia (e.g., Laos), and North Korea.

The business opportunities could also generate benefits to economic development, access to housing, climate change mitigation, waste reduction, and improved health outcomes

Beyond the direct job creation impact, these SDG-related opportunities in cities could provide a host of additional societal benefits (Exhibit 7).

Exhibit 7

Business opportunities in cities could also deliver a range of societal outcomes, linked to the SDGs

Challenge	Business opportunities	Relevant SDGs	Societal outcomes
Economic development	<ul style="list-style-type: none"> Affordable housing Public transport Cultural tourism 	 	<ul style="list-style-type: none"> Improved urban densification, leading to higher labour and capital productivity
Access to housing	<ul style="list-style-type: none"> Affordable housing Durable and modular buildings 	 	<ul style="list-style-type: none"> Addition of 440 million new units in cities, providing affordable housing to approximately 1.6 billion people in 2025
Addressing climate change	<ul style="list-style-type: none"> Energy efficiency – buildings Public transport Electric and hybrid vehicles ICE vehicle fuel efficiency Smart metering Timber buildings 	 	<ul style="list-style-type: none"> Energy efficient buildings reduce 2030 energy demand by 4.6% Efficient transport systems remove 1.5 billion tonnes of carbon dioxide annually by 2030 Substitution of timber for steel and concrete in construction reduces CO2 emissions by 500 million tonnes each year
Reducing waste	<ul style="list-style-type: none"> Car sharing Office sharing Durable and modular buildings Municipal water leakage rates 	 	<ul style="list-style-type: none"> More efficient use of existing vehicles, office and residential space can reduce the cost of new infrastructure 120 cubic kms of water saved from reducing water lost from leaking pipes
Better health & well-being	<ul style="list-style-type: none"> Autonomous vehicles Road safety Public transport Electric and hybrid vehicles Water infrastructure Resilient cities 	   	<ul style="list-style-type: none"> Potential for 90% less road deaths Reduce the 5 million premature deaths annually attributable to air pollution Universal clean water and sanitation Minimise loss to urban infrastructure and human lives due to climate related events

Source: McKinsey Global Institute; New Climate Economy; WHO; AlphaBeta analysis

These include:

- **Economic development:** Upgrading slums into affordable high-density housing would enable urban densification to increase. Denser cities are more productive in their use of labour, capital and land, and also support increased use of public transport, which also enhances productivity. Research from 261 Chinese cities in 2004, for example, suggested that labour productivity would rise by 8.8 percent if employment density doubled.⁵⁰ Urban sprawl, on the other hand, can increase the capital costs of providing utilities and public services by 10–30 percent or more, and increase motor travel and associated costs by 20–50 percent.⁵¹ Increasing the productivity of cities, which generate more than 80 percent of global GDP, would stimulate economic growth and prosperity.⁵² Expanding cultural tourism could also support job creation.
- **Access to housing:** Investment in affordable housing could expand the housing stock, upgrade slums and provide approximately 1.6 billion people with adequate and safe housing. Affordable housing helps reduce poverty through multiple channels, including by providing people with an investment asset which can be used as collateral for a small business investment.
- **Addressing climate change:** The SDG opportunities in cities would have a substantial impact on reducing global GHG emissions and mitigating climate change. Improvements to the energy efficiency of buildings could lower total final energy consumption by 4.6 percent by 2030. More efficient transport systems, based on increased public transport, and electric and hybrid vehicles, could help avoid 1.5 billion tonnes of carbon dioxide emissions annually. Replacing concrete and steel with wood-based construction materials could reduce emissions by a further 500 million tonnes per year. Smart metering could reduce electricity demand by enabling consumers to manage their electricity use more efficiently.
- **Reducing waste:** The growth of the sharing economy could significantly improve the efficiency and sustainability of resource use in cities. In particular, car sharing and office sharing models would better utilise existing resources and lessen the need for wasteful additional construction and manufacturing. In Europe, shifting to circular (including sharing) economy models in cities could reduce urban sprawl by up to 30,000 square kilometres by 2050.⁵³ A shift to more

⁵⁰ "Industrial Agglomeration and Difference of Regional Labor Productivity: Chinese Evidence with International Comparison", J. Fan, *Economic Research Journal*, 11, 73–84, 2006.

