THE STATE OF CITY CLIMATE FINANCE 2015

CITIES CLIMATE FINANCE LEADERSHIP ALLIANCE

CONTENTS

FOREWORD

The global community has arrived at a critical crossroads to shift the way in which we live. We have an unprecedented opportunity today to build and embrace a higher-value future. Securing this future requires innovative financing and public and private sector institutions are already scaling up their investments in low-emission, resilient cities in spades. This financing is bringing a host of benefits globally: from investment returns, to public health gains. As we look down the new path of sustainable, climate-resilient development, we see a future with investment firms increasingly shifting their portfolios – toward clean energy that powers thriving cities, sustainable buildings that improve living standards and worker productivity, and ecologically harmonious farms that make healthy food accessible to all. These investments lead to peaceful societies focused on long-term, equitable development that will enable our children and our children's children to thrive for decades to follow.

The most important investments today centre on the world's rapidly growing cities, home to more than half the world's population and responsible for 70 per cent of the world's energy consumption and the majority share of global greenhouse gas emissions. Investing in low-emission, climate-resilient urban infrastructure is a crucial first step toward building a sustainable future. Sinking today's capital into carbon-intensive buildings, transportation and energy systems would lock-in high emissions for decades to come, ensuring environmental collapse of an uncertain magnitude. The world's cities are the key staging grounds for building a healthy, sustainable future, and the time is now for realizing this vision – the moment calls for immediate action.

Observing the gap between the need for low-emission, climate-resilient investment and current project finance outlays, a high-level group of public and private organizations and governments launched in September 2014 the Cities Climate Finance Leadership Alliance (CCFLA), a coalition of cities, banks, national governments and civil society organizations with the aim of accelerating and scaling up climate-related finance for the world's cities. The group agreed that to improve capital flows, one needs to have an effective way to measure them. This inaugural CCFLA report – facilitated by the Executive Office of the Secretary-General's (EOSG) Climate Change Support Team (CCST) – is the first attempt to develop a systematic global assessment of the urban climate finance sector. The report provides an overview of the current challenges to financing and the solutions needed. Through this inaugural publication, we note the need to gather more data on climate-related finance flows to cities. This report also highlights the critical steps required to accelerate and scale up financing, accumulate more data on climate related finance flows to cities, and the innovative tools and instruments that can be replicated and scaled.

I am honoured to have been a part of the team that developed this groundbreaking publication, one that we hope will catalyze low-emission, climate-resilient investments in the world's burgeoning cities, spurring action that moves civilization toward a sustainable and equitable future.

Janos Pasztor
Assistant Secretary-General on Climate Change, United Nations

"Cities are taking the lead in addressing climate change – and they could be doing more, and acting faster, if barriers to accessing financing were removed. The recommendations in this report can bring more private and public investment to projects that reduce carbon, improve public heath, and protect people from risks."

– Michael R. Bloomberg the UN Secretary-General's Special Envoy for Cities and Climate Change

"Today, cities have the opportunity to lead the world towards a sustainable future. By helping them identifying and streamlining sources of financing, by strengthening their capacities, development banks like the Agence Française de Développement (AFD) contribute to enhance their access to climate finance. AFD welcomes the recommendations of the report to guide further initiatives and scale-up support to cities climate action."

– Anne Paugam, Chief Executive Officer, Agence Française de Développement

"In a rapidly urbanizing world, how we design and build the cities of the future will be critical for achieving our ambitions for sustainable development. There is no question that enhanced access to finance for cities will be critical. The State of City Climate Finance Report adds a valuable perspective on the key climate finance challenges and opportunities faced by cities."

– Naoko Ishii, CEO and Chairperson, Global Environment Facility

"With developing countries experiencing unprecedented population growth in their cities, low-carbon and resilient urban development is an absolute necessity, even though fully funding it is challenging. . As the 'State of City Climate Finance' report notes, most cities do not yet generate sufficient fiscal resources or have difficulty in accessing financial markets, blocking critical investments necessary to put them on a sustainable low carbon path. Last year the World Bank provided over US$3 billion in urban climate finance and technical assistance to help our clients build climate smart cities. We think it's possible to do more. We applaud the CCFLA for this first-of-its-kind report, and look forward to working with other CCFLA members to overcome these challenges, improving peoples' lives and protecting their future."

– Ede Ijjasz-Vasquez, Senior Director for the World Bank's Social, Urban, Rural and Resilience Global Practice

"The Report sends a clear message: at present urban areas are not receiving their fair share of climate finance. If we want the city of the future to be low-carbon and climate-resilient, we need to find ways to channel adequate financial resources to our cities and human settlements"

– Dr. Joan Clos, Executive Director, UN-Habitat

"Imagine removing the barriers to finally bringing finance to the picture and you will see the rapid deployment of clean energy projects that will improve the global economy, lower emissions and provide new jobs. The role of subnational governments is more important than ever, and California has shown that state and regional governments can institute policies that will grow the green economy, create jobs and clean our environment."

– Arnold Schwarzenegger, Founder and Chair, R20 – Regions of Climate Action

"Climate change poses the single biggest threat to the future health and livelihood of today's children. To protect and secure a healthy and sustainable future for children, we support the urgent global transition to a low carbon economy. Cities are increasingly at the forefront of climate change action. A key challenge is to replicate and accelerate the global scale up of climate-smart development. This report compares cities' funding of low carbon infrastructure with what is required at scale to effectively mitigate and adapt to climate change. The report also highlights innovative financing instruments developed by cities around the world that have been successful in attracting funds for climate change. CIFF is pleased to have supported the development of this report whose recommendations will, if implemented, deliver the paradigm shift needed in city climate finance"

– Shirley Rodrigues, Climate Change Director, Children's Investment Fund Foundation

"Cities are a key player in tackling the sustainability challenges faced by Latin America and the Caribbean. Development banks such as the IDB are helping instil innovation in the public and private sectors, improving lives in cities."

– Amal-Lee Amin, Climate Change and Sustainability Division Chief, Inter-American Development Bank

"Mayors are committed to climate action and a third of the remaining 'safe' carbon budget will be determined by urban policy decisions, but lack of finance is a major barrier to fulfil their full emission reduction potential. C40 welcomes this important report for highlighting the challenges that cities face, but also for laying out the practical actions needed to support the world's mayors to realise their visions of sustainable, low carbon and resilient cities"

– Mark Watts, Executive Director, C40

"ICLEI's ground-breaking Transformative Actions Program and the Local Government Climate Roadmap act to catalyze public and private investment in low-carbon and climate-resilient infrastructure, and we look forward to working with our CCFLA partners and the finance community to ensure that the trillions of dollars of annual city investment in infrastructure is low carbon development."

– Gino Van Begin, Secretary General, ICLEI - Local Governments for Sustainability

"The 2015 State of City Climate Finance report makes a valuable contribution to the current global discussion and rightly points to the opportunity for cities to lead the world towards a sustainable future, making important policy suggestions to improve the flow of financing to low-emission, climate resilient urban infrastructure. The Commonwealth Local Government Forum will work with its partners in CCFLA to implement the report's policy recommendations: this will be critical for all our members, but especially those in the many Commonwealth small island developing states, which are in the forefront of the impact of climate change and rising sea levels."

– Carl Wright Secretary-General, Commonwealth Local Government Forum

"Cities are increasingly concerned by the challenge posed by climate change to the health, safety, cost and quality of life for their citizens. This report by CCFLA illuminates the infrastructure investment gap and major barriers that must be overcome in order for cities to invest in low-carbon, next generation infrastructure."

– Lance Pierce, President, CDP North America

"While during COP21 Local Governments are recognized for the first time as key actors to face climate change, this publication will help to better understand the challenges and opportunities addressed to mobilize the necessary resources to engage actions to develop a low-carbon economy and invest in climate resilient infrastructure at local level. FMDV believes that this first CCFLA report will serve as a milestone in the construction of a productive dialogue amongst its members and partners."

– Jean-François Habeau, FMDV Executive Director

"The study takes an important first step toward understanding how much, where, how and from whom finance is flowing to support low-carbon and climate resilient urban development. As our Climate Finance Landscape reports have shown since 2011, proper measurement, tracking, and reporting of climate finance lays the foundation for efficient and impactful investments by public and private actors"

– Barbara Buchner, Senior Director of Climate Policy Initiative

"Climate finance comes in many different forms - what our cities really need for investment in climate and health is an enabling environment. I call on cities to combine climate and air pollution control - by investing in activities like reducing soot from heavy duty diesel vehicles and buses, and control methane release from landfills in order to improve air quality and avoid warming. We welcome the timely recommendations of the State of City Climate Finance report and look forward to contributing to the CCFLA efforts."

– Helena Molin Valdes, Head of the Secretariat of the Climate and Clean Air Coalition

ACKNOWLEDGEMENTS

The Executive Office of the Secretary-General's (EOSG) Climate Change Support Team (CCST) facilitated the production of this report on behalf of the Cities Climate Finance Alliance (CCFLA).

The CCFLA is grateful to the McKinsey Center for Business and Environment for providing research and analysis to inform this report.

CCFLA gratefully acknowledges the contribution of its members and partners who generously contributed information, time and resources to enable the production of this report.

The CCFLA would also like to gratefully acknowledge the Children's Investment Fund Foundation (CIFF) and Agence Française de Développement (AFD) for their financial support to the preparation and publication of this report.

CIFF CHILDREN'S INVESTMENT FUND FOUNDATION

afd AGENCE FRANÇAISE DE DÉVELOPPEMENT

SUGGESTED CITATION

Please use the following citation for this report: CCFLA (2015) State of City Climate Finance 2015. Cities Climate Finance Leadership Alliance (CCFLA). New York.

Note that throughout this report all references to $ amounts refer to US dollars

THE CITIES CLIMATE FINANCE LEADERSHIP ALLIANCE

The Cities Climate Finance Leadership Alliance (CCFLA) was launched at the UN Secretary-General's Climate Summit in September 2014 as a pioneering global platform to facilitate collaboration between public and private-sector institutions committed to mobilizing investments into low-emissions and climate-resilient urban infrastructure.

Since its launch, the Alliance has grown to include a diverse membership including national governments, leading global public and private finance institutions, city and subnational networks and associations, UN Agencies, and advocacy organisations operating across the world.

As of November, 2015 the current membership of the CCFLA includes:

- African Development Bank
- Agence Française de Développement
- Banco de desarrollo de América Latina
- Bank of America Merrill Lynch
- Bloomberg Philanthropies
- C40 Cities Climate Leadership Group
- Carbon Disclosure Project
- Children's Investment Fund Foundation
- CITI
- Cities Development Initiative for Asia
- Climate and Clean Air Coalition
- Climate Bonds Initiative
- Climate KIC
- Climate Policy Initiative
- Commonwealth Local Government Forum
- Deutsche Bank
- European Investment Bank
- FMDV
- Government of the Republic of France
- Government of the United States of America
- Global Environment Facility
- Global Infrastructure Basel
- Gold Standard Foundation
- ICLEI – Local Governments for Sustainability
- Inter-American Development Bank
- Japan International Cooperation Agency
- Johns Hopkins School of Advanced International Studies
- Kreditanstalt für Wiederaufbau
- Le Fonds Français pour l'Environnement Mondial
- Meridiam
- R20 - Regions of Climate Action
- Swiss Economic Development Cooperation State Secretariat for Economic Affairs
- Standard and Poor's Ratings Services
- United Nations Environment Programme
- UN-Habitat
- United Nations Capital Development Fund
- United Nations Secretary-General's Climate Change Support Team
- West African Development Bank
- World Bank
- World Resource Institute
- WWF

For further information on the CCFLA or to contact the Secretariat please visit the website at:
www.citiesclimatefinance.org

EXECUTIVE SUMMARY

The infrastructure planning and financing decisions made today will determine the world's climate and development outcomes for the next century. Taken together, these decisions will lead to the building of either low-emission, climate-resilient infrastructure that increases economic opportunity or more of what we have already, effectively locking the world into a carbon-intensive pathway with sprawling human settlements, hazardous pollution, and heightened vulnerability to climate change. Nowhere are infrastructure decisions more critical than in cities, which house half the world's population, consume 70 percent of the world's energy, and release at least the same proportion of energy-related greenhouse-gas emissions.[1]

At the current pace of urbanisation, the world's cities will grow by 65 million inhabitants a year between 2010 and 2025. Every year until 2025 this massive shift will create new infrastructure demand in India's cities alone equivalent to the entire current residential and commercial floor space of the City of Chicago. In China, meanwhile, cities will add two-and-a- half times that amount of new construction per year during the same timeframe.[2] How the world feeds, houses, transports, and powers its cities, and builds new ones, will shape our collective climate future.

This great upheaval holds out an unprecedented opportunity for cities to lead the world towards a sustainable future—but we must act fast. Over the next 15 years, roughly $93 trillion of infrastructure designed to be low-emission and climate-resilient will need to be built globally.[3] Analysis conducted for this report suggests that more than 70 percent of this infrastructure will be built in urban areas, at a cost of $4.5 trillion to $5.4 trillion per year. The value of infrastructure required in urban areas over the next 15 years could be greater than the $50 trillion value of all the infrastructure in the world today.

In light of this enormous demand, understanding climate finance flows holds singular importance—we know that an urban climate finance gap exists, and that it is significant. Analysis conducted for this report (detailed in the demand section) suggests $4.1 trillion to $4.3 trillion per annum will need to be spent on urban infrastructure just to keep up with projected growth in a business-as-usual scenario. We estimate an incremental 9 to 27 percent ($0.4 trillion to $1.1 trillion) more capital investment will be necessary to make this urban infrastructure low-emission and climate-resilient. Given differing methodologies and data limitations between our demand and supply estimates, the exact gap figure cannot yet be calculated. However, with CPI's current tracked climate finance totalling just $331 billion (inclusive of both urban and non-urban flows) the magnitude of the challenge for urban climate finance becomes clear.[4] Even if every dollar of current tracked climate finance were directed to urban areas, it would still not be enough to match the most conservative estimated requirement. Thus, climate finance will not close the infrastructure investment gap alone—indeed, it represents a small part of total financing flows—but it plays a vital catalytic role, and it will need to be scaled in the coming years.

CCFLA has set in motion a process for more comprehensive and aligned practices for gathering, tagging, and sharing project level data for urban climate finance initiatives, which will help produce more robust figures in the future. According to the climate finance figures provided by the development banks surveyed for this report, overall climate finance flows were just under $54 billion in 2014, representing 26 percent of the banks' total commitments.[5] The average proportion of climate finance channelled to urban areas was 31 percent.[6]

Today's financing landscape does not provide cities with adequate access to affordable financing suited to low-emission, climate-resilient infrastructure. The challenge is not simply to increase the amount of money in the pipeline, but also to create an enabling environment that encourages existing and new financing to flow from a broad spectrum of sources. Public and private funding can play a critical role in attracting investment. However, ramping up channels of city finance—such as transfers from national governments, revenues from local taxation and public services, and borrowing from local financial institutions, development banks, and international public or private sources—will be essential to ensuring adequate project funding.

With this in mind, the CCFLA has identified six major barriers that must be overcome: 1. Uncertainty over regulatory and tax policies that affect low-emission, climate-resilient infrastructure; 2. Difficulty in incorporating climate goals into urban infrastructure planning; 3. Lack of city expertise in developing low-emission, climate-resilient infrastructure projects that can attract financing; 4. Insufficient city control over infrastructure planning and complex stakeholder coordination; 5. High transaction costs; and 6. Lack of proven funding models at the city level.

CCFLA members have come together for the first time to propose a set of measures designed to improve the flow of financing to low-emission, climate-resilient urban infrastructure. A consensus has formed around focusing on measures that have high near-term potential to attract private investment and are relatively easy to scale and replicate. This emphasis, however, will not preclude a focus on projects with long-term impacts, as CCFLA will facilitate both near and long-term financing. The proposed measures are:

1. **Engage with national governments to develop a financial policy environment that encourages cities to invest in low-emission, climate-resilient infrastructure.** Development banks, international governing bodies, and NGOs can help national governments use grants, matching funds, tax transfers, and preferential loan rates to support wise investment. They can also help governments create policies that enable cities to set up their own mechanisms to price externalities.
2. **Support cities in developing frameworks to price climate externalities.** Donors can provide financial and technical support to cities in developing schemes to price climate externalities. National governments can empower cities to adjust their budgeting so that it accurately values positive and negative climate impacts and allocates cash flows accordingly.
3. **Develop and encourage project preparation and maximise support for mitigation and adaptation projects.** Project preparation facilities and their financing partners can change project selection criteria to favour low-emission, climate-resilient infrastructure; conduct climate assessments and design recommendations to improve the sustainability of traditional infrastructure projects; and build technical and financial capacity to advise on infrastructure that incorporates low-emission, climate-resilient technology.
4. **Collaborate with local financial institutions to develop climate finance infrastructure solutions for cities.** Development-bank capital and co-financing arrangements for some programmes can be channelled to local and regional banks, mortgage lenders, and other financial intermediaries to increase their awareness and experience of investing in low-emission, climate-resilient urban infrastructure. Local financial institutions can also provide an important channel for aggregating and dispersing international climate funding to cities.
5. **Create a lab or network of labs to identify catalytic financial instruments and pilot new funding models.** These labs should focus on using development-bank and concessionary capital to identify, pilot, and evaluate new instruments, models, and mechanisms for financing low-emission, climate-resilient urban infrastructure.

CCFLA recognises that these proposals will not by themselves overcome the array of complex challenges that cities face in accommodating unprecedented numbers of new arrivals while maintaining and improving the quality of life for existing residents as the effects of climate change strain resources and test resilience. Yet taken together, the proposals are an important step towards creating climate-smart cities built to safeguard the health and wellbeing of the people living within their bounds.

The solutions presented here will be used to inform CCFLA action over coming years as members further strengthen their collaboration in pursuit of the Alliance's mission.

INTRODUCTION

Cities are central players in the global movement to build a better future with an equitable economy and a stable climate. Urban areas are already home to half the world's population; by 2050, that share is expected to rise to two-thirds or more.[7] As the world rapidly urbanises, our cities' infrastructure—the built environment that houses, feeds, transports, and provides energy for people—will determine our climate future. Cities can be compact, connected, and climate-smart if municipal leaders plan, design, and finance low-emission, climate-resilient infrastructure. The benefits would extend beyond city dwellers to rural populations, since cities are responsible for more than two-thirds of global energy consumption and represent key platforms for collective climate action.

As densely populated areas reliant on constant supplies of fresh water and energy, cities are especially vulnerable to the effects of climate change. Moreover, three-quarters of the world's large cities lie on a coastline, making them especially vulnerable to rising sea levels and extreme weather events.[8] Climate adaptation and resilience-building measures are therefore needed at city level to address mounting risks to vital infrastructure such as water management and sanitation, energy production, transportation, and food systems. Indeed, efforts to mitigate and cope with climate change are already geographically, politically, and financially centred in urban areas.[9]

The 17 sustainable development goals (SDGs) finalised by negotiators from UN member states in September 2015 recognise cities' disproportionate importance in determining tomorrow's world. The SDGs establish an ambitious set of goals, targets, and indicators to inform national agendas and policies through to 2030. While SDG 13 calls for "Urgent action to combat climate change and its impacts", one stand-alone urban objective, SDG 11, challenges world leaders to "Make cities and human settlements inclusive, safe, resilient and sustainable". As cities develop policies to address each SDG, the urban unit itself can become a model of forward-looking, durable development.

A city's infrastructure investments determine its physical characteristics, including whether it is compact or sprawling and resilient or vulnerable to climate change. Creating a sustainable built environment calls for long-term planning and for priority to be given to low-emission, climate-resilient infrastructure. The resulting cleaner air, reduced congestion, healthier people, lower emissions, greater economic activity, increase in jobs, greater social equality, and enhanced security will improve economic, social, and environmental outcomes. The best infrastructure delivers "triple wins" in improved urban development, mitigation, and adaptation.

