

Cities and Climate Change

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Cities are at the Forefront of Climate Impact

We are living in the century of cities. Today, more than half the global population lives in urban areas. And this is expected to increase to 70 percent (6.7 billion people) by 2050. Cities are also the engine of the global economy, contributing over 80 percent of global gross domestic product (GDP).¹ They are centers of innovation and prosperity, but they will also bear the brunt of today's challenges such as climate change, inadequate infrastructure, population growth, and social and economic inequity.

Cities are hotspots for climate change. They consume over two-thirds of the world's energy and account for more than 70 percent of global carbon emissions. And with 90 percent of the world's urban areas situated on coastlines, cities face the risk of devastating climate change impacts such as rising sea levels and powerful coastal storms.² Urban heat islands—areas that are much warmer than surrounding areas because of human activity—often amplify heatwaves in cities. Cities' efforts to address climate change are pivotal to efforts to limit global warming to 1.5 degrees Celsius (°C), according to the Intergovernmental Panel on Climate Change.

Limiting global warming to 1.5°C will require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems. The changes needed are unprecedented in terms of scale and require large emissions reductions

in all sectors, a wide portfolio of mitigation options, and a significant increase in investment. Cities also have a range of adaptation options they can use to reduce the risks of sea level rise (such as coastal defense and hardening) and the risks to health, livelihoods, food, water, and economic growth in urban areas (such as green infrastructure, sustainable land use and planning, and sustainable water management).³

Consequently, the decisions made by city governments can have a direct and immediate impact on large numbers of people, perhaps even more so than policies made at a national or international scale. To meet the urgent challenges faced by their residents on a daily basis, cities are defining their own development trajectories, and the paths they take will have dramatic consequences. Because of cities' density and economies of scale, urban mitigation efforts can have a disproportionate effect, with significant cost reductions and co-benefits⁴ when carbon is reduced. Their decisions on what to prioritize politically, on what to build, and how to build it will reverberate globally, with significant implications for millions of people and for the planet as a whole.⁵

This is particularly relevant to emerging markets, as urban population growth is expected to be concentrated in just a handful of countries. Together, India, China, and Nigeria will account for 35 percent of the world's projected urban population growth to 2050. By 2030, the world is projected to have 43 megacities, each with more than 10 million inhabitants, and most of them in developing regions. However, the fastest-growing cities are those with fewer than 1 million inhabitants, many of them in Asia and Africa.⁶ These swelling urban populations will place additional demands on resources and services, particularly in poorer nations with large and growing informal settlements that lack basic services and are increasingly at risk of climate disasters. The world's informal settlement population is expected to triple to 3 billion by 2050.⁷

Globally, about 60 percent of the area expected to be urban by 2030 remains to be built. Urban policy decisions made by 2020 could account for up to a third of the remaining global carbon budget that is not already "locked in" by past decisions.⁸ As cities, particularly in developing countries, grapple with meeting the needs of their growing populations and tackling challenges such as housing, air pollution,





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congestion, and energy access, they have the opportunity to leapfrog historical approaches to urbanization by putting their scarce resources into clean transport, zero-carbon buildings, and training people to deliver green infrastructure. Ensuring an integrated approach to urban planning and investing in climate-smart city projects will be essential. Cities that don't change will not be viable in years to come.

Surging Climate Commitments by Cities

Recognizing the opportunity to address both development priorities and the climate challenge, 440 mayors and subnational leaders pledged to deliver up to 3.7 gigatons of urban greenhouse-gas emissions reductions annually by 2030, in the margins of COP 21 in Paris in 2015. As part of their commitments under the historic Paris Agreement, 113 national governments⁹ also signaled their ambitions to grow low-carbon, resilient cities by targeting improved solid waste management, efficient street lighting, and sustainable urban planning, among other investments, through their Nationally Determined Contributions (NDCs).

Since then, there has been a groundswell in city commitments to climate action. According to the United Nations (UN) Global Climate Action Tracker, almost 9,400 cities have committed to over 20,000 individual and cooperative actions, including with the private sector, to address climate change across a range of sectors.¹⁰ These cities of differing sizes, structures, geographies, and priorities are committing to climate-smart plans, partnerships, and investments in high-impact sectors such as green buildings, public transport, renewable energy, waste, climate-smart water, and electric vehicles, with the support of a range of global initiatives.