⁵¹ *Better Growth Better Climate: Synthesis report*, New Climate Economy, September 2014.

⁵² *The Economic Role of Cities*, UN-Habitat, 2011.

⁵³ *Growth within: A circular economy vision for a competitive Europe*, Ellen MacArthur Foundation, 2015.

durable and modular buildings can decrease construction waste and improve the re-usability of building components. Waste can also be mitigated by reducing leaks in the municipal water systems, saving 100 billion to 120 billion cubic metres of water annually by 2030.⁵⁴

- **Better health and well-being:** The quality of cities is a critical driver of health and well-being, and the SDGs create significant opportunities to improve the health of urban populations. Investments in water infrastructure could ensure clean water and improved sanitation for 828 million people who live in slums or informal settlements that are scattered around the world's cities.⁵⁵ Safe and adequate housing also has a major impact on improving health and well-being. Public transport and electric vehicles could reduce ambient air pollution, including NOx and other emissions, which caused 2.9 million deaths in 2013, most of them in cities.⁵⁶ Increasing the use of autonomous vehicles could play an important role in reducing road accidents, which are predicted to become the seventh leading cause of death by 2030.⁵⁷

⁵⁴ *Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, November 2011.

⁵⁵ *Water and Cities: Facts and Figures*; UN-Water Decade Programme on Advocacy and Communication (UNW-DPAC).

⁵⁶ *Global Burden of Air Pollution*, Institute for Health Metrics and Evaluation, 2016.

⁵⁷ *Global Status Report on Road Safety 2015*, WHO, 2015.

5. MAKING IT HAPPEN

Making this happen will require new approaches from business, government and civil society. Much has already been written on the public policy imperatives in cities, and so in this chapter we instead focus on the potential role of the private sector and the development of new business models. In many cases, insurgents enjoy the advantage of being able to start with a clean sheet, whereas incumbents may be less free to take risks with their brands and capital. Yet there is also a growing number of 'radical incumbents' who are learning how to be as agile and innovative as their new 'attackers'.⁵⁸

Given the transformative nature of the change required across the global economy, substantial investment will be needed to capture the SDG opportunities in cities. We forecast the total annual investment required for the 16 major opportunities identified in the cities system to be roughly \$2.5 trillion (Exhibit 8). To understand the scale of the challenge, it is useful to compare these incremental investment requirements with current global expenditure on major infrastructure classes, which, based on analysis by MGI, we estimate to be around \$2.2 trillion.⁵⁹ While some SDG-related investment will substitute for existing infrastructure investment, much of this investment will be additional.

Exhibit 8

The additional capital required to support the identified SDG opportunities in cities is larger than current global infrastructure spend

\$ billions; 2015 values¹



Source: Literature search; McKinsey Global Institute; AlphaBeta analysis

¹ Based on McKinsey Global Institute's estimate of historical global infrastructure expenditure in 84 countries that account for more than 90% of global GDP; energy is addressed in a separate system.

² Based on estimated investment requirements to capture SDG opportunities in cities. Rounded to nearest \$5 billion.

⁵⁸ See for example, *How to make a city great*, McKinsey & Company, September 2013; and *Getting Started with the SDGs in Cities: A Guide for Stakeholders*, UNSDSN and GIZ, July 2016.

⁵⁹ *Infrastructure productivity: how to save \$1 trillion a year*, McKinsey Global Institute, January 2013. This estimate excludes energy, which is addressed separately in the energy and materials system.

The quantum of investment needed is only one aspect of the capital challenge. The second important aspect is ensuring capital is available to the borrowers that will need it most. Given that much of the investment will need to be delivered by local governments in partnership with the private sector, the ability of cities to borrow will be a critical issue. Analysis by the World Bank has found that only 4 percent of the 500 largest cities in developing countries are deemed creditworthy in international financial markets.⁶⁰ Even in their own domestic markets, only 20 percent are creditworthy. Efforts such as the World Bank's City Creditworthiness Initiative will be important in increasing the flow of capital to urban infrastructure.⁶¹

⁶⁰ *Planning and Financing Low-Carbon, Livable Cities*, World Bank, September 2013.

⁶¹ *Better Growth, Better Climate: Cities, New Climate Economy*, September 2014.