Achieving this kind of development is a major challenge. Low-emission, climate-resilient infrastructure tends to cost less than alternatives over its lifetime, but can appear more expensive than other options when critical benefits such as emissions reductions are not reflected (or "internalised") in its price. Such infrastructure often requires more capital up front, although some smart investments have low upfront costs but require new ways of thinking about the planning and financing of urban development. Constructed wetlands, bioswales, and rain gardens are prime examples of low-cost, resilience-building developments that use ecosystem services to enhance an area's flood protection, stormwater management, and water quality. Yet these natural features are often overlooked in city budgets, and their benefits are seldom monetised.[10]

Better urban infrastructure calls for novel approaches to financing as well as design and development. Increasing the volume of finance does not go far enough; it is equally important to create an enabling environment for investment and to reduce risk so that financing can flow from a broad spectrum of sources. Public funding can catalyse private investment in climate projects, and all types of financing should be tapped: national government revenues, local taxes, income from public services, and borrowing.

When emerging and developed cities seek access to international financial markets and instruments for

KEY DEFINITIONS

LOW-EMISSION, CLIMATE-RESILIENT INFRASTRUCTURE is defined as transport, energy, water and waste, and telecom projects that are consistent with a 2°C pathway and resilient to the risks of climate change. A 2°C pathway creates a high probability of limiting the average global temperature rise to 2°C (3.6°F) above pre-industrial levels by 2100, and avoids the worst consequences of global climate change.* By contrast, continuing on a business-as-usual (BAU) pathway is likely to lead to a rise in temperature of 4–6°C (7.2–10.8°F) above pre-industrial levels over the same period.

URBAN INFRASTRUCTURE is defined as projects that fall within the physical boundaries of an urban area or are designed to meet the needs of city dwellers and industry, including access to water, electricity and heat, and transport and disposal of waste. Urban infrastructure also includes the management of natural phenomena that affect city dwellers, such as the removal of stormwater and the prevention of coastal inundation. Under this definition, urban infrastructure is not confined to the assets located inside a city itself. For example, a drinking water plant located outside a city would still count as urban infrastructure if it mainly served the needs of the city's inhabitants and industries.

Different institutions define urban infrastructure in different ways (see Appendix B for an analysis). This report seeks to establish a common definition to help meet the need for harmonisation in the way urban climate finance flows are measured.

CLIMATE FINANCE consists of financing flows directed towards mitigation or adaptation activities. Again, different institutions define and track climate finance in different ways. This report uses the MDB-

infrastructure projects, their perceived lack of creditworthiness and high default risk can be a barrier to securing credit. However, cities that employ transparent accounting can overcome this hurdle. As the volume of climate finance grows, cities will need to integrate climate considerations into their infrastructure planning if they are to attract new investment. For their part, financing institutions will need to build climate considerations into their strategies, products, and decision making in order to maximise their returns.

Financing urban climate initiatives represents an immense challenge. The Global Commission on the Economy and Climate suggests that the world will need to invest in roughly $93 trillion of low-emission infrastructure over the next 15 years.[11] More than 70 percent of this investment is likely to be in urban areas or to serve mostly urban dwellers. Yet current infrastructure spending stands at $2.5 trillion to $3 trillion per year: only half the sum needed to reach the commission's total.[12]

There is no time to lose. The infrastructure built now will last for decades, locking in future emissions and determining cities' vulnerability to climate change. As emerging cities in Asia and Africa grow rapidly and the global urban population increases by 70 million people a year, today's infrastructure decisions will ripple out long into the future.[13]

The world faces a series of interrelated challenges. First, past levels of global investment have not been nearly high enough to finance the infrastructure needed to support economic growth and development. Second, even if investments increase, they will lock the world into a high-carbon pathway unless they are channelled into low-emission, climate-resilient infrastructure. Third, financing must provide solutions that are geared specifically to urban areas and are affordable and practical, whether a city is small or large, emerging or developed.

This report examines the factors involved in ensuring that low-emission, climate-resilient infrastructure is financed and built on a sufficient scale over coming decades to address both forecasted urban infrastructure needs and the backlog. It focuses in particular on the use of climate finance, which represents only a fraction of overall investments and therefore needs to be deployed to catalyse the financing of climate-smart infrastructure and encourage new financing sources to be mobilised.

Although much progress has been made in measuring and increasing the flows of climate finance, more must be done. The international community, governments, and the private sector

IDFC's Common Principles for Climate Mitigation Finance Tracking and Common Principles for Climate Change Adaptation Finance Tracking unless otherwise noted.† These principles count as climate finance only the portion of financing that contributes to mitigation or adaptation, rather than the value of the entire project. This segregation of activities is, however, distinct from the notion of incremental costs as applied to climate investments. For example, under this definition, 100 percent of the financing for an urban mass-transit system would qualify as climate finance.

* Corresponds to IPCC RCP2.6.

† Common Principles for Climate Mitigation Finance Tracking, http://www.worldbank.org/content/dam/Worldbank/document/Climate/common-principles-for-climate-mitigation-finance-tracking.pdf; Common Principles for Climate Change Adaptation Finance Tracking, http://www.eib.org/attachments/documents/mdb_idfc_adaptation_common_principles_en.pdf.

must all play their part in the solution. Development capital cannot fill the gap alone, but can catalyse public and private finance and help develop and test innovative mechanisms. Climate finance flows will be essential not only for financing future infrastructure but for greening the infrastructure that already exists.

This report is the first global effort to assess the level of climate-related financing for cities. Intended for a broad audience, including government officials, development groups, and investors of all stripes, the report explores both the demand for financing for low-emission, climate-resilient infrastructure in cities and some elements of supply. Nine development finance institutions were surveyed to collect new data on urban climate finance.

Major barriers to financing low-emission and climate-resilient urban projects are identified in this report. In response to these barriers, the members of Cities Climate Finance Leadership Alliance (CCFLA) have come together for the first time to propose five solutions that could change the financing landscape for urban infrastructure.

DEFINING URBAN AREAS

There is no universal definition of what constitutes a city or urban area; different countries apply different criteria. This report employs the definition of urban population used in the UN's *World Urbanization Prospects* of 2014, which is based on national statistics from population censuses, population registers and administrative statistics.

Cities of fewer than 500,000 people are home to roughly half the world's urban population, and will be responsible for over a quarter of growth in global incomes and around a sixth of growth in greenhouse-gas emissions. The 700 cities with populations of more than 500,000 people account for the rest of the urban population, and will drive the bulk of growth and emissions in the coming years. The 28 megacities of more than ten million people account for one in eight urban dwellers.

Today's fastest-growing cities are medium-sized cities and cities of less than one million people in Asia and Africa. According to UN estimates, almost 90 percent of population growth up to 2050 will take place in these two continents. Solutions for financing low-emission, climate-resilient infrastructure will have to be applicable to and created for these contexts.

Large numbers of city dwellers live in slums or informal communities where residents lack secure tenure of the land or the dwellings they inhabit, neighbourhoods lack basic infrastructure and services, and housing may not comply with planning and building regulations. The UN estimates that slums and informal communities were home to 863 million people—roughly a third of urban dwellers in developing regions—in 2012. Such communities face additional challenges in securing low-emission, climate-resilient infrastructure since they often lack the most basic infrastructure, operate outside legal frameworks, are not formally recognised, and have the greatest challenges in accessing financial markets. Finding solutions for these communities is critical given their prevalence in the developing world and their significance in achieving development goals.*

* The extent to which slums and informal communities are counted in urban population estimates varies by country. For a full discussion, see the UN's World Urbanization Prospects: 2014 Revision.

Sources: G. Floater et al., "Cities and the new climate economy: The transformative role of global urban growth", New Climate Economy Cities Paper 01, LSE Cities, London School of Economics and Political Science; McKinsey Global Institute's Cityscope database; World Urbanization Prospects: 2014 Revision, Highlights (ST/ESA/SER.A/352), United Nations, Department of Economic and Social Affairs, Population Division, 2014

DEMAND FOR URBAN INFRASTRUCTURE

In order to develop a set of practical measures to facilitate the transition towards low-emission, climate-resilient urban infrastructure, it is necessary to understand the additional financing that will be required to support that change. This includes shifting the business-as-usual trajectory of urban investment from high to low carbon and adapting infrastructure to the changing environment. As described below, analysis conducted for this report suggests that global demand for low-emission, climate-resilient urban infrastructure will be in the order of $4.5 trillion to $5.4 trillion annually from 2015 to 2030. This reflects a BAU investment need of $4.1 trillion to $4.3 trillion and additional investment of $0.4 trillion to $1.1 trillion to ensure infrastructure is low emission and climate resilient, representing a premium of 9 to 27 percent.

This report aims to provide an order-of-magnitude estimate of infrastructure investment requirements at the city level, along with an estimate of the infrastructure-related investment needed to shift to a low-carbon scenario over the next 15 years on an annualised basis. It does not aspire to provide a precise estimate or trajectory of investments for the period from 2015 to 2030.

URBAN INFRASTRUCTURE DEMAND

The demand for urban infrastructure will be driven by the growing role that cities play in the global economy. The urban share of the global population is projected to grow from 51 percent today to 66 percent in 2050.[14] The share of global GDP attributable to cities is projected to reach an even higher figure, as they often include the most developed industrial zones and are home to the wealthiest people. Cities account for 82 percent of today's global GDP and will account for an estimated 88 percent by 2025.[15]

Under a business-as-usual scenario, the aggregate urban infrastructure investment demand is in the range of $4.1 to $4.3 trillion per year over the period 2015–30. This suggests that roughly 70 percent of business-as-usual demand for infrastructure is in urban areas. In this scenario, infrastructure will be built with similar emissions and resilience to our current infrastructure stock. The underlying drivers of these estimates are global demand for infrastructure and the urban share of GDP. A key assumption is that infrastructure demand is linked to GDP, as it has been historically. A detailed account of the methodology and sources used in estimating infrastructure demand is provided in Appendix A, section 1.

INFRASTRUCTURE PRODUCTIVITY

Financing requirements for infrastructure are based not only on demand but also on productivity. The estimates of demand in this report assume that infrastructure productivity will remain similar to what we see today. However, productivity could be dramatically improved; using assets more productively decreases costs because it reduces the need to build as much infrastructure in total. The McKinsey Global Institute (MGI) has identified three ways to improve infrastructure productivity:

- Selecting a smarter set of infrastructure projects to meet demand efficiently by avoiding investment in those that do not address clear needs, and also creating synergies, via groups of projects with co-benefits
- Streamlining delivery by investing in the design and planning stages to reduce project changes and delays
- Increasing asset utilisation, improving maintenance planning and using measures to manage demand for existing assets

According to MGI, implementing these steps could in theory reduce required outlays by 40 percent. The estimates in this report do not account for such radical changes in productivity, although the building of

compact, connected cities included in some estimates does share some of these characteristics.

It is worth noting that it is possible to over-invest in infrastructure, especially if existing infrastructure is failing to meet demand efficiently. In fact, some countries or regions have more physical infrastructure than they need. In such cases, building more creates little marginal value, and the priority should shift to raising productivity.

Sources: *Infrastructure Productivity: How to save $1 trillion a year,* McKinsey & Company, January 2013; Adrian Blundell-Wignall and Caroline Roulet, "Infrastructure versus other investments in the global economy and stagnation hypotheses: What do company data tell us?", 2014, http://www.oecd.org/finance/Infrastructure-versus-other-investments-Global-economy-Stagnation-hypotheses.pdf

INFRASTRUCTURE DEMAND IN LOW-EMISSION SCENARIOS

A key question underlying the debate on climate change is how much it would cost to build infrastructure that mitigates green-house gas (GHG) emissions. This report draws on multiple sources to triangulate the magnitude of investments required for low-emission infrastructure to meet global needs. This estimate does not include the additional cost of making infrastructure resilient, which is addressed in the next section. (Even so, planning, design, and project finance solutions do need to address mitigation and adaptation simultaneously.)

Although it is helpful to understand the implications of low-emission infrastructure on upfront capital requirements, the additional capital involved is highly intertwined with the full project costs. Moreover, this additional capital is not necessarily relevant to investors, who typically evaluate the full project finance requirements. Further, the value of the opportunity for building capabilities in investing and constructing low-emission infrastructure is the full value of the infrastructure affected, not just the incremental cost of a low-emission project.

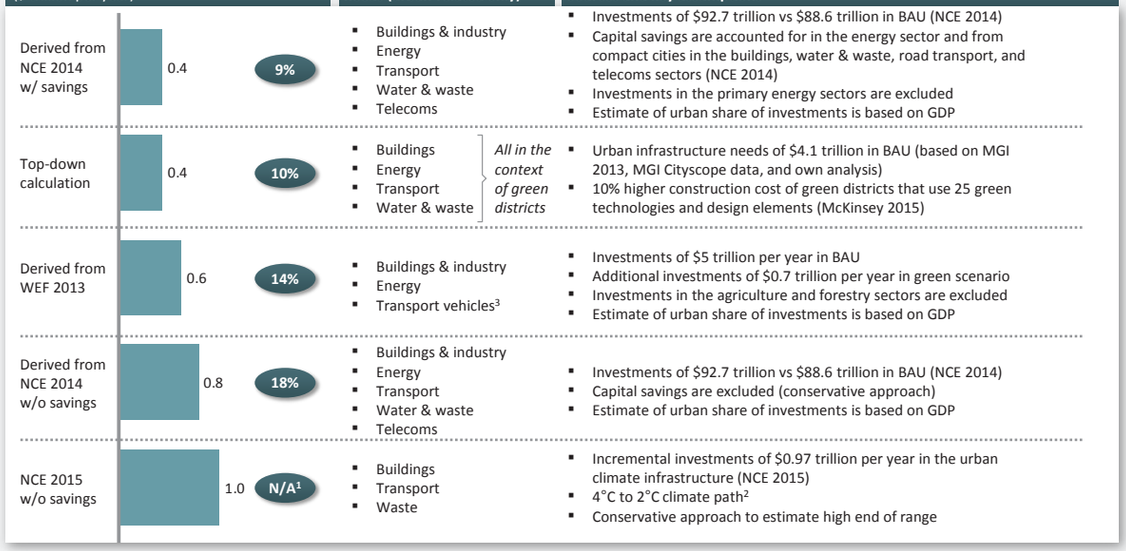
In this report, the demand for financing of urban infrastructure to ensure a shift to a low-emissions scenario is estimated to be in the range of $0.4 trillion to $1.0 trillion per annum. This would be an incremental cost in addition to the BAU investment required, and represents a 9 to 27 percent premium over the BAU estimates of $4.1 trillion to $4.3 trillion of annual investment in urban infrastructure (Exhibit 1). This estimate covers only the upfront capital required and does not include lifetime savings. Studies such as those conducted by the Global Commission on the Economy and Climate show that, over its lifetime, low-emission infrastructure costs less and has numerous non-monetised benefits.[16] A detailed explanation of the assumptions and calculations underlying this estimate can be found in Appendix A.

Estimates of infrastructure demand vary considerably because of differences in methodology and assumptions, which is why this report draws on multiple estimates to triangulate a range. There are three main reasons for the differences in these estimates, as explained in Appendix A, section 3.

First, different estimates make different assumptions about the business-as-usual pathway. This is important because the cost of a low-emission pathway is based on the size of the shift required between a continuation of the current course of action (BAU) and a low-emission pathway. All sources define the low-emission pathway as the 2°C pathway, which would be likely to limit global average temperature rises to 2°C above pre-industrial levels by 2100. Most sources define the BAU scenario as a 6°C rise in temperatures over the same period. However, the New Climate Economy (NCE) 2015 estimates use a 4°C rise as their baseline even though reaching that scenario would already require changes from the current state; this suggests that the real incremental investment needed could be even higher than the estimate.

Exhibit 1: Comparison of estimates for low-emission infrastructure

X Increase over business as usual (BAU), %



1 NCE 2015 does not estimate total investment needs in business as usual.
2 Despite using 4°C rather than 6°C as a baseline, NCE 2015 makes more conservative assumptions on incremental climate infrastructure costs.
3 WEF incremental investments analysis also includes the forestry sector, which is not applicable to cities.

Sources: Estimates were adapted with additional analysis from: *Infrastructure Productivity: How to save $1 trillion a year*, McKinsey & Company, January 2013; MGI Cityscope data; Shannon Bouton *et al.*, "Building the cities of the future with green districts", McKinsey & Company, May 2015; *Green Investment Report*, WEF, 2013; *Better Growth, Better Climate*, The New Climate Economy: The Global Commission on the Economy and Climate, 2014; *Seizing the Global Opportunity*, The New Climate Economy: The Global Commission on the Economy and Climate, 2015; "Energy technology perspectives", International Energy Agency, 2012–15

Second, these estimates define infrastructure in different ways, so affecting the cost estimates. For example, NCE takes the energy sector into account in its 2014 report *Better Growth, Better Climate*, but does not include it in its 2015 report *Accelerating Low-Carbon Development in the World's Cities*. Moreover, the definitions of sector infrastructure vary from one source to another. For example, some sources consider that energy-sector infrastructure includes oil and gas upstream and refining infrastructure and power- and heat-generating assets, while others do not.

Third, some estimates are more conservative than others in their assumptions about the capital savings that result from low-emission infrastructure. As would be expected, the estimates at the low end of the range assume greater capital savings from low-emission infrastructure than estimates at the high end of the range. Estimates from NCE's 2015 report *Seizing the Global Opportunity* are at the high end of the range, with incremental demand for urban climate infrastructure of $1 trillion per year. This is largely because the report's highly conservative assumptions do not account for avoided costs (such as vehicle purchases forgone because of investment in public transport) or savings in capital expenditure from more compact urban growth.

ADAPTATION

As the climate changes, city infrastructure will have to adapt to new conditions and risks. It will be essential to estimate and finance the cost of this adaptation. For the purposes of this report, World Bank estimates have been used to illustrate the scale of demand. The World Bank has drawn on two different climate models based on differing levels of precipitation, one extremely dry and one extremely

INVESTING IN COMPACT AND CONNECTED CITIES

Compact and connected cities illustrate how a coordinated investment in low-emission infrastructure can be translated into investment decisions on the ground. According to the New Climate Economy's 2014 report *Better Growth, Better Climate*, a shift to more coordinated, compact urban development could reduce infrastructure capital requirements by more than $3 trillion (or $200 billion a year) over the next 15 years and significantly reduce emissions largely by limiting urban sprawl and the additional infrastructure it requires. For example, denser transit-oriented city planning can reduce the amount of road infrastructure required.

Building more compact, connected cities can also result in social and environmental benefits not fully captured in the estimate. For instance, better road systems that reduce congestion, allow for carpooling, or reduce the number of vehicles on the road can improve air quality, thus driving healthcare savings as citizens breathe less polluted air. To realise such benefits, countries would need to place urban development at the centre of their economic development strategies.

NCE's review of recent studies performed in the United Kingdom, India, Peru, Malaysia, and Indonesia reveal many opportunities for coordinated investments that can produce climate benefits and reduce the lifetime costs of urban infrastructure. Urban investments in more-efficient vehicles, transport systems, buildings, and small-scale renewables could together reduce energy use and greenhouse gas emissions by 13 to 26 percent relative to BAU over ten years. The upfront cost of these investments would be recovered through savings in less than five years.

Source: Chapter 2, "Cities", *Better Growth, Better Climate*, The New Climate Economy: The Global Commission on the Economy and Climate, 2014, http://2014.newclimateeconomy.report/

wet. Both scenarios consider the additional investment needed to provide the same quality of infrastructure services with a 2°C temperature increase over pre-industrial levels by 2050,[17] and calculate the average annual sums required to meet the adaptation need from 2010 to 2050. The full methodology for these estimates can be found in the World Bank discussion paper "The costs of adapting to climate change for infrastructure".[18]

World Bank research suggests the capital costs required for adaptation infrastructure are $21 billion to $37 billion per year,[19] of which $11 billion to $20 billion is for urban infrastructure.[20] These estimates cannot be added directly to the low-emission figures because they are based on different climate assumptions, year ranges, and assumptions about baseline demand for total and urban infrastructure.

