

A photograph of three children splashing in the water in front of a large wind farm at sunset. The children are in the foreground, splashing water, while the wind turbines are in the background against a hazy, orange sky.

THE SUSTAINABLE INFRASTRUCTURE IMPERATIVE

Financing for Better Growth and Development

THE 2016 NEW CLIMATE ECONOMY REPORT

THE **NEW** CLIMATE **ECONOMY**

The Global Commission on the Economy and Climate

PARTNERS

Managing Partner



New Climate Economy
c/o World Resources Institute
10 G St NE
Suite 800
Washington, DC 20002, USA
+1 (202) 729-7600

New Climate Economy
c/o Overseas Development Institute
203 Blackfriars Road
London, SE1 8NJ, UK
+44 (0) 20 7922 0300

www.newclimateeconomy.report
www.newclimateeconomy.net





October 2016

Cover photo credit:
Flickr/The Danish Wind Industry Association

Current page photo credit:
Flickr/DFID



Photo credit: Flickr/IIP Photo Archive

The New Climate Economy

The Global Commission on the Economy and Climate, and its flagship project The New Climate Economy, were set up to help governments, businesses and society make better-informed decisions on how to achieve economic prosperity and development while also addressing climate change.

The New Climate Economy was commissioned in 2013 by the governments of Colombia, Ethiopia, Indonesia, Norway, South Korea, Sweden and the United Kingdom. The Commission has operated as an independent body and, while benefiting from the support of the partner governments, has been given full freedom to reach its own conclusions.

In September 2014, the Commission published *Better Growth, Better Climate: The New Climate Economy Report* and in July 2015 it published *Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate*. The project has released a series of country reports on Brazil, China, Ethiopia, India and the United States, and various reports on cities, land use, energy and finance. It has disseminated its messages by engaging with heads of governments, finance ministers, business leaders and other key economic decision-makers in over 45 countries around the world.

The Commission's 2016 report *The Sustainable Infrastructure Imperative: Financing for Better Growth and Development* is a synthesis of the latest evidence and analysis of relevance. In particular, the Commission's deliberations, findings and recommendations drew extensively on *Delivering on Sustainable Infrastructure for Better Development and Better Climate*, by Amar Bhattacharya, Joshua P. Meltzer, Jeremy Oppenheim, M. Zia Qureshi and Nicholas Stern (forthcoming) which was part of a work program launched by the NCE partnership to contribute to the milestone events in 2015 and inform and give concrete impetus to the delivery of sustainable infrastructure as a central element of the 2015 global agenda. In addition, please see page 150 for the full list of those who provided expert inputs or comments to the draft report.

The Commission's programme of work is conducted by a global partnership of numerous leading institutions, including: World Resources Institute (WRI, Managing Partner), Climate Policy Initiative (CPI), Ethiopian Development Research Institute (EDRI), Global Green Growth Institute (GGGI), Indian Council for Research on International Economic Relations (ICRIER), Overseas Development Institute (ODI), Stockholm Environment Institute (SEI) and Tsinghua University.

The Global Commission on the Economy and Climate

The Global Commission on the Economy and Climate comprises former heads of government and finance ministers, and leaders in the fields of economics, business and finance. Members of the Global Commission endorse the general thrust of the arguments, findings, and recommendations made in this report, but should not be taken as agreeing with every word or number. They serve on the Commission in a personal capacity. The institutions with which they are affiliated have therefore not been asked formally to endorse the report and should not be taken as having done so.

Felipe Calderón, Former President of Mexico (Chair)

Nicholas Stern, IG Patel Professor of Economics and Government at the London School of Economics and Political Science and President of the British Academy (Co-Chair)

Sharan Burrow, General Secretary, International Trade Union Confederation (ITUC)

Suma Chakrabarti, President, European Bank for Reconstruction and Development (EBRD)

Chen Yuan, Vice-Chair, National Committee of the Chinese People's Political Consultative Conference; former Chairman, China Development Bank

Helen Clark, Administrator, UN Development Programme (UNDP); former Prime Minister of New Zealand

Jamshyd Godrej, Chairman and Managing Director, Godrej & Boyce Mfg Co. Ltd., India

Stuart Gulliver, Group Chief Executive, HSBC

Ángel Gurría, Secretary-General, Organisation for Economic Co-operation and Development (OECD)

Chad Holliday, Chairman, Royal Dutch Shell

Sri Mulyani Indrawati, Finance Minister of Indonesia, former Managing Director and Chief Operating Officer, The World Bank

Naina Lal Kidwai, Chairman, Max Financial Services; Chairman, FICCI Water Mission

Caio Koch-Weser, Chair, European Climate Foundation, Former Vice Chairman, Deutsche Bank Group

Ricardo Lagos, Former President of Chile; Professor at Large, Watson Institute for International Studies, Brown University

Carlos Lopes, Executive Secretary, United Nations Economic Commission for Africa

Takehiko Nakao, President, Asian Development Bank

Ngozi Okonjo-Iweala, Former Minister of Finance, Federal Republic of Nigeria

Eduardo Paes, Mayor, Rio de Janeiro

Paul Polman, Chief Executive Officer, Unilever

Christian Rynning-Tønnesen, President and Chief Executive Officer, Statkraft

Kristin Skogen Lund, Director-General, Confederation of Norwegian Enterprise

Jean-Pascal Tricoire, Chief Executive Officer and Chairman, Schneider Electric

Maria van der Hoeven, Former Executive Director, International Energy Agency (IEA)

“ Investing in sustainable infrastructure is the growth story of the future. This report provides a roadmap to deliver a safe and prosperous future for ourselves and our children. Follow it well and follow it fast. ”

– The Global Commission on the Economy and Climate

Table of Contents



Executive Summary 10



Section 1 19
The sustainable infrastructure opportunity

1.1 Current investment trends 24
 1.2 Charting the finance roadmap 27



Section 2 29
A roadmap for financing sustainable infrastructure

2.1 Where does infrastructure finance come from? 30
 2.2 Barriers to sustainable infrastructure financing 33
 2.3 Key areas for action 37



Section 3 47
Transforming the financial system

3.1 Greening the financial system 49
 3.2 Strengthening the role of multilateral development banks and other development finance institutions 62



Section 4 65
Energy

4.1 Addressing the fundamental price distortions 69
 4.2 Strengthening investment frameworks, institutional capacity and policies 74
 4.3 Boosting investment in innovation 83



Section 5 85
Cities

5.1 Addressing the fundamental price distortions 89
 5.2 Strengthening investment frameworks, institutional capacity and policies 92
 5.3 Boosting innovation 99



Section 6 101
Land Use

6.1 Addressing price distortions and market failures 106
 6.2 Strengthening investment frameworks, institutional capacity and policies 109
 6.3 Boosting agricultural R&D investment 118



Endnotes 120

The Sustainable Infrastructure Imperative: Financing for Better Growth and Development

Key Messages

Investing in sustainable infrastructure is key to tackling the three central challenges facing the global community: reigniting growth, delivering on the Sustainable Development Goals, and reducing climate risk in line with the Paris Agreement.

A comprehensive definition of infrastructure includes both traditional types of infrastructure (everything from energy to public transport, buildings, water supply and sanitation) and, critically, also natural infrastructure (such as forest landscapes, wetlands and watershed protection).

Significant investment is needed over the next 15 years: around US\$90 trillion, which is more than the entire current stock. These demands are driven by ageing infrastructure in advanced economies and higher growth and structural change in emerging market and developing countries, especially rapid urbanization.

The global South will account for roughly two-thirds of global infrastructure investment (or about US\$4 trillion per year). This new infrastructure offers a great opportunity to “leapfrog” the inefficient, sprawling and polluting systems of the past.

Transformative change is needed now in how we build our cities, produce and use energy, transport people and goods, and manage our landscapes.

The challenge is urgent. The window for making the right choices is uncomfortably narrow because of lock-in of capital and technology and because of a shrinking carbon budget. The next 2-3 years will be crucial in bringing about a fundamental change of direction. We can build cities where we can move, breathe and be productive, we can foster ecosystems that are robust and resilient, and we can avoid the potential displacement of millions of people.

We have a historic opportunity to deliver inclusive economic growth, eliminate poverty and reduce the risk of climate change. Now is an opportune time to act because of record low interest rates, large available pools of finance and rapid technological change.

More money alone won't do the job. A range of barriers must be tackled to raise the quantity and the quality of infrastructure investment. Concerted action in four, inter-linked areas can together help us overcome these barriers and build the sustainable infrastructure of the 21st century:

1. We must collectively **tackle fundamental price distortions** – including subsidies and lack of appropriate pricing especially for fossil fuels and carbon – to improve incentives for investment and innovation, to drastically reduce pollution and congestion, and to generate revenue that can be redirected, for instance, to support poor people.
2. We must **strengthen policy frameworks and institutional capacities** to deliver the right policies and enabling conditions for investment, to build pipelines of viable and sustainable projects, to reduce high development and transaction costs, and to attract private investment.
3. We must **transform the financial system to deliver the scale and quality of investment needed** in order to augment financing from all sources (especially private sources such as long-term debt finance and the large pools of institutional investor capital), reduce the cost of capital, enable catalytic finance from development finance institutions (DFIs), and accelerate the greening of the financial system.
4. We must **ramp up investments in clean technology R&D and deployment** to reduce the costs and enhance the accessibility of more sustainable technologies.

Multilateral and other DFIs can support countries and catalyse a virtuous circle of action on sustainable infrastructure. Public investments continue to be essential. Private finance will need to significantly scale up to meet our infrastructure requirements.

The Global Commission has identified a number of priority actions to rapidly shift investments toward sustainable infrastructure. A number of their previous recommendations are also relevant to this agenda.

Figure A

Action areas to scale up and shift public and private investments to sustainable infrastructure



Tackle fundamental price distortions



Strengthen investment policy frameworks and capacity



Transform the financial system to deliver the scale and quality of investment needed



Boost investments in clean technology R&D and deployment

TO ACHIEVE THIS, THE GLOBAL COMMISSION CALLS ON:

- Governments to phase out subsidies for fossil fuels and agricultural inputs and incentives for urban sprawl.*
- Governments, including through the G20, to set a deadline for fossil fuel subsidy phase-out of 2025 at the latest.
- Government to introduce strong, predictable carbon prices as part of good fiscal reform;* with all developed and emerging economies, and others where possible, committing to introducing or strengthening carbon pricing by 2020.†
- All countries to develop transition plans to accelerate a scale-up of clean and resilient energy solutions and a phase-out of coal, in a way that delivers fully on energy access goals and facilitates a just transition for workers.
- The G20 and other countries to adopt key principles ensuring the integration of climate risk and climate objectives in national infrastructure policies and plans; these principles should be included in the G20 global infrastructure initiative, as well as used to guide the investment strategies of public and private finance institutions, particularly multilateral and national development banks.†
- Cities to commit to developing and implementing low-carbon urban development strategies by 2020, prioritising policies and investments in public, non-motorised and low-emission transport, building efficiency, renewable energy and efficient waste management.†
- Multilateral and other DFIs – via their shareholders – to enable the doubling of their investments in financing sustainable infrastructure as quickly as is feasible, and scale up further as warranted.
- Governments and investors to agree on common standards for and scale up green bonds as an instrument to enhance liquidity in financial markets and unlock capital for investment.
- Countries, especially those in the G20, to build on the Task Force on Climate-related Financial Disclosures' work to move toward appropriate mandatory disclosure standards as a matter of corporate governance.
- Governments, multilateral and bilateral finance institutions, the private sector and willing investors to work together to scale up sustainable land use financing, for halting deforestation and putting degraded farmlands and forests into restoration.†
- Governments and the private sector to scale up innovation in key low-carbon and climate-resilient technologies, tripling public investment in clean energy R&D and removing barriers to entrepreneurship and creativity.*
- Governments and businesses to substantially increase investments in R&D and deployment, and calls on governments to develop genuine research partnerships, across countries and with the private sector.

This agenda will help translate the ambitions of the 2015 development and climate goals into effective delivery in countries and key economic systems.

Note: * - recommendations from the 2014 Global Commission report; † - recommendations from the 2015 Global Commission report.

Executive Summary

Investing in sustainable infrastructure is key to tackling three simultaneous challenges: reigniting global growth, delivering on the Sustainable Development Goals (SDGs), and reducing climate risk. Following the milestone achievements of 2015 – including the ambitious global goals set for sustainable development and its financing in Addis Ababa and New York, and through a landmark international agreement on climate action in Paris – the challenge is to now to shift urgently from rhetoric into action.

Infrastructure underpins core economic activity and is an essential foundation for achieving inclusive sustainable growth. It is indispensable for development and poverty elimination, as it enhances access to basic services, education and work opportunities, and can boost human capital and quality of life. It has a profound impact on climate goals, with the existing stock and use of infrastructure associated with more than 60% of the world's greenhouse gas (GHG) emissions. Climate-smart, resilient infrastructure will be crucial for the world to adapt to the climate impacts that are already locked-in – in particular, to protect the poorest and most vulnerable people. Ensuring infrastructure is built to deliver sustainability is the only way to meet the global goals outlined above, and to guarantee long-term, inclusive and resilient growth.

A comprehensive definition of infrastructure includes both traditional types of infrastructure (everything from energy to public transport, buildings, water supply and sanitation) and, critically, also natural infrastructure (such as forest landscapes, wetlands and watershed protection).

Sustainability means ensuring that the infrastructure we build is compatible with social and environmental goals, for instance by limiting air and water pollution, promoting resource efficiency and integrated urban development and ensuring access to zero- or low-carbon energy and mobility services for all. It also includes infrastructure that supports the conservation and sustainable use of natural resources, and contributes to enhanced livelihoods and social wellbeing. Bad infrastructure, on the other hand, literally kills people by causing deadly respiratory illnesses, exacerbating road accidents and spreading unclean drinking water, among other hazards. It also puts pressure on land and natural resources, creating

unsustainable burdens for future generations such as unproductive soils and runaway climate change.

The challenge is urgent: the investment choices we make even over the next 2-3 years will start to lock in for decades to come either a climate-smart, inclusive growth pathway, or a high-carbon, inefficient and unsustainable pathway. The window for making the right choices is narrow and closing fast, as is the global carbon budget. The time is ripe for a fundamental change of direction. Today's low interest rates and rapid technological change mean that this is an especially opportune moment for sustainable infrastructure-led growth, and for investing in a better future.

The world is expected to invest around US\$90 trillion in infrastructure over the next 15 years, more than is in place in our entire current stock today. These investments are needed to replace ageing infrastructure in advanced economies and to accommodate higher growth and structural change in emerging market and developing countries. This will require a significant increase globally, from the estimated US\$3.4 trillion per year currently invested in infrastructure to about US\$6 trillion per year. The Global Commission has found that it does not need to cost much more to ensure that this new infrastructure is compatible with climate goals, and the additional up-front costs can be fully offset by efficiency gains and fuel savings over the infrastructure lifecycle. But many of these solutions require higher up-front financing, with the savings and other benefits accruing later. To deliver these solutions at scale, financing and investment have to be mobilised and better deployed from a multitude of different domestic and external sources, including national and local governments, multilateral and other development banks, private companies and institutional investors. International financing will be particularly important to support this transition in developing countries.

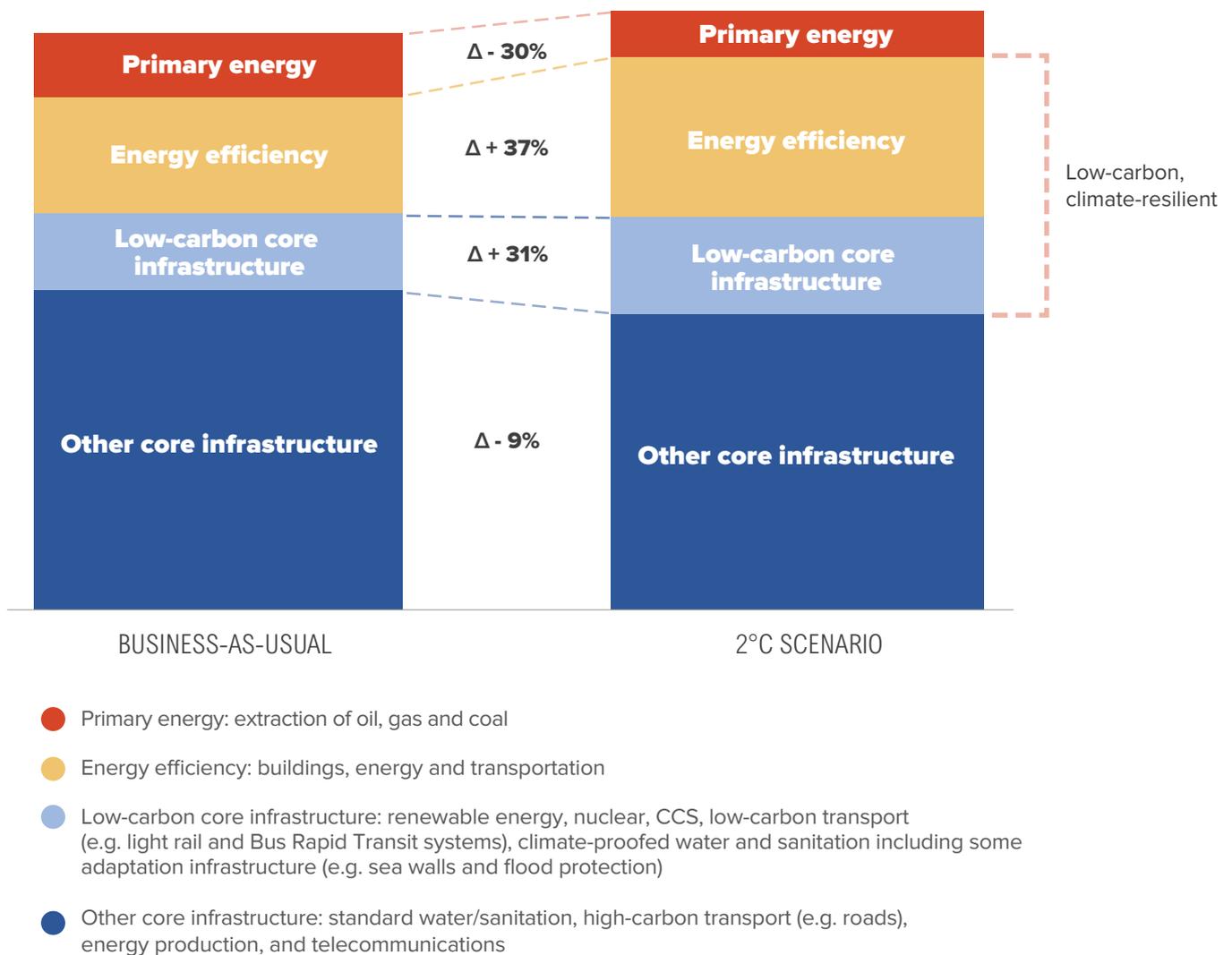
The global South will account for roughly two-thirds of global infrastructure investment (or about US\$4 trillion per year) and can lead in building new sustainable infrastructure that “leapfrogs” the inefficient, sprawling and polluting systems of the past. Developing countries, such as those in Asia and Africa, need infrastructure to improve access to basic services, drive development and meet the needs of rapidly-urbanising populations and an expanding middle class. Resource-rich countries that rely on natural

capital need to manage, maintain and enhance ecosystem goods and services. Many advanced economies, meanwhile, have to replace and upgrade power transmission and distribution systems, long-neglected bridges, water and sewerage pipelines, mass transit systems and other infrastructure.

Transformative change is needed now in how we build our cities, transport people and goods, produce and use energy, and

manage our landscapes. Globally, at least 60% of infrastructure investment over the next 15 years will be made in the energy and transport sectors.ⁱ To transform the energy sector, it is estimated that investments in oil, coal and gas must decrease by about one-third by 2030, while investments in renewables and in energy efficiency must increase by at least a similar proportion if we are to keep global average temperature rise below 2°C (see Figure B).