Capital is not the only challenge. Several other levers will be important for the private sector in unlocking these business opportunities:

- **Engaging with public policy.** Action by governments will be critical to fully capturing the value of many of the SDG opportunities, and business needs to work with governments to ensure the requisite policy tools are in place. These include regulatory frameworks, such as measures to catalyse investment; infrastructure; pricing of social and environmental externalities; reform of price subsidies in fossil fuels, food and water; and land titling. UN-Habitat estimates that 70 percent of land in developing countries is unregistered, which discourages investment in housing and reduces access to finance.⁶² The revision of building codes can also play a critical role in stimulating energy efficiency and new construction approaches, such as increased use of timber.
- **Product innovation.** Businesses will need to focus their innovation capabilities on potential opportunities emerging from the SDGs and understand how to better partner with government (and particularly research agencies) on developing new solutions. Product innovation will be critical to many of the SDG-related opportunities in cities, including energy efficiency in buildings, autonomous vehicles, and durable and modular buildings.
- **Driving sustainability through supply chains.** Companies will need to rethink supply chain management, focusing more on transparency, partnering with local producers and distributors, and driving efficiency gains. In electric and hybrid vehicles, for example, new supply chain models may be needed to expand drivers' access to charging or battery switching. Companies will also need to apply the same discipline to resource efficiency as they did in the past to labour. The construction industry, which is central to many of the opportunities in cities, is the

world's largest consumer of raw materials; in the United States, it is responsible for 40 percent of solid waste.⁶³ While much construction waste is re-used or recycling, improved material efficiency will be important to reducing costs.

- **Internalising social and environmental costs.** While governments have for the most part made limited progress in reforming tax systems to accurately price environmental and social costs (and benefits), the most progressive companies are forging ahead with internal 'shadow pricing' to increase the value on positive social and environmental outcomes. The Carbon Pricing Leadership Coalition, which brings together the public, private and social sectors to build momentum for carbon pricing, reports that over 1,000 companies globally are already disclosing their current or intended internal carbon pricing.⁶⁴ There is also increasing pressure from investors for businesses to disclose their environmental impacts, including through mechanisms such as the Carbon Disclosure Project. Incorporating social costs into economic activities could help stimulate incentives for change. As shown in Chapter 3, pricing some of the externalities associated with these cities opportunities can significantly raise their value.
- **Educating consumers.** Unlike insurgents, incumbents have already built their brands, and can ally them with sustainability to capture market share. Consumer preferences on sustainability are changing quickly: in 2015, 66 percent of consumers in 14 countries were willing to pay more for sustainable products, compared to 50 percent in 2013 – and incumbents can be better placed to serve them.⁶⁵ In many areas, businesses will need to educate consumers around new SDG-related business models. For example, consumers need to understand how to use the additional information from smart metering to reduce and optimise their energy use.
- **Turning public-private partnerships (PPP) into real business opportunities.** Partnerships have already yielded combined social benefit and private sector opportunity in many contexts: consider, for instance, the Global Alliance on Vaccines and Immunization (GAVI), which has since 2000 vaccinated half a billion children, saved 7 million lives and achieved \$80–100 billion in economic benefits. The challenge for business is how to identify areas where a PPP would make sense (and not make sense), and ensure that the PPP is designed appropriately to capture the opportunity.

⁶² *Tackling the world's affordable housing challenge*, McKinsey Global Institute, October 2014.

⁶³ *Shaping the Future of Construction: A Breakthrough in Mindset and Technology*, World Economic Forum, May 2016.