A 2014 review of adaptation costs from the United Nations Environment Programme estimated that global climate-change adaptation costs would be roughly $150 billion annually by 2025–30 if global warming were to be limited to 2°C above pre-industrial levels. (Greater increases in temperature would increase the adaptation costs.)[21] These estimates include urban and non-urban areas and infrastructure, as well as other investments such as landscape restoration and local capacity-building programmes. However, if we were to employ the assumption developed by the World Bank on the basis of its own methodology in 2010, which estimated that up to 80 percent of adaptation costs over the period 2010–50 would be in urban areas, the estimated adaptation costs would be $120 billion per year by 2025–30.[22] This figure represents the cost of all urban adaptation rather than urban infrastructure alone, yet it suggests that the real infrastructure costs are likely to be higher than World Bank estimates.

SUPPLY OF URBAN CLIMATE FINANCE

Estimating the global supply of urban climate finance is subject to a number of challenges. Gaps in urban data mean that a concrete figure for the supply of climate finance in cities has yet to be established. A goal of this inaugural report from the CCFLA is to shed light on these gaps and set in motion more robust and harmonised practices for recording, tagging, and sharing project-level data for urban climate finance initiatives.

This report uses a snapshot of data from nine development bank partners to gain a better understanding of existing sources of climate finance. Together, these nine institutions accounted for more than $54 billion in climate financing in 2014 (see the section "Deep dive: Development bank urban climate finance" on page 20). Many of these institutions follow the MDB-IDFC's Common Principles, which is a first step towards the harmonisation of climate data globally.[23]

This report uses the best of the limited data available to provide insights into the scale of urban infrastructure climate finance. It has gathered new data from development banks to establish the scale of flows, the sectors receiving financing, and the instruments used.

In addition to development finance flows, increasing financing for low-emission, climate-resilient infrastructure in cities will require coordinated efforts by governments, development banks, and private-sector actors. Ensuring that a large part of urban infrastructure built over the next decades is low emission and climate resilient requires more than just mobilising additional financing equal to the incremental cost of this infrastructure.

International and development finance can have a catalytic effect in driving financing towards climate-smart infrastructure in cities, but the amount needed to close the global urban infrastructure gap and make that infrastructure sustainable will also require policy support from local and national governments, the bringing of climate objectives into the mainstream within local financial institutions and the involvement of private investors beyond direct contributions to project costs. The question of how to distribute climate finance between projects and use it in the most efficient way to achieve the best results at scale is critical, and goes beyond the quantitative analyses of the supply of climate finance laid out in this report.

All the same, the recording of urban climate finance data will dramatically improve our understanding of the landscape and help decision makers reflect on the deployment of investment in sectors and geographies with the most pressing needs. Many institutions have already begun to apply urban tags to project-level data. As this process becomes more standardised, more robust and comparable data will become available to deepen our understanding of the financing landscape and of the ways to deploy climate finance at scale in the most efficient way.

GLOBAL CLIMATE FINANCE FLOWS

The Climate Policy Initiative (CPI) estimates that tracked global finance for climate mitigation and adaptation reached $331 billion in 2013.[24] CPI defines climate finance as capital flows directed towards emission reductions, climate resilience, and the development and implementation of enabling policies. It acknowledges that major gaps in data continue to impede its analysis.

The CPI data reveals that mitigation projects, defined as activities that promote "efforts to reduce or limit greenhouse gas (GHG) emissions or enhance GHG sequestration", received 91 percent of tracked climate finance in 2013, while only 7 percent went towards adaptation (this ratio may be slightly overstated because CPI does not capture private adaptation flows).[25] This imbalance is not surprising since many mitigation projects now have proven business cases, particularly in the field of renewable energy, and have become more familiar to investors.

It is commonly assumed that climate finance is primarily concessionary or motivated by social and environmental goals, yet 75 percent took the form

of commercial financing through balance sheets, commercial-rate loans, and equity. This is largely because 78 percent of the 2013 mitigation finance tracked by CPI was invested in renewable energy, which now has a proven business case and is often developed via independent power producer (IPP) programmes involving private developers. Only 25 percent of climate finance came from grants, below-market-rate loans, and other forms of concessionary finance. As a result, even if the volume of climate finance grows, there could still be a shortfall for important projects that do not generate commercial returns, posing a particular challenge for cities that may struggle to pay market rates for loans.

Cities in developing countries in particular have difficulty obtaining commercial financing and gaining access to international credit markets. In fact, of the 500 largest cities in emerging economies, only 4 percent are deemed creditworthy in international markets.[26] Demand and supply for commercial and sub-commercial rate finance vary by region and development context. The 75:25 percent split taken from CPI data may not hold across all regions and economies.

When CPI estimates are interpreted in an urban context, they may understate certain sectors because of a lack of available data. For instance, the data used for this analysis did not include private investments in energy efficiency, which are heavily concentrated in urban areas but difficult to capture due to current data limitations. Gaps in the tracking of project-level data make it necessary to adjust this estimate to gain a fuller picture of global climate finance. First, the only private investment captured in the estimate is from the renewable energy sector, with investments valued at $191 billion. CPI estimates a further $100 billion to $330 billion a year comes from private investments in energy efficiency, and another $10 billion from private investments in forestry and land use.[27] Second, the CPI data does not capture private investments in climate-relevant transport or adaptation projects. Third, the data does not capture investments from governments' domestic public budgets, which CPI estimates at $60 billion for 2013.

CPI provides data on public adaptation financing estimated at $25 billion. Other estimates give further details on available funds. Based on OECD-DAC estimates, the IPCC measured the proportion of bilateral official development aid (ODA) focused on urban adaptation at 20 percent of bilateral climate adaptation portfolios, equivalent to $0.65 billion to $1.6 billion per annum. These measurements were made on average for 2010–11.[28] Defining the scope of adaptation activities remains a principal challenge in tracking and recording this data.[29] A recent mapping exercise by CDC Climate found that most tracked initiatives foster adaptation as risk-reduction measures. These can include actions such as capacity building and vulnerability reduction that seek to improve preparedness for current threats. The exercise indicated that chronic stress induced by climate change was less often included in the scope of adaptation interventions.[30]

URBAN CLIMATE FINANCE FLOWS

As yet there is no centralised repository for data on urban climate finance flows. Some actions have been taken to capture and record this data, but efforts have been hindered by a lack of agreement on what constitutes "urban" and "urban climate finance". Estimating the global supply of urban climate finance is therefore subject to a number of challenges such as the boundaries of urban projects. Some institutions consider only those assets located within city boundaries as urban infrastructure, while others argue that assets outside city boundaries that serve municipal-level objectives should also be included. This latter approach requires a degree of subjective expert judgment to identify and record infrastructure assets serving primarily urban needs.

The definition of urban climate finance used in this study is "investments in infrastructure and broader climate-related initiatives that contribute to low-carbon urban development or urban resilience". Such definition covers projects that fall within the physical boundaries of an urban area or are

designed to meet the needs of city dwellers and industry, including access to water, electricity and heat, transport, and disposal of waste.

Institutions contributing data to this report were asked to follow this definition, but some reported only projects taking place within city boundaries because of time and data constraints. It is therefore likely that the urban climate estimates in this report may be understated.

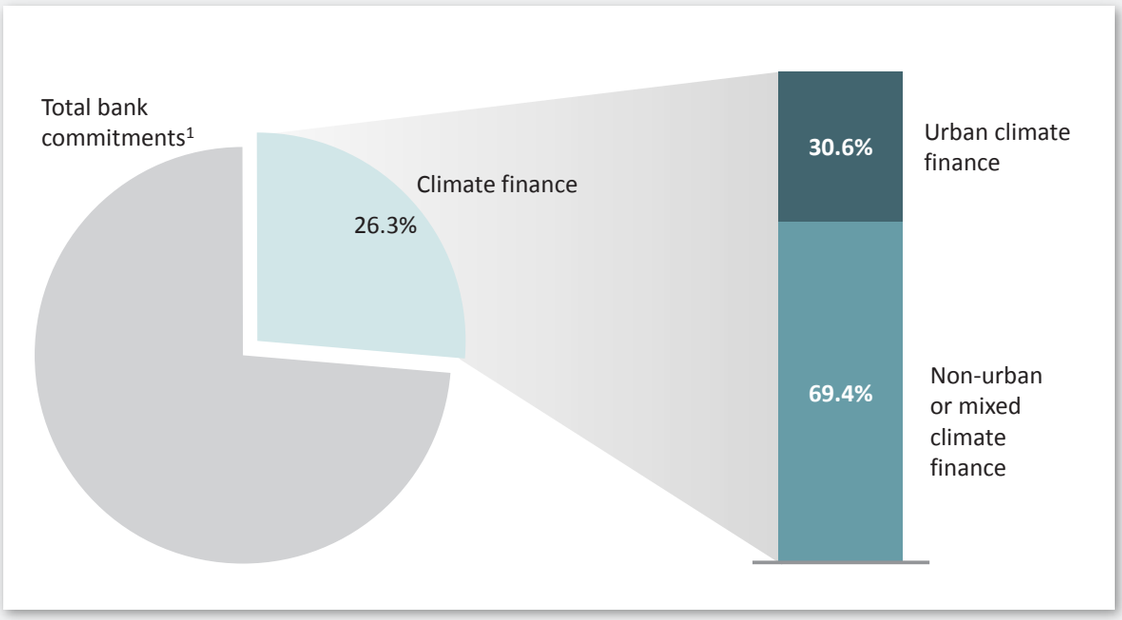
DEEP DIVE: DEVELOPMENT BANK URBAN CLIMATE FINANCE

To provide initial insights for this report, a survey of urban climate finance activity by development banks was carried out. Nine institutions[31] provided data on recent low-emission, climate-resilient infrastructure projects in and around urban areas.

The institutions contributing to our analyses followed their own tracking methodology, which was aligned with the MDB-IDFC's Common Principles for Climate Mitigation Finance Tracking and Common Principles for Climate Change Adaptation Finance Tracking.[32] These principles employ an activity-based assessment of projects and count as climate finance only those components that contribute directly or indirectly to reducing emissions or enhancing resilience. An "activity" can be a project, project component, or proportion of a project.[33] It is important to note that the Common Principles do not define "urban" climate finance, so there is some variability in the approaches taken by individual institutions. An explanation of methodological differences can be found in Appendix B.

The nine institutions surveyed accounted for more than $221 billion in total financial commitments

Exhibit 2: Snapshot of urban climate finance in 2014



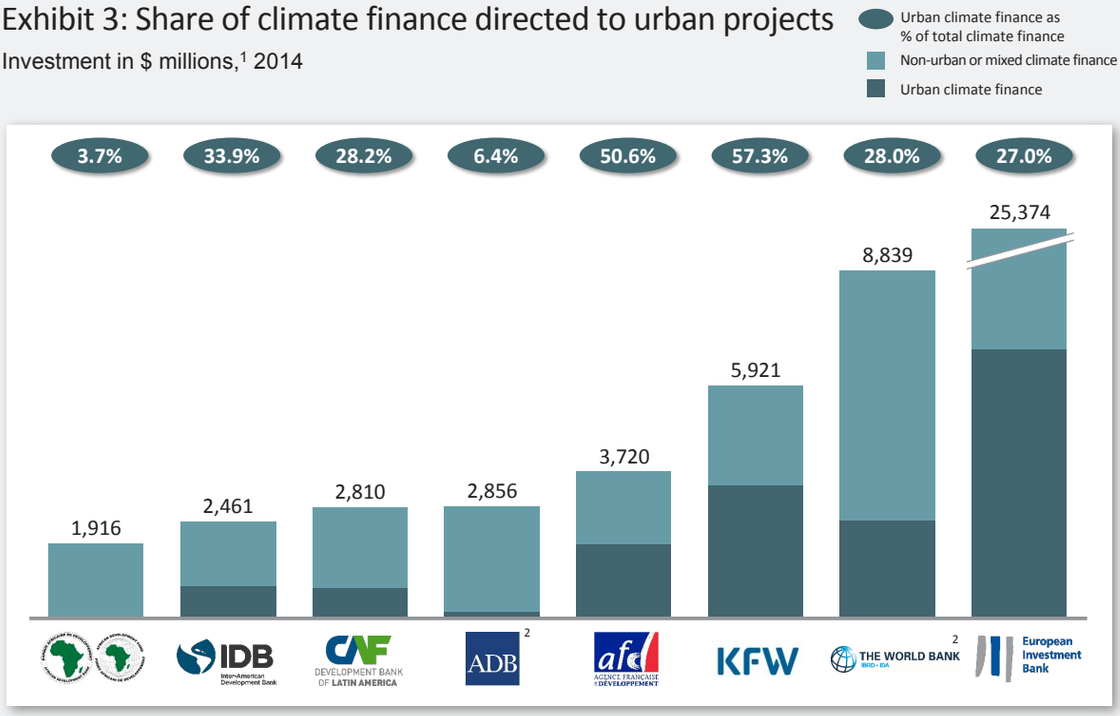
1 Based on data provided by Asia Development Bank, Agence Française de Développement, Africa Development Bank, CAF Development Bank of Latin America, Inter-American Development Bank, Japan International Cooperation Agency, KfW Development Bank, and World Bank. JICA figures represent total disbursements rather than approvals/commitments; JICA is not included in the total bank climate figure as it did not provide data.

in 2014. Overall climate finance flows from the eight institutions that reported total climate finance figures were just under $54 billion,[34] representing 27 percent of these banks' total commitments (Exhibit 2).[35] Although this survey was not comprehensive, it is likely to be fairly representative of multilateral and bilateral development finance institution (DFI) flows. The total volume of climate finance identified in our survey was just below the total of $57 billion captured by CPI for multilateral and bilateral DFIs in 2013.[36]

The nine participating institutions identified $19 billion in urban climate finance.[37] (This number is not directly comparable to the $54 billion in total climate finance from DFIs as that figure does not include data from the Japan International Cooperation Agency, for which total 2014 climate finance figures were not available.) Urban climate finance comprised 31 percent of total climate finance on average for the institutions providing this data.[38] Appendix B provides a detailed methodology.

Exhibit 3: Share of climate finance directed to urban projects

Investment in $ millions,[1] 2014

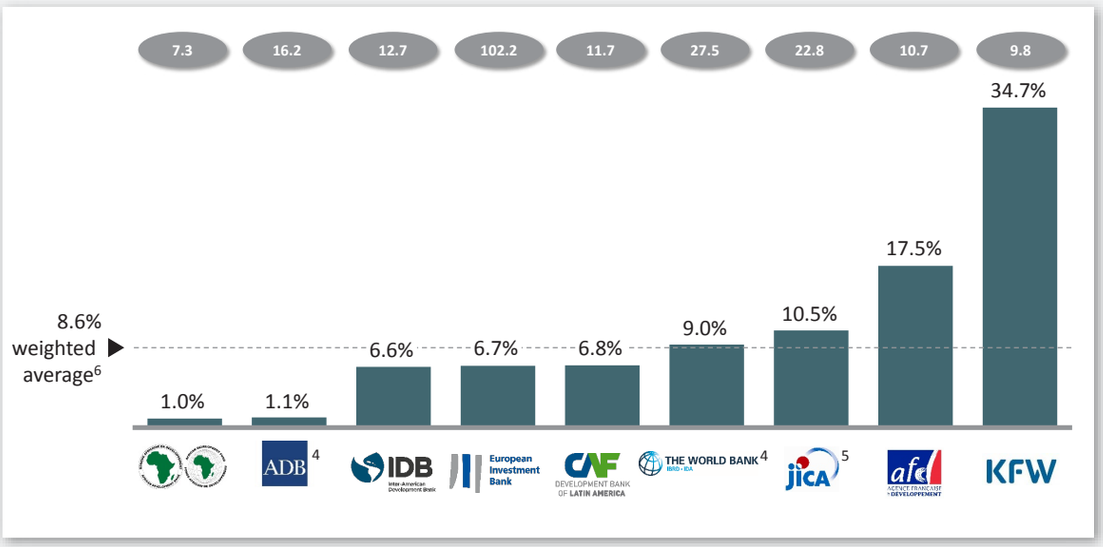


1 Other currency amounts converted to US dollars using average annual exchange rates for 2014.
2 ADB and WB include as "urban" only projects taking place within the geographic boundaries of urban areas.

On average, urban climate finance represents 9 percent of overall bank financing commitments.[39] However, this figure may under-represent the amount of climate financing actually flowing to cities as some institutions took a conservative approach in reporting urban climate finance data and provided data only on projects taking place within the geographic boundaries of urban areas.[40] A simple average of the proportion of total commitments going towards urban climate across institutions reveals that banks typically allocate around 10 percent of total financing to urban climate initiatives.[41] The weighted average is lower as institutions providing the largest volume of overall climate financing tended to allocate a lower proportion of that financing to urban climate (Exhibit 4).

Exhibit 4: Share of development bank capital directed to urban climate finance

2014, %

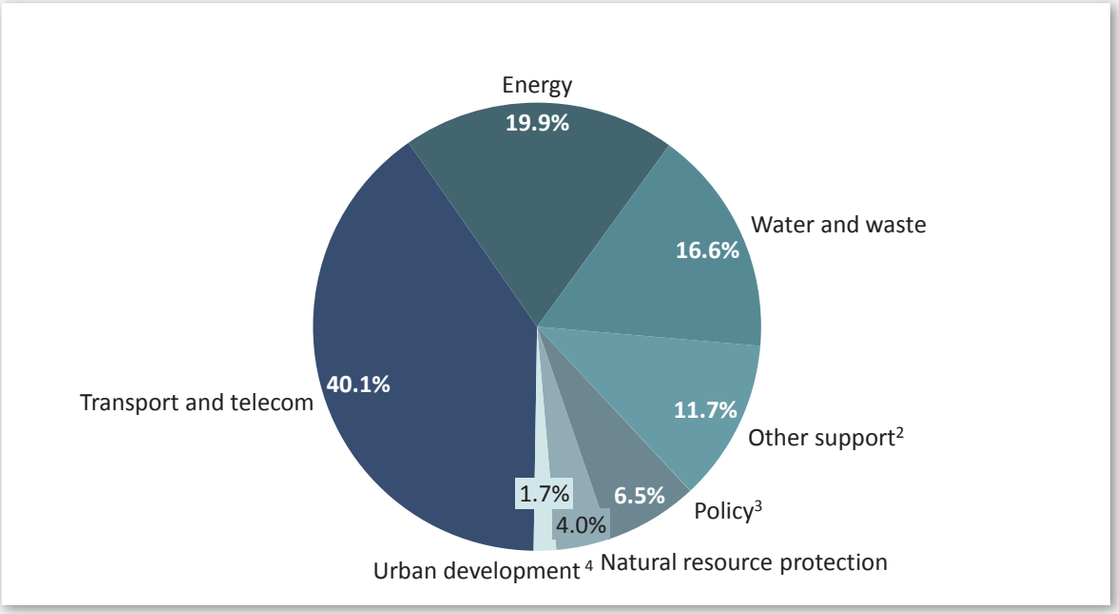


1 Total urban climate figures reported by each institution or calculated as a sum of reported urban mitigation and urban adaptation finance.
2 Total bank commitments sourced from 2014 annual reports; ADB provided an amended number which excludes financing not directly administered by ADB.
3 Calculations based on totals in US dollars; currency conversions made using average exchange rates for calendar year 2014.
4 ADB and WB include as "urban" only projects taking place within the geographic boundaries of urban areas.
5 JICA totals reflect total disbursements rather than approvals/commitments.
6 Weighted average of urban climate finance as % of total bank commitments across the nine DFIs.

Within the banks' total investment in urban climate finance in 2014, 72 percent went to urban mitigation and 28 percent to urban adaptation.[42] Regional data were not available from all institutions so no attempt was made to explore this split from a regional perspective.

SECTORS. At the sector level, some common themes emerge from the snapshot of data compiled for this report. More than 76 percent of urban climate finance from these institutions was directed to transport, energy, and water and waste in 2014 (Exhibit 5).[43] Sector groupings are largely based on the data received from surveyed institutions. Some institutions did not disaggregate transport and telecom, so the two have been grouped together for the purposes of this analysis, although the majority of investment is in transport.