Figure B
Change in infrastructure spending required for a 2°C scenario
 (percentage change in expenditure over 2015-2030 compared to Business-as-Usual)



Note: Δ is the mathematical symbol for change.

Source: Bhattacharya et al., 2016; Global Commission on the Economy and Climate, 2014

ⁱ Note that this does not include investment needs for natural infrastructure, for which reliable estimates are lacking.

We need to increase both the quantity and the quality of infrastructure investment, but major barriers persist. These include unfavourable policies and investment regulations, a lack of transparent and bankable project pipelines, inadequate risk-adjusted returns, a lack of viable funding models and often high transaction costs. Unlocking finance for sustainable infrastructure will require coordinated reforms across policies, institutions and practices in financial markets.

More money alone won't do the job. Concerted action in four, inter-linked areas can together help us overcome these barriers and build the sustainable infrastructure of the 21st century. Governments will play a leading role in shaping and directing action across these areas. The Global Commission emphasises the particularly catalytic role that multilateral, regional and bilateral development finance institutions, as well as national development banks, can play in supporting countries and enabling a virtuous circle of action on sustainable infrastructure. In order to reach the scale of investments needed, however, the private sector will have an increasingly significant part to play in infrastructure investment.

First, we must collectively tackle fundamental price distortions – including subsidies and lack of appropriate pricing which leads to poor infrastructure investment decisions – to improve incentives for investment and innovation, and to generate revenue. The Global Commission on the Economy and Climate has repeatedly emphasised the importance of phasing out fossil fuel subsidies (which amounted to around US\$550 billion in 2014ⁱⁱ) and other distorting subsidies and tax breaks, such as those for water use, company cars and parking, and access to natural resources. Evidence is building of how successful reforms can free up scarce government revenues for other priorities, such as protecting poor households and managing the transition for affected sectors. For example, these savings can be channelled into programmes that benefit poor people, through better targeted income support and social safety nets, through investments in pro-poor infrastructure such as off-grid renewable energy solutions and energy efficiency, etc.

In the last three years, almost 30 countries have initiated or accelerated reforms of their fossil fuel subsidies, with many taking advantage of low oil prices to do so. Egypt, for instance, raised fuel prices by 78% in 2014 and plans to double them over the next five years; Canada has phased out several subsidies to oil, gas and mining, including ending targeted support to tar sands production; Indonesia raised gasoline and diesel prices by 33% in 2013 and another 34% in 2014; and India eliminated diesel subsidies in October 2014 after incremental hikes. Given that subsidies to energy and fuel often particularly benefit middle- and high-income households, reforms can be progressive and channelling the savings into the right areas can benefit the poorest and most vulnerable in society.

While there is momentum, further reform is needed in both developed and developing economies. Both the G7 countries and North American leaders recently set a deadline of 2025 to phase out their fossil fuel subsidies. Other countries, including the G20, should follow suit. Many international institutions (such as the IMF, OECD, World Bank and IEA) have shown important leadership on this and are supporting progress in countries around the world.

The Global Commission also continues to emphasise the fundamental importance of strong, effective and rising carbon prices as a necessary condition for inclusive and low-carbon growth, in line with the Paris Agreement. Current pricing schemes collectively cover only about 12% of global GHG emissions, but a number of countries and companies have recently stepped up action, including through energy pricing reforms that effectively send a price signal to shift to cleaner energy solutions. Around 40 countries have implemented or scheduled carbon pricing. China, for example, will establish a national emissions trading system in 2017, expected to be the largest in the world. France adopted a carbon tax on transport, heating and other fossil fuels in 2014, and Vietnam took action in 2015 to adjust taxes, including on transport fuels, to better reflect their carbon content. Similarly, over 1,000 companies have now adopted an internal carbon price or plan to do so soon. Corporate leaders with pricing already in place include major consumer staples companies, such as Nestlé and Unilever; car brands, such as Mazda and General Motors; energy companies, such as Shell and BP; and financial giants, such as Barclays.

ⁱⁱ This number is based on IEA and OECD data and includes direct subsidies and other support for the exploration, production, and consumption of fossil fuels in developed and developing countries. When the IMF adds non-internalised externalities (e.g. air pollution, traffic congestion, climate change), the estimates rise to US\$4.9 trillion in 2013, or 6.5% of global GDP.

The Global Commission welcomes the emerging coalitions of governments, investors and businesses that have the potential to accelerate action globally on carbon pricing and fossil fuel subsidy reform, including by highlighting evidence of good practice and building multi-stakeholder partnerships for reform.

The Carbon Pricing Leadership Coalition, launched at COP21 in Paris, for example, is helping to build the evidence base on effective carbon pricing systems and share lessons learned. It brings together leaders from the public and private sectors, including from 26 governments, over 90 businesses, and more than 30 other strategic partners.

More broadly, pricing of infrastructure services should reflect the full costs of their provision, including where possible the social and environmental externalities. Lack of proper user charges for built infrastructure is a major impediment to attracting private investment, as private investors and operators require predictable and robust revenue streams to recover their costs. For public-managed infrastructure, lack of appropriate pricing limits the availability of funds for properly maintaining the existing infrastructure or for extending service to those without access (e.g. to water, energy, roads and public transport). Overall, poor pricing leads to reduced service provision and quality. This can turn into a vicious circle, whereby infrastructure users are dissatisfied with the services, and thus reluctant to pay for them. For energy and urban systems, pricing is essential to reflect the social costs of externalities, for example the costs of air pollution from fossil fuel use as well as of congestion from urban vehicle use. For natural infrastructure and ecosystem services, pricing to reflect the value of these services can ensure efficient use, for instance, by reducing wasteful use of water or timber, and help secure finances to support local communities to invest in restoration and maintenance of the ecosystems.

Second, we must strengthen policy frameworks and institutional capacities to deliver the right policies and enabling conditions for investment, to build pipelines of viable and sustainable projects, to reduce high development and transaction costs, and to attract private investment. Countries need a well-defined and appropriately designed pipeline of bankable, sustainable projects. But the capacity to develop and implement projects is low because of underlying

issues such as poor planning, lack of mandate, skills shortages, inadequate regulatory frameworks for public-private partnerships and implementation, and weak enabling policy environments. Governments and development finance institutions are already working to expand capacity, but much more is required, including increased concessional finance for project preparation, and strengthened support for implementation within a broader policy reform process (such as measures to tackle inefficiencies, improve governance and combat corruption) which reaches beyond central government agencies to cover subnational and local-level entities.

Overall, governments have to make a greater effort to “invest in investment” – to improve public infrastructure planning, management, governance and policies. At the same time, to ensure sustainability over the long term, investment plans and project selection must better reflect environmental and social sustainability criteria. Governments should develop and implement procurement processes that incorporate sustainability criteria and are systematic and consistent in approach.

A stable and predictable policy and regulatory environment can attract investment in infrastructure, supported by stronger enabling environments for business, for example by enhancing competition, trade policies and corporate disclosure. Of particular importance is the need to strengthen governance frameworks, including anti-corruption measures. Public-Private Partnerships (PPPs) can help, if implemented well, to secure private engagement in sustainable infrastructure investment. Improving the institutional and regulatory frameworks for PPPs – including the transparency and credibility of processes for selection and agreement on projects, consistency of policy and implementation, and standardisation of contracts and documents – is essential to boost investor confidence and attract the scale of investment needed.

Clear national, subnational and sectoral development strategies, with accompanying infrastructure and investment plans, are essential to guide long-term public and private investments. Leadership will be needed to monitor progress and ensure that these plans promote low-carbon and climate-resilient development, reflect the financial realities of each country, and are aligned with their Nationally Determined Contributions to achieve the 2°C goal in the Paris Agreement.

A number of countries are starting to take steps in the right direction. For example, Colombia is working to mainstream climate action across its national

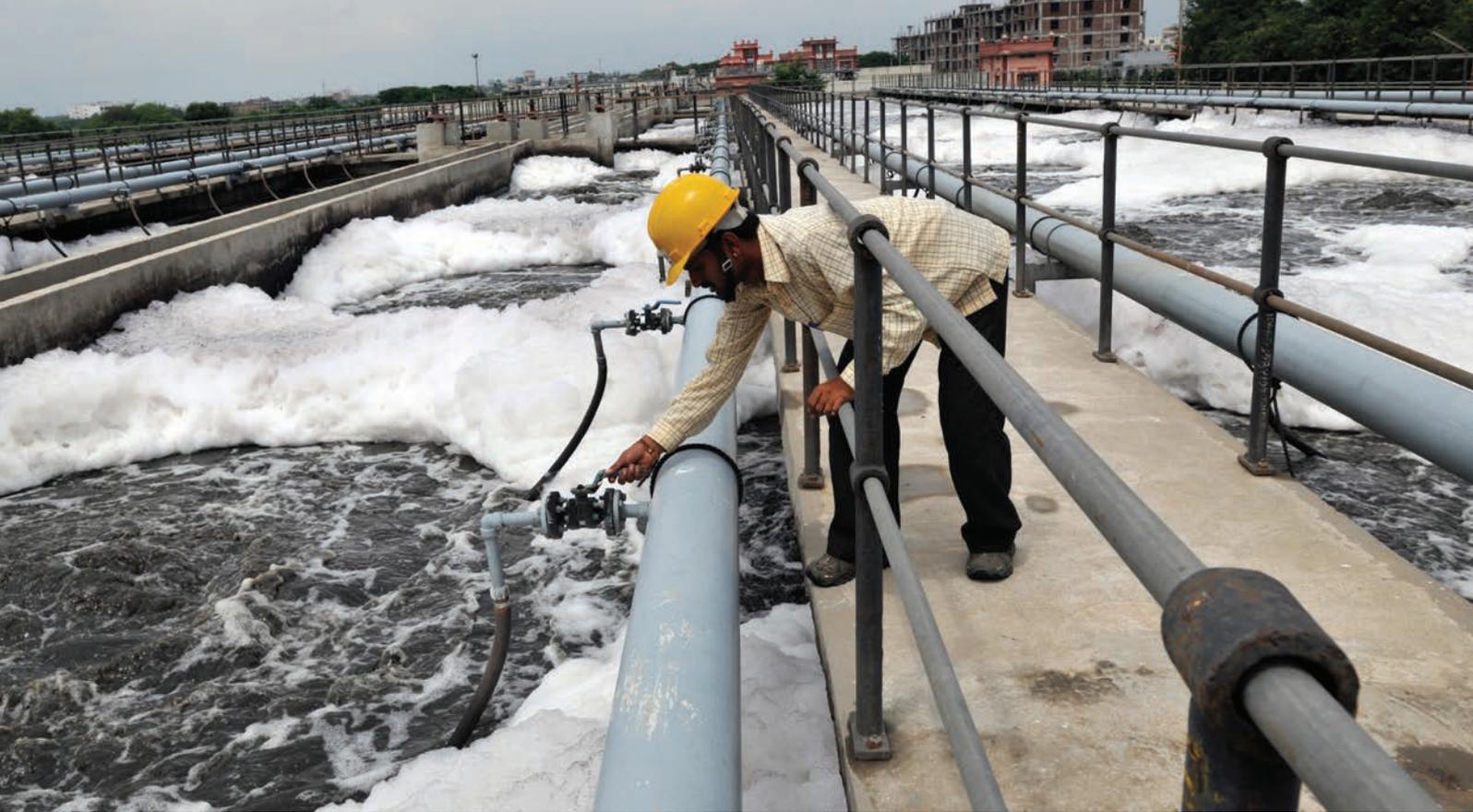


Photo credit: Flickr/ADB

development plan and, amongst other pro-active measures, has established a focused programme on public-private collaboration, with priority attention to investment in infrastructure and achieving environmental sustainability. It has also put a range of fiscal incentives in place for investment in low-carbon technologies and environmentally resilient practices, such as in the forestry sector. In the area of resilience, Zambia has received US\$1.5 million to support a sustainable investment strategy based on its development priorities through the Pilot Program for Climate Resilience, and is making good progress to broadly integrate resilience objectives into its national development planning.

In addition to national strategies, governments must also develop and implement sectoral plans that align with climate goals. Building support for these will not always be easy, especially given potential resistance from powerful incumbents who benefit from business-as-usual. The rapid transformation needed in the energy sector to meet climate goals is particularly challenging.

The Global Commission calls on all countries to develop transition plans to accelerate a scale-up of clean and resilient energy solutions and a phase-out of coal, in a way that delivers fully on energy access goals and facilitates a just transition for workers.

These transition plans should include both measures to ensure that clean energy solutions are economically attractive and affordable, and those that will better reflect the true costs of coal and other fossil fuels. The Global Commission welcomes the establishment of a Just Transition Centre that is initiated by the International Trade Union Confederation (ITUC) with emerging partnerships with business and civil society, focused on dialogue between governments, employers, workers and civil society around how to ensure a “just transition” towards including at national and sectoral levels. **Third, we must transform the financial system to deliver the scale and quality of investment needed in order to augment financing from all sources (especially private sources such as long-term debt finance and the large pools of institutional investor capital), reduce the cost of capital, enable catalytic finance from development finance institutions (DFIs), and accelerate the greening of the financial system.** The scale of financing requirements for sustainable infrastructure calls for a strengthening of resources from all sources: public and private, domestic and external. It will involve regulatory action, policies, better governance frameworks and business practices to harness capital markets and the financial system to deliver sustainable development.

Public finance, whether through domestic resources or through development finance, will remain fundamental to the provision of infrastructure, including by playing

a catalytic role in attracting private finance. In developing and emerging economies, about 60–65% of the cost of infrastructure projects is financed by public resources, while in advanced economies this figure is around 40%.

National budget allocations to support sustainable infrastructure investment are essential and should increase. This will often include the use of revenues that countries raise themselves, for example through taxes, or other finance they are able to raise, including through bonds, loans, or through development finance institutions. Fossil fuel subsidy reform and carbon pricing, emphasised above, can also be important sources of capital for sustainable infrastructure. And whatever the source of financing, ensuring effective public spending, including through strong, transparent and green public procurement practices, can allow scarce public resources to achieve more.

Beyond public financing, there is real need to significantly scale up private financing to meet our infrastructure requirements. But there are real challenges in tapping adequate private investment and in bringing down the high costs of finance. Banks and local financial institutions are well suited to provide long-term debt finance in the construction phase. There is also much greater scope to attract institutional investors through equity offerings and the development of local capital markets, including for “take-out” finance (where securitisation of initial debt occurs to make it long-term and attractive to institutional investors). Take-out finance can also help free up capital for more projects over time, since banks are able to sell a part of their loans to a third party and reinvest the money as projects become operational.

DFIs, including Multilateral and Bilateral Development Banks, can play a pivotal role in pioneering and scaling up financing models for sustainable infrastructure that can crowd in private finance. This is especially true in developing countries and in emerging economies, which often face prohibitively high costs of capital due to high perceived risks. For example, interest rates are as high as 18% in India for off-grid renewable energy financing through domestic capital markets. This must change, and can be facilitated through the use of innovative measures, such as more extensive use of guarantees, insurance and other de-risking instruments. In addition to the development and wider deployment of risk mitigation instruments, DFIs can play a role through the use of blended finance more generally (including concessional and non-concessional finance, and dedicated climate finance),

and help create more viable and replicable financing models and tools (e.g. for credit enhancement and risk mitigation). Successful instruments and platforms should be replicated and scaled-up. There is also a need to emphasise the “development” role of DFIs, paying particular attention to the needs of less developed countries for whom the challenges of preparing, financing and executing sustainable infrastructure projects are particularly acute, rather than operating like commercial banks when assessing infrastructure investment risks.

Recognising their important catalytic role, the Global Commission calls on multilateral and other development finance institutions – via their shareholders – to enable the doubling of their investments in financing sustainable infrastructure as quickly as is feasible, and scale up further as warranted.

A number of DFIs are stepping up their investments already, including through measures to expand their capital base, blend finance from different sources and leverage private and other investment in sustainable infrastructure. They are also partnering with countries to strengthen policies, institutions and capacities to reliably deliver domestic resources and ensure a solid pipeline of bankable projects tailored to national priorities. The New Development Bank (BRICS Bank), for example, has recognised the imperative around sustainable infrastructure and is demonstrating initial leadership in this area. In April 2016, it launched its first four investments, worth US\$811 million, all for clean energy projects. In July 2016, it announced its plans to issue green bonds worth approximately US\$450 million. Other important steps are being taken by a number of DFIs, in particular to help crowd in other sources of finance. The European Bank for Reconstruction and Development (EBRD), for example, has played a significant role in accelerating energy efficiency. Since 2006, cumulative EBRD financing of Sustainability Energy Financing Facilities has reached more than €3.4 billion (US\$3.7 billion) in over 100,000 sub-projects, involving more than 100 partner financial institutions in 24 countries, including large international banks and small banks in Central Asia and the Caucasus.

There is increasing potential to mobilise green finance to bolster support for low-carbon and climate-resilient

infrastructure through new tools and approaches like green bonds and green infrastructure. The green bond market reached US\$42 billion in 2015. HSBC, working with the Climate Bonds Initiative, predicts that the amount could more than double this year. With the right approach, green bonds can be powerful instruments and play a tremendous role in facilitating sustainable infrastructure investment and growth. For example, the Philippines issued the first climate bond for a geothermal project in an emerging economy, as a form of credit enhancement. The US\$225 million-equivalent local currency bond comes in addition to a direct Asian Development Bank local currency loan of US\$37.7 million equivalent. Such credit-enhanced project bonds offer an attractive alternative to bank financing, and can mobilise long-term capital to help close the region's infrastructure gap. Applying global standards can ensure that the proceeds are used to finance projects with demonstrable climate or other environmental benefits.

The Global Commission calls on governments and investors to agree on common standards for and scale up green bonds as an instrument to enhance liquidity in financial markets and unlock capital for investment.

A number of major investors, including pension funds and insurance companies, are already starting to shift their investments. For example, over 400 investors with US\$25 trillion in assets have joined the Investor Platform for Climate Actions, committed to increasing low-carbon and climate-resilient investments, including by working with policy-makers to ensure financing at scale. The Norwegian Sovereign Wealth Fund, the largest in the world, has taken steps recently to divest from companies with large coal assets. Attracting more institutional investors to finance sustainable infrastructure would be a big prize, as they have in total an estimated US\$100 trillion in assets under management.

While these examples are promising, further action is required to shift the financial system to support investment in sustainable infrastructure, including through the use of equity offerings, appropriate risk mitigation and development of local capital markets to provide the large sums that will be needed for take-out finance. Establishing some forms of infrastructure as a distinct asset class could also help make it a standard part of investment portfolios and unlock access to large pools of capital, such as from institutional investors.

Investors and shareholders can play a critical role in demanding that companies use environmental, social and governance (ESG) standards, and in considering these as the bottom line for investments. Simplification and standardisation of reporting requirements are both essential for transparency and to ensure that the climate risks that affect financial performance, including the physical risk of climate change and the potential for stranding high-carbon assets, are considered in investment decisions.

An industry-led task force, established under the Financial Stability Board at the request of G20 finance ministers, is drafting recommendations for voluntary measures to disclose climate-related financial risks. The Global Commission welcomes the work of the Financial Stability Task Force on Climate-related Financial Disclosures, and looks forward to its recommendations. Implementing such standards can help ensure that investors have all the information they need to assess whether a company's capacity and strategies can generate value over time, including whether medium- and long-term business strategies align with the policy direction reflected in the Paris Agreement.

A number of countries are leading the way already. France, for example, has introduced mandatory corporate disclosure of climate information, which includes financial risks from climate impacts and carbon reporting across the supply chain. The Chinese central bank has proposed mandatory climate disclosure as part of a series of other reforms to help green its financial system.

The Global Commission calls on countries, especially those in the G20, to build on the work of the FSB Task Force on Climate-related Financial Disclosures to move toward appropriate mandatory disclosure standards as a matter of corporate governance.

The culture and incentives for financiers has started to change but should go further, for example to prioritise and value more sustainable long-term investments over a narrow focus on short-term gains. To enable this, we have to ensure that financial regulations such as capital and solvency rules do not inadvertently act as disincentives to participation by banks and institutional investors. Revamping the financial system will also require a "greening" of banks and their practices or, where existing institutions are insufficient, establishing green investment banks.