Cities in Africa, Latin America, and South Asia have accelerated their commitments to tackle climate change in the last two years. Through ICLEI—Local Governments for Sustainability, over 1,500 cities across 124 countries are receiving support to develop robust and resilient low-to-no emissions development strategies, green their procurement, and catalyze finance for transformative actions. Through the Global Covenant of Mayors, over 9,000 cities have committed to registering and tracking their climate-related actions and emissions, with many using a

newly released harmonized standard for reporting data that helps cities plan, implement, and monitor their actions in a transparent manner.¹¹ The decarbonization commitments already made by these cities, if fully implemented, could achieve annual reductions of 1.4 gigatons of carbon dioxide equivalent (CO₂e) by 2030. From a business-as-usual level, that's equivalent to taking all the cars in the United States off the road for one year. These city-level commitments exceed the current ambitions of NDCs, showing that alignment across levels of government can pave the way for greater ambition—and action.¹²

While many of these commitments are overall emissions reduction targets, cities are going further and trying to identify sector-specific targets. Through the One Planet Charter, 815 cities from 65 countries, including 25 emerging markets, made commitments where the private sector can play a key role in supporting implementation. These commitments range from pledging to procure only zero-emission buses from 2025 and ensuring that a major area of the city is a zero-emission zone by 2030 (Medellín, Colombia),¹³ to moving towards 100 percent renewable electricity city-wide by 2035 (Malmö, Sweden),¹⁴ to pledging to reduce the amount of waste sent to landfills and incineration by 50 percent and increase the diversion rate¹⁵ to 70 percent by 2030 (New York, United States).

Cities are moving from pledges to action, with 27 of the world's largest cities in the C40 Cities Initiative having achieved at least 10 percent lower emissions than their peak as they work towards decarbonization by 2050. Through this initiative, cities are starting to develop Paris Agreement Compatible Climate Action Plans. Seven C40 cities have already published climate change strategies designed to deliver on the 1.5°C goal, and a further 65 have committed to do so, helping lead cities worldwide towards a low-carbon future.

The ability of cities to make such commitments and act on them is determined by their access to data about sector-specific emissions and resource potential, which is necessary for them to set their mitigation goals and identify reduction opportunities.

Data: A Critical Lynchpin to Climate Action

The Environmental Insights Explorer—a new tool to assist cities with developing a greenhouse-gas emissions inventory—was announced at the 2018 Global Climate Action Summit in San Francisco. It is the first result of a new long-term partnership between the Global Covenant of Mayors, Bloomberg Philanthropies, and Google through the Innovate4Cities Accelerator. Almost two-thirds of the Global Covenant of Mayors member cities have yet to develop a greenhouse-gas emission inventory. The tool is a new addition to the suite of solutions that will assist with this, and over time will expand its coverage to include thousands of cities globally, allowing local governments to instantly

and freely access the data they need to develop city greenhouse-gas emissions inventories—a process that used to cost a megacity between \$250,000 and \$700,000 and take up to two years to complete.

Through the partnership, Google will work with the Global Covenant of Mayors' network partners and committed cities to develop tools and insights based on its proprietary data, providing cities with high-quality and action-oriented information on areas such as transportation and building emissions, weather forecast models, and rooftop solar potential. The tool will be a web-based application that allows cities to freely explore aggregated data and plan climate action. It currently exists in beta release

(<https://insights.sustainability.google/>) with data for Buenos Aires (Argentina); Mountain View, California (United States); Pittsburgh, Pennsylvania (United States); Victoria, British Columbia (Canada); and Melbourne, Victoria (Australia). The partnership is working to quickly expand its global coverage, aiming to have high-quality data online for the next 50 cities by the end of 2018 and adding another 2,000 cities in 2019, with a focus on emerging economies. Cities are invited to provide comments and feedback, and nominate their city to be next on the site.