Exhibit 5: Breakdown of urban climate finance by sector, 2014[1]



1 Estimates based on aggregated data from ADB, AFD, CAF, IDB, JICA, KfW, AfDB, WB (IBRD and IDA only); may not add up to 100% due to rounding or differences in reporting methodologies across institutions.
2 Includes education, technical cooperation, agriculture, non-identified items, and other items that may not directly affect infrastructure.
3 Includes democracy, civil society, and public administration.
4 includes sustainable economic development.

Most urban mitigation finance went to transport and energy-efficiency projects, perhaps because these sectors have emerging models that allow the recovery of upfront capital costs and are well aligned with urban priorities.[44] Energy-efficiency projects yield savings in total cost of ownership, and many programmes exist to capture these savings, such as the property assessed clean energy (PACE) programme in the United States and energy-savings performance contracting (ESPC) used by agencies in the United States, Europe, and Asia. In transport and telecom, end-user charges such as bus and subway fares generate revenue streams to pay back investments. Some 45 percent of urban adaptation was concentrated in water and waste projects, perhaps because the effects of climate change have visibly manifested themselves in rising sea levels and increased the frequency and intensity of extreme precipitation events.[45]

Instruments. For the eight institutions that reported data on urban climate finance instruments, 81 percent was in the form of commercial-rate and sub-commercial-rate loans; 5 percent was in the form of grants; and 2 percent was in the form of financial intermediation.[46] A small proportion of reported financing (more than 1 percent) was earmarked for technical cooperation initiatives such as education and capacity building, which can be reimbursable or non-reimbursable. The remaining 12 percent of captured flows could not be identified by instrument. Grants made up a higher proportion of captured finance for adaptation (9 percent) than mitigation (3 percent).[47] This finding may indicate that urban adaptation projects require more concessionary financing or that donors are more inclined to give it to these projects. It may also reflect the tendency to direct development finance towards low-income, low-emission countries where mitigation opportunities are limited but adaptation is a priority.

THE URBAN CLIMATE FINANCE GAP

The gap between supply of and demand for urban climate finance should be seen in the light of the overall backlog in urban infrastructure so that consideration can be given to measures to make that infrastructure low emission and climate resilient. The Global Commission on the Economy and Climate's New Climate Economy report of 2014 estimates that global demand for urban infrastructure will exceed $89 trillion between 2015 and 2030.[48] It estimates that a further $4.1 trillion will need to be spent to make that infrastructure low emission and climate resilient, representing a 5 percent increase in upfront capital.[49] Financing the backlog of urban infrastructure needs and ensuring that infrastructure is low emission and climate resilient will be no small feat. The role of climate finance must be seen against this backdrop.

The ability of cities to finance urban infrastructure is based on their budgets and creditworthiness; their ability to exploit existing assets in order to finance new ones; their ability to access regional or national government funding streams; and their access to capital markets and private finance.[50] These constraints are important for multiple players that determine the overall urban finance landscape, including local authorities, households, utilities, and other private companies. In practice, much of the $93 trillion in global infrastructure demand may be financed by local sources: national governments, fiscal transfers, local commercial finance markets, or local financial institutions. While international institutions and DFIs have made significant strides in channelling finance to low-emission, climate-resilient infrastructure, the scale of the gap for climate-relevant urban infrastructure commands attention from a spectrum of investors including governments, development banks, and private corporations and financial institutions. It will be important to identify how best to deploy limited amounts of DFI capital to ensure it is as catalytic as possible in driving investment for low-emission, climate-resilient urban infrastructure. In addition to contributing directly to project funding, it can be applied to help shape enabling environments that support infrastructure investment from a range of investors.

The analysis conducted for this report indicates that $4.1 trillion to $4.3 trillion will need to be spent on urban infrastructure per year merely to keep up with projected growth in a business-as-usual scenario. An incremental 9 to 27 percent ($0.4 trillion to $1.1 trillion) will be needed to make this urban infrastructure low emission and climate resilient. With CPI's tracked climate finance (urban and non-urban) totalling just $331 billion, it is reasonable to assume that the gap for urban climate finance is large.[51] Even if every dollar of this finance were directed to urban areas, it would still not be enough to match the most conservative estimates of incremental investment required for low-emission, climate-resilient infrastructure.

Numerous data constraints mean that our supply and incremental cost estimates cannot be directly compared following a supply/demand approach. The supply numbers largely apply to total project costs rather than the incremental costs over a BAU scenario required to make infrastructure sustainable. This distinction may be less relevant to projects such as energy-efficiency retrofits, whose costs are in theory 100 percent incremental since they are above and beyond the BAU alternative, but it becomes important in new-build construction projects. A large portion of the supply analysis comprises total project costs for renewable energy projects. To compare these to the incremental demand estimates, it would be necessary to know how much more capital a renewable energy project requires than its high-carbon alternative. The same caveat applies to sectors such as urban transport.

Moreover, data indicates that approximately 75 percent of climate finance comes at commercial rates. While this form of financing works for projects with proven payback models, many critical low-emission, climate-resilient infrastructure projects do not provide adequate returns to support market-rate financing in the current policy environment.[52] Financing such

infrastructure may require not only an increase in the volume of climate finance, but also an increase in the share that is concessionary.

Lastly, our analysis reveals that more than 70 percent of climate finance from surveyed development banks goes towards mitigation projects that focus on energy and transport and telecom. Nearly half of development bank climate financing that flows to adaptation projects goes to water and waste projects. The higher proportion of finance flowing to mitigation projects may reflect the fact that mitigation projects have more proven funding models to help financing (for instance, paying for energy-efficiency upgrades through total-cost-of-ownership savings). This suggests there is a need for innovative instruments and mechanisms to help improve the risk/return profiles of low-emission, climate-resilient infrastructure.

CHALLENGES IN FINANCING LOW-EMISSION, CLIMATE-RESILIENT URBAN INFRASTRUCTURE

Although the need for additional urban infrastructure financing is clear, there are a number of persistent challenges. This report focuses on some of the major barriers that prevent cities from securing investment in low-emission, climate-resilient urban infrastructure, and from planning, developing, financing, executing, and operating it.

Actions must be taken to unlock investment for global infrastructure in general by tackling challenges such as market and policy failures that lead to inadequate public investment and planning, risks to sovereign policies that affect the economics of infrastructure projects, lack of capacity among project developers, and lack of incentives for private financiers. However, the focus of this report is on barriers that hinder urban climate finance in particular.

In identifying barriers to investment, this report focuses on those that affect a variety of investor types (banks, insurance companies, multilateral development banks, pension funds, and sovereign wealth funds); hinder investment across the project lifecycle from initial planning to operation and maintenance; and concern both the supply and the demand sides of the equation. Focus groups, expert interviews, and a broad literature review were conducted, and CCFLA members used this input along with their own expertise and experience to arrive at a set of barriers, taking into account challenges to climate finance in general as well as city climate finance in particular.

Municipalities face a number of challenges that impede their ability to obtain financing for a plethora of developmental objectives. First, many cities are not perceived as creditworthy, particularly in developing countries.[53] This perception may be driven by cities' lack of control over budgets or their inability to collect taxes and other revenues at the municipal level. Unable to obtain debt financing on international markets, many cities must rely on local financial institutions that may or may not have the capacity to help them finance large-scale infrastructure projects.

Existing frameworks for international climate finance primarily focus on the national rather than municipal level.[54] As a result, many cities regard this finance as insufficient and too complicated to be a feasible option given limited staff capacity.[55] In addition, many investors have limited experience of lending to sub-national entities, which can add to the perceived risks involved in municipal finance.[56]

Climate finance itself faces many risks and challenges, including the need to finance rapidly evolving and sometimes unproven technologies. This evolution also carries the risk that investments will become outdated or obsolete if assets incorporating new technologies are designed to last for decades. The rapid change in climate-relevant technologies and the policies governing them also creates risks for investors who may rely on regulations such as tax breaks or subsidies to make their climate investments economic.

This report focuses on areas where the risks and challenges associated with city finance meet those of climate finance, in the hope that it will shed light on the areas with the most acute need that will benefit from the attention of policy makers, development finance institutions, and private investors alike. The report recognises that not all challenges will be equally relevant for every city and development context, but focuses on barriers that affect cities from a broad range of economic and geographic contexts. Understanding these barriers is essential to understanding the gaps in urban climate finance and the measures needed to close them. Some of these barriers mainly affect private investors, while others present challenges for development banks and public-sector institutions as well.

Six key barriers were identified, and they fall into three major categories:

REGULATION AND GOVERNANCE

1. Uncertainty over regulatory and tax policies that affect low-emission, climate-resilient infrastructure

INFRASTRUCTURE PLANNING

2. Difficulty in incorporating climate goals into urban infrastructure planning
3. Lack of city expertise in developing low-emission, climate-resilient infrastructure projects that attract financing
4. Insufficient city control over infrastructure planning and complex stakeholder coordination

FINANCIAL PREPARATION

5. High transaction costs for low-emission, climate-resilient infrastructure in cities
6. Lack of proven funding models for low-emission, climate-resilient infrastructure at the city level

Each of the barriers is further complicated by gaps in data collection, transparency, and consistency in relation to low-emission, climate-resilient infrastructure. The lack of robust and credible data leads to even greater uncertainty over regulation and governance, while an absence of clear models and outcome data makes infrastructure planning more complicated. Similarly, deficiencies in established data on transaction costs and financial returns makes financial preparation more difficult. Finally, the lack of consistent and publicly available reports on emissions-reduction and resilience targets inhibits cities' ability to present needs-driven financing cases to investors.

Global initiatives are responding to these challenges with solutions, such as the Compact of Mayors, the Covenant of Mayors, CDP cities reporting programme, ICLEI's carbon*n* platform and the new ISO standard for sustainable cities.[57] This report recommends that cities join and use these new global platforms, as standardised data will help them to secure their financing needs. Establishing better data collection and reporting, which is one of the aims of the CCFLA, will also be helpful in overcoming the barriers below.

1. Uncertainty over regulatory and tax policies that affect low-emission, climate-resilient infrastructure may prevent prospective investors from forecasting project economics accurately and thus deter investments. In particular, shifts in national, state, regional, or city-level climate policies—such as carbon-emissions taxes, energy-efficiency incentives, or fossil-fuel subsidies—could change the economics of a project over the course of its development. Although public-sector financiers may be prepared to work in such environments, private-sector investors are often wary of the heightened risks associated with policy uncertainty. Private-sector reluctance also dampens investment from public institutions and development banks, which often employ public-private partnership (PPP) agreements or co-financing arrangements with private-sector investors.

Risk sensitivity is especially problematic when it comes to attracting private finance to cities in developing countries, where there are often higher levels of uncertainty over policies that influence the economics of investing in low-emission, climate-resilient infrastructure, such as tax subsidies. Although similar issues affect cities in developed countries, the perceived risk of policy instability tends to be higher for developing countries, making it more difficult to attract public and private finance to cities in these countries. Some countries also have weaker regulatory and investment frameworks for public/private investments, private property rights, and foreign investment compacts, which compounds the problem.[58]

Investors' general inexperience in investing in emerging regions and lack of familiarity with local policy and business environments puts cities in developing countries at a further disadvantage. This lack of experience pushes up transaction costs, as investors need to perform extra diligence to familiarise themselves with the relevant investment

environment and expect higher returns to compensate them for perceived higher risks.

2. Difficulty in incorporating climate goals into urban infrastructure planning often means that climate-related projects are given lower priority than initiatives that address shorter-term needs, such as investments in education, healthcare, and public safety. Political leaders must balance infrastructure investments that may not pay off during their term in office with the challenges that new developments may pose, such as disruptions during construction, impact on local employment and real-estate prices, and fears about changes in the price or quality of services.[59]

The development of low-emission, climate-resilient projects needs to be synchronised with city planning at large, with climate goals and priorities syndicated with and incorporated into multiple agencies and functions. Emissions are not only embedded in infrastructure but driven by infrastructure use. A classic example is the influence of spatial and transportation planning on mobility and its associated emissions.

Climate commitments at city, state, and regional levels may not align with or find support from national targets. The lack of agreed standards for what constitutes low-emission, climate-resilient infrastructure also complicates project design and planning. Some cities may lack technical expertise and experience of incorporating climate-performance indicators into requests for proposals for new projects. These challenges are complicated by a lack of consensus on which indicators should be used, particularly for climate-resilience projects. When clear and measurable performance indicators are incorporated, city officials and developers must prioritise performance tracking, which may require additional investment. The Kronsberg district of Germany, for instance, invested in a quality-assurance programme to ensure that developers would meet sustainable building and construction standards and enlisted green construction experts and quality inspectors to help track project performance. This monitoring incurred extra costs that were funded by subsidies from the district and the European Union.

Developing low-emission, climate-resilient infrastructure can cost an extra 5 to 10 percent or more in upfront capital expenditure.[60] City planners and developers may find this upfront investment difficult to justify given the time it takes for many projects to pay off. Investments in energy efficiency, for example, can increase construction costs, although they reduce operating costs, thereby reducing the total cost of ownership. Consumers are often unwilling to pay the increased upfront costs. At the same time, many developers' business models focus on selling while projects are still under construction, negating "build, operate, transfer" approaches that could allow recovery of upfront capital expenditures.

Other types of low-emission, climate-resilient infrastructure cost more over their lifetime because benefits such as lower carbon emissions, cleaner air, and increased resilience are not accounted for—this is unlikely to change until externalities are properly priced. Failing this, cities may need to make climate goals a priority and require developers to meet them. Establishing clear climate goals is particularly important for many essential adaptation projects that may not be "bankable" in the traditional sense but could attract investment if prioritised.

3. Lack of city expertise in developing low-emission, climate-resilient infrastructure projects that can attract financing can hinder the development of new projects. Cities develop fewer projects than national governments in any given time span, so it can be difficult for them to justify or build expert capacity for planning and developing projects.[61] Moreover, cities and their lenders may struggle with the evaluation of climate benefits both at a financial level, such as quantifying monetary trade-offs, and at a technical level, such as quantifying climate resilience and greenhouse-gas emissions.

Some cities may lack experience in project management, climate finance instruments, infrastructure procurement, and green technologies. Cities often struggle with building a feasible economic model for infrastructure investment. The task of coordinating cohesive urban planning that integrates climate objectives across a diverse set of stakeholders including city departments, urban planners, investors, residents, and others can make this even more difficult. While there are many critical projects, especially in adaptation, that are not "bankable" for investors in the current policy environment, there are others that have the potential to generate sufficient revenue streams to pay back capital costs. Even when financially attractive projects are planned and developed, weak channels for communicating requests for proposals and restrictions on the bidding process can contribute to a low number of bids.[62]

4. Insufficient city control over infrastructure planning and complex stakeholder coordination hinders project development, planning, and management. Even when cities are committed to low-emission, climate-resilient infrastructure and have the expertise to develop investable projects, they can still lack the control to direct investment. For instance, the majority of their carbon emissions may be produced by power plants that are planned and controlled by national, state, or regional governments.

Similarly, cities may not be able to capture revenues or cash flows driven by investments in low-emission, climate-resilient infrastructure, which limits their ability to borrow against the increased productivity that their own infrastructure may generate. This inability to monetise infrastructure investments can prevent cities from investing as it means they are unable to pay back upfront capital costs. The inability to collect revenue also affects a city's creditworthiness and hence its ability to borrow.

These issues vary in severity from sector to sector. Revenues may be easier to capture for energy-efficiency projects in public buildings, but more difficult in waste and transport projects financed by public-private partnerships. For the latter, national policies can help support low-emission, climate-resilient urban infrastructure by allowing revenues to be captured and used to pay back upfront investment costs.

Many cities have successfully mandated energy-efficiency retrofits in publicly owned buildings and are able to pay back loans through monthly savings on energy bills.[63] In the United States and Europe, energy service companies have developed expertise in engaging with state and local governments to capture these opportunities.[64] Similarly, several cities have developed public-private partnerships, especially in waste and transport, which have stimulated large-scale private-sector infrastructure investments. Well-managed PPPs can deliver lower-cost, higher-quality infrastructure and services, making them a practical option for infrastructure financing. For example, the East and Gold Line Enterprise (Eagle) PPP developed in 2011 by the US city of Denver, Colorado constructed 122 miles (196 kilometres) of commuter and light rail at $300 million below internal cost estimates.[65]

In many developing countries, the ability of local governments to borrow in order to finance their own infrastructure investments remains underdeveloped and constrained.[66] Faced with restricted access to national and international finance, cities in these countries are forced to make investments on a "pay as you go" basis, meaning that capital expenditures for infrastructure and other urban projects are restricted to funds available in any given fiscal year.[67] This makes it particularly difficult for these cities to engage in coherent infrastructure portfolio planning or to choose options that might cost more upfront but have a lower total cost of ownership.

5. High transaction costs for low-emission, climate-resilient infrastructure in cities increase overall project costs and reduce returns, deterring investment by the cities themselves and outside investors. Transaction costs are already higher for infrastructure than many other asset classes, and are then magnified by the real and perceived challenges of new green technology, the small scale of some projects, and the complexity of cities' project development and financing systems. Inefficient processes and delays, high due-diligence costs for investors, and the high cost of capital also drive up transaction costs. Since many transaction costs are fixed, this is especially challenging for small projects.

Infrastructure projects are complicated by the fragmented nature of decision ownership in cities. Environmental authorities, city departments, and urban planners—as well as owners of municipal infrastructure assets and utilities—are often separate entities, each with their own decision rights. This makes project coordination complex and time consuming, and it can be difficult to move projects through planning at a pace investors consider reasonable. Add to this participants' lack of familiarity with low-emission and climate-resilient designs and technologies, and it is easy to see why many projects never get past the concept stage or lose their sustainability objectives in the process. Once projects are approved, it can also be difficult to understand who will be responsible for delivery or predict where projects are likely to run up against obstacles. All these factors add to the risk of project failures and delays, further pushing up transaction costs.

Low-emission, climate-resilient infrastructure can have higher transaction costs overall because technologies and standards are new. The lack of experience with and performance data for many sustainable technologies, such as anaerobic digestion for waste-to-energy projects, adds to the complexity and cost of investors' due diligence. The use of lawyers, engineers, transaction specialists, and other advisers can account for 1 to 5 percent of project costs.[68] As these costs are not capitalised, they are extremely difficult to recoup, preventing many projects from getting off the ground.

Many cities struggle to establish creditworthiness, which increases their cost of capital in general. In fact, only 4 percent of the 500 largest cities in developing countries are deemed creditworthy in international debt markets, and 20 percent in local markets.[69] Although international markets are not necessarily an appropriate solution, especially given the potential currency risks of such loans, these markets' judgements of creditworthiness drive up the costs of financing more widely. Being perceived as having a high risk of default, as signalled by a lack of creditworthiness, increases financing costs from most lenders.

The small scale of many projects makes high transaction costs even harder to justify. Assets such as energy-efficiency investments in buildings and micro power generation are often impractical for traditional large investors to finance. Admittedly, many of these projects receive some form of concessionary capital that should improve risk-adjusted returns, but the complicated processes involved in securing funding from development banks and other investors can create bureaucratic hurdles that slow project preparation and push up transaction costs.

6. Lack of proven funding models for low-emission, climate-resilient infrastructure at the city level means investors are often unfamiliar with such projects and find it difficult to incorporate reductions in operating costs, improvements in air quality, increased resilience, and other relevant factors into their cost/benefit analyses. To complicate things further, many urban infrastructure projects lack the clear revenue streams that would allow investors to recover their full costs over the lifetime of an asset. This is particularly true of adaptation projects, which can incur high upfront costs while delivering benefits that are environmental and social rather than financial, such as rain gardens (that absorb stormwater run-off from impervious urban areas), or that may not prove their value for

decades, such as infrastructure built to withstand 50- or 100-year flood events. Climate finance may involve incorporating climate change routinely into existing infrastructure investments, which continues to be a challenge for investors and developers. This suggests there is a need for innovative instruments and mechanisms to help improve the risk/return profile of low-emission, climate-resilient infrastructure.

Even where proven funding models for climate-related infrastructure projects exist, many investors feel the returns do not compensate for the higher risks.[70] For their part, cities often struggle to recoup additional capital costs through total cost of ownership savings, where applicable, because savings from investments in more-efficient infrastructure may accrue to sectors funded by national rather than local budgets. For example, city investments in public transport that dramatically reduce air pollution may generate savings in the national healthcare budget. If nothing is done at national level to reallocate these savings back to the city, it may face difficulty in continuing to invest at local level.