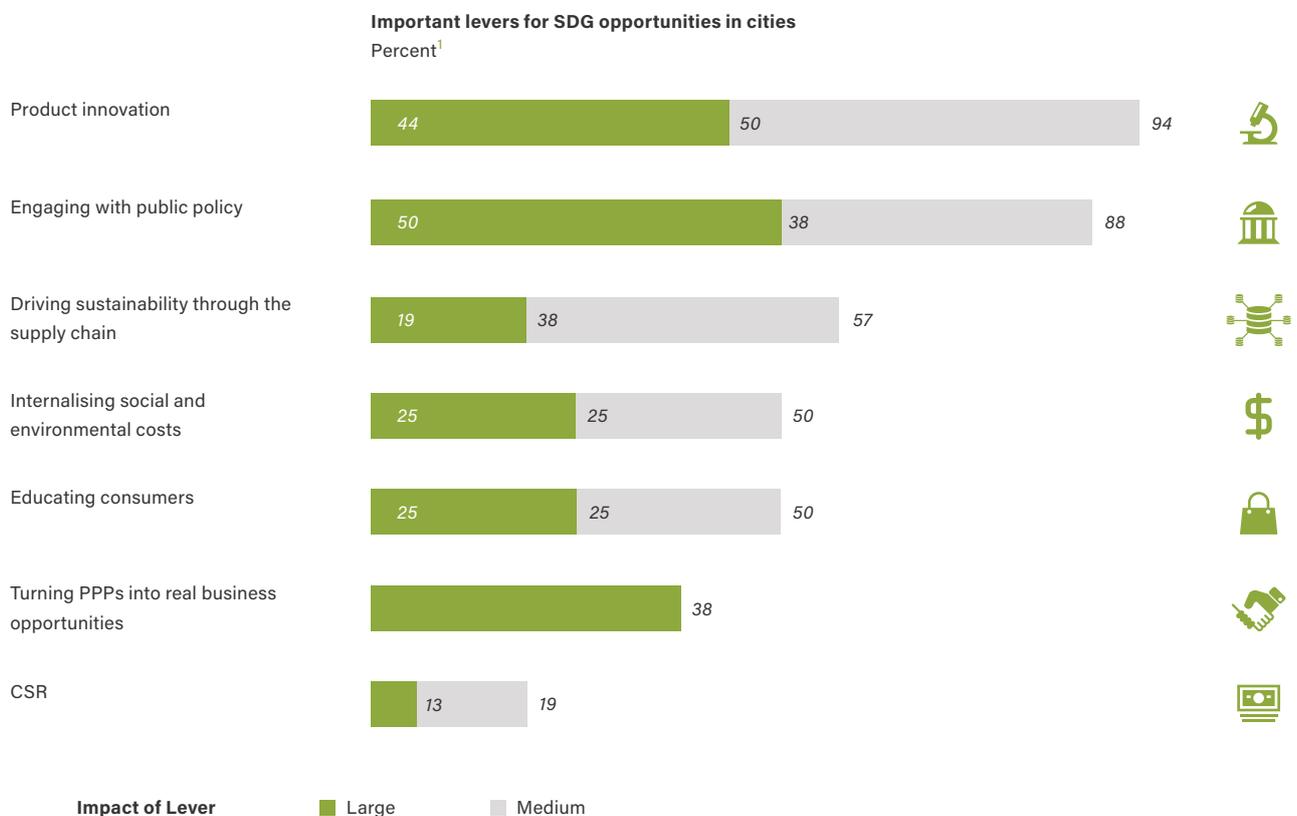
⁶⁴ "CPLC highlights internal carbon pricing at 'Pathways to Impact' Conference", Carbon Pricing Leadership Coalition, 8 July 2016.

⁶⁵ *Global Sustainability Report*, Nielsen, October 2015.

So which levers are most important? Assessed against the 16 business opportunities from an SDG-compatible world identified in the cities system, we find the most important levers are around product innovation and engaging with public policy (Exhibit 9). Driving sustainability through the supply chain is also critical. What is also interesting is what doesn't matter – corporate social responsibility (CSR) is generally a side issue to achieving the main business opportunities identified.

Exhibit 9

Product innovation and engaging public policy are the most important levers for business in cities



Source: AlphaBeta analysis

¹ Refers to the percentage of SDG-related business opportunities identified in cities where this lever could have either a medium or large impact on the likelihood of successful implementation of the opportunity.

APPENDIX: METHODOLOGY FOR SIZING BUSINESS OPPORTUNITIES IN CITIES

The value of each opportunity is calculated as the difference between an estimate of the ‘business as usual’ (BAU) scenario in 2030 and the SDG scenario in 2030 (SDG). The dollar amount therefore represents the incremental annual value in 2030, and is expressed in 2015 US dollars. In some instances, we use multiple methods of estimation to inform our range.