“To overcome the gap cities face between their climate ambition and full-scale implementation, we must mobilize all the resources and knowledge already available to provide cities with the tools, information, and partnerships they need. The Innovate4Cities agenda is a starting point for the Global Covenant of Mayors and all the cities it represents. By working together, we can make significant progress in securing a climate safe world and meeting the goals of the Paris Agreement.”

— **Tri Rismaharini**, Global Covenant of Mayors Board Member, Mayor of Surabaya, Indonesia

“Google’s innovative new tool is an initial response to this call and will provide cities of all sizes with the data they need at no cost—saving cities valuable time and money and enabling them to redirect those resources toward further actions.”

— **Don Iveson**, Mayor of Edmonton, Canada

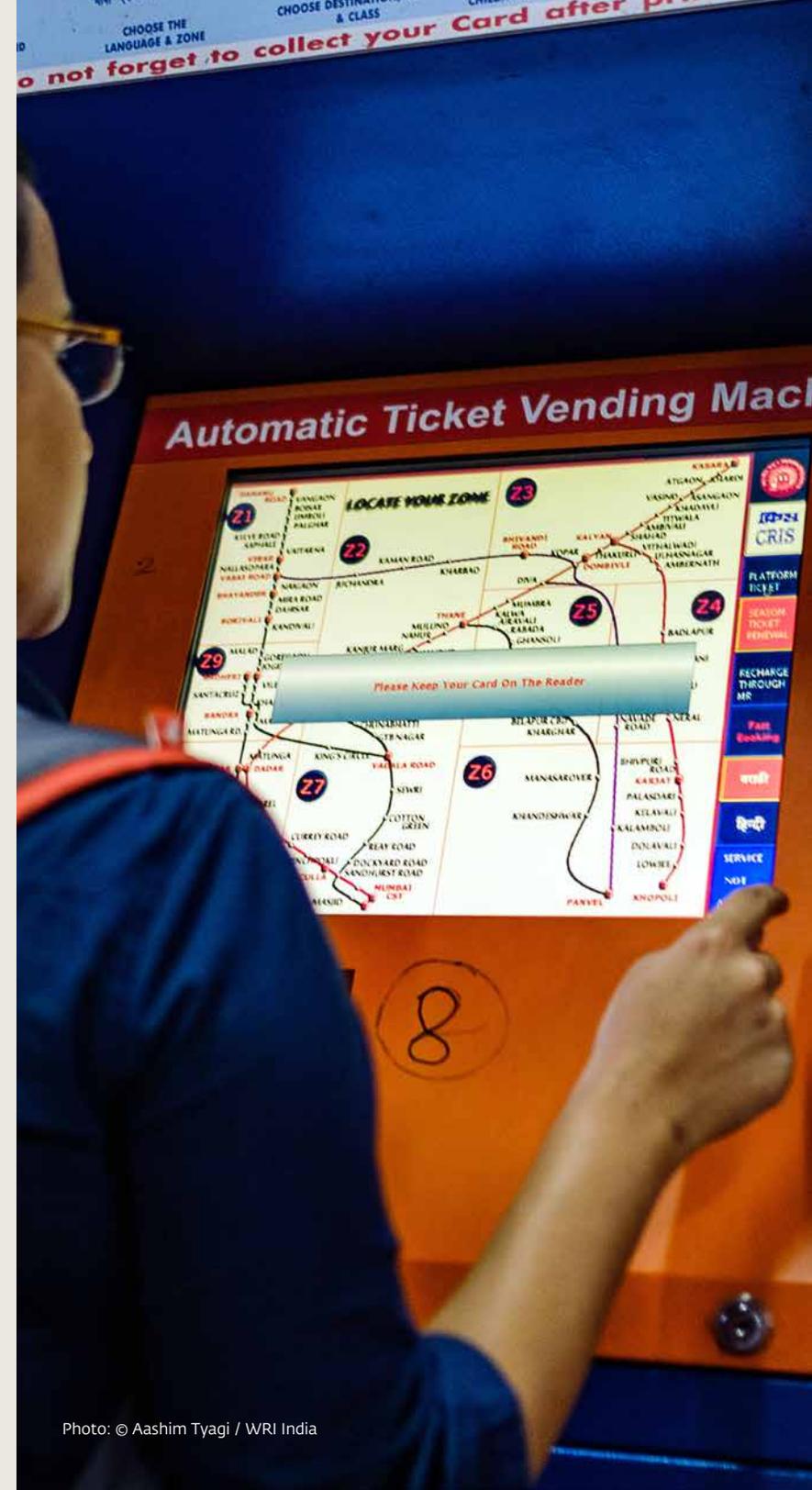




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The Role of the Private Sector in Cities