SOLUTIONS

The analysis of the barriers to financing climate initiatives in cities and the resulting gaps in supply and demand shape the recommendations set out in this report, which lay out a set of measures that could transform urban infrastructure worldwide. The recommendations advocate taking actions at the city, national, and international levels that require coordination between governments, development banks, philanthropic organisations, international governing bodies, and the private sector. They form the foundation of CCFLA's action roadmap, which has already begun to influence members' commitments and interventions.

The recommendations cover three key areas: policy, capacity building, and financing. Many of them rely at least partly on development banks and other sources of concessionary capital because their risk-adjusted returns are not attractive to private investors in the current policy environment, whereas development banks are well suited to supporting such projects, particularly in developing countries.[71] Reliance on concessionary capital can be reduced over time as local capabilities are built and private-sector investors see projects producing consistent returns. Increasing the volume of financial instruments and funding models will help to fuel a self-sustaining marketplace for low-emission, climate-resilient urban infrastructure.

The recommendations were designed, honed, and drafted by a global coalition of leading climate finance and urban experts, including CCFLA members, and were based on private- and public-sector expertise collected through focus groups, expert interviews, and workshops with CCFLA members and advisers. In 2015, CCFLA members created four focus groups with representatives from private-sector investors and operators, city officials from the developed and developing world, and DFIs. More than a dozen leading experts in the field provided invaluable input through a series of interviews.

CCFLA members and advisers held a workshop to synthesise the input and agree on solutions. In selecting recommendations, alliance members considered impact over time, favouring solutions with relatively large near-term impact, especially those that apply or catalyse private-sector investment. Proposals were evaluated for their feasibility, taking into account ease of stakeholder coordination and alignment with existing political agendas. Priority was given to plans that would scale up proven models or instruments and to projects that dedicate resources to investigating, proving, and disseminating new funding models for low-emission, climate-resilient urban infrastructure.

The recommendations address a wide range of cities and sectors and include actions for national and local governments. They are:

1. Engage with national governments to develop a financial policy environment that encourages cities to invest in low-emission, climate-resilient infrastructure.
2. Support cities in developing frameworks to price climate externalities.
3. Develop and encourage project preparation and maximise support for mitigation and adaptation projects.
4. Collaborate with local financial institutions to develop climate finance infrastructure solutions for cities.
5. Create a lab or network of labs to identify catalytic financial instruments and pilot new funding models.

1. Engage with national governments to develop a financial policy environment that encourages cities to invest in low-emission, climate-resilient infrastructure

Cities are leaders and innovators, but they also respond to the policy and financial incentives created by national governments. This report recommends that development banks, international governing bodies, and NGOs engage with national governments to create financial incentives and policies that encourage cities to invest in low-emission, climate-resilient infrastructure. National

governments can begin by using grants, matching funds, tax transfers, and preferential loan rates to support investment, and then use regulatory power to spur cities to set up frameworks and marketplaces that price externalities. These strategies would improve the risk-adjusted return profile for low-emission, climate-resilient infrastructure and change the financial calculus for cities.

National governments have traditionally influenced policy at the local level by using mandates, grants, matching funds, tax transfers, and preferential loan rates to create strong financial incentives. The US government, for instance, frequently uses such tools to influence state policy in education and healthcare, as with the "Race to the Top" programme, which requires states seeking federal grants to implement standards for teacher effectiveness and educational performance.[72] Following a similar approach, national governments could raise matching funds for low-emission, climate-resilient urban infrastructure projects. Such an approach would be especially effective for programmes that create long-term savings, such as resilient infrastructure projects that reduce national expenditure on managing natural disasters and rebuilding.

South Africa, for example, has used financial policy to support its goal of adjusting the national economy to a low-carbon growth trajectory.[73] In 2011 the government established a Green Fund with $80 million in funding[74] to provide finance for high-impact, job-creating green-economy projects throughout the country with a focus on cities and towns. The Green Fund finances projects directly through instruments including project and capital-development grants, research and policy-development grants, and concessionary project-development loans. The flow of funds is broad and flexible, as grants can be given to project developers, municipalities, provinces, private-sector entities, NGOs, government departments, and academic institutions.

Some cities are leading the way by creating frameworks and marketplaces to price externalities, while others are blocked by restrictive legislation at the national or state level. National governments that introduce enabling legislation to allow cities to develop their own incentives for low-carbon, climate-resilient infrastructure, such as pricing stormwater runoff and creating trading schemes for emissions, will see smart urban policies proliferate. The Netherlands, for example, has made urban sustainability a policy goal and introduced tax reform to incentivise forward-looking long-term policies.[75] Governments can also address obstacles at the national level that hinder local initiatives. Some countries require cities to obtain central approval to use congestion-charge revenue or similar fees, for instance, because this type of policy is deemed to be a new tax.[76] Lifting such barriers could benefit cities and nations alike.

What works in a megacity may not work in an emerging city, even in the same country. Giving cities regulatory freedom, within broader national policy objectives, to implement their own solutions would allow approaches to be tailored to specific contexts.

Impact

In revising policies and financial incentives at the national level, governments would create more favourable environments for investment while signalling their support for climate-resilient infrastructure to cities and investors. Financial incentives created by grants, tax transfers, matching funds, and preferential loan rates would shift the decision-making equation in favour of supporting this sort of infrastructure, with measurable results in the form of new projects. As cities implement these programmes, they will acquire experience, capacity, and expertise that will in turn help them build additional infrastructure more efficiently.

Following this report's recommendations would also allow cities to experiment with new programmes and financing structures rather than being locked into policies dictated by national

governments. With renewed autonomy, cities could push innovation and ambition beyond the usual limits and create policies that work for their particular context. The resulting policy environment would encourage urban leaders to develop and pilot a host of programmes, some with universal application that could be adopted by other cities. As synergies multiply, the proliferation of experiments would lead to groundbreaking solutions.

USING TAX TRANSFERS TO INCENTIVISE CITY CONSERVATION: BRAZIL'S ICMS-ECOLÓGICO

Federal and state governments can influence city behaviour by changing how revenues are allocated. In Brazil, a fiscal transfer mechanism known as ICMS-Ecológico allows participating states to transfer a portion of their sales tax revenues to municipalities based on the creation and management of protected conservation areas. This policy compensates local governments for land-use restrictions and creates a financial incentive for conservation.

Introduced in the early 1990s, ICMS-Ecológico is not a national government mandate but an option that states can choose to adopt. Three-quarters of the tax redistribution to cities is defined by the federal constitution, with the remainder allocated by state legislation. To date, 11 states have adopted the scheme, under which 1 to 6 percent of the municipal share of sales tax is allocated to municipalities in line with ecological criteria. These transfers have provided significant income. For instance, in Paraná in southern Brazil, some $200 million was redistributed under the scheme between 1992 and 2001, and protected areas grew by more than 165 percent.

In the state of Rio de Janeiro, which implemented ICMS-Ecológico in 2009, a total of $33.7 million was transferred to 63 of 92 municipalities in the first year, with dramatic results. The protected area of the Atlantic Forest doubled in two years to 5 percent of the state's total land area, an achievement that Brazil's environment secretary Carlos Minc attributed largely to the tax transfer.

While the scheme has driven major conservation gains, it also has pitfalls. A study found that 40 percent of the counties with protected areas in Rondônia, for instance, were worse off in tax revenues after the scheme was introduced. The counties that lost out tended to be the poorer ones. Moreover, the initially strong effect of incentives weakens over time as the area of protected land increases and the return on protecting the same acre falls in proportion to the total. Implementation of such policies therefore requires careful optimisation if such downsides are to be minimised or avoided.

Whether this type of tax transfer scheme could be used to promote low-emission, climate-resilient infrastructure in cities is less certain. Because most of the municipalities in Brazil receiving the transfers were quite small, those transfers represented a meaningful revenue stream, which might not be true for larger cities. The scheme also relies on the existence of provisions within the tax system for states to transfer revenue to cities. Even if such a mechanism could be put in place, operating it could be challenging, as sustainability metrics such as emissions avoided are harder to measure and monitor than protected conservation areas. Moreover, municipalities have the authority to create protected areas in most cases, whereas building sustainable infrastructure requires cities to work with a range of stakeholders from the private as well as the public sector.

Despite its drawbacks, the scheme illustrates the power of national governments to create enabling

environments and financial incentives for cities to promote beneficial policies. A similar programme that provided incentives for sustainable infrastructure or transfers based on environmental indicators such as carbon emissions or water quality could transform the built urban environment at no additional cost for countries or cities.

Sources: R. Cassola, "TEEBcase: Financing conservation through ecological fiscal transfers Brazil", 2010; ICMS Ecologico website; R. Medeiros et al, "Contribution of Brazilian protected areas to the national economy: Executive summary", FFS 2011, Brasilia, UNEP-WCMC; M. Grieg-Gran, "Fiscal incentives for biodiversity conservation: The ICMS Ecológico in Brazil", Discussion Paper No. 00-01, 2000, IIED, London; P. May et al, "Using fiscal instruments to encourage conservation: Municipal responses to the 'ecological' value-added tax in Paraná and Minas Gerais, Brazil", in *Selling forest environmental services. Market-based mechanisms for conservation and development*, edited by S. Pagiola, J. Bishop, and N. Landell-Mills, London & Sterling: Earthscan 2002

Feasibility

Changing national policy, especially in financing, can be a challenging and protracted process. Depending on the political system, it may involve legislation or approval from multiple agencies and branches of government. Stakeholder coordination will be complex and require champions within national governments who can convene and convince diverse groups. The experience and relationships of international organisations at the national level will be critical to shifting the policy environment. Philanthropic organisations, working with non-governmental organisations could also play an important role in supporting policy development and transformation. Challenging though working at the national level can be, a single change can shape investments in dozens of cities, justifying what can be a complex process.

ENABLING A GREEN ECONOMY: RWANDA'S ENVIRONMENT AND CLIMATE CHANGE FUND

Established in 2012 with support from the United Kingdom's Department for International Development (DFID), Rwanda's Environment and Climate Change Fund (FONERWA) finances projects that promote sustainability, climate resilience, and green growth. The fund facilitates preferential access to domestic financing and creates a streamlined access point for securing external financing from climate funds and development banks.

Such an innovative funding model could be particularly effective for low- and middle-income countries that want to incentivise sustainable projects but have limited resources. FONERWA is the only fund in Rwanda that mobilises the national government's own revenue sources, such as environmental fines and fees, environmental impact assessment fees, and proceeds from forestry and water funds. Linking the fund directly to sources of revenue demonstrates the government's commitment and creates a reliable and self-sustaining source of financing. The government has committed $4.2 million, but mobilised $80 million. The fund achieves this impressive leverage by assisting projects in securing external financing from development institutions and international climate funds. It also mobilises private-sector contributions by requiring grant-based project co-financing or equity from private-sector financing recipients, as well as using partner banks such as the Rwanda Development Bank.

FONERWA aims to galvanise district- and municipal-level participation by targeting 10 percent of total financing to these projects, a focus that has proved successful. As of data available in October 2015, 190

of the 1,089 applications were from district stakeholders, and 27 of Rwanda's 30 districts had submitted an application. Of the 27 projects selected for financing, eight were led by district governments, representing almost a third of total financing.

Current projects cover a wide range of development areas and include a private-sector mini hydro-power plant in Gaseke, green real estate projects in Gasabo, and a district grant for rainwater harvesting and reuse in Kamonyi. The variety of financial instruments applied includes grants, credit lines, low-interest loans, and equity. FONERWA plans to diversify the range of instruments and financing models to include viability gap funding and guarantees, among others.

FONERWA's experiences offer a number of lessons for other climate investment programmes. In the early stages, applicants tended to submit multiple micro projects with limited impact. FONERWA responded by developing workshops to enhance applicants' ability to propose integrated projects that could make a strategic contribution to Rwanda's sustainable development. In addition, some projects have had issues with delayed disbursements of funds and longer than expected times from approval to execution. The fund is increasingly responding to performance challenges as they manifest themselves. It recently created more capacity for technical assistance and engagement with selected projects, and reduced calls for proposals from four to two per year. All these changes were triggered by the need to boost the quality of proposals so as to improve the implementation of funded projects.

Despite these challenges, FONERWA demonstrates how national governments can shift incentives in favour of low-emission, climate-resilient infrastructure by designing and implementing mechanisms to allow enhanced access to government financing, and by improving access to external sources of capital and underpinning it with technical support and guidance.

Sources: Debbie Caldwell, "Final evaluation of the CDKN Rwanda FONERWA capacity building support project", Climate and Development Knowledge Network, March 2015; Government of Rwanda, FONERWA website, accessed October 2015; "Sustainable financing mechanism for environment and climate change initiative in Rwanda", Government of Rwanda, http://static1.squarespace.com/static/537dea6de4b00847c54026be/t/53f1dfa0e4b002b1af097561/1408360352282/fonerwa_brochure_web.pdf

Next steps

To make this recommendation a reality, donor funding will be needed to support the effort for a number of years. One possibility would be for a coordinated donor-funded initiative to support national governments in the development of fiscal instruments by providing counterpart funding and technical advisers to design and implement the measures. Funding and technical assistance would be critical given that different countries need different fiscal mechanisms and solutions will have to be developed specifically for the local context. This is likely to be a complicated endeavour; however, given the importance of urban climate finance and the likely central role of fiscal instruments in making progress on it in future, this could be a priority for DFIs.

2. Support cities in developing frameworks to price climate externalities.

This report's second recommendation is to support cities in developing their own frameworks and marketplaces to price climate externalities. Donors can provide financial and technical support, while national governments can allow cities to restructure their budgeting so that it accurately values and internalises positive and negative climate externalities and attributes associated cash flows accordingly.

The policy environment largely determines which externalities are and are not priced and monetised. In some cases, putting a price on climate-related externalities is difficult; in others, there are clear ways to measure costs and benefits, as with asthma-related healthcare costs that stem directly from pollution and the degradation of air quality. There are two types of climate externalities: those that have a largely local impact, such as congestion, smog, and stormwater runoff, and those that have a largely dispersed global impact, such as carbon emissions. It can often be easier to build support for pricing local climate externalities, since their impact is closer to home.

Cities can be supported in developing appropriate frameworks in two ways. First, they can be allocated resources for developing mandates, mechanisms, and trading systems that create financial incentives for sustainable infrastructure and improve market efficiency by pricing climate externalities such as stormwater runoff and air pollution. Cities can pass laws to mandate behaviour change, create subsidies, or taxes that put a value on climate externalities and establish markets to trade in them. Innovative regulation is needed to provide dynamic incentives to support the development of new and evolving climate technologies.[77]

In addition, governments can create a stable policy environment and ensure transparency on future policy changes so as to reduce the regulatory uncertainty that deters investment.[78] The principal goal for policy frameworks is to internalise climate externalities that create or destroy value. Taxes, surcharges, and fees can be designed to help market participants understand and pay for the full social, environmental, and financial costs of infrastructure development and use, and to make more informed choices when evaluating low-emission, climate-resilient projects against their business-as-usual equivalents.

A variety of schemes already exists to help jurisdictions place value on local and global climate externalities to drive more-efficient marketplaces. As of September 2015, 39 countries and 23 cities, states, and provinces have employed carbon-pricing instruments, mostly in the form of carbon taxes or emissions-trading systems.[79] Which system works best depends on the local context. For instance, trading systems tend to work better in places where there is a greater disparity in costs for various players to meet regulatory standards. In such places, actors with the greatest cost of meeting regulations are willing to pay for regulatory credits from those who find it less expensive to meet standards. For example, the city of Tokyo launched a successful cap-and-trade programme that allows firms to purchase credits permitting them to pollute from firms that voluntarily reduce their emissions. By the scheme's fourth year, emissions were reduced by 23 percent compared with base-year emissions.[80] Tokyo's long-term goal is to cut its carbon emissions by 25 percent from 2000 levels by 2020.[81]

Similarly, London, Stockholm, and other cities have introduced a congestion charge to reduce traffic density and air pollution. In London, the charge is levied on most vehicles driving through central areas during peak hours on weekdays, and is used to fund improvements to public transport. From 2003 to 2013, the scheme reduced traffic volumes by 10 percent and generated roughly $4.4 billion in revenues.[82] Other cities have implemented similar frameworks or marketplaces, but many need targeted support to do so, or are held back by obstacles such as regulation requiring them to obtain central approval to use the revenues generated by pricing schemes.

The second way to support cities in developing appropriate frameworks is to allow them to restructure their budgeting so that it accurately values and internalises positive and negative climate externalities and attributes associated cash flows accordingly. This is needed because low-emission, climate-resilient infrastructure often creates benefits that accrue to other sectors and are reflected in other parts of the city budget. For instance, a city could use its transportation budget to finance a local cycling scheme, but accrue savings in its healthcare budget as citizens exercise more and breathe cleaner air. In the current policy environment, it is very difficult to measure and reallocate these healthcare savings to fund the upfront costs of the cycling scheme.

Some cities have managed to take an integrated view of the full set of positive externalities when making infrastructure decisions. For example, Copenhagen in Denmark plans to build a network of 28 cycle superhighways that is expected to reduce CO2 emissions by 7,000 tonnes per year, generate savings in health costs of $45 million a year, and reduce congestion, at a cost of only $60 million to $151 million.[83] Analysis of the costs and benefits of cycling in Copenhagen found that the net social gain is equivalent to $0.21 per kilometre, mostly from healthcare savings. When these indirect benefits are taken into account, the network has an estimated internal rate of return of 19 percent per year.[84]

As cities begin to price the benefits of low-emission, climate-resilient infrastructure, they can introduce tools to extend this valuation into infrastructure planning and investment decision making. A number of cities, including Cape Town, Durban, Vientiane, and Kampala, have already begun to use ecosystem service valuation to inform planning decisions.[85] This technique could be extended to infrastructure planning as clear pricing for externalities is developed.

The accurate pricing and allocation of these externalities makes it possible to establish funding models for infrastructure investments that were previously difficult to monetise or realise adequate returns on. Policy changes that support these actions should be simple even though the instruments they govern may be sophisticated. Over-complicated local tax policies and infrastructure service fees make impact difficult to evaluate and may create perverse incentives.[86]

Impact

When the indirect benefits and costs of climate externalities have been internalised, the stakeholders involved in infrastructure development—governments, investors, developers, and end users—can be incentivised to make decisions that create more value or mitigate more costs in relation to emissions and climate resilience. For example, putting a price on carbon makes the economics of renewable energy and energy efficiency much more attractive.

Many examples at national and city level show the potential of marketplaces to reduce externalities in a cost-effective manner. For example, the sulphur dioxide cap-and-trade programme in the United States has helped cut SO2 emissions from power plants by more than 50 percent since 1990. Under this market-based scheme, compliance costs were half what they would have been under conventional regulatory mandates. At a city level, the cap-and-trade programme implemented in Tokyo in 2010 reduced greenhouse-gas emissions by 23 percent against the baseline by 2013, far surpassing mandatory reduction rates of 6 to 8 percent and fuelling investment in energy-saving technology. As such examples indicate, introducing markets for climate externalities can drive carbon reductions and spur investment.

However, these markets can be difficult to get right. The European Union's trading system was implemented in 2005 and covers more than 11,000 power stations, industrial plants, and airlines in 28 countries, but has struggled with low prices and excess allowances.[87] When prices are too low or credits too plentiful, trading schemes may not achieve a significant impact on behaviour or emissions.

Feasibility

This recommendation in most cases relies on cities being given the authority to impose additional fees and charges and collect the associated revenues. These processes can be complicated, since authority for taxation and revenue collection usually sits at the national level. Establishing prices and creating a market for trading climate externalities should be easier because these steps do not involve changes to revenue-collection policies; however, they are complicated to get right. Cities will need to cooperate with each other and with national governments to ensure they have sufficient capacity to price externalities properly and to incentivise investment in low-emission, climate-resilient infrastructure.