The New Climate Economy in Action in Key Economic Systems: Energy, Cities and Land Use

This report outlines how this action agenda can be systematically applied in the real economy. It looks at this through the three key economic systems identified in earlier work of the Global Commission on Economy and Climate that are the major sources of economic growth and have the highest potential for reducing emissions – namely energy, cities and land use. It outlines specific opportunities and challenges in scaling and shifting finance for sustainable infrastructure investment.

Energy: The economic case for investing in clean energy is fast becoming clear, with the costs of renewable energy falling to levels that are increasingly out-competing fossil fuels, and with an increased awareness of the benefits of energy efficiency improvements. This case is particularly clear when we consider the health and economic costs to society of the roughly 4 million premature deaths that occur each year due to fossil fuel-related air pollution. Despite this, coal power capacity equivalent to about 1,500 plants is planned or under construction worldwide today. Close to US\$1 trillion worth of current energy assets are at risk of being stranded if markets fail to anticipate the transition to a low-carbon economy. Coal has the largest negative impacts on human health through the pollution that it causes, yet it receives significant tax breaks in most countries, and its export and development internationally continues to be supported by a number of governments. Given these challenges, the development of dedicated energy transition plans can dramatically accelerate the shift to a clean energy mix, in a way that delivers clean and resilient energy access. A wide range of stakeholders need to be engaged in formulating national and industrial plans to ensure a just transition for all those affected, as noted above.

Cities: Urban infrastructure decisions taken over just the next five years are likely to determine up to one-third of the remaining carbon budget at the global level and will also determine the vulnerability of city dwellers and urban infrastructure to climate impacts. Compact, connected and coordinated urban infrastructure can be low-carbon and resilient while also promoting equitable growth. This includes the development of bicycle infrastructure and affordable mass transport systems such as bus rapid transit to reduce congestion, and regulations and incentives to enhance energy efficiency in buildings. The scale of the investments required makes it difficult for cities to finance them alone, and thus national-local partnerships need to be strengthened. Cities also need to identify and scale up successful examples of how to package sustainable infrastructure into bankable projects and raise finance. National governments can support cities by ensuring that they have the mandate for action, and by working with them to find effective financing solutions.

Land use: The Commission has estimated that land use interventions have the potential to deliver about 30% of the reductions in GHGs needed by 2030. There is an enormous and still not fully realised opportunity for low-cost investments in technologies and practices that can increase agricultural productivity and resilience, protect and restore forests, enhance livelihoods for rural people and lower the required investment in built infrastructure. Such investments can contribute to growth, poverty alleviation and food security, while also delivering essential ecosystem services for adaptation and resilience. This includes increasing public and private investments in R&D and deployment for agriculture and forest solutions, such as climate-smart agricultural technologies and practices, which remains an area of relative under-investment globally at about US\$32 billion per annum. Governments and development finance institutions should also work together with the private sector and civil society, particularly local communities, to design and scale up partnerships, mechanisms and incentives to attract and shift private finance into sustainable land use.

Fourth, we must ramp up investments in clean technology research and development (R&D) and deployment to reduce the costs and enhance the accessibility of more sustainable technologies. Investing in new technologies and practices can make them significantly cheaper and accelerate deployment, reducing upfront financing needed for sustainable infrastructure in both advanced and emerging economies. It can also help overcome the advantages

enjoyed by incumbent technologies and make investing in new technologies less risky.

Over the next 15 years, when key infrastructure systems will be built and locked in for decades, a pressing challenge is to deploy existing state-of-the-art technologies and business models or those that can rapidly be demonstrated at commercial scale, even as we also invest in next-generation technologies for the longer term.

The Global Commission welcomes the recent launch of several promising collaborative multi-partner global initiatives that aim to boost R&D and deployment with climate change as a central theme. Mission Innovation, launched at COP21 in Paris, brings together 21 members as of August 2016 — including the world’s five most populous countries: China, India, the United States, Indonesia and Brazil — that have committed to doubling public investments in clean energy research over the next five years. Similarly, the new Breakthrough Energy Coalition brings together 28 major individual investors with a collective net worth of more than US\$350 billion to provide capital for research on high-risk but promising clean energy technologies. And the Low Carbon Technologies Partnership initiative brings together 150 companies and 70 partners to develop and implement concrete actions that go beyond business-as-usual to tackle climate change.

Better public and private support at scale, public-private initiatives and enhanced international cooperation including in the private sector will be essential to accelerate the innovations of the future and their rapid deployment. Time-bound public investment in the deployment of and access to new existing low-carbon and climate-resilient technologies will be essential to open new markets and overcome incumbent technology and actor advantages.

The Global Commission calls on governments and businesses to substantially increase investments in R&D and deployment, and calls on governments to develop genuine research partnerships, across countries and with the private sector.

The four actions outlined here together set out the beginnings of a roadmap for financing sustainable infrastructure in the new climate economy.

A number of the Recommendations of the Global Commission on Economy and Climate agreed in 2014 and 2015 are still relevant today and essential to this agenda. In addition, as indicated above, the Global Commission has identified a number of further priority actions that can help to rapidly shift investments toward sustainable infrastructure.

Ramping up investment in sustainable infrastructure is the growth story of the future. The Global Commission finds that investing in sustainable infrastructure can boost growth and global demand in the short term, a priority for today’s economic and financial decision-makers. Over the medium term, it can spur innovation, creativity and efficiency of energy, mobility and logistics. It can help to lay the foundation for sustainable industrialisation. And it underpins the only sustainable, long-term growth path on offer, bringing with it a means to increase living standards, promote inclusion and reduce poverty. While the challenges and opportunities vary in different parts of the world, investing in sustainable infrastructure is in the collective global interest as well as in the self-interest of individual countries, whatever their stage of development.

If we act now and act together to finance sustainable infrastructure, better growth, better development, and a better climate are within our reach.



SECTION 1

The sustainable infrastructure opportunity

The year 2015 was a landmark one for sustainable development and climate change.

The world set ambitious goals through the Addis Conference on Financing for Development in July 2015, the adoption of the 2030 Agenda and the Sustainable Development Goals (SDGs) in September, and by reaching a landmark international agreement on climate action at COP21 in Paris in December. This new global agenda has mobilised the support not only of national leaders, but also of mayors, business leaders, investors, civil society and citizens. Now the task is to quickly turn that momentum into on-the-ground action to implement the Paris Agreement, achieve the SDGs, and reignite global economic growth.

Sustainable infrastructure is crucial to all three goals. Investing in it can support inclusive growth, enhance access to basic services that can reduce poverty and accelerate development, and promote environmental sustainability.

For growth: Boosting investment in sustainable infrastructure can stimulate demand at a time when many economies are struggling. The International Monetary Fund (IMF) estimates that for advanced economies, investing an extra 1% of GDP in infrastructure will yield, on average, a 1.5% increase in GDP within four years.¹ In emerging and developing economies, where infrastructure is often inadequate, the benefits for productivity and growth can be even greater, particularly if the investments are accompanied by reforms that increase institutional capacity for better planning and stronger budget processes and rules to guide public spending.² Beyond the immediate boost to growth, investment in sustainable infrastructure can spur innovation and efficiency in key systems such as energy, mobility and logistics. Since the economic and financial crisis that started in 2008, governments have responded with a number of monetary, fiscal and structural policy reforms to boost growth. While important, these have not yet fully delivered the scale and quality of growth desired. The divide between the poorest and the wealthiest continues to grow in many countries, and large gaps persist in basic infrastructure and related services in a number of countries. Awareness is rising of the role that boosting investment in sustainable infrastructure can play to complement and bolster other reforms to deliver better long-term, sustainable and inclusive growth. The pace of action must be accelerated to realise these opportunities.

For inclusive development: Infrastructure is key to the delivery of a number of essential services. It provides a foundation for much of the SDGs' vision for inclusive development. Infrastructure is directly addressed in SDG 9, which calls for resilient infrastructure and sustainable industrialisation. It is key to achieving multiple other goals, such as SDG 6, for instance, on clean water and sanitation and SDG 7 on affordable, reliable, sustainable and modern energy for all. Those basic components, in turn, make it possible to achieve SDG 8 on sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all. Sustainable infrastructure is also central to SDG 11 on safe, resilient and sustainable cities. And natural infrastructure is crucial to SDG 2 on ending hunger and to SDG 15 on protecting forests and biodiversity and combatting desertification.

For the climate: Infrastructure underpins all the major sources of greenhouse gas emissions: our energy systems, transport systems, buildings, industrial operations and land use. The existing stock of infrastructure and its use are associated with more than 60% of the world's total greenhouse gas (GHG) emissions.³ The types of infrastructure we build – coal power plants vs. wind farms and solar arrays, for example, or mega-highways vs. public transit systems – will determine whether we stay on a high-carbon growth path or move towards a climate-smart future. Investing in sustainable infrastructure is thus critical to achieving SDG 13 on combating change climate and its impacts. Not only will it determine GHG emission levels, but it is crucial for resilience: infrastructure can help us withstand climate change impacts and extreme events, or it can increase vulnerability, particularly for the poor.⁴ Countries that are still building much of their basic infrastructure, such as in much of Africa and parts of Asia, have a major opportunity to build climate-smart from the outset, often at no or little additional cost, and avoid costly retrofitting later. They have an opportunity to lead the way on green development, leapfrogging some of the inefficient infrastructure developments that are now proving costly in other countries.

Growth, development and climate action are inextricably tied. Development is impossible without growth, and growth is pointless unless it lifts up the poorest. Climate change threatens both growth and development. If we don't take ambitious action now, it is estimated that up to 720 million people could fall back into poverty by 2050⁵ and the costs of adaptation could reach US\$500 billion dollars per year, unravelling development gains to date.⁶ The future impacts of climate change on poverty relate to today's policy choices.⁷ World Bank research shows that

rapid, inclusive and climate-informed development, including sustainable infrastructure, can prevent most short-term impacts whereas immediate pro-poor, emissions-reduction policies can drastically limit long-term consequences.

Infrastructure can be the pillar upon which we base our growth, development and climate action, or it can crumble beneath us. If we want a prosperous, climate-resilient future, we must invest in sustainable infrastructure; it is the growth story of the future.

Figure 1
Sustainable infrastructure supports many of the Sustainable Development Goals



Source: Bhattacharya et al., 2016.⁸

Box 1:

What is sustainable infrastructure?⁹

Infrastructure, as we use the term in this report, refers to human-built structures and facilities that underpin power and other energy systems (including upstream infrastructure, such as the fuel production sector), transport, telecommunications, water and waste management. It includes investments in systems that improve resource efficiency and demand-side management, such as energy and water efficiency measures. We also interpret the term to include “natural” infrastructure in the form of land use, agriculture and forestry management. Natural, ecosystem-based infrastructure is increasingly recognised as an important complement to traditional “hard” infrastructure, for example by absorbing emissions through forests and soils, or by attenuating the impacts of floods on traditional infrastructure. It can even be a substitute for more traditional infrastructure, for example by providing water purification in many cases at lower cost than the development of a new water treatment plant. By *sustainable* infrastructure, we mean it is:

Socially sustainable: Sustainable infrastructure is inclusive – it serves all, not just a select few – and contributes to enhanced livelihoods and social wellbeing. It may be expressly designed to meet the needs of the poor by increasing access to basic services such as clean energy, water and sanitation, by supporting poverty reduction, and by reducing vulnerability to climate change. Socially sustainable natural infrastructure will protect the resources that communities depend on and build resilience to natural hazards and climate change.

Economically sustainable: Economically sustainable infrastructure does not burden governments with unpayable debt, or impose painfully high costs on users. It helps create jobs and boost GDP, and may include opportunities to build capacity among local suppliers and developers and strengthen livelihoods.

Environmentally sustainable: Environmentally sustainable infrastructure limits all types of pollution during both construction and operation, and supports the conservation and sustainable use of natural resources. It contributes to a low-carbon, resource-efficient economy, for example, through energy- and water-efficiency. It is resilient to climate risks such as sea-level rise and extreme weather events, and – particularly with natural infrastructure – can also increase resilience.

While some infrastructure is unsustainable by one or more of these measures, what constitutes sustainable infrastructure often depends on national circumstances, where sustainability will need to be gauged relative to what could have been built or developed instead. For example, investing in combined-cycle natural gas power plants might help a country or a region phase-out coal power in the near-term but it might also “lock in” natural gas at the expense of renewables.¹⁰ In the final sections of this report, we explore the meaning of sustainable infrastructure in three key economic systems: energy, cities and land use. This includes, for example, discussions of the opportunities and challenges to increasing investments in energy efficiency measures in buildings and industrial facilities, in mass transit systems to reduce the use of individual vehicles, and in efficient land use, agricultural and irrigation infrastructure.

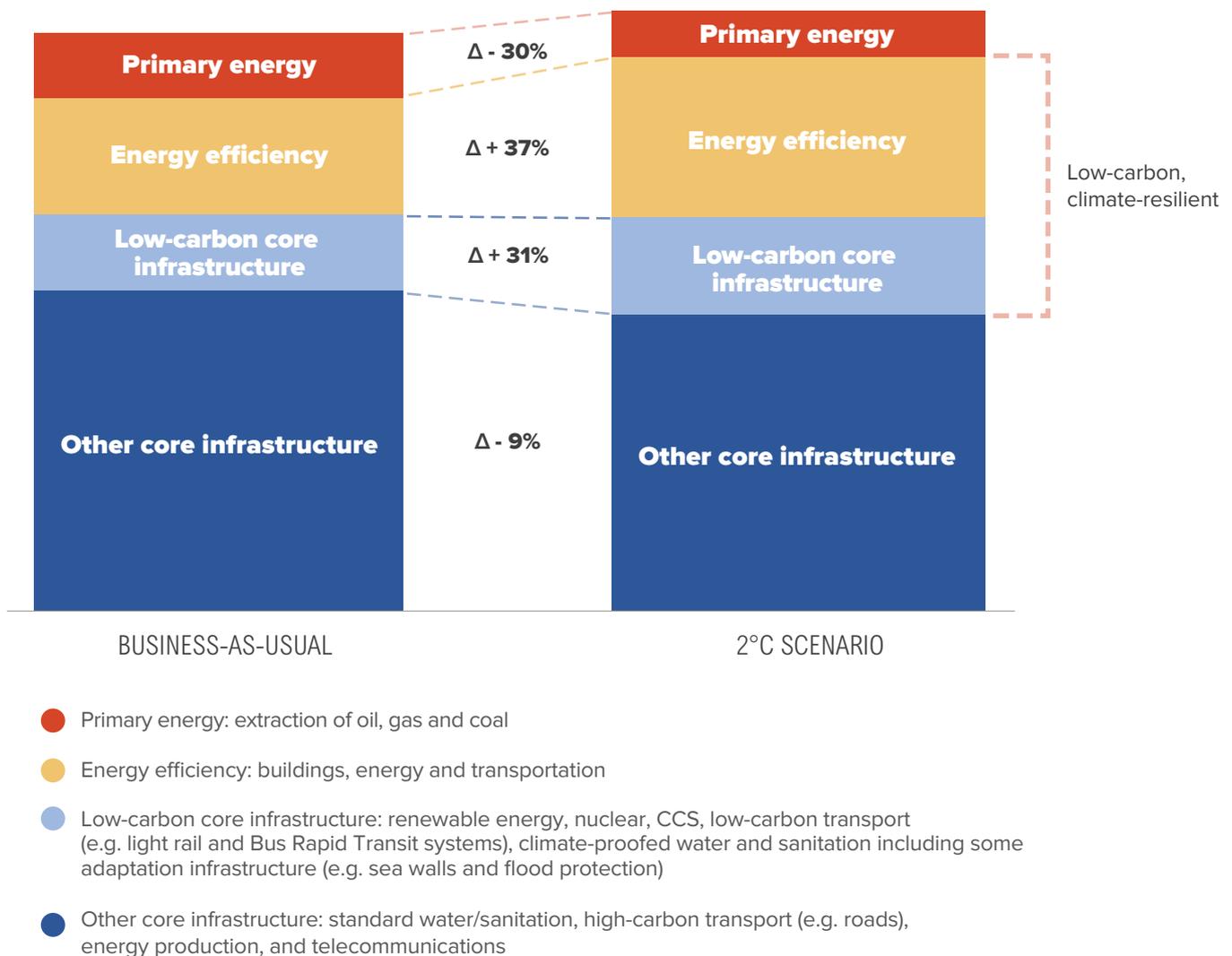
A final key point about sustainable infrastructure is that it contributes to **resilience**. Infrastructure will increasingly need to withstand climate change impacts and extreme weather events such as floods, droughts and extreme heat – and help protect us from these impacts. This means existing infrastructure needs to be “climate-proofed”, and climate risks need to be taken into account in the design of new infrastructure – natural and built. Tackling climate risks through infrastructure design, maintenance and operation will benefit all and is essential to reduce poverty and protect the most vulnerable populations.

The world will invest more in infrastructure over the next 15 years than our entire current stock. To meet demand, which will rise further because of a growing population, faster urbanisation and advances in technology, the world needs to invest about US\$90 trillion in infrastructure between now and 2030—roughly doubling current global investment levels.¹¹ While the next 15 years are critical, the investment choices we make even over the next 2-3 years will start to lock in for decades to come either a climate-smart, inclusive growth pathway, or a high-carbon, inefficient and unsustainable pathway. This is our chance to ensure that we build more infrastructure and the right

kinds of infrastructure, to support economic, social and climate goals.

A key insight of *Better Growth, Better Climate*,¹² the 2014 flagship report of the Global Commission on the Economy and Climate, was that low-carbon and resilient infrastructure does not need to cost much more than the “business-as-usual” alternatives (see Figure 2). The report showed that a shift to low-carbon infrastructure would increase investment needs by as little as 5%, and those higher capital costs could potentially be fully offset by lower operating costs – for example, from reduced fuel use.¹³

Figure 2
Infrastructure spending needed for a 2°C scenario (2015-2030, percentage change)



Note: Δ is the mathematical symbol for change.

Source: Bhattacharya et al., 2016; Global Commission on the Economy and Climate, 2014¹⁴



Photo credit: Flickr/Graham Crouch/World Bank

The first key step is to change how we finance infrastructure, to reflect the new global realities and show results on the ground. That is the focus of this report.

The approval of the SDGs and the signing of the Paris Agreement have made it clear that the transition to a sustainable, climate-resilient future is already under way. The challenge now is to ensure that it benefits all countries at all stages of development.

Achieving that is a task not only for governments, financial institutions and businesses, but for citizens as well, who not only use infrastructure, but also fund it through their taxes, pensions and personal investments. Already, individuals are making more informed decisions, joining shareholder movements and citizen groups to learn more about where their money goes and seeking to influence the direction of public and private investments alike. The awareness, involvement and support of individual citizens is crucial to enable the actions that will drive sustainable infrastructure investment.

1.1 Current investment trends

Over the past decade, annual infrastructure investment has grown by about US\$1 trillion, reaching an estimated US\$3.4 trillion per year in 2014.¹⁵ This is still not nearly enough to match investment needs, which are estimated at about US\$6 trillion per year, on average, to 2030.

The main source of finance and investment in infrastructure in developing countries is public resources, comprised of direct budgetary contributions and external public finance.¹⁶ However, the private sector also plays an increasingly key role – to a greater or lesser extent depending on the type of economy. In developing countries, about 60% of infrastructure investment comes from public funds, on average. By comparison, in advanced economies, the private sector accounts for 60% of relevant investment, and only about 40% comes from the public sector.