Cities have long been responsible for creating and maintaining environments that are conducive to business prosperity. Municipal governments have traditionally been responsible for policies, planning, design, and financing of urban infrastructure projects and service delivery. Climate change has added a new dimension to this responsibility, which, to be managed effectively, requires cooperation across the public and private sectors, as municipalities face both capacity and funding constraints in fulfilling this role. This coincides with a proliferation of new technologies, from artificial intelligence to big data, which can help cities become more livable, resilient, and better able to respond to challenges. Businesses can play a key role in supporting cities through a combination of innovation, know-how, financing, and new service delivery models in addition to the traditional benefits they bring to cities, such as jobs and tax revenue. Research by Siemens suggests that the economic opportunities arising from upgrading public transport infrastructure alone is about \$800 billion per year.¹⁶

Businesses are reliant on public infrastructure and environmental policies to support and guide their operations. In Thailand, Hitachi and Lite-On Technology identified frequent and intense rainfall as a serious risk to doing business in Bangkok. Both companies reported that they had to shut down their factories for over a month when the city flooded in 2011, which impacted transport systems and their supply chains, and resulted in a combined loss of nearly \$96 million. The city of Bangkok now categorizes climate change risks from flooding as extremely serious, forecasting that the economic damage from flooding could rise four-fold.¹⁷

Delivering climate-smart city infrastructure at the scale required poses a significant investment challenge, given the high upfront capital investment and operations and maintenance expenses involved. The global financing needed to implement the Sustainable Development Goals (SDGs) is estimated to be between \$5 trillion and \$7 trillion per year, with a \$2.5 trillion annual financing need in developing countries for key infrastructure sectors and related areas.¹⁸ By consensus, the Organisation for Economic Co-operation and Development, Boston

Consulting Group, and the World Bank Group estimate the annual global infrastructure investment need to be about \$3.7 trillion—of which only about \$2.7 trillion is currently met.¹⁹ At \$1 trillion per year, this makes the financial deficit larger today than it has ever been.

Urban infrastructure has received only a fraction of total private infrastructure investment, highlighting the challenge for cities to deliver on the ambition of the Paris Agreement, especially for those with constrained public budgets. IFC analysis of private sector investment and the availability of capital from new types of investors, including pension funds and insurance companies, indicates untapped potential for the private sector to finance and sponsor urban infrastructure investments. In the last 15 years, less than 20 percent of private investment in infrastructure has been directed to urban infrastructure, and there has been a declining trend in the number of projects with private investment. Given the scale of the financing gap, the constraints on city budgets, and the potential for activating these underused funding sources, city governments have a key role to play in creating enabling conditions to secure the required private sector investment.

There is, however, growing interest from the private sector to invest in climate-smart cities. According to the UN, 170 companies have made almost 400 individual commitments specifically tied to supporting the SDG 11 commitment to building sustainable cities, and almost 1,700 companies have committed to almost 3,000 actions addressing climate change.²⁰ Businesses from around the world, alongside cities and regions, have signed the Net Zero Carbon Buildings Commitment, led by the World Green Building Council. The signatories include businesses throughout the building and construction supply chain, and leaders from some of the world's biggest cities plus two major regions. Collectively, the signatories are ready to eliminate 209 million metric tons of CO₂e from their buildings by 2050—equivalent to taking 44.7 million cars off the road.²¹