PRICING AND TRADING CLIMATE EXTERNALITIES: STORMWATER RETENTION CREDITS IN WASHINGTON, DC

In 2014, the District Department of the Environment in Washington, DC launched its Stormwater Retention Credit Trading Program with the goal of protecting waterways and making the city more resilient to climate change by promoting a market for green infrastructure and stormwater control. Under a new credit-trading facility, participants receive stormwater retention credits (SRCs) for exceeding regulatory requirements or making voluntary investments in green roofs, rain gardens, or other infrastructure projects that reduce stormwater runoff or protect bodies of water in the Washington, DC area. All new development projects permitted after January 2014 must meet standards for stormwater retention, but may use SRCs to satisfy part of their requirement. This programme has stimulated a citywide market, since regulated sites are allowed to buy SRCs from unregulated properties and others that have earned SRCs elsewhere in the city.

Trading schemes are not, however, a panacea for managing climate externalities. They can be complex and politically contentious to set up, and many cities opt for simpler schemes, such as introducing stormwater charges as part of a householder or business's monthly water bill. Philadelphia operates a scheme in which every parcel of residential, commercial, and public land in the city is billed by the water department for the management of stormwater. Those with larger expanses of impervious surfaces are charged more since they produce more runoff, but can receive a credit that permanently reduces their water bill if they install infrastructure that reduces runoff, such as rain gardens or cisterns.

What works for one city may not work for another, so it makes sense for cities to develop their own frameworks and marketplaces for pricing climate externalities. The choice of solution will be influenced by a city's size, density, location, and governance structure. Trading systems are attractive when some participants find it much cheaper to deal with an externality than others, so that a marketplace gets results in the cheapest way. In the case of stormwater, many sites in dense cities such as DC lack space for lawns, rain gardens, cisterns, or other retention facilities. Developers of such sites would be more willing to pay for credits to meet their regulatory requirements than developers in less dense areas who have the option of building cheaper retention facilities. In Ann Arbor, Michigan, by contrast, most developers have space to construct inexpensive stormwater retention facilities, meaning there is little demand for a credit system.

This case shows how adaptation investments that might not meet investors' risk-adjusted return criteria can be made more attractive through trading schemes. Pricing and trading mechanisms for climate externalities can incentivise voluntary actions that lower emissions or improve resilience, while reducing the costs of regulatory oversight.

Sources: Donna Henry, "DDOE approves first stormwater retention credit trade", DC.gov, 19 September 2014, http://green.dc.gov/release/ddoe-approves-first-stormwater-retention-credit-trade; "Reduce your stormwater fees", Philadelphia Water, http://www.phillywatersheds.org/whats_in_it_for_you/reduce-your-stormwater-fees; interview with city sustainability official; "District recognized at international climate leadership awards", Sustainable DC, DC.gov, 25 September 2014, http://sustainable.dc.gov/release/district-recognized-international-climate-leadership-awards

Next steps

The first step in implementing this solution is to engage with city governments to explore their willingness to adopt frameworks and marketplaces. Development banks and other organisations can select cities in which to pilot models for pricing externalities. Such cities will need support in selecting the best framework for their specific context and building robust stakeholder networks. Organisations that promote the sharing of best practices between cities, such as C40, ICLEI (formerly the International Council for Local Environmental Initiatives), UCLG (United Cities and Local Governments), and development banks, could play an important role in supporting pilot cities and in turn use insights from the pilots to shape and improve the next wave of city initiatives.

3. Develop and encourage project preparation and maximise support for mitigation and adaptation projects

To attract investment, projects must meet feasibility requirements and be based on a robust business case. Many cities struggle to develop bankable projects because they lack the management expertise and experience to prepare them. This can be even more challenging for complex low-emission, climate-resilient infrastructure projects where cities need to procure the best green technology and use climate finance instruments.

Moreover, project preparation can be expensive: the World Bank estimates that it accounts for 5 to 10 percent of total project costs.[88] By supporting infrastructure projects through early-stage development across functions such as feasibility, design, and project structuring, project-preparation facilities help address one of the major constraints for financing infrastructure: the lack of "bankable" projects. However, these facilities rarely focus on urban infrastructure or on low-emission, climate-resilient infrastructure, creating a major opportunity to improve impact on these projects. Project-preparation facilities need to be strengthened to provide expertise for such projects and, where possible, to prioritise the sustainability of the overall portfolio of projects. If this could be done, it would have a significant impact given the high leverage often achieved by project-preparation grants. For example, the Inter-American Development Bank's (IDB) AquaFund has helped countries prepare and secure a pipeline of $1 billion in water infrastructure projects with 20 project-preparation grants totalling only $11 million.[89]

Project-preparation facilities and their financing partners can support low-emission, climate-resilient infrastructure by changing project-selection criteria to favour low-emission, climate-resilient infrastructure; conducting climate assessments and creating design recommendations to improve the sustainability aspect of traditional infrastructure projects; and building the technical and financial capacity to advise on infrastructure that incorporates low-emission, climate-resilient technology.

These facilities can increase support for low-emission, climate-resilient projects in three ways. First, they can change the criteria for accepting projects by creating explicit preferences for low-emission, climate-resilient infrastructure and by ensuring they do not support unsustainable high-carbon projects such as coal plants. For this to happen, a critical mass of existing facilities would need to agree to a new set of principles for project selection. Many facilities are already moving in this direction: for example, the IntraFund introduced by the IDB includes criteria for sustainability and adaptation.[90] Such approaches should be optimised to reflect best practices and adopted by the full range of project-preparation facilities.

This change can also be driven by facilities' financing partners. If they declare they will not provide finance for certain types of projects, that sends a strong signal to the market, making it unlikely that these projects will be supported by project-preparation facilities. For example, the European Investment Bank has defined an

emission performance standard of 550g CO2/kWh for power-sector projects, and will not finance projects that exceed it.[91]

Second, facilities can conduct climate assessments and create design recommendations to improve the sustainability aspect of traditional infrastructure projects: for instance, through the use of low-carbon materials in roads and bridges. Technical advisers would need to develop their ability to conduct climate assessments and recommend design changes to increase sustainability. Such capacity can be built more rapidly if best practices are shared between facilities and ultimately transferred to cities so that urban managers learn to make climate-smart investments independently.

Third, facility leaders can build the technical and financial capacity to advise on infrastructure that incorporates low-emission, climate-resilient technology, such as wind turbines and bus rapid-transit systems. Sustainable infrastructure often has specific design requirements or needs long-term or concessionary financing. Technical advisers could help build cities' capacity to understand how to access suitable financing instruments for these projects. To act on this recommendation, either each facility could build up its own capacity or a consortium could field a team to work across facilities as needed. This could improve efficiency by concentrating expertise, since a given facility may well have only one waste-to-energy or bus rapid-transit project at a time.

In addition to improving and scaling existing facilities, it may also be necessary to build new facilities to support low-emission, climate-resilient urban infrastructure. These new facilities could help to fill the gap in project preparation capacity and accelerate a pipeline of green projects. Such facilities would be particularly helpful if they specialised in particular regions or infrastructure asset types, such as municipal waste-to-energy plants or bus rapid-transit systems.

Impact

This recommendation would create impact in three ways. First, adjusting selection criteria to favour sustainable infrastructure provides incentives for cities to propose such projects, as it increases their chance of being selected. Second, as facilities adopt the new criteria, more of their well-structured, bankable projects will be low carbon and climate resilient, which will help such projects compete successfully for financing against traditional projects. Third, as cities work with project-preparation facilities to increase the sustainability of their projects, they will build their own capacity, enabling them to develop low-emission, climate-resilient projects for themselves in future.

HELPING CITIES WITH PROJECT PREPARATION: THE CITIES DEVELOPMENT INITIATIVE FOR ASIA

Whereas many existing project-preparation facilities work at the national level and incorporate sustainability to varying degrees, the Cities Development Initiative for Asia (CDIA) focuses on supporting cities in developing sustainable infrastructure. Established in 2007 as a joint initiative led by the Asian Development Bank to serve medium-sized cities in the Asia and Pacific region, the CDIA supports projects that emphasise environmental improvement, poverty reduction, climate change mitigation, and adaptation or improved governance.*

The CDIA focuses on early-stage support, helping cities with infrastructure investment programming and prioritisation, pre-feasibility studies, and project-finance structuring, building cities' organisational and institutional capacity throughout the process. The projects it supports must be within a city's

existing development plan and have strong stakeholder support. Cities must propose the projects themselves and show strong ownership and commitment, including a minimum in-kind contribution such as staff time or office space equal to 20 percent of the value of the project preparation services. Unlike a standard project-preparation facility, the CDIA is independent and not tied to an individual financing source. One CDIA expert suggested that this allows it to find the best possible financing source for a project instead of having to cater to a specific institution.

As CDIA personnel explain, working directly with cities allows them to focus on the projects cities need most, rather than national funding priorities. The close link between projects and city development plans and goals empowers cities and ensures their commitment, which is often manifested through the reallocation of municipal budgets to fund a project. The CDIA's interactions with cities also help to build their capacity and strengthen local institutions. For example, after a city team from Banda Aceh, Indonesia completed a pre-feasibility study with the CDIA, it learned the process, created a special administration unit to execute the project, and raised financing from multiple donors, including the World Bank.

The CDIA has completed pre-feasibility studies for 85 infrastructure investment projects for cities in developing Asia, of which 49 projects have attracted $5.9 billion in financing. The CDIA itself has an annual expenditure of $5 million to $20 million and supports an average of 20 projects per year. The sectors most frequently supported are flood and drainage management (27 percent) and urban transport (26 percent). Recent climate mitigation and adaptation projects include solid-waste management in Balikpapan, Indonesia; urban transport in Yogyakarta and Palembang, Indonesia; and flood control in Xinyu, China and Valenzuela, Philippines. City interventions are complemented and consolidated by a cycle of training measures as well as city-to-city sharing and learning events at national and regional level.

The CDIA's support for an integrated flood risk management project in Valenzuela, Philippines demonstrates the role it plays in supporting climate-resilient infrastructure. One of 16 local governments that makes up Metro Manila, Valenzuela is a growing city situated largely below sea level, and experiences significant flooding. Many previous studies had been conducted on flooding in Metro Manila, but action had not been focused on Valenzuela until the local government worked with the CDIA.

The CDIA conducted a pre-feasibility study on the local impacts of flooding in Valenzuela and examined boundaries with other municipalities. It proposed and costed a series of interventions: pumping stations, flood walls, auxiliary drainage, and programmes to increase local people's capacity to deal with flooding, including improvements to the disaster risk management office and early warning system. To date Valenzuela has invested $2 million of city money out of a total of $4 million to construct a centralised disaster and emergency response building. It envisages securing further financing of more than $13.4 million through a loan from the national government that will pay for pumping stations and auxiliary components. The project demonstrates how taking a hyper-local approach to a well-known problem can dramatically change outcomes.

* Other founders include the governments of Austria, Germany, Spain, Sweden, and Switzerland, the Nordic Development Fund, and the Shanghai municipal government, with additional funding from Germany's KfW.

Sources: CDIA project overview document and interviews with staff; *Accelerating Infrastructure Delivery*, World Economic Forum, April 2014

Feasibility

Because this recommendation builds on existing facilities and seeks to improve and refine existing mechanisms, adopting it should be relatively easy. The challenge will lie in convincing disparate project-preparation facilities that low-emission, climate-resilient infrastructure is a priority. In addition, while facilities can send signals about the types of projects they would like to see proposed, there needs to be a pipeline of low-emission, climate-resilient infrastructure projects for them to select from. Seeding these ideas is likely to entail reaching out to cities and possibly providing support for sector reform and pipeline development, which could be done through established channels maintained by national, regional, and international development banks, private investors, as well as city and subnational networks. National policy incentives will also determine what types of projects are generated and pursued.

Next steps

The first step is to conduct a thorough review of practices at project-preparation facilities by building on the G20's work assessing facilities in Africa and Asia.[92] Next, facilities willing to pilot the concept should codify and implement a set of best practices for supporting low-emission, climate-resilient infrastructure. For facilities still at the planning stage, such as the World Bank's Global Infrastructure Facility, these practices should be incorporated into the initial design.

4. Collaborate with local financial institutions to develop climate finance infrastructure solutions for cities

This report's fourth recommendation is for development finance institutions to work with local and regional banks and other financial intermediaries to develop climate finance solutions. DFIs can provide cities with capital and expertise that can be used to leverage infrastructure investment from local financial institutions. Under the right conditions, development-bank capital can be channelled to climate finance projects via local and regional banks, mortgage lenders, and other financial intermediaries to increase their awareness and experience of investing in low-emission, climate-resilient urban infrastructure projects. Governments have an important role to play in creating the right enabling environment for local financial institutions to be effective.

There are a number of reasons why local financial institutions can play a valuable role in financing low-emission, climate-resilient urban projects. First, local financial institutions can play a critical role as a channel for international climate finance to reach cities.[93] Existing frameworks for international climate finance focus on the national level, making it difficult for municipal entities to access financing.[94] Local financial institutions can be more responsive to local needs and pool significant amounts of international climate finance to refinance smaller projects.[95] A study by CDC Climate Research and AFD that mapped channels for urban adaptation finance concluded that local intermediaries can create leverage to increase the availability of adaptation finance for cities, and they are well positioned to promote climate-resilient urban development.[96]

Second, local financial institutions are well placed to understand and manage some of the risks inherent in municipal and climate finance. Many municipalities find it very difficult to secure affordable financing on international markets because they are not considered creditworthy; among the 500 largest emerging-economy cities, only 4 percent are deemed creditworthy by international markets.[97] By contrast, local financial institutions are in a position to develop a good grasp of the creditworthiness of local developers and governments looking to finance infrastructure projects. The ability to accurately access credit outside traditional frameworks is particularly relevant to investments in low-emission, climate-resilient infrastructure, since assets such as solar panels are often owned by small, diverse entities such as households, which may not meet traditional credit standards.

In addition, projects such as micro grids and waste-to-energy plants often have small deal sizes that make them a better fit for local institutions that invest in smaller projects and have smaller investment portfolios. Their experience of doing business locally can help them keep transaction costs relatively low, which is essential for small projects.

Another advantage offered by local financial institutions is that they can provide medium- and long-term financing in local currencies, thus reducing currency risk, a core challenge for municipal financing. Longer tenor lengths suit the financing needs of low-emission, climate-resilient infrastructure that can require longer payback periods.[98]

Using local financial intermediaries to incentivise markets can be a powerful tool in catalysing private investment for urban projects. Involving local institutions will help build their capabilities and enable more low-emission, climate-resilient infrastructure to be planned, financed, and executed at the city level. In turn, this experience will help local institutions learn how to assess the risks, credibility, and return profiles of a variety of projects. The use of concessionary capital allows local financial intermediaries to provide below-market-rate financing to support the development of new technologies and funding models for low-emission, climate-resilient infrastructure.[99] In this way, these intermediaries can gain experience in new markets and technologies without taking on excess risk. As institutions and cities execute more local projects and build their expertise, they will require less support from development-bank and other concessionary capital. That capital can then be deployed in other sectors or locations where an understanding of these investments is still developing and there are no natural funding streams.

One example of this type of programme is IDB's beyondBanking platform for financial intermediaries operating in the areas of energy efficiency, renewable energy, and waste and water treatment. This initiative supports technical cooperation and promotes the principles of sustainable environmental, social, and corporate governance in financial intermediaries in Latin America and the Caribbean.[100]

It is important to note that local finance institutions are not the best solution for every project; for example, they are not necessarily a good fit with major infrastructure projects that require long-term financing. Their use should be targeted to where they can be most effective, such as filling the largely untapped potential for financing energy-efficiency and waste projects, especially through public-private partnerships.

Impact

The engagement by cities and development banks of local financial institutions such as banks, insurance companies and private-equity funds can increase private-sector financial flows to urban climate projects while simultaneously enhancing intermediaries' capacity to provide financing for low-emission, climate-resilient infrastructure. The focus should be on intermediaries that serve cities so as to ensure that more financing is provided directly to their climate initiatives. The more familiar financial institutions are with working with city governments and planners, the easier it will be for them to provide project financing at the city level.

CHANNELLING CAPITAL THROUGH LOCAL FINANCIAL INTERMEDIARIES: MEXICO'S ECOCASA PROGRAMME

EcoCasa is the first programme aimed at reducing emissions in Mexico's housing sector. By channelling development capital through a local financial intermediary, the Sociedad Hipotecaria Federal (SHF) or federal mortgage society, it spurs investment in low-emission, climate-resilient infrastructure. Launched in February 2013, EcoCasa is already half way to its goal of financing

27,600 sustainable homes by 2019. Achieving this goal would prevent a total of 1 million tonnes of C02e emissions, the equivalent of taking more than 210,000 cars off the road. Adapting to climate change has been a priority in Mexico for some time, but financing at concessionary rates has helped build developers' capacity to advance low-emission, climate-resilient urban development.

The programme involves the Clean Technology Fund (CTF), Inter-American Development Bank, and Germany's KfW Development Bank in providing more than $50 million in sub-commercial loans and concessionary capital to the SHF. In turn, it issues loans to local housing developers that use technologies such as reflective paint, efficient gas boilers and refrigerators, solar water heaters, and energy-saving windows to minimise greenhouse-gas emissions, reduce water use, and secure other climate benefits.

The SHF is a national credit corporation that operates as a second-tier bank developing markets for mortgage financing in Mexico. Under the EcoCasa programme, it uses sub-commercial-rate loans from the CTF (with a 20-year maturity, 10-year grace period and 0.75 percent service charge plus 0.45 percent upfront fee) to provide loans to developers, as well as long-term mortgages related to green housing. It applies an additional spread when lending these funds. It is charged with identifying eligible developers and creates and maintains its own procedures and standards for selecting projects. Its local presence makes it well suited to offering credit and mortgages to local borrowers and providing financing instruments for housing and infrastructure at prices that reflect their real risk.

The EcoCasa programme also seeks to enhance local capacity through a technical cooperation package funded with $2 million of CTF grants that supports SHF's activities and helps it disseminate knowledge and best practices. This package is used to help implement rating and monitoring procedures that address domestic thermal performance, water usage, and building material lifecycles; to strengthen capabilities in the housing industry and housing-finance institutions through technical studies and training opportunities; to spread knowledge on low-carbon housing among the public, industry, universities, and government institutions; and to support the development of public policies for low-carbon housing. A proportion of the funds is designated to help any local developers that wish to participate in the programme to build capacity.

Channelling development capital through local financial intermediaries is not without risks. Policy changes could undermine the economics of low-emission, climate-resilient projects and make them unfeasible even with sub-commercial-rate loans. The intermediary also needs to be able to evaluate and manage local borrowers' credit risk and offer loans accordingly. For example, a deterioration in Mexican borrowers' creditworthiness could undermine the economics of the EcoCasa programme, especially since local financial institutions are more exposed than international ones to local markets.

Sources: "EcoCasa program: Mexico energy efficiency program part II: Proposal for submission to the CTF Trust-Fund Committee", Inter-American Development Bank, July 2012; "EcoCasa and Mexico's green for all housing recovery", Developing Smart Cities, 2 September 2015, http://www.developingsmartcities.org/2015/09/02/ecocasa-and-mexicos-green-for-all-housing-recovery/

As their capacity grows, local intermediaries will be able to identify attractive projects and appropriate funding models with less support from multilateral development banks and other donor organisations. In addition, the relationships these intermediaries build with city governments will encourage future investments to flow directly to cities. The intermediaries could combine their capital with that provided by development banks or public funding to finance climate infrastructure investments that would not otherwise be feasible. Over time, increased amounts of private financing could be "crowded in" to the market in this way.

The use of financing from local intermediaries allows smaller-scale projects to be funded that might be deemed impractical by larger financial institutions. Local intermediaries have smaller balance sheets and are better suited than large multinational banks to considering city-level projects. The relative ease of facilitating project diligence locally may also reduce transaction costs.

Feasibility

Numerous cases already exist of development finance institutions working with or channelling capital through local financial intermediaries, so this recommendation should be relatively straightforward to implement. However, challenges arise in ensuring that the intermediaries have the expertise to assess climate investments and, in particular, the rapidly evolving technologies that often accompany them.