Public investment rates are a good proxy for assessing investment trends. While advanced economies

have seen declining public investment over the past three decades, emerging markets and low-income developing countries have bucked this trend, especially since the 2000s. In developing countries, public investment rates increased from around 4–5% of GDP in the mid-2000s to 6–7% of GDP today.¹⁷ Indeed, developing countries now account for about 65% of total infrastructure investment today (or US\$2.2 trillion per year) – a far greater proportion than previously estimated.¹⁸

China’s share is the largest, estimated at a staggering US\$1.3 trillion, 38% of total global infrastructure investment in 2014 – more than was invested in all developed countries combined.¹⁹ India, Russia and the oil-rich countries of the Middle East have also substantially increased spending in recent years. Sub-Saharan Africa has stepped up infrastructure investment significantly as well, including through the Programme for Infrastructure Development in Africa (PIDA), which is developing a vision and strategic framework for regional and continental infrastructure,²⁰ but with wide variations among countries. More modest increases can be seen in

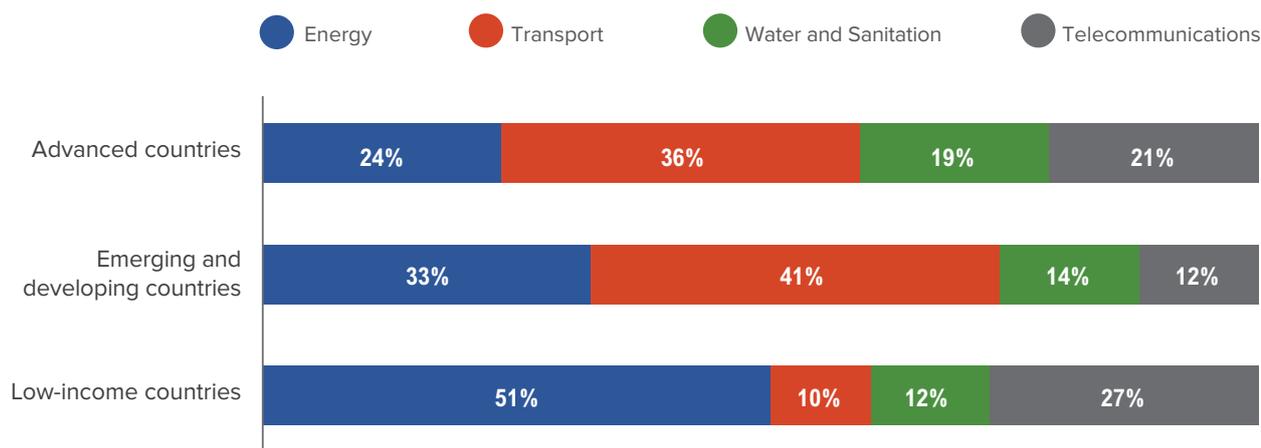
Latin America and Southeast Asia. Among advanced economies, Australia, New Zealand and Canada have seen robust growth in infrastructure spending, while the United States and Japan registered more modest growth, and the European Union’s public investment rates have kept declining since the economic slowdown in 2009.

As shown in Figure 3, the sectoral distribution of infrastructure investment varies by income group. Across all countries, the most is spent on the transport and energy sectors: 40% and 30% of total investment, respectively. However, advanced and emerging market economies put more focus on transport, in particular rebuilding and maintaining existing infrastructure and building new roads, rail and other transport infrastructure, such as ports and airports. Low-income developing economies, on the other hand, put more focus on energy infrastructure, aiming to provide energy to cities, rural areas and industry to enable development.

Table 1 provides an overview of the drivers of demand for sustainable infrastructure in countries at different stages of development, as well as differences in their respective capacities to finance those investments.

Figure 3
Sectoral distribution of infrastructure financing, 2010-2012

Transport is a dominant sector for infrastructure investment in advanced and emerging market economies, while energy is the dominant sector for low-income developing countries.



Source: Bielenberg et al., 2016.²¹

Note: Based on a sample of 75 countries. This does not include investment in natural infrastructure.

Table 1

Financing sustainable infrastructure – challenges vary by type of economy²²

Type of economy	Drivers of demand for sustainable infrastructure investment	State of play for the supply of finance for infrastructure investment
Global	<ul style="list-style-type: none"> • Rapid pace and nature of growth in emerging and developing economies relative to advanced economies • Achieving climate and sustainable development objectives of the Paris Agreement and the SDGs requires early and systemic action and investment in new and existing infrastructure 	<ul style="list-style-type: none"> • Large investment gap • Multi-decadal decline in public investment (investment to GDP) • Uneven participation of private sector • Slow and uneven pace of policy reforms to incentivise investment in sustainability
Low-income developing economies*	<ul style="list-style-type: none"> • Expanding access to basic services: housing, clean water and sanitation, energy, mobility and irrigation for agriculture • Building resilience to climate change and other stresses • Improving connectivity, e.g. through mobile networks for financial services, early warning systems and road networks for access to markets 	<ul style="list-style-type: none"> • Weak foundations for public investment that constrain direct budgetary contributions, heightening reliance on external development finance as a main source of finance • Weak domestic capital markets and low creditworthiness that limit potential for private investment • Insufficient policies and weak enabling conditions to attract domestic or foreign investment to sustainable infrastructure • Limited capacity and use of infrastructure planning at the national and subnational levels, and uneven attention to sustainability where such planning processes exist
Emerging and middle-income developing economies	<ul style="list-style-type: none"> • Need to achieve greater access to basic services - water, energy, food, mobility - and address the infrastructure deficit • Trend of urbanisation and regional connectivity in emerging and developing economies • Growing middle classes with rising incomes • Heightened focus on resilient, low-carbon infrastructure 	<ul style="list-style-type: none"> • Relatively sound public institutions and solid foundations for public investment • Policy enabling conditions for green investment have the potential to be strengthened; national development banks often have potential to support infrastructure investment • Strong capital markets and relatively high levels of domestic private investment, as well as potential to demonstrate creditworthiness and improve access to bond markets
Advanced economies	<ul style="list-style-type: none"> • Replacing or rehabilitating existing infrastructure, because past neglect of infrastructure has led to large backlogs, as well as water and efficiency losses • Opportunities provided by upgrades to improve the sustainability footprint of existing infrastructure 	<ul style="list-style-type: none"> • Policy enabling conditions increasingly in place to incentivise sustainable infrastructure investment • Strong capital markets and creditworthiness providing access to bonds markets and other debt financing through banks • Emergence of green banking • Growing use of green bond markets and other means to attract institutional investors

*The infrastructure investment demand projections in this report reflect assumptions about rapid growth projections that will shift many low-income countries to middle-income status by 2030, diminishing the number of countries in this group and the relative size of its demand by 2030.

1.2 Charting the finance roadmap

As shown in Table 1 and Figures 3 and 4, there are clear global indications of where and what kinds of infrastructure investment will need to take place over the coming 15 years.

Emerging, middle-income and low-income developing economies will drive the majority of future infrastructure demand – as much as 70% (or about US\$4 trillion per year) – given their development needs and the structural transitions they are expected to undergo. And because so much of their infrastructure is yet to be built, greenfield investments could provide them opportunities to leapfrog to clean systems and technologies and become leaders in developing more sustainable infrastructure.

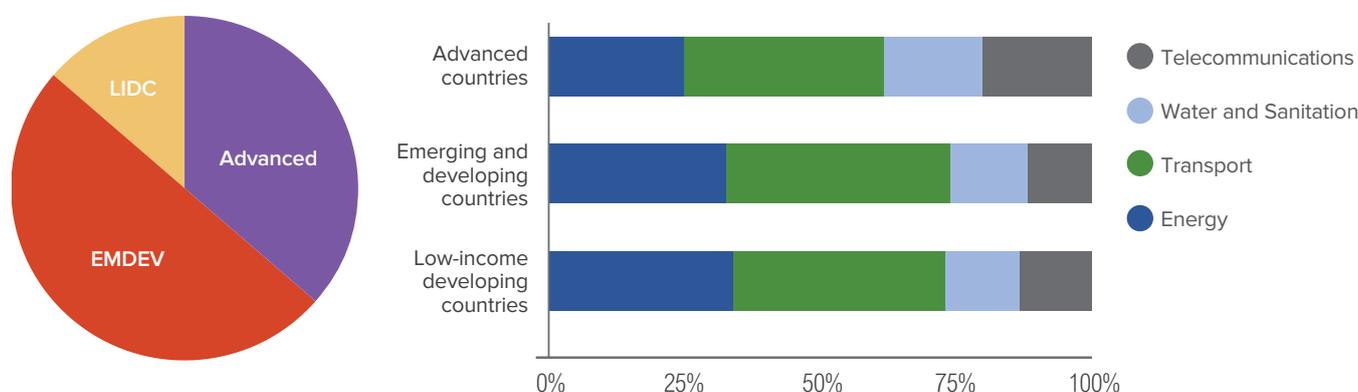
China will likely account for less of the incremental increase than it has recently. And the composition of

these investments is already shifting in China, with an increased focus on replacing old infrastructure with new, and cleaning it up in the process.

In advanced economies – which will account for 30% of the global total – investments will largely focus on rehabilitating or replacing ageing existing infrastructure that has suffered from neglect or chronically insufficient investment. The main priorities for these investments are in sustainable energy, cities, and land use, as well as in improving low-carbon transport corridors, and water and waste management.

Globally, at least 60% of infrastructure investment over the next 15 years will be made in the energy and transport sectors,²³ with broad variation across countries and type of economy – from advanced to low-income (see Figure 4).

Figure 4
Percentage of projected cumulative infrastructure demand by sector and income groups 2015-2030



Source: Bhattacharya et al., 2016.

Note 1: LIDC includes low-income and lower middle-income developing countries; EMDEV includes emerging economies and upper middle-income developing countries; advanced includes upper high-income and lower high-income countries. These categorisations cluster projected demand for infrastructure investment by developing country income groups – looking at these according to the lower or higher capacity in domestic capital markets. This recluster of income groups explains the shifts in projected demand by sector on the right compared to Figure 3.

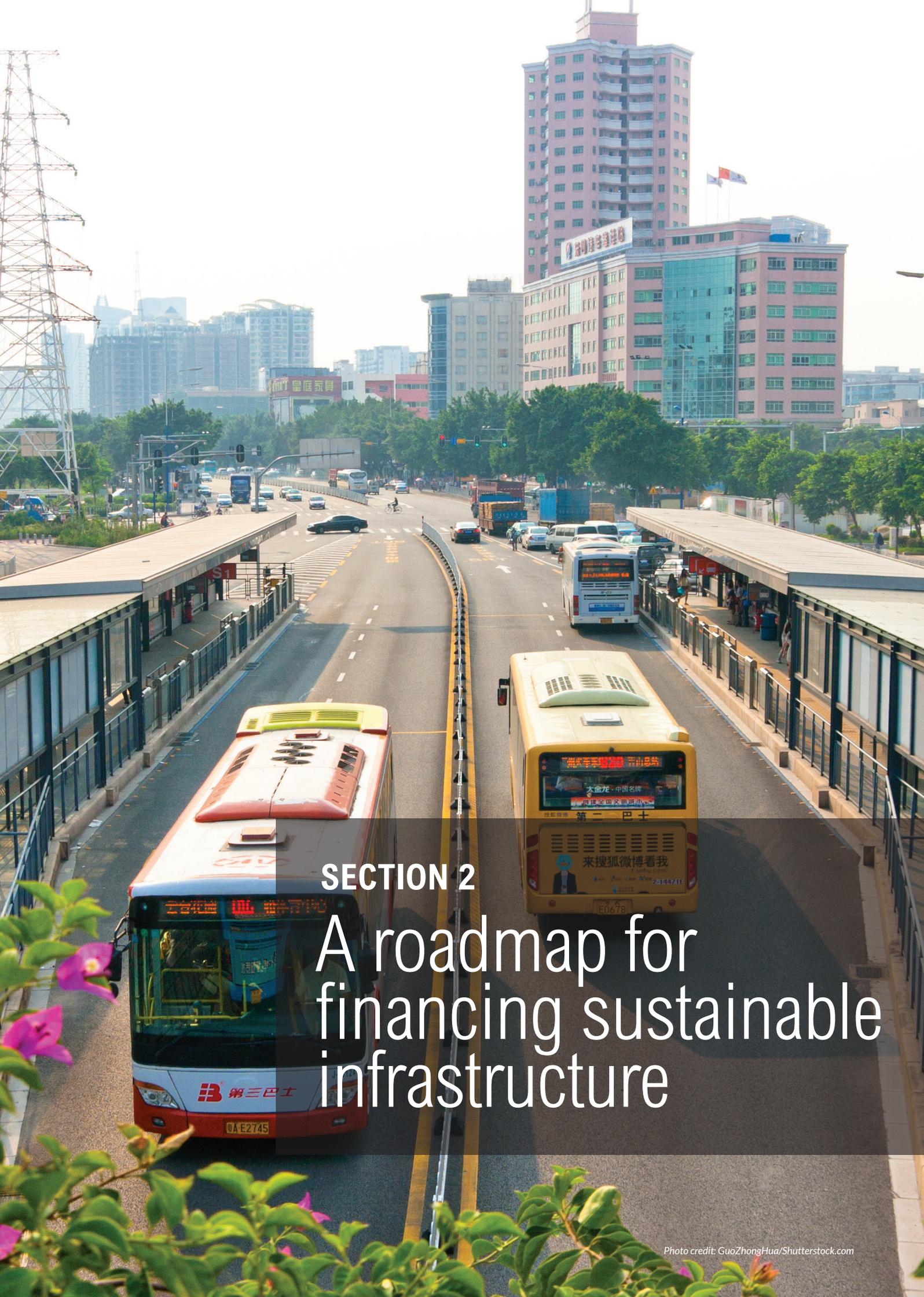
Note 2: Projections are based on the mid-point of range estimates. They exclude fossil fuel extraction and use, expenditure to enhance energy use efficiency, operation and maintenance costs, and additional investments in sustainability.

Improving water-related infrastructure will be essential to achieving success on human development, social and environmental indicators and to build resilience to climate change. We need to better manage the risks of water-related stress, in particular as these are exacerbated by overuse of natural water resources and by climate change, including risks associated with groundwater depletion, poor river flows, droughts, extreme weather and flooding. Better managing water risk will also help address related vulnerabilities in the power sector, such as potential disruptions due to shortages of cooling water, and shrinking reservoirs and unreliable river flows that jeopardise hydropower and other forms of power production. Sustainable land use practices offer a key solution to water stress and security challenges, but better managing watersheds will also need to be accompanied by large investments in both ecosystem-based natural infrastructure and hard infrastructure to improve access to safe water supply, particularly in growing urban areas (see Section 6 for further discussion on natural infrastructure).

Transport-related investment is set to rise significantly. This presents a major opportunity to make these sectors more environmentally sustainable. Freight, for instance, could be moved over rail instead of on highways. Factoring in sustainability in decisions around regional transport and improving connectivity between population centres, seaports, airports, and other hubs could drive a long-term shift from high-carbon to low-carbon systems. China's One Belt One Road initiative is a prime example of a major, yet nascent and untapped opportunity to deliver

environmental and social sustainability alongside economic development (see also Box 7 on China). The initiative is a strategy for cooperation and development across countries in Eurasia, which will not only set regional connectivity patterns well into the future, but is also expected to amount to US\$4–6 trillion of investment across Asia, Europe and Africa.²⁴ For the initiative to meet its full potential it should incorporate social and sustainability aspects that avoid locking in the wrong kinds of infrastructure as the global low-carbon, climate-resilient economy transformation gathers pace.

The sections that follow lay out a roadmap for financing a safer, more prosperous future. We outline the landscape of potential sources of sustainable infrastructure finance, the main barriers that inhibit it, and the actions needed to overcome those barriers. It will be critical to deploy financing from all available sources to achieve the scale and the quality of infrastructure investment we require. The report covers actions targeting governments, businesses, development banks and investors aiming to better harness public and private resources for transformative change. It applies these actions to the public sector through policy and institutional frameworks, to the wider global financial architecture, as well as to the three key economic systems that drive growth and emissions²⁵ – energy, cities, and land use – demonstrating the tremendous opportunity before us.



SECTION 2

A roadmap for financing sustainable infrastructure

2.1 Where does infrastructure finance come from?

Before tackling the “how-to” of financing sustainable infrastructure, this section first assesses the landscape of sources, actors and instruments of financing (see Figure 5). Section 2.2 then outlines the main barriers to shifting and scaling up the finance needed for sustainable infrastructure. Finally, Section 2.3 outlines some of the solutions that are starting to take hold in some countries and sectors, which can be scaled up to deliver sustainable infrastructure investment.

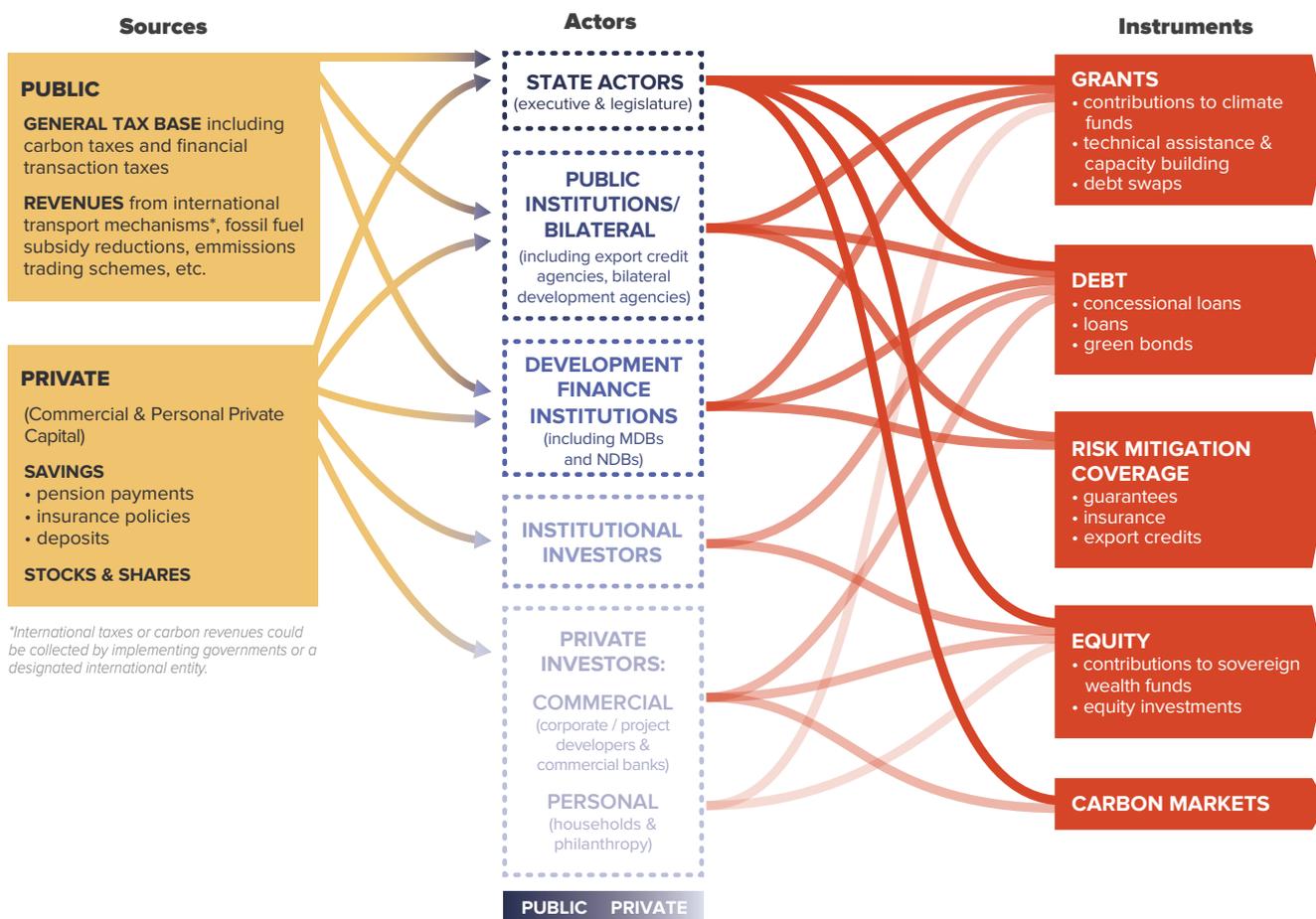
This discussion is organised around the various public and private sources of finance, yet equally important is the question of whether the finance is external or domestic. For example, the majority of global capital flows targeting climate change are raised and spent within the same country (72%) at the moment, and this share rises to 92% when looking at private flows alone.²⁶ More generally, for all infrastructure investment in

developing countries, domestic resources far outweigh external development finance.²⁷ As such, domestic sources of capital, both public and private, remain particularly important for sustainable infrastructure investment, which in turn highlights the need to get domestic policies right. External finance – both public and private – will also feature and can in particular help catalyse domestic investment. However, as it is largely a domestic challenge, financing sustainable infrastructure requires domestic leadership and bold policy reforms to take the agenda forward.