City policies are creating the space for companies to innovate and invest. For example, Beijing in China is attracting investment due to its use of smart technologies in transport. Mobike and Ofo are providing urban mobility solutions through dockless bike services, resulting in 50 million bike journeys a day and fewer cars on the road. In 2017, the



city announced plans to replace its fleet of 70,000 fossil-fuel-powered taxis with electric cars, creating the space for further private investment. India's Smart Cities Mission has provided \$15 billion to develop 100 smart cities and rejuvenate another 500 over the course of five years, with each city receiving about \$15 million per year. To win the funding, cities have to showcase the feasibility and impact of a project and establish a new private company/special purpose vehicle to oversee the implementation.²²

The financial sector is also increasingly interested in investing in cities. For example, Swiss multinational bank Pictet has launched the first investment fund targeting smart cities, seeded with €652 million. Similarly, HSBC screens its climate solutions database for stocks with a minimum market capitalization of \$500 million from categories in sectors where new technologies, inventions, and ideas are allowing cities to work better. It has identified 37 stocks, of which over 60 percent are from emerging markets, particularly in China. HSBC, ANZ, and the Autonomous Community of Madrid have issued SDG bonds, with proceeds from all three funding SDG 11.²³

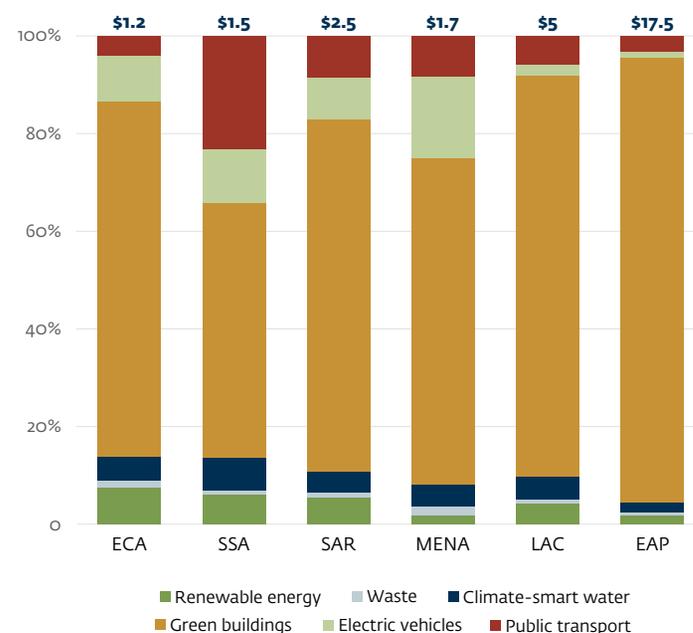
With 400 cities having submitted almost 1,150 projects for support worth close to \$60 billion,²⁴ there is scope to build a pipeline of

investments that are attractive for bond finance. Cities need resources to prepare their projects, particularly in the early stages and know-how in terms of access to finance.

Traditional fiscal instruments such as tax and spend approaches are unlikely to meet the financing needs for city-level climate action²⁵ and subnational borrowing constraints and lack of creditworthiness often restrict direct access to debt instruments.²⁶ Central governments and provincial and municipal bodies are unlikely to fund the required infrastructure developments alone given large budgetary deficits and levels of debt. Commercial and institutional investors need attractive returns on investment and are therefore unlikely to commit funds to infrastructure unless there are tangible opportunities that meet their risk-reward criteria.²⁷ Filling the funding gap will require new and additional sources of finance, with country governments setting out adequate fiscal safeguards to service debt and manage public risks and liabilities. See the section on Financing Climate-Smart Investments in Cities for details on the necessary underpinning conditions and innovative instruments being used by municipal governments to attract private capital for infrastructure projects.

A range of initiatives led by local, international, private, and public actors are already attempting to address these challenges in accessing finance. Local authorities and municipalities can encourage collaboration internally because urban infrastructure considerations often overlap across various departments and state and national agencies, requiring coordination at different levels of government to achieve policy alignment. Central governments could support cities in their efforts through adequate regulatory frameworks and incentives, and by encouraging best practice in public sector governance and finance management.²⁸ The private sector, including financial institutions and investors, can share expertise in financing infrastructure and provide direct financing support. Multilateral and national development banks can also share expertise in designing and structuring infrastructure projects across and within sectors to build a pipeline of bankable investments. Institutions and initiatives operating in finance, cities, and sustainability, including civil society and academia, need to continue their efforts to identify gaps, disseminate best practice and lessons learned, and encourage multi-stakeholder dialogue.²⁹