Affordable housing (\$650–1,080 billion)

Description	Sizing Assumptions	Sources
Providing adequate, safe and affordable housing to the population currently living in inadequate housing	<p>BAU: The affordability gap is the difference between the annualised current market price of a basic standard unit and what households earning 80% or less of the median income in that area could pay for housing. This gap is not addressed and continues to grow at current rates.</p> <p>SDG: The housing gap is closed in 2030. The cost of the global affordable housing gap is estimated at about \$650 billion in 2012; the need for affordable housing will increase from 330 million units to 440 million units from 2012–2025, which is an annual increase of 2.6%. This will grow the affordability gap in 2030 to over \$1 trillion.</p>	MGI Tackling the world’s affordable housing challenge (2014) ⁶⁶

Energy efficiency – buildings (\$555–770 billion)

Description	Sizing Assumptions	Sources
Improving energy efficiency in buildings through using more energy efficient lighting, cooking, cooling solutions and appliances	<p><i>Method 1</i></p> <p>BAU: Energy efficiency improves in line with the New Policies scenario from the International Energy Association (IEA).</p> <p>SDG: IEA estimates additional energy efficiency in buildings could be achieved through energy efficient lighting, cooking, cooling, appliances, and space and water heating, which could reduce total final energy consumption by 3.8–4.6 %. Assume average weighted energy price is \$1,000–1,800 per tonne of oil equivalent (toe) and total final energy consumption before efficiencies of 11,221 million tonnes of oil equivalent (Mtoe).</p>	IEA World Energy Outlook (2015)

⁶⁶ *Tackling the world’s affordable housing challenge*, McKinsey Global Institute, October 2014.

Energy efficiency – buildings (\$555–770 billion) (continued)

Description	Sizing Assumptions	Sources
	<p><i>Method 2</i></p> <p>BAU: Energy efficiency improves in line with the IEA's 4DS Scenario.</p> <p>SDG: NCE estimates energy cost savings from incremental improvements in efficiency in residential and commercial buildings based on three levers: new building heating efficiency, heating retrofits, and appliances and lighting (a fourth lever, solar PV, is included in a separate renewables opportunity in the energy and materials system, in a forthcoming report). NCE also assumes energy price increases of 2.5% per year, but this has been excluded for consistency with other opportunities.</p>	<p>NCE Cities Low-Carbon Development (2015)⁶⁷</p>
	<p><i>Method 3</i></p> <p>BAU: Energy efficiency improves by roughly 14% in residential buildings and roughly 12% in commercial buildings.</p> <p>SDG: MGI estimates a further improvement in energy efficiency in residential and commercial buildings of 20% above the BAU improvements, including through improved building heating and cooling performance as a result of retrofitting existing buildings and improved energy efficiency in new buildings, and switching to efficient lighting, appliances and electronics.</p>	<p>MGI Resource Revolution (2011)⁶⁸</p>

⁶⁷ *Accelerating Low-Carbon Development in the World's Cities: Working Paper*, New Climate Economy, 2015.

⁶⁸ *Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, 2011.

Electric and hybrid vehicles (\$310–320 billion)

Description	Sizing Assumptions	Sources
Energy savings from increased penetration of EVs, PHEVs and hybrid EVs	<p><i>Method 1 – Resource efficiency approach:</i></p> <p>BAU: Sales penetration of PHEVs is 15% and sales penetration of EVs is 4%.</p> <p>SDG: Assuming aggressive policies could mean that EVs comprise 62% of new light-duty vehicle sales in 2030 (51% PHEV and 11% EV) versus base case of 15% sales penetration for PHEVs and 4% for EVs in 2030.</p> <p><i>Method 2 – Market size approach:</i></p> <p>BAU: Electric vehicle market size in 2019 is forecast to be \$272 billion. This is assumed to grow at 4.4% in line with McKinsey’s forecast of global automotive industry growth.</p> <p>SDG: According to Navigant Research, global EV sales will grow at 10%, which is the SDG case, while according to McKinsey global automotive industry growth will be 4.4% (the BAU case).</p>	<p>MGI Resource Revolution (2011)</p> <p>Transparency Market Research;⁶⁹</p> <p>McKinsey Automotive revolution (2016);⁷⁰</p> <p>Navigant Research⁷¹</p>

⁶⁹ *Electric Vehicles Market – Global Industry Analysis, Size, Share, Growth, Trends and Forecast, 2013 – 2019*, Transparency Market Research, 2015.

⁷⁰ *Automotive revolution – perspective towards 2030: How Convergence of disruptive technology-driven trends could transform the auto industry*, McKinsey & Co, January 2016.