Several tools have been developed to address this need, such as the Climate Assessment for FI Investment, a web-based tool that creates a standard for financial intermediaries to use in assessing potential transactions that is based on climate criteria specified by the International Finance Corporation (IFC). The tool allows intermediaries to monitor results and track progress for investment and advisory projects in energy efficiency, renewable energy, climate adaptation, and similar initiatives.[101] The intermediaries are able to learn, build capacity, and gain confidence in investing in low-emission, climate-resilient infrastructure, and can develop a portfolio of project performance records to inform future investment decisions.

In addition to supplying capital, development banks and other donors will need to provide guidance or standards as to what qualifies as a low-emission, climate-resilient infrastructure investment. The prospect of healthy returns from such investments should incentivise financial intermediaries to perform proper diligence and work closely with city governments, thereby building climate-related development capacity for all concerned.

Next steps

In the short term, multilateral development banks and other donors of concessionary capital could expand their efforts to identify local financial intermediaries with the capacity to structure and finance urban infrastructure investments and the knowledge and transaction history to effect real change in their locality. By working with these carefully selected intermediaries, donors may be able to increase project funding while simultaneously building the capacity of city governments. Intermediaries could share their knowledge and expertise with neighbouring institutions through forums or workshops, creating a new cadre of candidates for receiving concessionary capital for local low-emission, climate-resilient infrastructure projects.

A number of underlying reforms could be made to support a greater role for local financial institutions, such as improving capital markets and regulatory frameworks. Local financial institutions also benefit from improvements in local governments' fiscal resources and access to credit. Capacity building within the institutions themselves would help improve their understanding of municipal and climate finance. Similarly, municipalities would benefit from building capacity for budgeting, fiscal management, and accountability.[102]

5. Create a lab or network of labs to identify catalytic financial instruments and pilot new funding models

The final recommendation of this report recognises that cities need innovative forms of financing because of the additional challenges they face in pursuing low-emission, climate-resilient infrastructure projects. Such innovations could include creating new instruments or funding models, adapting existing instruments or models for low-emission, climate-resilient infrastructure, or increasing access to existing instruments, models, and markets. A standalone urban climate finance lab or series of networked labs could serve as the locus of these development efforts. It could use philanthropic, development-bank, and concessionary capital to identify, pilot and, evaluate instruments, models and, mechanisms for financing urban infrastructure.

Cities would benefit from a focus on local-scale instruments because of the unique financing challenges they face, such as a lack of control over the revenue streams that could pay for initiatives such as public transport schemes. Similarly, cities are often unable to capture savings that accrue to an entity other than the one making the climate investment, such as energy-efficiency programmes in schools that save money in education budgets, or bike lanes and pedestrian-friendly urban planning that deliver healthcare savings from a reduction in obesity rates. In addition, many cities struggle with debt limits and creditworthiness, often because they find it difficult to collect sufficient revenues. The ability to experiment and innovate to find solutions to these challenges is critical.

The new lab or network of labs should identify and share financing practices with the potential to drive low-emission, climate-resilient urban infrastructure investment at scale, such as green bonds, long-term currency swaps, and risk guarantees. It could also build on existing initiatives and focus on piloting proven funding models and mechanisms in new market contexts or sectors. This could include adapting funding models such as land value capture, long used to finance railways, metros, and highways. This model seeks to capture the additional value created by infrastructure through impact fees, special assessment districts, or tax increment financing. If adaptation infrastructure were to make a community safer from flooding and increase property values, for instance, this value could be used to finance the upfront investment.[103]

A range of tools will be needed to address different city contexts. For example, many cities in emerging economies do not have a sufficient credit rating to attract institutional investors with any green bond issuance they might wish to do[104]—a partial guarantee on a green bond could allow them to proceed. Some instruments can be complementary to other tools, such as currency swaps and guarantees that can help mitigate risks.

The proposed lab or network could also play a vital role in developing verification processes and communications strategies that lend confidence to investors considering mechanisms and marketplaces for climate finance. To allow control and scalability, funding models and instruments will need to be standardised, as will the practices for developing them. Confidence in the green credentials of new instruments, such as the definition of green projects, is a prerequisite for attracting and retaining new investors and building a sustainable market. Similarly, transparency in underlying assets and cash flows is essential in allowing investors to engage in proper due diligence. Standardised documentation on green credentials is crucial in enabling the green bond market to scale, as it dramatically reduces investors' transaction costs for due diligence. Once standardised in the lab, successful instruments and models can be scaled across geographies.

The new labs proposed by this report should draw on the experience of established labs and form partnerships with them to create a broad network and strong ecosystem for climate finance initiatives. The best solution may involve enhancing an existing lab rather than creating a

new network from scratch. On the other hand, setting up a new lab could reduce political or bureaucratic barriers if stakeholders are carefully chosen and aligned from the beginning. Whichever approach is adopted, the lab should focus on cities so that it can tackle the specific challenges faced in financing low-emission, climate-resilient infrastructure.

EXISTING EXAMPLES OF APPROACHES TO IDENTIFY AND DEVELOP FINANCIAL INNOVATION

A number of labs or coordinating bodies are promoting financial innovation to achieve climate objectives. One such initiative is Climate-KIC's new Low Carbon City Lab, which aims to reduce cities' greenhouse-gas emissions by one gigatonne per year. The lab will work in conjunction with the South Pole Group to design innovative finance frameworks for cities, while CDC Climat will host its first training sessions.

The development of the green bond market demonstrates the need for a coordinating body, which is a role that labs could play.* As of July 2015, corporate issuance of climate-aligned bonds amounted to $597.7 billion in debt outstanding, an increase of more than $95 billion on the 2014 total. To help the green bond market to grow, the Climate Bonds Initiative (CBI), the World Bank, and other MDBs have worked to establish standards to lend credibility to bond issues and allow them to come to market more quickly. Standards are critical, since some earlier bond issues with loose ties to green assets have lost credibility and been dubbed "pale green". Efforts such as CBI's Climate Bond Standards and Certification Scheme should give investors confidence that funds invested in green bonds are being used to deliver low-carbon infrastructure. The standards provide clear, sector-specific eligibility criteria for climate-aligned and green-labelled bonds, and a standards board composed of public and private entities provides oversight.

To prepare cities for green bond issuance, the CBI and its partners have established coalitions to provide educational activities and capacity-building programmes. The CBI also drafts policy papers and interacts with the press to disseminate information, and sets up development committees in countries that propose to adopt green bonds in local markets. Development banks provide additional strategic support in emerging and developing markets. The development of the green bond market also requires technical assistance and education for issuers, underwriters, and investors. Both the World Bank and the CBI have dedicated resources to educating underwriters on developments and trends in the market, which one expert described as essential to selling the green bond narrative to investors.

The coordination of efforts to promote the development, standardisation, and marketing of new instruments and models is an important function for the proposed labs, and one that is not always served by financial markets. Developing an efficient process for identifying and testing new mechanisms requires a concerted effort that may be more successful when a coordinated body exists to direct activities.

Another example of a lab performing such a function is the Global Innovation Lab for Climate Finance, established by the United Kingdom, United States, and Germany in partnership with a group of climate finance donor countries (Denmark, France, Japan, the Netherlands, and Norway) and private-sector representatives. It uses expertise from local governments and field experts to

build institutional knowledge and identify funding models and financial mechanisms for investments in low-emission, climate-resilient infrastructure. It also identifies, stress-tests and refines the design of innovative financial instruments for developing countries. The Climate Policy Initiative (CPI) acts as a secretariat for the lab and provides analytical support for its expert members.

The lab's goal is to accelerate climate finance proposals and channel private investment to appropriate infrastructure projects. It draws on input from global stakeholders to identify mechanisms that can drive infrastructure investments at scale. An initial call for ideas in June 2014 generated more than 90 proposals for innovative climate finance instruments. Over the course of nine months, these ideas were stress-tested and refined to produce formal proposals. Four proposals were selected, including ideas for connecting climate-related development projects with financing; insurance schemes that guarantee savings from energy-efficiency projects; long-term currency swaps to mitigate exchange-rate risk, particularly in developing markets; and an agricultural supply-chain adaptation facility to provide education and long-term financing of resilience projects for farmers. These ideas were endorsed by lab members and have been taken forward to implementation.

One of the projects, Climate Investor One, will facilitate early-stage development, construction financing, and refinancing for renewable energy projects in developing countries, and is being piloted by FMO (the Netherlands Development Finance Company) in conjunction with South Africa's Phoenix Infraworks. Another project, Energy Savings Insurance, is being piloted by the IDB with support from the Danish Energy Agency. Yet another, the Agricultural Supply Chain Adaptation Facility, is to be piloted by IDB in partnership with Calvert Investments in Latin America and the Caribbean. Since launch, the lab and its initiatives have attracted more than $170 million in funding.

* Green bonds are defined as "any type of bond instruments where the proceeds will be exclusively applied to finance or re-finance in part or in full new and/or existing eligible green projects and which follows the four green bond principles". Green projects are defined as "projects and activities that will promote progress on environmentally sustainable activities."

Sources: "New global Climate-KIC programme set to help cities unlock their climate change mitigation potential: Low Carbon City Lab", Climate-KIC, 31 March 2015, http://www.climate-kic.org/press-releases/new-global-climate-kic-programme-set-to-help-cities-unlock-their-climate-change-mitigation-potential-low-carbon-city-lab/; What are Green Bonds?, World Bank in partnership with PPIAF, 2015, http://documents.worldbank.org/curated/en/2015/09/25082410/; Barbara Buchner and Sarah Painter, "Update on instruments", The Global Innovation Lab for Climate Finance, webinar, 2015; "About the Global Innovation Lab for Climate Finance", http://climatefinancelab.org/about/; "Second lab principal meeting of the Global Innovation Lab for Climate Finance", 16 April 2015, http://climatefinancelab.org/event/second-lab-principal-meeting-of-the-global-innovation-lab-for-climate-finance-2/; "Overview fact sheet", Global Innovation Lab for Climate Finance, http://climatefinancelab.org/wp-content/uploads/2015/10/The-Lab-Overview-Fact-Sheet-Second-Cycle.pdf; "Energy efficiency insurance: Product overview", HSB Engineering Insurance and Munich Re, https://www.munichre.com/site/hsb-eil-mobile/get/documents_E1886381732/hsb/assets.hsb.eil/Documents/Knowledge%20Center/Downloads/Document%20Library/HSBEI-1225-1214-1%20Energy%20efficiency%20Insurance%20-%20Product%20overview.pdf

Impact

The proposed network of labs should seek to drive change in two ways. First, it should identify, develop, and pilot new funding models and instruments for low-emission, climate-resilient infrastructure using concessionary capital such as grants and donations. This source of funding is important because the piloting process carries inherent risks that the capital invested may not be recoverable if funding models or instruments fail. Piloting itself is critical, as infrastructure projects without proven funding models are unlikely to attract financing.

By offering innovative instruments such as insurance or guarantees that can mitigate climate or city-specific risks, the lab network can protect investors against unforeseen regulatory changes that could affect climate-related infrastructure projects, thereby catalysing investment. For instance, the Global Innovation Lab for Climate Innovation offers insurance for energy-efficiency investments to protect investors from changes to utility rates or taxes that might jeopardise the savings they receive from their investments. The German reinsurance firm Munich Re has developed a similar offering for the street-lighting sector.[105] Other instruments could be created to provide guarantees against other forms of regulatory uncertainty. Development-bank or other concessionary capital may be required up front to help jump-start this market, but this need should diminish as new funding models prove themselves and attract more private investment.

Second, the proposed lab or network should also serve as a repository of best practices, knowledge, and standards for climate finance, and disseminate them to local governments and financial entities. The standardisation of practices for developing funding models as well as the models and instruments themselves is essential for providing control and scalability.

The credentials of new instruments for low-emission, climate-resilient infrastructure will need to be established—for instance, by defining "green" projects or specifying the use of proceeds for climate finance bonds—in order to attract and retain investors and build a sustainable market. Transparency on underlying assets and cash flows will be essential to allow investors to engage in proper due diligence. One priority for the new labs should be to standardise instruments and models that prove successful so that they may be scaled across locations.

Feasibility

The implementation of this proposal should be straightforward as far as stakeholder coordination is concerned, since development banks' goals are well aligned with investment in low-emission, climate-resilient urban infrastructure. If the proposed new lab partners with existing labs and draws on their knowledge, its chances of success will be increased and its learning enhanced. Identifying the level of government with which to partner to effect change in cities may be more challenging, as the authority to make decisions on climate policy rests at various governmental levels in different countries. Even when countries have dedicated climate-action teams, they typically exist at national level and may not be familiar with the infrastructure needs of individual cities.

Moreover, cities often lack the revenue-collection authority that would enable them to provide revenue streams for funding new infrastructure assets. Labs are likely to face the additional challenge of coordinating national and local governments in order to pilot funding models and instruments for low-emission, climate-resilient infrastructure.

Next steps

One or more labs could be set up by institutions with experience in urban development and infrastructure investment and access to concessionary funding. Priority should be given to instruments that are relevant to large numbers of cities and are thus scalable on a global basis. Each lab could test two or three models or instruments within the first 6 to 12 months. The results would inform the lab's next steps as it begins to build a knowledge base that can be drawn on by other entities seeking to develop innovative climate finance solutions. The lab should also pursue early partnerships with cities to obtain their input on the challenges that innovative financing mechanisms can address and to pilot possible solutions.

CONCLUSION

To manage and improve a city and create a better society, it is first necessary to measure its qualities. To understand where urban climate finance stands today was the impetus for creating this annual report. The report establishes a framework for tracking the state of financing for low-emission, climate-resilient urban infrastructure, identifying key barriers, and proposing solutions. The data it contains will become more robust year on year, but there is no time to lose—the current state of knowledge is enough to make action imperative.

With the right financing conditions, cities can lead the global community in implementing climate-change projects and setting in motion a transformation of society. Cities house more than half of the people on Earth, contribute the lion's share of global GDP, consume the largest share of energy, and release the majority of emissions. They are also disproportionately vulnerable to the effects of climate change. Climate solutions should not merely include cities, but be born and tested in them, capitalising on their compact, connected, and climate-smart attributes. These solutions can only come to fruition if cities are able to finance and build low-emission, climate-resilient infrastructure, and to do so rapidly.

The Cities Climate Finance Leadership Alliance was formed to help document and address these issues. By bringing together a range of voices, the CCFLA hopes to foster collaboration among institutions that may never have worked together before. This report is the first of what is expected to be an annual series, and it will be supplemented by other research reports and meetings designed to tackle issues of regional or sectoral interest.

APPENDIX A: METHODOLOGY FOR ESTIMATING DEMAND

1. UNDERLYING METHODOLOGY

This report uses two methods to estimate first the aggregate demand for urban infrastructure investments and then the incremental demand for climate-related infrastructure investments.

First, it applies an approach based on the ratio of infrastructure stock to GDP (as outlined in *Infrastructure Productivity: How to save $1 trillion a year*, McKinsey & Company, January 2013) to city-level GDP projections obtained from the McKinsey Global Institute's Cityscope database in 2015.

Second, it compares these estimates with figures derived from the World Economic Forum (WEF) *Green Investment Report* of 2013 and the Global Commission on the Economy and Climate's 2014 New Climate Economy (NCE) report *Better Growth, Better Climate*. To compare the results from the first step with estimates from other sources, the urban share of future infrastructure investments had to be carved out, as these sources did not specify the split between urban and non-urban financing. The resulting estimates of the aggregate urban infrastructure investment demand are in the range of $4.1 trillion to $4.3 trillion per year.

According to *Infrastructure Productivity*, the average long-term value of infrastructure stock in most economies is roughly 70 percent of GDP. This estimate is based on an examination of infrastructure stock for 12 countries for which comprehensive historical spending data is available. The approach assumes that future investments in infrastructure will be large enough to maintain this ratio and that they will compensate for the ageing of existing infrastructure and the depreciation of costs.

This report applies that approach to the urban share of the economy to estimate cities' future infrastructure needs, assuming that the global economy will grow at an average 3.3 percent per year from 2012 to 2025. Urban areas will drive the bulk of this growth, with combined urban economic growth averaging 3.9 percent per year in 2012–25, increasing city GDP from roughly $60 trillion in 2012 to just under $100 trillion in 2025. The resulting city infrastructure investments under a business-as-usual (BAU) scenario are in the order of $4.1 trillion per year.

In order to compare the findings of the infrastructure stock-based approach with the estimates available from the WEF and NCE reports cited above, the urban share of future infrastructure investments had to be carved out, as these sources did not specify the split between urban and non-urban financing. This approach is explained in section 2 of this appendix.

The WEF's *Green Investment Report*, which provides an overview of infrastructure spend across a wide range of sectors including energy, transport, buildings and industry, water, telecommunications, and forestry and agriculture, estimates the total demand for infrastructure investment under the BAU scenario to be $5 trillion per year. This estimate is used as the basis for deriving the urban share of investments by excluding investments in the forestry and agriculture sectors as not directly attributable to cities, and segregating urban investments based on the average share of GDP represented by cities, projected at 85 percent.[106] The resulting aggregate urban investments are estimated to be in the order of $4.3 trillion per year.

The NCE report *Better Growth, Better Climate* forecasts that $89 trillion will have to be invested in infrastructure globally in 2015–30, or $5.9 trillion per year. Carving out cities' share of investment yields a figure of $4.3 trillion per year. Although the NCE report covers the period 2015–30 and the infrastructure stock-based approach outlined above covers 2012–25, the annualised estimates are comparable.

2. USING NCE 2014 ESTIMATES OF INFRASTRUCTURE INVESTMENT NEEDS IN THE URBAN CONTEXT

Estimates derived from the NCE 2014 report

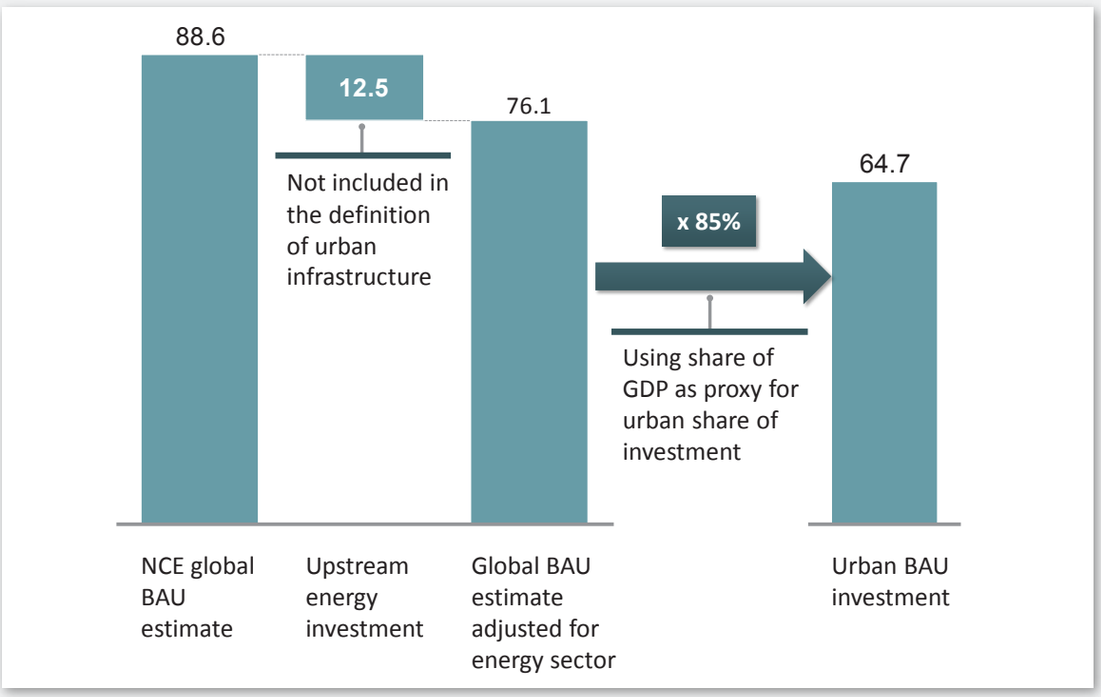
Better Growth, Better Climate were modified to estimate urban investment.