Public finance and funding

Public resources from national budgets have historically been a major source of funds and finance for infrastructure investments, and will remain so in the future, particularly for assets that deliver public

Figure 5
Sources of infrastructure finance



Source: adapted from CPI and CICERO, 2015.²⁸

goods. National budgets include the use of revenues that countries raise themselves, in particular through taxes, or other finance they are able to raise, for example through bonds and loans or, in some cases, funding provided through development finance institutions. In developing and emerging economies, 60–65% of the cost of infrastructure projects is financed by public resources,²⁹ although the total amount of public investments is often constrained due to inadequate fiscal revenues, given often low rates of taxation and challenges with tax collection, and limited access to debt financing. In advanced economies, public resources contribute about 40% of the total, an amount that has shrunk largely as a result of the global economic crisis.

Lately, subnational and local governments have been raising revenue finances of their own and have, in a number of instances, successfully issued infrastructure or green bonds. In this arena the main actors are typically those in the public sector, e.g. public corporations or state or municipal utilities. Public revenues may also be used to fund private concessions as infrastructure operators or other private entities – for example, using procurement mechanisms or public-private partnerships (PPPs).

The effectiveness of domestic funds is also critical to ensure that more positive impact can be achieved with the resources available. Auctioning for public procurement has emerged as a good example of how to improve efficiency in using limited public resources for sustainable infrastructure investment. For example see the Renewable Energy Independent Power Producer Procurement Programme in South Africa (Box 20).

Development finance institutions (DFIs), including multilateral development banks (MDBs), bilateral development banks and agencies, and national development banks (NDBs) are a key source of public finance for sustainable infrastructure. Though they sometimes operate on a commercial basis, DFIs are public institutions with a clear mandate to support implementation of national development plans and policies. They are well placed to work as a bridge between governments and private investors, and to use public finance to catalyse private financing. This is especially important for developing countries with limited access to capital markets; advanced economies tend not to rely on international public finance institutions.

Aggregate public investments in infrastructure in developing countries have benefitted from

Box 2

Public-private partnerships and sustainable infrastructure

A public-private partnership (PPP) is “a long-term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility, and remuneration is linked to performance”.³⁰

PPPs for infrastructure projects can involve private sector participation in all stages of project development and operation – that is, the development, financing, construction, operation, maintenance, transfer, deconstruction or redesignation of public infrastructure.³¹

PPPs are one of the governance arrangements that can enable and secure private engagement in sustainable infrastructure investment. They feature prominently in the delivery of various infrastructure projects today and could be used to help scale up sustainable infrastructure. Where governments opt to use PPPs, the delivery of environmental performance, including emission reduction and climate resilience, needs to be actively monitored and managed as an integral part of the project.

increased external borrowing and growing official development assistance (ODA), allocated through bilateral or multilateral institutions as well as by enlarging the fiscal space for domestic spending by national governments. Where national development banks are in place, they have the potential to leverage public funding to crowd in private co-finance for infrastructure investment (see Box 3). Beyond this, MDBs and bilateral development institutions also often act as sources of knowledge on sector best practices and technical expertise to support strategy development, investment planning and project preparation. For example, to assist African countries with their capacity development for integration of climate change into their national development planning and design of long-lived infrastructure investments, the World Bank, the Africa Union Commission (AUC) and the United Nations Economic Commission for Africa (UNECA) have teamed up to develop a program of analytical work on Enhancing the Climate Resilience of Africa’s Infrastructure (ECRAI). A major outcome of the programme is the Africa Climate Resilient Investment Facility (Afri-Res), which will provide guidelines, training, advisory services,

and data and other tools to help attract funding from various sources of development and climate finance to meet the incremental cost of climate-proofing Africa's infrastructure.³²

Newly established multilateral development banks, such as the Asia Infrastructure Investment Bank (AIIB) and the New Development Bank (BRICS Bank), are increasingly a source for financing infrastructure in emerging economies. The first four investments of the BRICS Bank, for a total of US\$811 million in loans, as announced in April 2016, are in renewable energy or clean grid infrastructure development in Brazil, China, India and South Africa.³³ NDBs, meanwhile, provide long-term capital finance for infrastructure that is more explicitly linked to specific government mandates. However, although the number of NDBs and their asset portfolios have been growing, especially over the last two decades, not all countries have NDBs, and only a small portion of NDBs play a role in infrastructure planning, development and financing (see Box 3).

Box 3 The role of national development banks³⁴

NDBs are financial intermediaries that offer long-term capital finance. They help diversify the domestic economy, boost its competitive edge and encourage investment activity in accordance with specific regional development and reform priorities, within national borders and occasionally in specific international regions. By 2005, there were over 550 development banks worldwide, of which 32 were international, regional and sub-regional development banks, and about 520 NDBs.

Despite a proven potential to attract infrastructure investment from the private sector, a recent survey found that of 90 NDBs across 61 countries only 4% have an infrastructure-targeted mandate.³⁵ Only a few NDBs, such as those in China, Brazil, South Africa, Algeria and Germany, have made significant infrastructure financing commitments. There is a large opportunity to broaden the mandate of NDBs to include infrastructure financing, and to do this in partnership with MDBs where they can add value and help scale up investment. As part of the major effort required to implement the SDGs and the Paris Agreement, there is also an imperative for NDBs and other public financial institutions to aggressively mainstream green investment in their programmes and investment portfolios.³⁶

Climate finance

At COP16 in Cancún in 2010, developed countries agreed to mobilise US\$100 billion per year by 2020 for developing-country climate action, from both public and private sources. The Green Climate Fund was also established as an important vehicle for delivering climate finance; it was operationalised in 2014 after achieving US\$10 billion in multi-year pledges.³⁷

An internationally agreed definition of climate finance is lacking, with estimates of how much is available already today varying depending on the definitions used.³⁸ Based on recent analyses, DFIs play a key role, with multilateral and bilateral institutions disbursing about a third of climate finance, while another third is mobilised from private sources.³⁹ Direct public finance, in the form of grants and concessional loans, continues to provide the largest share for adaptation and mitigation, including performance-related funding to prevent deforestation and forest degradation, and to support increased deployment of renewable energy. While public international finance flows including official development assistance remain critical, these funds can be used to catalyse action and mobilise far greater sums of private and other public sources of investment, both domestic and international.

Catalytic use of public finance includes support for instruments to mitigate the risks faced by private investors, in order to attract private capital. Such instruments include partial risk, "first loss" and export credit guarantees, policy risk insurance and various kinds of pooled funds.⁴⁰ DFIs, including the World Bank Group and other multilateral banks, have pioneered these, but scaling up existing instruments and funds and further developing new ones that can attract larger flows needs to be a priority.

Although it can be catalytic in nature, what is reported as climate finance is of course only a sub-set of what this report considers; this report aims to address the full range of investments and sources of finance needed to deliver sustainable infrastructure.

Private finance and related instruments

Private finance for sustainable infrastructure comes from many sources, but predominantly from corporate finance – companies' balance sheets – and from project finance. It can also be raised and allocated through a variety of instruments, some of which are used to blend public and private finance to invest in sustainable infrastructure.

Project finance uses a limited-recourse financial structure (a separate entity, often called a “special purpose vehicle” or SPV) to borrow money for a project, and relies on the cash flow generated by the project to pay back the debt and equity used to finance it. The project is a self-standing entity that can then be a vehicle to keep project debt off company or other investor balance sheets.⁴¹ For infrastructure projects, both corporate and project finance rely largely on debt financing through syndicated bank loans (see below). In all instances, cost recovery is key to making a project bankable, and creditworthiness will make or break access to debt financing.

Corporate bonds and new equity are also used in private finance, but they have not been used much for infrastructure. Equity has particular potential to play a larger role in financing the early phases of projects. In the equity arena, it is utility companies, developers, commercial banks and other private investor groups that will drive decisions on infrastructure investment. Commercial banks, individuals and households, philanthropies and impact investors can also provide project finance. Alternative equity finance forms, such as **crowdfunding** are also beginning to emerge, allowing small contributions from a large number of individuals to be channelled, often using internet-mediated registries, to projects that require big investments. Abundance Investment⁴² in the UK for example, has raised more than £10 million (US\$13 million), and invested this sum in 14 different energy projects, with two of its largest projects being funded by 650 investors each.

Syndicated bank loans are the preferred instrument of private infrastructure finance because they allow for closer monitoring by banks with sector and other specialised expertise. This can be particularly critical during the more complex, riskier first steps of project planning and construction, when greater flexibility and time-bound interventions are needed, such as gradual disbursement of funds, or renegotiation and restructuring of loans in response to unforeseen developments.⁴³ The arranging bank may be an official institution, for example a development finance institution (see below) or a commercial bank. **Bond finance** is less suited for the early stages however it can be used by municipalities, for example, to fund upfront capital investments. This is the case in the United States, where tax treatment favours municipal bonds. The largest potential for bond finance is to bolster financing for well-established sponsors, including multilateral development banks but also corporations, and for refinancing once projects reach their operational phase. The potential for bond finance

is enormous once projects are operational and the underlying cash flows stabilise, effectively making infrastructure projects akin to fixed-income securities, because it can potentially tap into large capital pools from institutional investors.⁴⁴

The overall volume of private finance has grown significantly over the last two decades. **Assets under management (AUM)** held by private investors through private banks, pension funds, insurance companies and investment funds are currently estimated at US\$100 trillion (excluding around US\$40 trillion in private bank assets), up from US\$35 trillion in 2001.⁴⁵ Except for a brief decline during the global financial crisis, they have maintained a robust growth trajectory, and the trend is likely to continue. However, despite this boom in private finance, very little of the increased pool of capital (less than 1%) is being directed towards long-term investment, and even less is being made available for infrastructure or sustainable infrastructure financing. There is some evidence that the share of non-bank private investment targeted at infrastructure projects is growing modestly, but much more is needed. Unless clear and strong environmental policies are in place to require investments to deliver environmental performance, any gain in private financing for infrastructure could lock in climate change and vulnerability rather than low-carbon and resilient sustainable development.

2.2 Barriers to sustainable infrastructure financing

There are several inherent challenges to infrastructure finance, including increasing the scale and targeting of domestic and international public finance. To complement scaled-up public finance, a major challenge is to increase and guide private finance flows. A range of barriers exist that hamper private investment flows to infrastructure generally, based largely on the dynamic interactions between finance, policy, and institutions (see Figure 9).⁴⁶ Ensuring that infrastructure is sustainable adds further challenges.

Unfavourable investment regulations and policies

Many policies persist that create market distortions, such as subsidies and tax breaks for fossil fuels – which fail to address externalities such as air pollution and GHG emissions – or steer public finance and investment into high-carbon, maladaptive infrastructure. Combined, they skew incentives to favour incumbent technologies, practices and fuels,

and the infrastructure that supports them, over more sustainable options.

Uncertainty around tax policies can negatively impact infrastructure investment, making it difficult to project long-term net cash flows. The outlook for tax policies and subsidies that support sustainable infrastructure is often unpredictable, including for example for tax credits that support renewables, which are often short-term or liable to be reversed. Tax policies are often not structured to reward longer-term investment choices or reflect the lower climate-related risks associated with sustainable and resilient infrastructure.

Regulations on investment limits, capital adequacy, reserve requirements, the valuation of assets and liabilities, and limits on foreign investment can discourage investors from making longer-term and cross-border investments. Such regulations and policies have generally been put in place for specific reasons, such as to support financial stability or protect pensions. But governments should carefully monitor them for their unintended consequences, such as potential disincentives to long-term investment in sustainable infrastructure, and consider amending them accordingly as needed.

For example, concerns have been raised that the Basel III and Solvency II regulations may hamper infrastructure investments by banks and insurance companies. Basel III regulations of banks' capital, leverage and liquidity intentionally discourage any mismatches in the maturity of assets and liabilities, which makes it harder and costlier for banks to issue long-term debt, such as project-finance loans. Solvency II is an EU directive that codifies and harmonises EU insurance regulation, treating long-term investments in infrastructure as having a similar risk profile to long-term corporate debt or investments, and thus requiring higher capital ratios.⁴⁷ Whether the concerns about these two regulations are warranted remains to be seen. The relevant institutions should continue to monitor the impacts and maintain an open dialogue with banks and investors to ensure that capital and solvency rules among others do not inadvertently act as disincentives to participation by banks and institutional investors.

Lack of transparent and bankable project pipelines

There is broad consensus in the international financial community that neither capital nor projects are lacking. Instead, there is a lack of bankable projects –

at least on terms that meet the expectations of those who steward the finance, with the most notable gap in lower-income developing countries.⁴⁸ As discussed further below, many projects are not bankable because they do not appear likely to deliver high enough risk-adjusted returns to attract private-sector equity or debt (see Figure 6), or the costs and risks are insufficiently allocated across investors. Other projects lack the proper documentation to demonstrate their bankability and attract investors. Developing projects so they can successfully attract capital is a complex and time-consuming process. Box 4 describes the key stages and what it takes to structure an investment so that it is viable. Middle- and low-income countries also face challenges in finding the resources necessary to support project development.

In many markets, the financial community also lacks the knowledge and connections needed to properly evaluate projects and monitor them once they are under way. If a bank sees multiple opportunities in a specific geography or sector, it can invest in local staff and partnerships – but often they have little information to work with. Governments often fail to develop long-term plans for infrastructure, so how the project fits into the plan for future infrastructure – or in the case of developing countries how it fits into development plan and priorities – remains unknown. And even when there are long-term plans, the pipeline may not be well-developed or clearly communicated to investors: for instance, only half of G20 countries publish infrastructure plans or roadmaps.⁴⁹ With sustainable infrastructure in particular, a further challenge is that investment will often need to be driven by public policy (e.g. a carbon price, pollution-control requirements, or efficiency standards) to ensure environmental performance. If the right policy signals are not in place, affordable finance for such projects is less likely to materialise.

The time-scale of infrastructure projects also complicates matters. Smaller-scale projects may take a few years to implement, but major infrastructure projects may take much longer: an average of 5 years from early conception to construction for very large projects; many MDB-financed projects take 9 years or longer.⁵⁰ Large-scale infrastructure projects in Africa can take 7-10 years to prepare and move to financial closure, then another 3-5 years for construction. This is 10-15 years for project preparation alone, whereas in advanced economies, project development involving the private sector may be much quicker, an estimated 2-8 years.⁵¹

Not all projects make it to closing and construction; some may fail to attract capital, for several reasons (see Figure 6). Further, if the preparatory process is prolonged, market conditions may change, so the original assumptions no longer hold and updates are required. For example, input costs (especially related to newer technologies) may increase or decrease, and market, regulatory and policy conditions may change.

The cost of project preparation is also substantial, typically 2.5–5% of total investment.⁵² Investing US\$90 trillion in infrastructure would thus entail US\$2–4.5 trillion in project preparation costs from 2015–2030, or US\$150–300 billion per year.⁵³ Broken down by sector, estimated project preparation costs would be about US\$1–2 trillion for energy and US\$0.7–1.3 trillion for transportation. Project preparation costs may be higher where infrastructure spans several countries, as in China’s One Belt, One Road initiative, since there is a need to coordinate activities across jurisdictions. The World Bank has suggested that regional projects are about twice as expensive to prepare as national projects.⁵⁴

Inadequate risk-adjusted returns

Many investors do not finance infrastructure simply because it does not offer competitive risk-adjusted returns. Private actors that are well-positioned to perform due diligence and take on potentially risky investments, such as private equity firms, often require returns of 10–15% which is above what most infrastructure projects can offer. Other institutional investors, such as pension funds, may be willing to accept lower returns, but want relatively safe investments. To take on more risk, they would also seek additional returns.

Sustainable infrastructure can carry a higher upfront cost, and because the technologies and platforms are often newer, the risk is often perceived to be much higher. In order to make them an attractive proposition, investors can mitigate the risks through risk-sharing or broader cost allocation. In addition, while returns from sustainable infrastructure can be low relative to other investing options, better models to capture the positive returns from the lower total

Figure 6
Key factors that shape views of bankability



Source: Nassiry and Nakhooda, 2016.⁵⁵

Box 4

Phases of project development⁵⁶

Project development involves several phases of activity, and within each of those phases, there is a subset of activities referred to, collectively, as project preparation. They include early-stage project conceptualisation and definition, to mid-stage feasibility assessment, late-stage project financial structuring, and transaction support to close the financing. Once the project is implemented, monitoring and impact assessment are essential to ensure success and may identify attractive refinancing options.

Each stage of project development involves specialised skills and expertise and may require engagement by a range of different actors: national and subnational government officials, multilateral development banks, development finance institutions, commercial banks, private equity or venture capital investors, industrial or technology companies, donor agencies, engineering and construction firms, environmental and social experts, legal and financial advisors, and monitoring and evaluation specialists. Targeted support from the development community for the preparation of specific projects in developing countries can expand the project pipeline and strengthen the capacity of key stakeholders in developing countries to engage with one another.

While the process can be described step-wise as above, in practice it is rarely linear and may involve iteration to earlier stages, particularly in relation to ensuring that the policy and regulatory environment supports the long-term financial viability of the investment. Financial structuring depends on the cost of capital as well as input prices, which vary depending on market conditions. In energy investments, changing technology prices over time represent an important variable.

lifetime costs that sustainability implies, such as through enhanced resilience, lower operational costs, and fewer carbon emissions, can make them a more attractive option.⁵⁷

Lack of viable funding and business models

Many governments, particularly at the subnational level, have not built up their creditworthiness enough to access affordable debt finance. And as noted above, many infrastructure projects cannot deliver the rates of return needed to attract equity finance. Often, especially in middle- and low-income countries, utilities cannot collect enough money from users to allow full cost recovery; this may be due to high poverty rates, and/or to government policies. In some sub-Saharan African countries, for instance, as much as 70% of water infrastructure does not generate any revenue at all;⁵⁸ even water infrastructure that generates revenue is often highly subsidised, making it subject to fiscal risk and/or financial stability risk.⁵⁹

The split incentives of sustainable infrastructure are also worth noting: for instance, developers pay more to make buildings energy-efficient, but it is

the homeowner or business that benefits from lower energy bills. Unless investors can capture enough of the savings to the operator or owner, they lack incentives to cover the higher upfront costs. And the positive externalities – cleaner air, reduced emissions, ecosystem services – can be hard to calculate and even harder to monetise to become a return for an investor.

High transaction costs

Infrastructure projects often involve inefficient bidding and procurement processes that discourage private investment. The standards applied can be diverse and inconsistent. Investors with limited resources, time and expertise, such as pensions and insurance companies, find it difficult to assess projects when standards are so fragmented. The capital costs of seemingly similar infrastructure projects can vary dramatically due to local conditions as well as differences in design, engineering, management, procurement and sourcing. Having to sort through these differences and tailor financing structures to each project increases transaction time and costs.⁶⁰

In that context, sustainable infrastructure projects that are based on new technologies can be particularly challenging, as they lack a track record of long-term investment returns. Scale is also an issue: some sustainable infrastructure projects, such as distributed and micro-generation renewable energy projects, comprise small-scale assets, and transaction costs can be very high unless a number of projects are bundled together. Streamlining project preparation and partnerships can help to lower transaction costs. It is also important to monitor and assess impact and performance for sustainable infrastructure investments, to establish a track record.