⁷¹ *Electric Vehicle Market Forecasts*, Navigant Research, 2015.

Public transport in urban areas (\$170–205 billion)

Description	Sizing Assumptions	Sources
Increasing penetration of public transport in cities	<p><i>Method 1</i></p> <p>BAU: Public transport adoption remains at current levels.</p> <p>SDG: MGI estimates the energy saved from shifting nearly 23% of passenger kilometres from light-duty vehicles to public transit buses and BRT; shift of nearly 3% of passenger vehicle kilometres to metros.</p>	MGI Resource Revolution (2011)
	<p><i>Method 2 – Investment needs</i></p> <p>BAU: Investment in new transport infrastructure is projected based on the IEA's 4DS Scenario.</p> <p>SDG: New Climate Economy estimates that the total incremental investment needed to enable expansion in public transport use – leading to a 20% lower per kilometre mode share for light-duty vehicles – is \$6.9 trillion between 2015 and 2050, which is then annualised.</p>	NCE Cities Low-Carbon Development (2015) ⁷²
	<p><i>Method 3 – Investment needs</i></p> <p>BAU: Investment in new transport infrastructure continues at historical rates based on the baseline scenario by the Institute for Transportation and Development Policy (ITDP) and University of California Davis (UC Davis).</p> <p>SDG: The ITDP/UC Davis forecasts the additional annual capex investment required under their 'high-shift' scenario (including infrastructure and equipment purchases) for BRT, metro, trams and buses over 2010–2050. We calculate the 2030 opportunity based on the difference between the baseline and 'high-shift' scenario.</p>	WRI (2010) ⁷³

⁷² *Accelerating Low-Carbon Development in the World's Cities: Working Paper*, New Climate Economy, 2015.

⁷³ *The Trillion Dollar Question II: Tracking investment needs in Transport*, World Resources Institute, 2010.

Car sharing (\$115–205 billion)

Description	Sizing Assumptions	Sources
Increasing use of ride and car sharing services to improve vehicle utilisation and efficiency	<p>BAU: Private vehicles remain utilised at current rates.</p> <p>SDG: Ellen MacArthur Foundation estimates the primary resource benefit from car and ride sharing in Europe in 2030. The European Union (EU) accounts for 27% of global GDP and 39% of OECD GDP, so the estimate is scaled globally based on this range.</p>	Ellen MacArthur Foundation (2015) ⁷⁴

Road safety equipment (\$50–170 billion)

Description	Sizing Assumptions	Sources
Improving car safety devices and equipment to reduce the number of road accidents	<p>BAU: Car safety equipment market grows at the rate of global automotive industry growth (4.4%).</p> <p>SDG: Car safety devices and equipment are expected to grow over 10% annually given the current trends. According to market research firms, the market size would be \$153 billion by 2020. Strategy& estimates indicate that the car safety devices market size in 2021 is expected to be €50 billion globally. We have scaled this opportunity to 2030 using the expected growth in the market size. The opportunity is the difference between the expected market size and the rate of growth of the overall global automotive industry (4.4–10%).</p>	McKinsey Automotive Revolution (2016) ⁷⁵ Market and Markets (2015) ⁷⁶ Strategy & (2015) ⁷⁷

⁷⁴ *Growth within: A circular economy vision for a competitive Europe*, Ellen MacArthur Foundation, 2015.

⁷⁵ *Automotive revolution – perspective towards 2030*, McKinsey and Company, January 2016.

⁷⁶ *Car Safety Market by System Type, Safety Regulations by Region, Impact Analysis – Trends & Forecast to 2020*, Markets and 77 Markets, 2015.

⁷⁷ *Connected Car Study 2015: Racing ahead with autonomous cars and digital innovation*, Strategy&, September 2015.