Urban infrastructure investment in BAU. The NCE report estimates that global infrastructure investment needs will be in the order of $88.6 trillion over the period 2015–30 under the BAU scenario. For the purposes of this report, infrastructure investments in the energy sector upstream of power production are not counted as urban infrastructure, although power plant infrastructure generating power for cities is included.[107] A total of $12.5 trillion of the $88.6 trillion investments required in the BAU scenario relates to upstream investments such as mining and extracting, refining and transport for the oil and gas sector, and coal mining, and is excluded from the analysis. After these adjustments, the aggregate infrastructure investment demand in the BAU scenario is estimated at $76.1 trillion.

Next it is necessary to estimate the portion of the $76.1 trillion that should be attributed to cities, which is calculated on the basis of their share of GDP. An analysis of a sample of cities from developed and developing countries based on publicly available data on cities and historical data on country-level infrastructure spend indicates that the average ratio for a city's infrastructure spend to GDP is in line with the corresponding country-level ratio.[108] Therefore this report assumes for the purposes of city-level analysis that the urban share of country-level infrastructure spend is in line with the urban share of national GDP. On average, cities will generate 85 percent of global GDP in 2012–25, so 85 percent of the remaining country-level investment can be assumed to take place in urban areas or to serve primarily urban areas. The resulting global urban infrastructure demand is estimated at $64.7 trillion in the BAU scenario, or an average of $4.3 trillion per year (Exhibit A1).

Exhibit A1: Urban share of BAU investment

2015–30 ($ trillions)



Urban infrastructure investment in low-carbon scenario. A similar methodology can be followed to attribute the share of additional investment required in a low-carbon scenario. NCE estimates that global additional net investments required will be $4.1 trillion, calculated as $13.5 trillion in additional capital expenditure minus $9.4 trillion in savings. For each investment or savings, an urban portion can be allocated.

- **Additional capital costs:** NCE estimates $13.5 trillion in additional investment globally, based on $8.8 trillion in energy-efficiency investments and $4.7 trillion in low-carbon technology investments. Using the urban share of GDP as a proxy and taking 85 percent of these country-level investments to be urban yields a figure for urban investments of $11.5 trillion.
- **Capital savings:** NCE estimates that low-carbon infrastructure could produce savings of $9.4 trillion from capital expenditures reductions on fossil fuels, electricity transmission and distribution, and compact cities. Of the fossil-fuel savings, $2.0 trillion derives from power-plant infrastructure and $3.7 trillion from the upstream supply chain. Savings from the fossil-fuel supply chain are excluded because upstream energy investments are not included as urban infrastructure. From the $2.0 trillion in savings on power-plant infrastructure and the $0.3 trillion in electricity transmission and distribution, 85 percent or $1.7 trillion can be apportioned to urban areas. The $3.4 trillion in savings from compact cities are attributed in full to urban areas. In total, this results in savings of $5.4 trillion (Exhibit A2).

Exhibit A2: Share of savings attributed to urban areas

2015–30 ($ trillions)

Category	Global savings	Share attributed to urban areas, %	Urban savings, %
Compact cities	3.4	100	3.4
Fossil fuels			
Upstream	3.7	0	0
Power plants	2.0	85	1.7
Distribution	0.3	85	0.3
Total	9.4	…	5.4

3. EXPLAINING THE RANGE IN ESTIMATED DEMAND

This report estimates the demand for incremental financing of low-emission, climate-resilient urban infrastructure to be in the range of $0.4 trillion to $1.0 trillion per year.

There is a wide gap between the estimates at the range's low and high ends. The figure at the lower end is derived using data from the 2014 NCE report *Better Growth, Better Climate* as explained above. That report states that the investment required to make infrastructure sustainable at a systems level is only 5 percent higher than that in the BAU scenario, equivalent to $4.1 trillion in incremental capital costs. This net figure represents $13.5 trillion in additional capital expenditure minus $9.4 trillion in savings. For each investment or savings, an urban portion can be allocated. Taking out the capital costs and savings associated with non-urban investments leaves an estimated total of $6.1 trillion in incremental climate finance requirements at city level over the period 2015–30, or $0.4 trillion annually. The incremental capital costs in this estimate are 9 percent higher than the $4.3 trillion needed for urban infrastructure in the BAU.

Better Growth, Better Climate bases its calculations on a transition from the 6°C baseline to the 2°C scenario of the IEA's Energy Technology Perspectives (2014).[109] Its estimate is at the lower end of the range because it assumes that certain capital savings will be achieved in the low-carbon scenario that are not included in the NCE's 2015 estimates.[110] In particular, it assumes that savings in energy efficiency will reduce the costs of electricity transmission and distribution in line with IEA (2012), and expects the transition to a compact urban model to lead to savings in the buildings, telecommunications, water and waste, and road transport sectors. In addition, it does not take into account investments in resilience.[111]

By taking the NCE's 2014 estimates but employing a more conservative approach that discounts any capital savings, this report estimates the urban share of the demand for incremental climate infrastructure investment to be $0.8 trillion per year, 18 percent higher than the $4.3 trillion needed in the BAU scenario.

The analysis outlined in this report is based on the BAU requirements for urban infrastructure investment estimated using the infrastructure-spend approach. It also draws on work that considers incremental investments needed to create and extend green districts.[112] According to this work, the use of a number of sustainable technologies and design elements in the greenfield development of green districts can lead to higher construction costs that can be recovered through operational savings. Overall, green districts are 8 to 10 percent more expensive in terms of upfront capital costs than conventional alternatives. Applying this 8 to 10 percent estimate to the $4.1 trillion infrastructure spend in the BAU calculation produces an incremental investment figure of $0.4 trillion.

This analysis does not take into account the incremental costs of low-carbon transitions in sectors not directly linked to green-district development or any resilience applications, although some of the technologies adopted, such as micro-grids, would increase resilience.

According to the WEF's 2013 *Green Investment Report*, additional investment in the low-carbon growth scenario is estimated at $0.7 trillion globally. Excluding the agriculture and forestry sectors and splitting out the cities' share in line with the urban share of GDP results in an incremental demand of $4.3 trillion: 14 percent more than in the BAU scenario. The WEF report, like the NCE report, uses the 6°C baseline and analyses the transition to the 2°C scenario, covering the buildings and industry, transport, and energy sectors. However, it does not assume any incremental investments in the water sector.

At the higher end of the range, the Global Commission on the Economy and Climate's 2015 NCE report, *Seizing the Global Opportunity* estimates the incremental demand for urban

climate infrastructure at $1 trillion per year. The analysis is based on a more detailed urban database developed by Erickson and Tempest,[113] uses the 4°C rather than 6°C scenario as a baseline, excludes the energy sector, and is highly conservative in its assumptions. For example, its estimates do not account for avoided costs (such as vehicle purchases forgone because of investment in public transport) or savings in capital expenditure from more compact urban growth.

In addition, this analysis is based on ambitious carbon-reduction measures and provides higher estimates than *Better Growth, Better Climate* for additional upfront infrastructure costs in the low-carbon scenario, though these estimates are still well within the expected range of uncertainty. In particular, *Seizing the Global Opportunity* suggests an incremental annual investment of $0.7 trillion rather than $0.3 trillion in the buildings sector, and $0.3 trillion rather than $0.2 trillion in the transport sector.

APPENDIX B: METHODOLOGY FOR DEVELOPMENT FINANCE INSTITUTIONS DEEP DIVE

Nine development finance institutions completed a survey to provide information on urban climate finance. The respondents were: Asian Development Bank (ADB), Agence Française de Développement (AFD), African Development Bank (AfDB), CAF Development Bank of Latin America, European Investment Bank (EIB), Inter-American Development Bank (IDB), Japan International Cooperation Agency (JICA), KfW Development Bank (KfW), and the World Bank (WB). The World Bank data used in this report comes from the International Bank for Reconstruction and Development and the International Development Association and does not include investments made by the Multilateral Investment Guarantee Agency or the International Finance Corporation.

1. METHODOLOGY FOR GATHERING DATA ON URBAN CLIMATE FINANCE

For the purposes of the survey, "urban climate finance" was defined as "investments in infrastructure and broader climate-related initiatives that contribute to low-carbon urban development or urban resilience". The participating institutions were asked to follow the MDB-IDFC's Common Principles for Climate Mitigation Finance Tracking and Common Principles for Climate Change Adaptation Finance Tracking.[114] These principles were developed to improve accuracy and consistency in the mapping of climate finance flows from multilateral development banks. However, they do not define *urban* climate finance, and additional work is needed to harmonise definitions of urban infrastructure and urban climate finance.

The Common Principles define "mitigation activities" as those that promote "efforts to reduce or limit greenhouse gas (GHG) emissions or enhance GHG sequestration".[115] The principles further emphasise the need for measuring and reporting mitigation impacts, stating that "any inclusion of climate-change impacts is not a substitute for project-specific theoretical and/or quantitative evidence of GHG emission mitigation".

The Common Principles define "adaptation finance tracking" as "tracking the finance for activities that address current and expected effects of climate change, where such effects are material for the context of those activities". These principles were not fully implemented for 2014 data, but lay the foundation for further joint work to address comparability in reporting and other relevant processes. They state that the adaptation finance tracking process consists of the following key steps: "Setting out the context of risks, vulnerabilities and impacts related to climate variability and climate change; stating the intent to address the identified risks, vulnerabilities and impacts in project documentation; [and] demonstrating a direct link between the identified risks, vulnerabilities and impacts, and the financed activities."

2. ASSESSING CLIMATE ACTIVITIES

The Common Principles are activity based and stipulate that individual projects be reviewed to assess the relevant proportions of mitigation and adaptation actions. Climate finance tracking requires the disaggregation of climate activities from non-climate activities. Only those portions of projects that contribute directly to mitigation or adaptation should be accounted for. According to the Common Principles, climate activities or projects can consist of a "stand-alone project, multiple stand-alone projects under a larger programme, a component of a stand-alone project, or a programme financed through a financial intermediary". For instance, in the case of a project with a total cost of $100 million and a $20 million documented component for energy-efficiency improvements, only the $20 million would be reported as climate finance. However, the methodology is not always clear-cut. Some projects that do not include an explicit climate or energy-saving component or have a climate-related primary goal may still be considered to be 100 percent climate finance, as with many transportation projects.

3. ANALYSING SURVEY RESPONSES

Each institution was asked to provide information about finance committed in recent years. The institutions provided aggregated rather than project-level data. They were asked where possible to give breakdown of flows for mitigation and adaptation activities; for individual sectors, such as transport, power, and water; and for financial instruments, such as loans or grants. To make data comparable, the following steps were taken:

- When institutions provided aggregate figures for a multi-year period, simple division was applied to estimate annual figures.
- For consistency, total bank commitments were taken from each institution's 2014 annual report. ADB provided an amended figure ($16.196 billion) that excluded finance not directly administered by ADB.
- Total climate figures were provided by the institutions themselves or, in the case of IDB, AfDB, ADB, and EIB, sourced from the 2014 joint report on multilateral development banks' climate finance.[116]
- Figures provided in currencies other than US dollars were converted using the average exchange rate in the relevant year.

Of the nine participating institutions, seven confirmed that they assessed the climate portions of relevant infrastructure projects and provided financing figures accordingly. The remaining two institutions, JICA and KfW Development Bank, did not disaggregate climate from non-climate activities as outlined above but provided total project costs for climate-relevant infrastructure projects. The use of total costs, however, does not indicate that climate finance is overstated for these projects, as care was taken to ensure that they achieved climate objectives in their entirety, not simply in part. Exhibit B1 at the end of this appendix provides a detailed list of exceptions to the suggested tracking and reporting methodology.

4. IDENTIFYING URBAN PROJECTS

The survey participants reviewed climate project portfolios and provided data on projects with an explicit urban focus. In the absence of a universally accepted definition of "urban", a working definition was adopted: "projects that take place within the geographic boundaries of an urban area or are designed to meet municipal-level objectives."

Participating institutions performed keyword searches and manual reviews of portfolios to identify projects that conformed to this definition. Often, however, distinctions were difficult to make as projects serving municipal-level objectives were not always tagged as such and therefore did not show up in the datasets. Even when projects were appropriately tagged, parsing out the urban portion of infrastructure projects could be difficult, and most institutions erred on the side of conservativeness in their reporting. For simplicity, some chose to include only projects taking place within the geographic boundaries of urban areas. These exceptions, noted in Exhibit B1, are likely to lead to an understating of total urban climate finance as projects located outside city boundaries were not counted even when they served primarily urban needs.

5. SECTOR REPORTING

The participating institutions were asked to provide sector breakdowns for mitigation and adaptation projects. All institutions except EIB provided these breakdowns. For ease of reporting, some sectors, such as transport and telecom, were grouped together based on how data was received. Exhibit B1 details assumptions to make data comparable and exceptions to the common methodology. Sector groupings and associated activities are outlined in Exhibit B2; flows not explicitly identified were marked as "other".

6. INSTRUMENT REPORTING

All institutions except EIB provided information on instrument breakdown. Exhibit B1 details underlying assumptions to make data comparable and exceptions to the common methodology.

Exhibit B1: Exceptions to common methodology and assumptions and calculations made to render participants' data comparable

Institution	Provided disaggregated data on climate portions of projects	Notes on climate finance tracking	Notes on urban tracking	Notes on sector and instrument tracking
ADB	✓		▪ Excludes projects outside city boundaries ▪ Excludes projects within city boundaries that have been classified and reported under energy or transport, such as district heating and bus rapid-transit systems, to prevent double counting across sectors	
AFD	✓	▪ Tracking of climate portion is based on a review at appraisal stage of the climate impacts of each project financed ▪ Total project cost is counted if the project's total carbon footprint shows a net reduction in emissions		▪ Excludes power-generation projects ▪ Sector/instrument splits were provided as percentages of total urban mitigation or adaptation finance; these percentages were used to calculate absolute monetary values ▪ Sector breakdowns were not provided for adaptation financing; these flows were allocated to "Other"
AfDB	✓		▪ Projects such as electricity or water and sanitation that supply both urban and rural areas were excluded	
CAF	✓			
EIB	✓		▪ Did not provide total climate figures for 2014, so excluded from the analysis of urban climate as % of total climate	▪ Did not provide splits, so excluded from sector and instrument analysis
IDB	✓			▪ Sector and instrument splits were given in aggregate for 2012–14; annual figures were estimated by dividing these by 3
JICA		▪ Total project costs provided ▪ Projects identified as "climate" were expected to achieve climate objectives as a whole, so the scope of projects provided may be smaller than at other institutions	▪ Did not provide total climate figures for 2014, so excluded from the analysis of urban climate as % of total climate	
KfW		▪ Provided total project costs without breaking out the climate portion ▪ For projects with both mitigation and adaptation effects, costs were split 50/50 between mitigation and adaptation to avoid double counting		▪ Sector and instrument splits were given in aggregate for 2010–14; annual figures were estimated by dividing these by 5
WB	✓		▪ Projects were identified as urban if their title, development objective, or components showed they had urban focus or scope ▪ Projects outside the geographic boundaries of urban areas were excluded	

Exhibit B2: Sector groupings used in the analysis

Sector	Activities included, based on segmentation by survey participants
Energy	▪ Renewable energy ▪ Low-carbon and energy-efficient generation ▪ Energy efficiency ▪ Energy-efficient building design and techniques ▪ Solar power ▪ Adaptation initiatives related to energy and other built environment and infrastructure ▪ Energy efficiency in heat and power ▪ Hydropower ▪ Electricity transmission and distribution
Transport and telecom	▪ Transport ▪ Sustainable transport ▪ Retrofits of existing vehicles with lower-carbon technologies ▪ Urban mass transit ▪ Non-motorized transport ▪ Integrated transport and urban planning that reduces the use of cars (e.g., denser developments, walking communities) ▪ Rail transport that shifts passengers or freight away from roads ▪ Transport and communication ▪ Adaptation initiatives related to transport and other built environment and infrastructure ▪ Inter-urban roads and highways
Water and waste	▪ Waste and wastewater management ▪ Water preservation ▪ Waste recycling ▪ General waste, sanitation and flood protection ▪ Waste collection and transportation ▪ Water supply
Natural resource protection	▪ Agricultural and natural resource–based adaptation ▪ Environmental protection ▪ Natural resources ▪ Adaptation initiatives related to industry, extractive industries, manufacturing and trade
Urban development	▪ Urban development ▪ Sustainable economic development
Policy	▪ Democracy, civil society, and public administration ▪ Local, sectoral, or national budget support to a climate-change adaptation policy ▪ Compulsory health finance ▪ Public administration in various sectors ▪ Sub-national government administration
Other support (includes non-identified items)	▪ Cross-cutting initiatives ▪ Miscellaneous mitigation and adaptation initiatives ▪ General finance sector (related to adaptation) ▪ Non-compulsory pensions and insurance (related to adaptation) ▪ General industry and trade sector (related to adaptation) ▪ Housing construction (related to adaptation) ▪ Industry and trade ▪ General agriculture, fishing, and forestry sector ▪ Education ▪ Disaster risk reduction ▪ Education, training, capacity building, and awareness raising on climate-change mitigation, sustainable energy, and sustainable transport; mitigation research ▪ Technical services or other professional support to beneficiary organizations for adaptation initiatives

NOTES

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[2] *How to Make a City Great: McKinsey Cities Special Initiative,* McKinsey & Company, 2013.

[3] Amar Bhattacharya *et al.*, "Driving sustainable development through better infrastructure: Key elements of a transformation program", July 2015, Brookings, http://www.brookings.edu/research/papers/2015/07/sustainable-development-infrastructure-bhattacharya.

[4] Barbara Buchner *et al.,* "The global landscape of climate finance 2014", Climate Policy Initiative, November 2014.

[5] Includes data from eight of the nine development banks that provided urban climate data for 2014; calculation based on a weighted average of total climate finance as a percentage of total bank commitments. A detailed explanation of methodology can be found in Appendix B.

[6] Calculation based on a weighted average of urban climate finance as a percentage of total bank commitments; JICA did not provide total climate figure for 2014 and was excluded from this analysis.

[7] *World Urbanization Prospects: 2014 Revision, Highlights* (ST/ESA/SER.A/352), United Nations, Department of Economic and Social Affairs, Population Division, 2014.

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[13] *World Urbanization Prospects: The 2014 Revision* (ST/ESA/SER.A/366), United Nations, Department of Economic and Social Affairs, Population Division, 2015.

[14] Ibid.

[15] According to estimates derived from the McKinsey Global Institute's Cityscope database v2.55 (2015), which includes cities with populations of 150,000 or more in developed countries and populations of 200,000 or more in developing countries and provides information for 2,910 cities in total. The estimates also include data for smaller urban areas taken from World Urbanization Prospects: The 2014 Revision (ST/ESA/SER.A/366), United Nations, Department of Economic and Social Affairs, Population Division, 2015.

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[19] All World Bank figures from this study are in 2005 dollars, and no discount is applied for future costs.

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[21] Claire Eschalier and Alexia Leseur, "Financing urban adaptation to climate change impacts: Mapping of existing initiatives", CDC Climat and Groupe Caisse de Depots in partnership with AFD, 30 June 2015.

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[25] Common Principles for Climate Mitigation Finance Tracking, http://www.worldbank.org/content/dam/Worldbank/document/Climate/common-principles-for-climate-mitigation-finance-tracking.pdf.

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[30] Ibid.

[31] Asian Development Bank, Agence Française de Développement, African Development Bank, CAF Development Bank of Latin America, European Investment Bank, Inter-American Development Bank, Japan International Cooperation Agency, KfW Development Bank, and the World Bank. The World Bank data used in this report comes from the International Bank for Reconstruction and Development and International Development Association and does not include investments made by the Multilateral Investment Guarantee Agency or the International Finance Corporation.

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[38] JICA did not provide total climate figure for 2014 and was therefore excluded from this analysis.

[39] Based on a weighted average of urban climate finance as a percentage of total bank commitments.

[40] A more detailed description of survey methodology and calculations is provided in Appendix B.

[41] Based on a simple average of urban climate finance as a percentage of total bank commitments.

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