\$29.4 Trillion Climate Investment Opportunity in Cities by Region (\$ trillion)



Estimating the Climate-Smart Investment Opportunity in Emerging Market Cities

This report aims to help cities, project developers, and investors better understand the investment opportunities in climate-smart urban infrastructure in developing countries. As future urban population and emissions growth will be concentrated in emerging markets, the report attempts to assess the climate investment opportunity in cities in these markets, informed by real city pledges, targets, and investment plans contained in city action plans or NDCs for each of the sectors analyzed. The analysis is related to the opportunities associated with cities' current stated ambitions and does not make any judgment as to their alignment with the 1.5°C or 2°C emissions pathway identified by the Intergovernmental Panel on Climate Change. The focus is on cities in the countries that IFC operates in and is not intended to provide



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a total estimate of the urban infrastructure gap globally. Rather, the report indicates the relative scale of the different climate investment opportunities across sectors and regions, namely East Asia and the Pacific, South Asia, Europe and Central Asia, Middle East and North Africa, Sub-Saharan Africa, and Latin America and the Caribbean.

Methodology

The analysis is based on a database of prioritized urban interventions and cost estimates for their implementation across six high-impact sectors: green buildings, public transport, electric vehicles, waste, climate-smart water, and renewable energy. A sector-specific methodology was used for the calculations depending on the level of available information, the details of which are available in Annex 1. This entailed measuring current and targeted sectoral estimates of usage and uptake of technologies and infrastructure required for each sector, and applying regionally disaggregated costs. To arrive at a cumulative

sectoral investment estimate up to 2030, these estimates were then scaled then scaled by projected urban populations by region in 2030.

Research into emissions reduction targets and commitments indicated a range of ambition across cities and regions. Benchmark cities with available targets and pledges have been used to represent cities of different sizes in each region and results have been aggregated into a global figure, ensuring that there is no double counting. The analysis only covers a limited number of sectors relevant to climate action, which do not include general road infrastructure, civil and defensive infrastructure, or major capital projects.

Regional results have been scaled using the projected total urban population in each region in 2030. Climate action plans or commitment data points were consulted across 21 cities of different sizes in the six regions, ranging in population from 500,000 to megacities with more than 5 million inhabitants, to inform the benchmarks for further scaling and aggregation. These climate-related ambitions were seen to be mostly

TABLE 1: Total investment opportunities by 2030 in cities by region, based on urban population projections and emission reduction targets

Region	Total urban population in IFC region	Total national population in region	Urban population share	Average GHG reduction targets reported in city plans	Average reduction target reported in country NDCs	Total scale of investment to 2030 (USD)	Regional proportion
East Asia Pacific	1,440 M	2,207 M	65%	35%	35%	17,550 B	60%
South Asia	819 M	2,046 M	40%	51%	21%	2,462 B	8%
Europe and Central Asia	180 M	268 M	67%	32%	23%	1,212 B	4%
Middle East and North Africa	355 M	522 M	68%	24%	21%	1,689 B	6%
Sub-Saharan Africa	682 M	1,465 M	47%	31%	27%	1,475 B	5%
Latin America and Caribbean	596 M	713 M	84%	27%	18%	5,046 B	17%
Total	4,072 M	7,221 M	56%	-	-	29,434 B	100%

Note: These and all subsequent numbers across the report follow rounding conventions to the nearest billion, which might lead to differences in summing to the total.

in line with the countries' NDC targets. The investment opportunity estimates identified assume that these targets and commitments will be achieved in full.

IFC estimates a cumulative climate investment opportunity of \$29.4 trillion by 2030 across six urban sectors in emerging market cities. Over half of this investment will be required in East Asia Pacific cities. The analysis assumes a total population of 7.5 billion in 2030, of which 4.1 billion are expected to be living in urban areas based on UN projections. The average overall rate of urbanization is assumed to be 56 percent, ranging from 40 percent in South Asia to over 80 percent in Latin America. More than half of the 4.1 billion people are expected

to live in Asia, across South Asia and the East Asia Pacific regions, consistent with the scale of the investment opportunity in these regions.