Autonomous vehicles (\$30–160 billion)

Description	Sizing Assumptions	Sources
Increasing use of autonomous vehicles	<p><i>Method 1 – Market size</i></p> <p>BAU: The Boston Consulting Group (BCG) estimates that the market size for autonomous vehicles in 2030 will be approximately \$60 billion.</p> <p>SDG: Lux Research estimates that the market size could be \$87 billion.</p>	Autonomous vehicle adoption study, BCG (2015); ⁷⁸ Lux Research Inc. (2014) ⁷⁹
	<p><i>Method 2 – Economic impact</i></p> <p>BAU: BCG estimates that the market size for autonomous vehicles in 2030 will be approximately \$60 billion.</p> <p>SDG: MGI estimates that the potential economic impact for autonomous vehicles could be \$200 billion in 2025, which is scaled to 2030 based on global car sales growth projections. The difference between the market size and the potential impact is the opportunity.</p>	

ICE vehicle fuel efficiency (\$155 billion)

Description	Sizing Assumptions	Sources
Improvements in fuel efficiency of ICEs in light-duty, medium-duty and heavy-duty vehicles	<p>BAU: Fuel efficiency of light-duty vehicles improves to just under 5 litres per 100 kilometres. Fuel efficiency of medium-duty and heavy-duty vehicles increases by 15% of SDG case.</p> <p>SDG: MGI estimates that fuel efficiency of light-duty vehicles can be improved by an additional 0.6 litres per 100 kilometres above the base case by 2030. For medium-duty and heavy-duty vehicles, improvements of 11% and 13% respectively are assumed.</p>	MGI Resource Revolution (2011)

⁷⁸ *Autonomous Vehicle Adoption Study*, Boston Consulting Group, 2015.

⁷⁹ *Self-driving Cars an \$87 Billion Opportunity in 2030, Though None Reach Full Autonomy*, Lux Research Inc., 2014.

⁸⁰ *Disruptive technologies: Advances that will transform life, business, and the global economy*, McKinsey Global Institute, 2013

Building resilient cities (\$90–155 billion)

Description	Sizing Assumptions	Sources
Improving resilience of urban infrastructure to climate change	<p><i>Method 1</i></p> <p>BAU: Expenditure on explicit adaptation activities, which ranged between \$23 billion and \$26 billion in 2012–2013, does not increase.</p> <p>SDG: Required climate adaptation expenditure is estimated to be \$140–300 billion annually by 2030. According to UNEP, 80% of the adaptation costs for 2010–2050 could be carried by urban areas.</p>	UNEP Adaptation Gap (2016) ⁸¹
	<p><i>Method 2</i></p> <p>BAU: Expenditure on explicit adaptation activities, which ranged between \$23 billion and \$26 billion in 2012–2013, does not increase.</p> <p>SDG: UNFCCC (United Nations Framework Convention on Climate Change) estimates that by 2030 the world will be spending an additional \$36–135 billion each year to address impacts associated with climate change. This is adjusted for the adaptation cost impacting urban areas and for the amount that is already being spent on climate adaptation.</p>	

Municipal water leakage (\$100–110 billion)

Description	Sizing Assumptions	Sources
Reducing water usage by controlling leaks in municipal water systems	<p>BAU: Current rates of leakage in municipal water systems continue.</p> <p>SDG: MGI estimates that the volume of water that can be saved through better controlling water leaks is 100–120 cubic kilometres. This is based on analysis of country case studies where actual leakage estimates are available, and then scaling these to the global level. The average price of water saved is \$0.90 per cubic metre.</p>	MGI Resource Revolution (2011) ⁸³

⁸¹ *The Adaptation Gap: Finance Report*, UNEP, 2016.

⁸² *Shaping Climate – Resilient Development*, Economics of Climate Adaptation, 2009.

⁸³ *Resource Revolution: Meeting the world's energy, materials, food, and water needs*, McKinsey Global Institute, 2011.

Cultural tourism (\$45–90 billion)

Sizing Assumptions	Sizing Assumptions	Sources
Opportunities from growing cultural tourism	BAU: Annual revenue from cultural tourism grows at current growth rates. SDG: Annual revenue from cultural tourism grows 0.5–1.0% faster than current rates. This is then adjusted for cities' share of cultural tourism (60%).	UNWTO (2015) ⁸⁴ World Travel and Tourism Council

Smart metering (\$35–90 billion)

Description	Sizing Assumptions	Sources
Increased use of smart metering to reduce energy consumption and costs	<i>Method 1</i> BAU: Navigant Research estimates the market size for smart meters in 2030 as \$20 billion. SDG: Market and Markets estimates the size of the smart meter market to be \$18.2 billion in 2019 and growing at a 10.2% compound annual growth rate (CAGR) from 2014–2019. We projected this growth forward to get the 2030 market size.	Market and Markets (2013); ⁸⁵ Navigant Research (2013) ⁸⁶
	<i>Method 2</i> BAU: Navigant Research estimates the market size for smart meters in 2030 as \$20 billion. SDG: McKinsey has estimated the value of advance metering and consumer applications in the US, which is scaled globally based on the United States' share of OECD GDP (assuming benefits are concentrated in more developed countries).	McKinsey, US smart grid value at stake (2010) ⁸⁷

⁸⁴ *Tourism highlights*, UNWTO, 2015.