A huge part of capital investment today is handled through passive investing methods or funds that allocate capital based on the performance of stock market indexes looking across the performance of publicly traded companies. These investments are guided by robo-investment or automatic investment platforms. Attracting capital to companies that outperform on both environmental and financial criteria is an important step to shifting financing toward sustainable infrastructure. A number of indexes already do this and more are emerging, providing a means to guide investors that choose to prioritise environmental sustainability in their portfolios. For example, see the MSCI ESG index, which currently uses standardised metrics to assess ESG governance risks; it scores and rates over 6,000 companies, 9,000 issuers and more than 350,000 equity and fixed income securities on a continuous basis.⁶¹ There are other such indexes operating and more emerging (e.g. FTSE/Russell Sustainability and ET Index, which is focused specifically on low-carbon and fossil free performance and targeting institutional investors). These all aim to provide more data in context to empower investors and shareholders to make better decisions to shift capital into sustainable infrastructure. Recommendations are forthcoming on how to strengthen and move towards more harmonised standardised metrics through the Task Force on Climate-Related Financial Disclosures under the Financial Stability Board (FSB) – see further discussion in Section 3.

Efforts to overcome these barriers must start from a clear recognition that markets alone cannot provide effective infrastructure investments, and private investments often cannot be realised without some form of public support. Whether led by public or private sector, the complexity of financing infrastructure in general cannot be underestimated.

For instance, financing for the US\$1.3 billion Nam Theun 2 hydropower project in Laos, which went online in 2010, involved a staggering 26 financial institutions: four multilateral development banks, three export credit agencies, three bilateral financing agencies, nine international commercial banks providing finance in hard currencies, and seven Thai commercial banks providing finance in Thai baht. And that is even before taking fully into account all relevant sustainability performance issues.⁶²

In general, projects in emerging markets and developing countries can be expected to face greater challenges. These include policy and institutional gaps, such as the absence of coherent and trusted legal frameworks; higher political and regulatory risk in countries with unstable regimes and/or high corruption levels; and limited institutional capacities and inadequate governance mechanisms. These issues of country and policy risk - combined with technology risk - can translate into higher costs, often because financial institutions seek higher returns to compensate for the risk. In India, for instance, the cost and terms of debt alone can add as much as 32% to the cost of utility-scale wind and solar PV projects. Thus, instead of unlocking opportunity, such finance adds to the barriers to investment. A final concern is that while all countries are exposed to climate change, many developing countries face particularly significant impacts and have very vulnerable populations. This has led the World Bank, for example, to highlight the importance of integrating climate change in the planning and design of power and water infrastructure in Africa.⁶³

2.3 Key areas for action

We have identified four areas where concerted action can help overcome these barriers and boost investments in sustainable infrastructure. They are:

1. We must collectively **tackle fundamental price distortions** – including subsidies and lack of appropriate pricing especially for fossil fuels and carbon – to improve incentives for investment and innovation, and to generate revenue that can be redirected, for instance, to support the poor.
2. We must **strengthen policy frameworks and institutional capacities** to deliver the right policies and enabling conditions for investment, to build pipelines of viable and sustainable projects, to reduce high development and transaction costs, and to attract private investment.

3. We must **transform the financial system** to deliver the scale and quality of investment needed in order to augment financing from all sources (especially private sources such as long-term debt finance and the large pools of institutional investor capital), reduce the cost of capital, enable catalytic finance from development finance institutions (DFIs), and accelerate the greening of the financial system.
4. We must **ramp up investments in clean technology R&D and deployment** to reduce the costs and enhance the accessibility of more sustainable technologies.

We provide an overview of each area here. Section 3 of the report delves deeper into action area 3 as a cross-cutting area, and then the final three sections apply the other remaining action areas to the specific contexts of energy, cities and land use.

Tackle fundamental price distortions

Correcting the pervasive and significant distortions in the pricing of climate risk, natural resource use and environmental harm is a key first step to creating an enabling policy environment for sustainable infrastructure. Those distortions – including the failure to price carbon or pollution, as well as a range of subsidies – strongly bias infrastructure investment towards fossil fuels and against cleaner energy technologies, encourage inefficient use of natural resources and wasteful consumption, and cause serious environmental impacts.

Globally, fossil fuel subsidies and tax breaks amounted to approximately US\$550 billion in 2014.⁶⁴ This reflects a reduction from previous years, partly due to continuing low oil prices but also partly as a result of significant reforms that are underway or have been launched in various countries.⁶⁵ There is also growing momentum around pricing carbon. Around 40 countries and more than 20 cities, states and regions, including 7 of the top 10 economies, have implemented or scheduled an explicit price on carbon. Together they cover an estimated 7 Gt CO₂e, or about 13% of annual GHG emissions – triple the coverage of a decade ago.⁶⁶ In addition, more than 90 countries refer to some form of carbon pricing in their Paris Agreement pledges.

A concerted push can translate this momentum into decisive action and overcome political and economic barriers. The Commission welcomes the coalitions that are being built to tackle these issues (e.g. through the G20 or the Carbon Pricing Leadership Coalition),

which can accelerate progress, provide political leadership, foster mutual learning, and help improve practices by developing guidance on technical, administrative, political and economic cooperation aspects of carbon pricing (see Section 4 – Energy).⁶⁷

Pricing reform should not, of course, be limited to the energy sector. Water subsidies, for instance, which are estimated at around US\$450 billion globally, or 0.6% of global GDP in 2012, encourage inefficient and unsustainable resource use and strain public budgets.⁶⁸ Like energy subsidies, they are also often inequitable; for example, in India, Nepal, Nicaragua, and Cape Verde, the richest households got an average of US\$3 worth of subsidised water for every US\$1 worth provided to the poorest households.⁶⁹ Governments need to review prices across sectors to align them better with economic fundamentals, including externalities, and use more targeted measures to help the poor.

More broadly, pricing of infrastructure services should reflect the full costs of their provision, including where possible the social and environmental externalities. Lack of proper user charges for built infrastructure is a major impediment to attracting private investment, as private investors and operators require predictable and robust revenue streams to recover their costs. For public-managed infrastructure, lack of appropriate pricing limits the availability of funds for other uses, such as extending access to essential energy, water and sanitation services to those without, or properly maintaining the existing infrastructure. Overall, poor pricing leads to reduced service provision and quality. This can turn into a vicious circle, whereby infrastructure users are dissatisfied with the services, and thus reluctant to pay for them. For energy and urban systems, pricing is essential to reflect the social costs of externalities, for example the costs of air pollution from fossil fuel use as well as of congestion from urban vehicle use. For natural infrastructure and ecosystem services, pricing to reflect the value of these services can ensure efficient use, for instance, reducing wasteful use of water or access to timber, and help secure finances to invest in restoration or maintenance of the ecosystems.

Strengthen policy frameworks and institutional capacities

Establishing a well-defined and appropriately evaluated pipeline of projects means tackling major underlying policy problems, such as an absence of national strategies, weak legal frameworks to protect investments, promote competition and trade,

poor planning, inadequate PPP frameworks and implementation, and skill shortages. There is also a need to better define what makes a bankable project; many infrastructure projects have high public-goods components that may never be considered viable using only financial assessment techniques designed to assess bankability from a private sector perspective. Overall the enabling policy environment in a country will determine the level of engagement from the private sector, but even in the best circumstances public investments will be essential to deliver sustainable infrastructure systems.

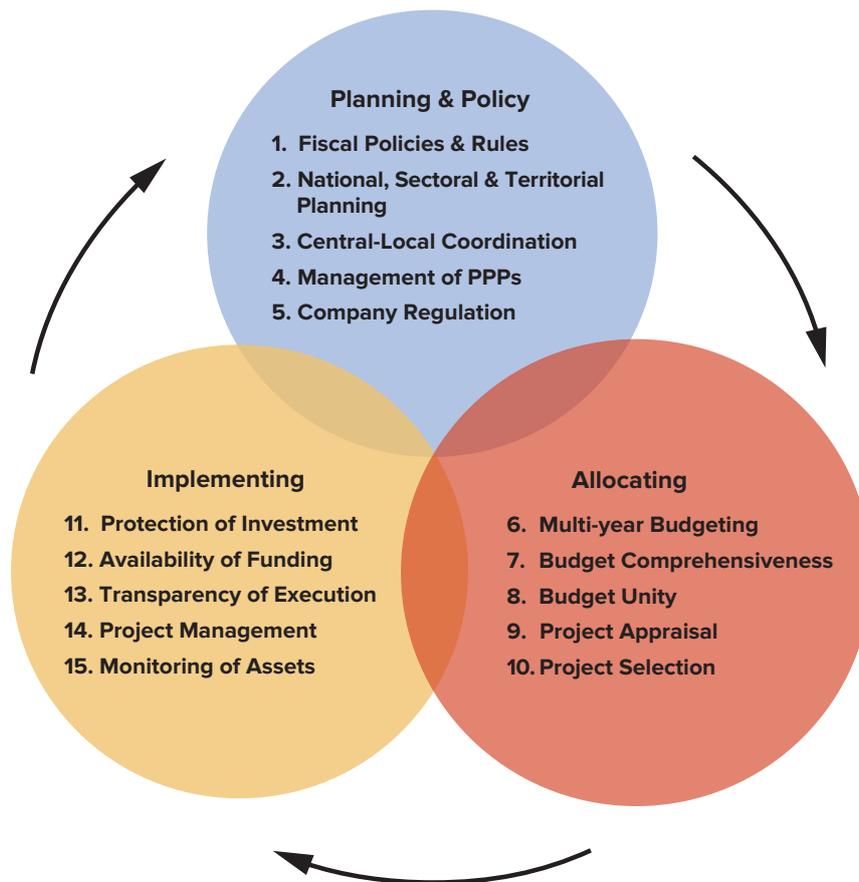
Given that a large share of the investment for sustainable infrastructure, especially in developing countries, is likely to come from the public sector, there is value in “investing in investment” –strengthening public investment management to drive growth

and environmental performance. As noted earlier, in advanced economies, investing an extra 1% of GDP in infrastructure in a single year will yield, on average, a 1.5% gain over four years.⁷⁰ While the multiplier effect is smaller for developing countries, the sustainability impact of new infrastructure in places with large deficits can be enormous.

Improving the efficiency and performance of public investments should involve planning for sustainable levels of investment across the public sector, allocating investments to the right sectors and projects, and implementing projects on time and to budget. Unpacked further, a number of institutional and efficiency improvements can contribute to overall performance in public operations while also helping to attract private investment where relevant (see Figure 7).

Figure 7

More efficient public investment: key institutional functions



Source: Adapted from IMF (2015): *Making Public Investment More Efficient*



Photo credit: Flickr/ADB

Key outcomes would be not just more efficiency in public investment, but also establishing the enabling conditions and a framework for private investment to lead in some spheres (e.g. in the energy sector).

Improving financing and scaling up investment in sustainable infrastructure also requires better planning and policies to incentivise this investment. All countries require clear national, sub-national and sectoral development strategies, with accompanying infrastructure and investment plans to guide long-term public and private investments. Leadership will be needed to monitor progress and ensure these plans promote low-carbon and climate-resilient development and are aligned with country climate commitments, as reflected in Nationally Determined Contributions and the Paris Agreement's long-term goal to keep average global warming below 2°C, while also reflecting the financial realities of each country. For many developing countries, such as those in Asia and Africa, the next few years are a chance to demonstrate leadership through these strategies and accompanying policies supported by a vision for how to build new sustainable infrastructure that leapfrogs the inefficient, sprawling and polluting systems that have become a drag on other economies. Early leadership to develop decarbonisation strategies along these lines is essential, including to integrate them in national economic and development plans and to provide a basis for project preparation. While investing in sustainable infrastructure makes good economic sense, many of the investments

required will entail up-front financing. International support – in terms of finance, access to clean technologies, capacity building, etc. – will be essential to support developing economies in this transition.

At a practical level for all countries is the challenge of domestic resource mobilisation for sustainable infrastructure. The state of New South Wales in Australia provides a good example of instigating an asset recycling policy to boost infrastructure and growth. Combined with an improved regulatory environment, the policy is expected to reduce regulatory conflicts, improve efficiency and customer prices, and lead to more responsive service delivery. The Australian federal government is encouraging this policy with incentive payments for asset recycling that will deliver additional funding. In practice however, few governments have this capacity.

Policy will also be essential in managing PPPs, where innovative business models will be needed to distribute the risks and responsibilities amongst different partners – public and private – to ensure adequate returns for private sector partners while also not absorbing inordinate risk and losses on the public sector side.⁷¹

Overall, governments have to make a greater effort to “invest in sustainable investment” – to improve public infrastructure planning, management, governance and policies, while ensuring that investment plans and project selection are solidly grounded in environmental and social sustainability criteria. These measures can help ensure that sustainable infrastructure projects

are bankable. Governments should also develop and implement procurement processes that incorporate sustainability criteria. A number of countries have put in place elements of sustainable procurement, but there is a need to develop more systematic and consistent approaches and to disseminate good practice.

Allocating scarce resources effectively will depend on careful project appraisal and preparation in key sectors. Capacity in this area is crucial to solving the project pipeline problem discussed earlier. The international community has launched numerous capacity building, technical assistance and learning initiatives to tackle this gap, including through the G20⁷² and the Pilot Program for Climate Resilience focusing on adaptation to climate change (see Box 5).

Governance challenges will also need to be addressed to ensure that the right projects are selected in the first place, to avoid spiralling costs.

Finally in implementation stages, timing deserves particular attention, as different issues may arise, and costs, including of finance, can vary over time (see Box 6). Ensuring availability of finance at reasonable cost is about ensuring the right finance is available for projects at the right stage of the project. And securing the right financing at the right time also begs the question of how and when to engage the private sector, recognising that most projects and many developers are local, but private finance could be local, national or international.

Box 5

The Pilot Program for Climate Resilience in Zambia⁷³

A key challenge will also be to ensure that appropriate financing is available for climate resilience and adaptation and that they are built into national strategy planning. The Pilot Program for Climate Resilience (PPCR) is designed to demonstrate ways that developing countries can make climate risk and resilience part of their core development planning.⁷⁴ It helps countries build on their National Adaptation Programs of Action and helps fund public and private sector investments identified in climate resilient development plans as well as provide support to countries that is compatible with the NAP process.

Under the PPCR, approximately US\$1.3 billion has been pledged to support nine countries (Bangladesh, Bolivia, Cambodia, Mozambique, Nepal, Niger, Tajikistan, Yemen, and Zambia), and two regions, the Caribbean (Dominica, Grenada, Haiti, Jamaica, St. Lucia, St. Vincent and the Grenadines) and the Pacific (Papua New Guinea, Samoa, Tonga). A pipeline of 66 projects and programmes has emerged from the PPCR work with these countries. To date, the PPCR is funding 32 projects totalling US\$616 million through grants, and it is expected to leverage another US\$784 million in co-financing.

Zambia, for example, has received US\$1.5 million to support an investment strategy based on national development priorities and is making good progress to broadly integrate resilience objectives into its national development planning.⁷⁵ The strategy aims to strengthen early warning weather systems, integrate climate resilience in infrastructure planning and investments and strengthen natural ecosystems and the adaptive capacity of farmers in highly vulnerable areas. The African Development Bank is supporting this phase by providing input on mainstreaming climate resilience into national development planning; strengthening institutional coordination and improving information for decision-makers; and shaping targeted awareness and communication. As budget allocations are linked to the strategy, individual ministries have taken up the mandate to work on climate issues, which in turn has strengthened country ownership of this programme.

The Zambia PPCR includes work on sustainable infrastructure, such as the Kafue sub-basin project, which, among other things, aims to make more than 500 km of roads resilient to floods and droughts. Most existing roads in the region are gravel-based and vulnerable to flooding, leading to large productivity losses when disasters hit. The project will also create an all-weather road from Victoria Falls, past the Kafue National Park and onwards to Lusaka. Not only is this work expected to yield tangible benefits, but it will also demonstrate the impact of investment in climate resilience for the rest of the country.

The PPCR includes funding to revise Zambia's outdated design standards and codes of practice, and to train contractors and regulators. Revised standards are to be built on improved hydrological and morphological modelling in the sub-basin. Training also covers how to adequately review bid documents and make appropriate choices.

Box 6

Getting the timing right for infrastructure financing⁷⁶

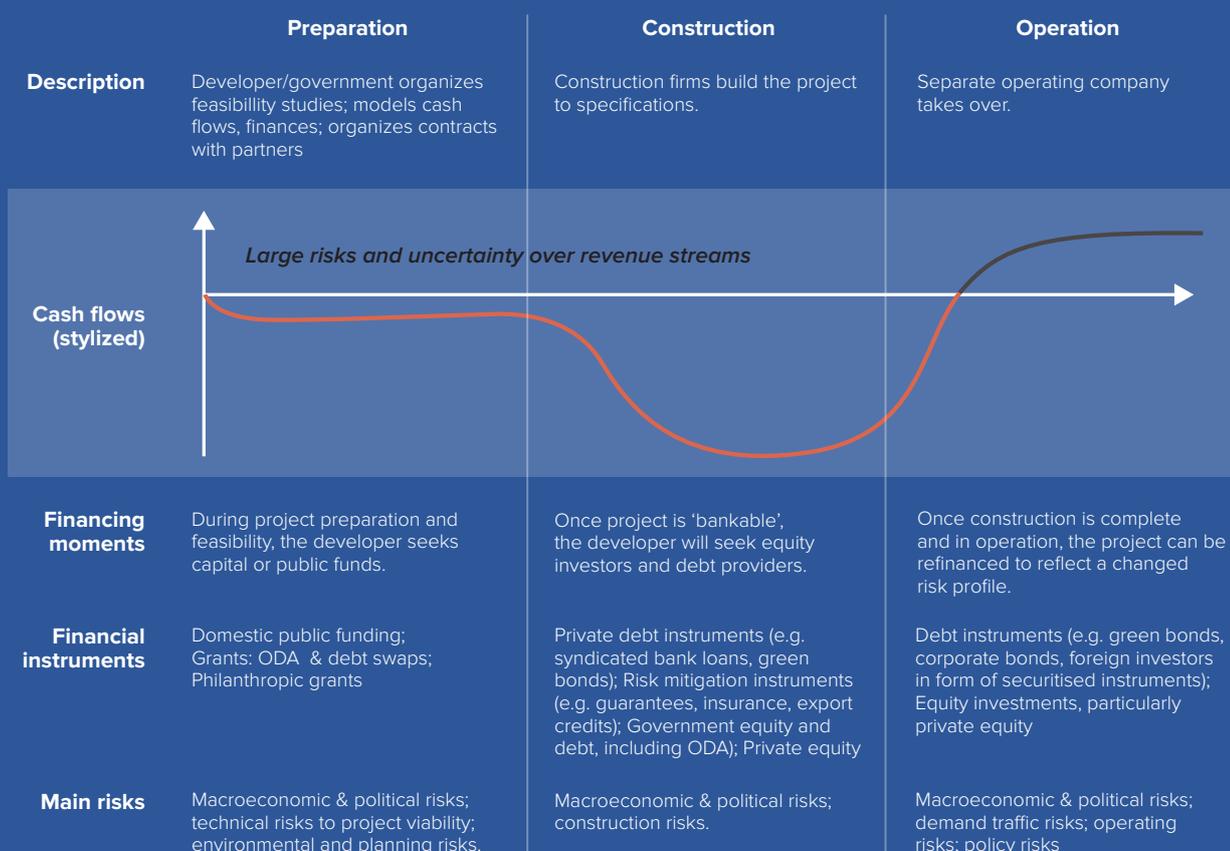
In the early project preparation stage, because of the higher risks and greater need for specialised expertise, equity finance can come primarily from sponsors (often construction companies) or governments. Raising affordable capital may be challenging, as the sponsors may not have the needed funds, and contractual and regulatory uncertainty may deter private investors or make costs prohibitive.

Banks – or debt investors, through syndication with banks – have a comparative advantage at this project preparation stage. They have the necessary expertise, and can monitor projects, match disbursements to project implementation, and if needed, restructure the financing in case of unforeseen events (for the same reasons, bond financing is less well suited to early stages of a project). Specialised infrastructure funds, some institutional investors, and providers of green finance may also be willing to take an equity stake or provide debt finance, but they have not been the main players thus far.