The results indicate that, with much of urban population growth occurring in Sub-Saharan Africa, South Asia, and East Asia Pacific, there is an opportunity for a low-carbon transition in cities that are not yet well established. Megacities in South Asia and East Asia Pacific also have significant potential for investments that yield emission reductions.

The global, regional, and sectoral investment estimates for cities represent the total market opportunity for fully implementing all stated climate-related commitments in all locations. While there is leadership and commitment behind cities' climate policies, targets, and goals, fully achieving all these objectives by 2030 may be unlikely. Some of the targets

TABLE 2: Shades of green: Investment potential in cities by region and sector to 2030

	East Asia Pacific	South Asia	Europe & Central Asia	Middle East & North Africa	Sub-Saharan Africa	Latin America & Caribbean	Total
Waste	\$82 billion	\$22 billion	\$17 billion	\$28 billion	\$13 billion	\$37 billion	\$200 billion
Renewable energy	\$266 billion	\$141 billion	\$88 billion	\$31 billion	\$89 billion	\$226 billion	\$842 billion
Public transportation	\$135 billion	\$217 billion	\$116 billion	\$281 billion	\$159 billion	\$109 billion	\$1 trillion
Climate-smart water	\$461 billion	\$110 billion	\$64 billion	\$79 billion	\$101 billion	\$228 billion	\$1 trillion
Electric vehicles	\$569 billion	\$214 billion	\$46 billion	\$133 billion	\$344 billion	\$285 billion	\$1.6 trillion
Green buildings	\$16 trillion	\$1.8 trillion	\$881 billion	\$1.1 trillion	\$768 billion	\$4.1 trillion	\$24.7 trillion
TOTAL	\$17.5 trillion	\$2.5 trillion	\$1.2 trillion	\$1.7 trillion	\$1.5 trillion	\$5 trillion	\$29.4 trillion



are likely to be aspirational and lack real political will for implementation. In some cities or regions there may be an upward or downward bias in the project cost estimates due to the lack of city-specific data or the absence of comparable projects in the country. These estimates do not make any judgment on the proportion of the investment opportunity that will be delivered by the public and private sector.

Summary of Key Findings

The lion's share of the investment opportunity is in green buildings (\$24.7 trillion), as shown in the chart above. This includes both new constructions and retrofits as cities race to accommodate their growing populations. Improvements in low-carbon mobility solutions, driven

by public transport infrastructure and the expected surge in electric vehicles, also hold significant investment opportunities (\$1 trillion and \$1.6 trillion respectively).

The availability and management of water resources is a primary concern for cities to meet the needs of their communities and ensure that they continue to attract private investment from businesses that rely on the resource for their operations, reflecting the \$1 trillion opportunity in climate-smart water. The regional variations in the size of the investment opportunity by sector reflect both the range in the targets set by cities and the differing cost coefficients for technologies and implementation by region. The policies and opportunities across



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the different sectors in each of the regions are considered in the City Deep Dives section of this report.

The Report

The following section discusses why and how cities should adapt to climate change, and the role the private sector can play in the implementation and financing of these efforts. It draws on insights from interviews with cities' Chief Resilience Officers.

The report then takes a closer look at six cities, one in each of the six regions of focus, reflecting a range of sizes and priorities. The analysis delves into the current context and policy frameworks in each, estimates the investment potential in key sectors, and identifies the key financial and policy instruments being used to unlock this opportunity for private investment. Each of these city deep dives is preceded by an overview of the investment opportunities in that specific region, looking at the policies and ambitions of cities across sectors, alongside examples of investments being undertaken. These chapters are interspersed with themes of interest to city policymakers and the private sector, linked by the common thread of addressing urban challenges.

The final section focuses on financing climate-related actions in cities, identifying the necessary criteria for attracting private financing and showcasing the primary financial instruments that can support these efforts, with innovative examples of how they have been applied by cities. Collectively, the report showcases the wealth of actions already taking place by both the public and private sector, and highlights scalable and replicable examples to deliver on the investment potential and need identified in the climate action plans and ambitions of cities.