⁸⁵ *Smart Meters Market worth \$18.2 Billion by 2019*, Markets and Markets, 2014.

⁸⁶ *Smart Electric Meters, Advanced Metering Infrastructure*, Navigant Research, 2013.

⁸⁷ *U.S. smart grid value at stake: The \$130 billion question*, McKinsey & Co, 2010.

Water and sanitation infrastructure (\$25–90 billion)

Description	Sizing Assumptions	Sources
Increasing the provision of clean water and sanitation to unserved or underserved areas	<i>Method 1</i> BAU: No additional investment to close the gap of required water and sanitation infrastructure. SDG: MGI estimates the annual incremental investment needed in water and sanitation infrastructure. Adjusted for cities' share of infrastructure needed, which is 60%.	MGI Infrastructure report (2013); ⁸⁸ Global Water Intelligence
	<i>Method 2</i> BAU: No additional investment to provide access to the unserved urban population. SDG: Copenhagen Consensus Center estimates the annual cost to provide universal access to water and sanitation to the unserved urban population.	Copenhagen Consensus Center (2015) ⁸⁹

Office sharing (\$40–70 billion)

Description	Sizing Assumptions	Sources
Increasing use of office sharing and telecommuting to increase building use efficiency	BAU: Office space remains utilised at current rates. SDG: Ellen MacArthur Foundation estimates the primary resource benefit from office sharing and telecommuting in Europe in 2030. EU accounts for 27% of global GDP and 39% of OECD GDP, so the estimate is scaled globally based on this range.	Ellen MacArthur Foundation (2015)

⁸⁸ *Infrastructure productivity: How to save \$1 trillion a year*, McKinsey Global Institute, 2013.

⁸⁹ *Benefits and Costs of the Water and Sanitation Targets for the Post-2015 Development Agenda*, Copenhagen Consensus Center, 2015.

Timber buildings (\$25–40 billion)

Description	Sizing Assumptions	Sources
Substituting steel and concrete in building construction for wood to reduce emissions	<p>BAU: Indufor’s baseline scenario forecasts that plantation timber supply will increase to 800 million cubic metres (m3) annually in 2030.</p> <p>SDG: Oliver et al use a scenario for greater use of timber in construction based on increasing the rate of wood growth harvesting from 20% to 34%, which implies a doubling of construction timber (from plantation and other sources) from around 1 billion m3 to 2 billion m3 annually. We constrained this potential demand growth to plantation timber only. Indufor’s most aggressive scenario forecasts that supply could increase to around 1100 million m3 annually in 2030. We assume average raw timber prices (industrial roundwood) of \$90–130 per m3.</p>	<p>Indufor Plantation Review (2012)⁹⁰</p> <p>Oliver et al (2014)⁹¹</p>

Durable and modular buildings (\$20–40 billion)

Description	Sizing Assumptions	Sources
Resource saving from shifting to more durable and modular designed buildings	<p>BAU: The take-up of durable and modular designed buildings remains at current levels.</p> <p>SDG: Ellen MacArthur Foundation estimates the annual primary resource benefit in 2030 from shifting to more durable and modular buildings in Europe. EU accounts for 27% of global GDP and 39% of OECD GDP, so the estimate is scaled globally based on this range.</p>	<p>Ellen MacArthur Foundation (2015)⁹²</p>

⁹⁰ *Strategic Review on the Future of Forest Plantations*, Indufor and Forest Stewardship Council, October 2012.

⁹¹ “Carbon, Fossil Fuel, and Biodiversity Mitigation With Wood and Forests”, Chadwick Oliver et al, *Journal of Sustainable Forestry*, Vol 33, 2014.

⁹² *Growth within: A circular economy vision for competitive Europe*, Ellen MacArthur Foundation, 2015.