Governments can also play a key role in driving down risks and costs of finance at this stage. This is where better public investment management, better alignment of policies to boost domestic resources and expand the fiscal space for public investment, increased capacity for PPP administration, and deployment of sustainable procurement are especially critical.

Figure 8

Risk and financing considerations at different phases of the lifecycle of an illustrative infrastructure project



Source: adapted from Bhattacharya, Romani, and Stern (2012)⁷⁷

Box 6

Getting the timing right for infrastructure financing (continued)

Given the high risks at the project preparation stage, and that it takes place well before any revenue streams are realised, this is not the ideal time to bring private, especially non-local, investors in. There are benefits to involving the private sector early as it provides a strong incentive to build for maximum operating efficiency and avoid costly overruns. However, for multiple reasons, in many countries, the early stages are best funded primarily through government finance, particularly if local capital markets are not well-functioning.

The construction phase is considered the riskiest, and thus targeted public support at this stage – such as through loan guarantees, currency or first-loss insurance – can mitigate risks and attract co-financing to get the project built.

Governments can also make a difference by adopting a stronger and more uniform price signal, a key driver for scaling up private finance that also reduces the need for major risk mitigation. This can also improve the functioning of local capital markets for sustainable infrastructure, such as through the targeted use of credit lines or loan guarantees. This is key since most infrastructure projects generate local-currency revenues, making external finance in foreign currencies riskier.

Once the project is fully operational and its costs and revenues are more certain and stable, default risk goes down, making refinancing possible. Ownership can shift from governments, banks and construction companies to investors with specialised expertise in operating and managing the asset. The asset should itself be securitised and sold as bonds to the private sector with the capital then ideally recycled back to finance new infrastructure investments.

In emerging economies and middle-income developing countries, DFIs, including MDBs and NDBs, can play a key role in both the early and operating stages. They bring an essential convening power and ability to reduce perceived risks through their presence, structuring abilities, and use of innovative instruments that can crowd in private-sector finance. Brazil, for instance, is currently investing around US\$300 million in renewable energy but needs to invest 10 times as much to match demand. MDBs and other DFIs could come together to put in place a platform with the right planning, project preparation and finance that involves the private sector at the right time, and with the right technologies and good governance to bring their investments to scale. Along with public support from the G20, Brazil could invest the US\$3 billion needed.

In low-income developing countries, where local DFIs may not exist to support investment and capital markets are weak, there is an even greater need for and dependence on external development finance to support investment in sustainable infrastructure.

Transform the financial system

Meeting the infrastructure requirements of the next 15 years will require a combination of public and private investment. Ramping up public investment is immensely important, especially when it comes to investments that will benefit the broader public, like a number of investments to adapt infrastructure to the impacts of climate change. National budget allocations to support sustainable infrastructure investment should increase. Yet public investment cannot meet the total requirements alone. What it can and should do is to help crowd-in and guide private finance to fill the gap.

We need to transform the financial architecture globally and within countries to attract private investment. The broader financial system, through

coordinated reforms across policies, institutions and practices, needs to adjust to reflect the realities of building a sustainable, low-carbon future. A wide range of priority actions are needed to mobilise private financing for sustainable infrastructure: strengthening local capital markets; developing and using viable financing models, risk mitigation approaches and blended finance; expanding the definition of fiduciary duty and strengthening reporting and disclosure; enhancing frameworks for climate risk management and project screening; establishing infrastructure as an asset class; and accelerating new tools and institutions like green bonds and green investment banks. DFIs, including MDBs, have an important role to play here as well, as they can boost the effectiveness of public resources and help to catalyse private investment.



Photo credit: Flickr/IIP Photo Archive

In recent years, multiple new initiatives have started to focus in particular on mobilising green finance, including at the national level such as with the Green Finance Task Force under the People's Bank of China, and at the international level through the Financial Stability Board's Task Force on Climate-related Financial Disclosures and the G20's Green Finance Study Group. Dozens of green investment banks have emerged at multiple levels of government, and issuances of green bonds have tripled since 2012. Still, much remains to be done to boost the profile of green finance in the financial system.

Ramp up investments in clean technology R&D and deployment

Over the next 15 years, more infrastructure will be built than all that is currently in place. To avoid locking-in to unsustainable and outdated technologies, we need to step up investment in clean technology development and deployment. Such investments can reduce the upfront costs of sustainable infrastructure and help overcome incumbent technology advantage. Supporting technology diffusion for rapid demonstration and

uptake, including through time-bound incentive policies, can trigger rapid learning-by-doing, and thus lower the financial risks associated with investing in new and untried technologies. Europe's experience with feed-in tariffs in the energy sector and solar and wind are a strong example of this.

South Korea provides a clear example of the benefits of increased clean-tech research and development (R&D) investment. Gross domestic expenditure on R&D is high, at over 4% in 2012, and favours a few, large-scale programmes in partnership with large firms. South Korea now has a Green Technology R&D plan as well as a renewables portfolio standard that was introduced in 2012, with planned investments of US\$8.2 billion in offshore wind to grow generation capacity sixfold, to 2.5 GW by 2019.⁷⁸

Corporate partnerships are another essential part of R&D for clean technology. The Eco-Imagination partnership illustrates the types of activities and the scale of investment that the private sector can bring (see Box 20 in Section 4).

Investment in R&D and deployment of sustainable technologies needs to be scaled up far more still. Better public support, public-private initiatives, and enhanced international cooperation can help accelerate the innovations of the future. Promising efforts include the recently unveiled Mission Innovation: each of the 20 participating countries and the European Union will seek to double their governmental and/or state-directed clean energy research and development investment over the next five years. The US-India Partnership to Advance Clean Energy (PACE) has mobilised US\$2.5 billion for clean energy deployment since 2009, is now mobilising another US\$1.4 billion for Indian solar projects, and

has spurred significant investments in India by US renewable-energy firms (see also Section 4: Energy).⁷⁹ In the private sector, the Breakthrough Energy Coalition led by Bill Gates brings together 28 major investors from 10 countries with a collective net worth of more than US\$350 billion to finance research on promising, but higher-risk, clean energy technologies. The Low Carbon Technologies Partnership initiative (LCTPi), hosted by the World Business Council for Sustainable Development (WBCSD), brings together 150 companies and 70 partners to develop and implement concrete actions that go beyond business-as-usual to tackle climate change.⁸⁰

Box 7

Green China – A global lesson

China's 13th Five Year plan formalises an economic shift from carbon-intensive industries, like iron and steel, to services, while seeking to maintain a robust 6.5% GDP growth rate – the envy of many developed countries. The new Five Year Plan also means that China will likely over-deliver on its climate commitments for 2020. Researchers estimate that China is already exceeding its target of a 40–45% reduction in carbon intensity from 2005 levels by 2020, and the reduction could be as high as 50%. Other notable elements of the 13th Plan include:

- Explicit reference to managing the structural transition for workers in high-emitting sectors where production will be reduced to eliminate over-capacity (such as coal, steel, iron);
- An intention to shift up the economic value chain, away from a reliance on manufacturing towards services, and towards consumption patterns that are less resource-intensive;
- A target to increase investments in R&D to 2.5% of GDP.

China's renewable energy investment in 2015 was around US\$100 billion: a 17% increase from the year before and around 36% of the global total.⁸¹ The US was far below this, with US\$44.1 billion, up 19%. China has installed more wind capacity – 145 GW – than the US, Germany and India combined. Recent data suggests that these investments, as well as successful efforts to reduce coal use, may have helped carbon dioxide emissions slow, or even fall, last year. Indeed, China's coal consumption seems to have reached its peak in 2014. Next year will also see the world's largest emissions trading scheme being implemented across the country, when China expands its seven pilot trading systems to the national level.

Markets are already responding. China's green bonds markets could deliver around US\$230 billion for renewable energy investment within the next five years.⁸² With sufficient financing, demand for green investments could grow by as much as 15% per year. China is also demonstrating regional leadership on green finance, including through the BRICS Bank.⁸³

The old growth model based on manufacturing exports lifted millions of Chinese out of poverty and made China an economic superpower. But it also brought challenges, including a coal-dominated energy mix that was damaging to people's health. Our estimates placed damage to health from poor air quality, much of which is associated with burning fossil fuels, at around 10% of China's GDP.⁸⁴ Now, however, China's policy-makers plan to show the world decisively that climate action and economic growth go hand-in-hand.

Figure 9

Action areas to scale up and shift public and private investments to sustainable infrastructure



Tackle fundamental price distortions



Strengthen investment policy frameworks and capacity



Transform the financial system to deliver the scale and quality of investment needed



Boost investments in clean technology R&D and deployment

TO ACHIEVE THIS, THE GLOBAL COMMISSION CALLS ON:

- Governments to phase out subsidies for fossil fuels and agricultural inputs and incentives for urban sprawl.*
- Governments, including through the G20, to set a deadline for fossil fuel subsidy phase-out of 2025 at the latest.
- Government to introduce strong, predictable carbon prices as part of good fiscal reform;* with all developed and emerging economies, and others where possible, committing to introducing or strengthening carbon pricing by 2020.†
- All countries to develop transition plans to accelerate a scale-up of clean and resilient energy solutions and a phase-out of coal, in a way that delivers fully on energy access goals and facilitates a just transition for workers.
- The G20 and other countries to adopt key principles ensuring the integration of climate risk and climate objectives in national infrastructure policies and plans; these principles should be included in the G20 global infrastructure initiative, as well as used to guide the investment strategies of public and private finance institutions, particularly multilateral and national development banks.†
- Cities to commit to developing and implementing low-carbon urban development strategies by 2020, prioritising policies and investments in public, non-motorised and low-emission transport, building efficiency, renewable energy and efficient waste management.†
- Multilateral and other DFIs – via their shareholders – to enable the doubling of their investments in financing sustainable infrastructure as quickly as is feasible, and scale up further as warranted.
- Governments and investors to agree on common standards for and scale up green bonds as an instrument to enhance liquidity in financial markets and unlock capital for investment.
- Countries, especially those in the G20, to build on the Task Force on Climate-related Financial Disclosures' work to move toward appropriate mandatory disclosure standards as a matter of corporate governance.
- Governments, multilateral and bilateral finance institutions, the private sector and willing investors to work together to scale up sustainable land use financing, for halting deforestation and putting degraded farmlands and forests into restoration.†
- Governments and the private sector to scale up innovation in key low-carbon and climate-resilient technologies, tripling public investment in clean energy R&D and removing barriers to entrepreneurship and creativity.*
- Governments and businesses to substantially increase investments in R&D and deployment, and calls on governments to develop genuine research partnerships, across countries and with the private sector.

This agenda will help translate the ambitions of the 2015 development and climate goals into effective delivery in countries and key economic systems.

Note: * - recommendations from the 2014 Global Commission report; † - recommendations from the 2015 Global Commission report.

Right photo credit: Need source



SECTION 3

Transforming the financial system



Photo credit: Flickr: Nonie Reyes / World Bank

This section focuses on cross-cutting reforms and institutional changes that could improve how the financial system works to support private finance and investment in sustainable infrastructure, including by scaling up and targeting public finance through development finance institutions (DFIs) to better leverage private finance. Building on the work of the UNEP Inquiry into the Design of a Sustainable Financial System,⁸⁵ among others, the first part of this section highlights policy innovations in developing and developed countries that are starting to show how to better align the financial system with sustainable development, as well as international collaborations that are supporting national action to achieve that goal. The second part then examines some of the recent developments and innovations in multilateral development banks (MDBs) and other DFIs that are helping to increase their direct financing for sustainable infrastructure, and to crowd in private investment.

Transforming the financial system and its intermediaries is essential to scaling up sustainable infrastructure finance. Although public finance and investment will continue to play a critical role, particularly in low-income countries, large amounts of private capital are needed as well – and this will only flow if the right market signals are present within the financial system. Private financing of infrastructure that is high-carbon, not climate-resilient, or generally

unsustainable still significantly outweighs private flows to sustainable infrastructure. Actions by regulators and policy-makers in the financial system can reorient incentives and reframe how investors view risks and potential returns. Reforms in the financial regulatory system and in the practices of central banks, combined with other policy reforms (e.g. to price carbon and support innovation and to use sustainability criteria when screening projects), can level the playing field between sustainable and unsustainable options and thus give a powerful boost to private investment in sustainable infrastructure.

Mark Carney, Governor of the Bank of England, has said climate change is a “tragedy of the horizon”, because its worst impacts “will be felt beyond the traditional horizons of most actors – imposing a cost on future generations that the current generation has no direct incentive to fix”.⁸⁶ Although some climate change impacts are already being felt, the most serious impacts – and the benefits of mitigation and even some adaptation today – may be several decades away. That is far longer than the timeframes for most decision-makers looking ahead: beyond the business cycle, the political cycle, and even the horizon for most regulators, including central banks. The horizon for monetary policy, for example, is two to three years – a decade if we consider the credit cycle. Addressing climate change and other sustainability issues,

including the financial risks they pose, requires a shift away from the tyranny of “short-termism” to take a longer view.

Tackling climate risks now is preferable to a “wait and see” approach, as greenhouse gas concentrations in the atmosphere will continue to rise, as will the associated total costs of action in terms of emission reductions and adapting to the climate change that is locked-in.⁸⁷ This is particularly true when financing infrastructure, which is relatively expensive and long-lasting. Yet investors focused on short-term gains might be discouraged by the fact that the upfront capital requirements for sustainable options can be higher relative to “brown” alternatives, with the benefits accruing over several years. Even energy efficiency investments may take five years or more to recover first costs. Infrastructure investments, by their nature, require patient capital, and sustainable infrastructure, even more so – but the benefits over time can be substantial.

Broadly, there are five policy priorities to transform the financial system to mobilise private finance for more sustainable investment – called the “5 R’s” in the UNEP Inquiry work:⁸⁸

- 1. Reallocation:** Mobilising and reallocating private finance to green investments, including through green bonds and green banking. In the case of emerging economies and other developing countries, where local financial institutions and capital markets are weak, strategic use of resources garnered by MDBs and other DFIs will be needed, working with leadership from host country governments.
- 2. Risk:** Enhancing frameworks for systemic risk management to take into account macro-prudential or systemic risks in the financial system related to climate change, including from the physical risk of climate change, and from climate policies.
- 3. Responsibility:** Clarifying the core responsibilities of financial institutions under fiduciary duty or legal liability definitions to assess and take into consideration environmental, social, and governance factors.
- 4. Reporting:** Better reporting and disclosure across the three actions above.
- 5. Roadmaps to a strategic reset:** Harmonising and linking initiatives across countries to achieve coherence at the systems level, which

will increase the capacity of increasingly global financial systems to support renewed economic competitiveness and improved sustainability performance.⁸⁹

As part of the overarching architecture to mobilise private finance and investment for sustainable infrastructure, DFIs play a very important role. They are particularly important for those projects that do not otherwise offer risk-return profiles matching the appetite of private investors. DFIs can participate in a number of ways, from being an investment partner to offering to mitigate financial risk, such as through guarantees, in turn, making it possible to bring in private investors. DFIs have also played a pioneering role in launching some of the instruments discussed in this section – such as green bonds – helping to prove a concept or establish the track record necessary to mainstream widespread replication and use. There is an urgent need to scale up DFI investments in sustainable infrastructure, focussed on approaches that can help “crowd in” private finance.

The actions outlined above aim to regulate and better use financial institutions for sustainable development. To be effective, the reforms must also be supported by strong environmental policies, which are key drivers of demand for green finance. The attractiveness of green investments is influenced by the risks in the real economy associated with highly polluting or resource-intensive alternative investments. It is only through setting the right broader policy frameworks that environmental costs become real in financial terms.

3.1 Greening the financial system

In the last year, there has been a great deal of progress and momentum to green the financial system through various initiatives, campaigns and task forces. National financial regulators and central banks are starting to consider sustainability factors within macro-prudential risk management.

The UNEP Inquiry is working with partners and countries across these issues, with the aim of aligning the financial system with sustainable development. Its flagship report, *The Financial System We Need*, published in October 2015, found that a “quiet revolution” is under way to integrate sustainable development into financial system policies and regulations, largely led by those governing the financial system and often in collaboration with market actors. The pace of action has accelerated since the report launch.

Some of the most ambitious actions have been taken by developing and emerging economies, which are recognising both short- and long-term benefits from better aligning the financial system with sustainable investment, including increased economic development, closer alignment of the real and the financial economy, and greater monetary resilience. This refers in part to the challenge that there is often an increasing volume of financial activity that is not accompanied by increased investments into economically productive and long-lived assets. It also refers to making the financial system and those productive investments resilient to climate change.

The People's Bank of China has been leading the way. It established a Green Finance Task Force that gave 14 recommendations on information flows, legal frameworks, fiscal incentives and institutional design. It has also taken action, including the publication of a Green Financial Bond Guideline in December 2015 for bonds issued by financial institutions.⁹⁰ Indonesia's financial regulator launched a Roadmap for Sustainable Finance that lays out the developments needed to advance sustainable finance through 2019. In 2011, the Banco Central do Brasil was the world's first banking regulator to ask banks to monitor environmental risks as part of the implementation of Basel III's *Internal Review for Capital Adequacy*.

The Bangladesh Bank has an initiative to integrate socially responsible, inclusive and environmentally sustainable financing in the institutional ethos of the country's financial sector (see Box 10). The Kenya Bankers Association and the commercial banks in Kenya have developed a set of universal principles to guide banks in balancing their immediate business goals with the economy's future priorities and socio-environmental concerns.⁹¹ Regulators and banking associations from more than 20 developing and emerging economies have now joined the Sustainable Banking Network, organised by the International Finance Corporation (IFC) to help regulators build their knowledge and exchange best practices.⁹²

Such reforms could equally benefit advanced economies. As noted above, a real infrastructure investment deficit exists in core infrastructure in a number of developed countries, with economic and sectoral growth starting to break down or lose efficiency as a result.

The Swedish government, for example, commissioned the Financial Services Authority to submit a report on sustainability aspects of the bank's lending in 2015 and published an assessment of the risks that climate

change poses to financial stability in 2016.⁹³ In France, under Article 173 of the new Energy Transition Law, the government has requested a report by December 2016 on how to implement regular stress tests related to climate change.⁹⁴ France has also implemented mandatory disclosure of climate risks, and the People's Bank of China has proposed it.⁹⁵

International efforts are gaining traction as well. In December 2015, the Financial Stability Board launched an industry-led Task Force on Climate-related Financial Disclosures. Chaired by Michael Bloomberg, it will develop recommendations for voluntary, consistent climate-related financial disclosures for use by companies to inform lenders, insurers, investors and other stakeholders. The Task Force's recommendations are to be published for further consultation in late 2016; a first report has been published that reviews existing climate-related disclosures (see below and Box 14 for further discussion).⁹⁶ Building on these recommendations to move towards mandatory disclosure can help to rapidly scale, standardise, and accelerate the use of climate-related financial risk information in investment decisions across countries.

Under the Chinese presidency in 2016, the G20 has established a Green Finance Study Group. Its purpose is to identify institutional and market barriers to green finance, and based on country experiences, to develop options for enhancing the ability of the financial system to mobilise private capital for green investment.⁹⁷ It reported to the G20 Summit in September 2016.

Investors themselves, including institutional investors, are also taking action, working largely through self-regulation of the industries they invest in. Integration of environmental, social and corporate governance (ESG) is high on the agenda for many asset owners and managers across the European Union and North America. PGGM of the Netherlands, Zurich Insurance of Switzerland and PensionDanmark in Denmark are leading voices on this. ESG integration has faced resistance by some investors, who argue that it harms financial performance (see discussion on fiduciary duty below). However, recent work by Deutsche Bank and the UN Principles for Responsible Investment initiative shows that ESG integration does not have a negative correlation with corporate financial performance, and in most cases even has a positive impact.⁹⁸

Beyond ESG integration in publicly listed portfolios is the use of other asset classes to steer private

capital to sustainable infrastructure, such as impact investments (see Section 4 and Box 32), alternative private infrastructure funds, and alternative structured sustainable public-private partnership funds (e.g. the Africa Agriculture and Trade Investment Fund, Box 33). All are emerging private sources of capital for investment in climate mitigation and adaptation that could be scaled up and replicated.

In December 2015, more than 400 investors with US\$24 trillion in assets made a commitment through the Investor Platform for Climate Actions to increase low-carbon and climate-resilient investments, including by working with policy-makers to help them develop measures that encourage capital deployment at scale for a low-carbon transition; developing their own capacity to assess climate-related risks and opportunities; identifying low-carbon investment opportunities; and improving disclosure.⁹⁹

Divestment campaigns, aiming to encourage institutions to withdraw their investment from fossil fuel assets, are changing the landscape as well. Around 520 institutions with US\$3.4 trillion in assets under management have committed to divest from fossil fuels, including universities, cities, religious institutions, pension funds, foundations and others.¹⁰⁰ The Portfolio Decarbonisation Coalition (PDC) is attempting to mobilise a critical mass of institutional investors to gradually decarbonise their portfolios.¹⁰¹ In 2015 and 2016, Norway's sovereign wealth fund, one of the top 10 investors in the global coal industry, has taken steps to divest from companies that are heavily engaged in coal operations (see Box 8), and has also pushed for greater climate risk disclosure by oil companies.¹⁰² Divestment from coal makes financial sense: a 2015 Mercer report suggested that under a range of plausible climate change scenarios average annual returns from the coal sub-sector could fall anywhere from 18 to 74% over the next 35 years, with even steeper declines in the coming decade.¹⁰³

In May 2016, investors with more than US\$10 trillion in assets endorsed shareholder resolutions calling on ExxonMobil and Chevron to stress-test their business strategies against a scenario in which climate actions were taken to keep global warming below 2°C; though both measures failed, each was backed by about two-fifths of shareholders.¹⁰⁴ Proxy voting and shareholder activism have a long history in certain regions, particularly the US. The ISS Voting Analytics Database shows an upward trend over 2010–2015 in resolutions related to environmental and social issues, reaching 489 in 2015.¹⁰⁵

Development finance institutions, including MDBs and NDBs, are also moving to limit or eliminate new investments coal-fired power generation (see below).

Box 8

Norway's Sovereign Wealth Fund decision: An example of an institutional investor taking climate change issues into account

As noted above, Norway holds the biggest sovereign wealth fund in the world, estimated to be worth US\$872 billion. In 2015, Norway's Parliament instructed the fund to divest from companies making more than 30% of their turnover from coal operations, initially affecting investments in more than 52 companies worldwide. In May 2016, the fund indicated it might also exclude another 40 companies for using coal in their operations.¹⁰⁶

The fund also supported shareholder motions to push ExxonMobil and Chevron to account for how they manage climate risk, and will continue to ask this of oil companies in which it invests, including ExxonMobil and Chevron, as well as companies that have already done so (e.g. BP and Royal Dutch Shell).¹⁰⁷

Norway's decision to divest its Sovereign Wealth Fund from coal was based on both an interest to reduce its climate-related financial risks and on ethical issues. The fund has strict ethical criteria that guide its investment policy, including considerations of severe environmental damage.¹⁰⁸

Green bonds

Bonds are familiar instruments for investors – green bonds are just bonds with proceeds that are earmarked for projects with climate or other environmental benefits.¹⁰⁹ This familiarity creates great potential to rapidly scale up finance to green investments through green bond markets.¹¹⁰ The first “labelled” green bond was issued by the European Investment Bank in 2007. In 2015, labelled green bonds issuance totalled just under US\$42 billion, up from US\$37 billion the previous year, and more than 16 times as high as in 2012.¹¹¹ The 2015 total included US\$3.2 billion from first-time issuers in Brazil, Denmark, Estonia, Hong Kong, India, Latvia and Mexico, tapping into both

domestic and international markets.¹¹² In July 2016, the New Development Bank (BRICS Bank) announced its plans to issue green bonds worth approximately US\$450 million.¹¹³

The labelled green bonds market has historically been dominated by development banks (or DFIs including but not limited to MDBs), but the issuer base is continuously broadening. Of the US\$42 billion in bonds issued in 2015, US\$15 billion was issued by commercial banks, US\$10 billion by corporations, US\$8 billion by DFIs, US\$4 billion by US municipalities and US\$4 billion by regional governments.¹¹⁴ With total issuance in mid-July 2016 surpassing the 2015 total, CBI and HSBC expect issuances to soar to US\$100 billion by the end of the year.¹¹⁵ While the share of development bank issuance is declining, their strong credit-worthiness helps the market to meet demand for AAA-rated green bonds.

The types of issuers have diversified; however the corporate green bond universe remains dominated by the financial, energy, and real estate sectors.¹¹⁶ There is vast potential to expand in other sectors, including marine, transport, agriculture and forestry, waste, information and communications technologies, industrial energy efficiency and investments related to adaptation.¹¹⁷

There are, however, some concerns around the credibility of green bonds that need to be addressed if these are to be successfully scaled up. For example, there is no globally accepted definition yet of what makes a bond “green”, nor are there explicit rules around green bond issuance, and the market is not standardised. This has led to concerns about potential “greenwashing”, in which bonds of questionable environmental value are marketed as “green”. Some also question whether the use of the “green” label on bonds has led to new investments or simply rebranded investments that also would have moved forward on similar terms even without the green label. As bonds are primarily refinancing instruments, they are mainly used for planned or completed projects. They allow equity investors and banks to free up capital from existing assets and recycle into new projects.¹¹⁸ In high-interest rate contexts, green bonds can provide a cheaper alternative than shorter-term bank loans to finance low-carbon and climate resilient projects. However, further market development requires transparency, monitoring and a track record of performance to establish green or climate performance in infrastructure as an asset class so as to underpin future growth in the green bond market.¹¹⁹

There are two main voluntary practices available in the market to increase transparency and credibility of green bonds: the Green Bond Principles (GBP) and the Climate Bonds Standard. The GBP are stewarded by the International Capital Markets Association and provide process guidance for issuers, investors and underwriters about key components of a credible green bond, standardising disclosure, ensuring information to support evaluation of environmental impacts, use of external review and opinions, and facilitating transactions.¹²⁰ The Climate Bonds Standard, developed by technical working groups under the Climate Bonds Initiative’s stewardship, builds on the GBP and also incorporates a taxonomy with technical criteria to define projects and assets that can be considered “green” and therefore qualify for green bond financing. These guidelines and standard are increasingly widely accepted, but there remains a question of whether and when common definitions and disclosure rules will become mandatory. Standards that are harmonised, simple, easy to use, and viewed as credible by businesses would help to significantly scale the market and deliver results.

To reassure investors over the use of the proceeds, around 60% of issuers to date have incorporated an independent review or second opinion on the “greenness” of the bond as part of the issuance process.¹²¹ Projects and assets that meet the Climate Bonds Standard can also be certified, offering investors a clear trademark of the “greenness” of the bond and guaranteeing monitoring over the whole life-cycle of the bond. Although including some form of verification adds to the issuance cost, which could prevent a more rapid scaling-up of green bonds, it has helped to boost investor confidence and demand.

Pressure for strong and harmonised standards is growing as the market expands beyond niche status, with institutional investors and ratings agencies already getting more involved in the standards discussion. For example, more than 25 of the largest institutional investors signed a Statement of Investor Expectations for the Green Bond Market in 2015, which gives guidance to issuers around eligibility, initial disclosures, intended use of proceeds, reporting on use of proceeds, project impacts/benefits, and independent assurance.¹²² China and India have already issued green bond guidelines to provide clarity and boost their green bond markets (see above and Box 9 on China).

A number of green bond indices have also been created by mainstream providers to help determine what qualifies as “green”, including offerings launched in 2014 from Barclays & MSCI, S&P Dow Jones, Bank of America Merrill Lynch, and others.¹²³ The specific design of these products varies, but they are all intended and allow them to more easily identify and target green investment products in their portfolios.¹²⁴ The Oslo Securities Exchange created the first separate green bond listing in 2015. Combined these actions are seeking to raise investor confidence and will facilitate market development.

Drawing on experience to date and on industry-led voluntary initiatives, governments should agree on common standards for and scale up green bonds as an instrument to enhance liquidity in financial markets and unlock capital for low-carbon, resilient investments. Such standards could build on the GBP and Climate Bonds Standard. The standards should be internationally applied and ensure that the proceeds are used to finance projects with sufficient and demonstrable climate or other environmental benefits. The application of mandatory standards will help to build investor confidence, ensure that green bonds are actually delivering “green” outcomes and help to underpin future growth of the green bonds market.

Green investment banks and green banking strategies¹²⁵

Banks play a central role in funding infrastructure of all types, particularly in the early stages. Therefore, it is important to “green” the banking system – public and private – to reduce investments into GHG-intensive infrastructure and increase the flow of capital towards sustainable infrastructure. This can be pursued through reforms of existing institutions or by creating new specialised institutions, such as dedicated green investment banks (GIB) or GIB-like entities.

Public green investment banking can facilitate private investment in low-carbon, climate-resilient infrastructure, leveraging relatively limited public resources to maximise impact. Using innovative transaction structures, risk reduction and transaction-enabling techniques, and local and market expertise, green banking can channel private investment, including from institutional investors, into low-carbon and other green projects. It facilitates investment in such areas as commercial and residential energy efficiency retrofits, rooftop solar photovoltaic systems, and municipal-level energy-efficient street lighting and waste management systems.

Box 9

Case study: China and its growing green bond market

China’s People’s Bank established a green bond market in December 2015 to complement green bank lending. It also published guidelines on the issuance of green bonds, the first country to do so.¹²⁶ The market opened to strong private interest in January 2016. The Shanghai Pudong Development Bank Company raised US\$3.1 billion, with the bank paying 3% annual interest on its three-year bonds, a lower rate than the central bank benchmark or similarly structured commercial bonds. More recently, the Shanghai Stock Exchange announced a pilot programme for trades of corporate green bonds that will encourage firms to seek independent assessments of green qualifications.

Chinese banks are also raising funds offshore. The Agricultural Bank of China, one of the top four commercial banks in China, issued US\$1 billion in green offshore currency bonds in October 2015 that trade on the London Stock Exchange.¹²⁷ It was eight times oversubscribed.¹²⁸ China’s green bonds market is expected to grow to US\$230 billion within the next five years,¹²⁹ but green financing in general will likely need to expand even faster to support China’s ambitions. A share of this is likely to be financed through green bonds.

Growth from green investing should have great benefits for China. Ma Jun, chief economist at the People’s Bank of China, estimates that with sufficient financing, demand for green investments could grow by 10–15% per year. 2016 is likely to be pivotal in China for financing better growth, and the People’s Bank has already projected issuance of RMB 300 billion (US\$46 billion) of labelled green bonds in 2016.

In some cases, “greening” existing institutions may be preferable to creating new institutions. For example, many countries have national development banks or public investment, infrastructure or industrial development banks that focus on domestic investment. These banks are typically much larger than even the largest GIB, so “greening” them, or creating separate green banking windows within them, can have a substantial impact. This is the route that China is taking. It is also possible to expand green existing investment programmes that are already housed in different government agencies and institutions.

Box 10

How Bangladesh has led the way in embedding sustainable development into banking regulations¹³⁰

In 2011, the Bangladesh Bank issued the Green Banking Policy and Strategic Framework,¹³¹ which explains to banks how to adopt green policies and incorporate climate risk into corporate risk management practices. Since then, the share of banks with green banking units and policies has steadily increased, now approaching 100%. The policies tend to directly replicate the Bangladesh Bank's guidance.

Banks are asked to report on environmental due diligence carried out in relation to loan applications from environmentally sensitive areas like agribusiness, cement, chemicals, housing, engineering, metals, pulp and paper, tannery, sugar and distilleries, garment and textiles, and ship-breaking. During fiscal year 2014, banks disbursed a total of US\$20 billion to 30,540 rated projects, up from US\$8.9 billion in 2012 and US\$3.4 billion in 2011.

Banks report on their exposure to "direct green finance", which includes financing for key green technologies such as renewable energy and biogas, water supply, wastewater treatment, solid and hazardous waste disposal, green buildings, green products and materials, clean transportation, land remediation, and sustainable land management. They also report on "indirect green finance", which includes overall financing to projects with end-of-pipe pollution treatment.

The Bangladesh Bank also has a public green refinancing scheme: a US\$25 million low-cost refinancing window to provide liquidity support to lenders for green financing in 11 specified categories. Overall US\$13 million was disbursed from this fund during fiscal years 2010–2014. The main uses were for biogas, solar assembly plants and energy-efficient brick kilns.

Regulatory approaches are in place in some countries to embed sustainable development and climate change criteria into existing banking practices – spanning public and commercial bank operations – including, for example, in Bangladesh (see Box 10).

Where greening existing institutions may be slow or fail to produce results, it may be faster and easier to create a GIB, to demonstrate that investment in sustainable infrastructure is viable. In advanced economies and some emerging economies, which typically do not have development banks, over a dozen GIBs and GIB-like entities have been created, typically with a focus on clean energy. They have been established at the national level (in Australia, Japan, Malaysia, Switzerland and the UK), in several US states (California, Connecticut, Hawaii, New Jersey, New York and Rhode Island), and in one city (Masdar, United Arab Emirates); now Montgomery County, MD, in the US is setting one up.

These entities can leverage large amounts of private investment. For example, for every US\$1 it has invested to date, the UK Green Investment Bank has mobilised an estimated US\$3 of private capital.¹³² The Connecticut Green Bank attracted US\$10 in private investment per US\$1 of public capital spent in 2013.¹³³

Green investment banks have also achieved attractive returns. The UK Green Investment Bank turned profitable in the second half of the 2014–15 year, and is projected to generate an overall return of 9% when its projects are fully operational.¹³⁴ In 2014, The Australian Clean Energy Finance Corporation achieved a 4.15% return (net of operating costs), exceeding the portfolio benchmark return of 3.14%.¹³⁵

The impact of green investment bank investments on jobs has been impressive, too. The Connecticut Green Bank's investments as of June 2015 are estimated to have generated more than 3,000 jobs.¹³⁶ The Clean Energy Finance Corporation in Australia has financed projects for businesses that employ more than 35,000 people.¹³⁷ Since 2010, the 165 projects funded by the Green Technology Financing Scheme are estimated to have created about 2,500 jobs.¹³⁸

Governments tailor their green banking strategies and GIBs to their national and local contexts. GIBs and GIB-like entities have diverse rationales and goals: meeting ambitious emissions targets, supporting local community development, lowering energy costs, developing green technology markets, creating jobs, lowering the cost of capital and facilitating investment in such areas as water and waste management. Given the success to date in green banking in areas such as

clean energy, it is worth assessing the opportunity to engage an even broader portfolio of investments.

It is also important to motivate banks to shift their lending away from “brown” investments that are incompatible with low-carbon, climate-resilient development. Even as many leading banks have established “green” business units or product offerings, many continue to be major players in financing high-carbon projects, such as coal mines and coal-fired power plants.¹³⁹ This is where the measures discussed in Section 2 and elsewhere in this section – from carbon pricing, to climate risk disclosure requirements – are crucial (see also discussion in Section 4, 5 and 6 on key systems – energy, cities and land use). Given the size of commercial and public banking portfolios and their key role in supporting the early stages of infrastructure investments, their choices will to a great extent determine the nature of future infrastructure.

Institutional investors¹⁴⁰

Institutional investors, mainly based in the advanced economies, hold on the order of US\$100 trillion in assets under management and represent a potential source of substantial new capital to fund sustainable infrastructure (see Table 2). They comprise banks and insurance companies, pension funds and hedge funds, mutual funds, sovereign wealth funds and endowments; they pool capital to invest in assets that may be securities, real property or other tangible assets such as infrastructure. Yet to date, institutional investors have not been major investors in infrastructure, for a variety of reasons. Surveys of large pension funds, conducted by the OECD, suggest that less than 1% of their asset allocation in 2015 went to direct equity investment in unlisted infrastructure.¹⁴¹ Other surveys of institutional investors show the average allocation for all forms of infrastructure investment is 6.4%.¹⁴²

There are a number of main barriers to institutional investment in green infrastructure: uncertainty in the policy environment and insufficient policy support, a lack of suitable financial vehicles that provide the liquidity, risk-return profiles and aggregation investors need; and a shortage of objective information and quality data on transactions and underlying risks.¹⁴³ As discussed in Section 2, similar issues hinder private investment in green infrastructure overall. In addition, some institutional investors – such as pension funds or insurance companies – often face legal constraints on the types of asset classes in which they can invest. They may also have to face the challenge that infrastructure is not recognised as a proper asset class on its own and

to overcome embedded practices that do not recognise ESG issues (see Boxes 11 & 12).

When institutional investors do invest in infrastructure, they tend to choose projects that are already operational, with stable cash flows. Given the complexity of infrastructure projects, many investors prefer to focus on familiar markets, where they are best positioned to assess areas such as policy risk due to their understanding of the local context. For example, European institutional investors have become increasingly visible in renewable energy projects in Europe. As institutional assets grow in emerging markets, this represents an important potential source of investment for these markets.

Preliminary research for the G20 Green Finance Study Group by the OECD studied 33 cases of institutional investment in green finance in 17 countries, where public finance served as a risk mitigant or enabler of the financial transaction in sustainable infrastructure.¹⁴⁴ The cases were mostly in G20 countries, but there are also examples from Kenya and Uruguay both for wind power, from Peru for water, and the Philippines for geothermal power. The study also found a pan-Asian fund, a pan-African fund, and a fund targeting countries eligible for ODA. The results suggest that governments are already

Box 11 **Unlocking new investment by establishing infrastructure as an asset class**

Institutional investors represent one of the largest potential pools of new capital to fill the investment gap for infrastructure. At present, infrastructure only represents a small percentage of the investment portfolios of institutional investors, and there is not always a consistent treatment of infrastructure as a potential investment in planning portfolio investment strategies. Taken as an asset class within portfolios alongside other traditional classes such as debt and equity, infrastructure would have potential advantages in offering long-term, stable cash flows with low correlations to other asset classes to match long-term liabilities. There would thus be value in collaboration between investors and investment consultants to distinguish a subset of infrastructure that could meet the definition of a distinct asset class, and then to incorporate it systematically into portfolio planning.

Table 2

Overview of Institutional Investors' Assets under Management, 2015

Institutional Investors	Assets Under Management (US\$)	Current investment in infrastructure for infrastructure investment	Current investment in emerging markets & developing economies
OECD Institutional Investors	80 trillion	1% on average implies US\$800 billion (mostly in OECD). Leading investors may have 5%-10%	Estimated 10% overall, but very small in infrastructure
Emerging Market Institutional Investors	5 trillion	Less than 1% on average. 0.5% implies US\$25 billion	High percentage
Sovereign Wealth Funds	4 trillion	Unclear – 2% would imply US\$80 billion	Relatively high
Other global institutional capital (asset or wealth)	20 trillion	Assumed 1% on average implies US\$200 billion	Very small

Source: World Bank Finance & Markets, PPIAF, 2015.¹⁴⁵

working to mobilise institutional investment in green infrastructure, using a variety of approaches. For example, for the ReNew Wind project in India, a listed project bond was used to refinance project debt, underwritten by two banks in a private placement with a view to selling them to other institutional investors. The India Infrastructure Finance Company Ltd. (a wholly government-owned company) provided a partial credit guarantee, and the Asian Development Bank (ADB) provided a backstop. The study found pension funds were the most active type of institutional investor but other types of investors, such as sovereign wealth funds and insurance companies, were also active.

A key question that remains is how big a role institutional investors could play in closing the sustainable infrastructure investment gap. Even the institutional investors that are most active in the infrastructure domain only allocate around 10% of their portfolio to such assets, due to the need to maintain adequate diversification of their investments. It is unclear whether there is much scope to seek even higher allocations than this level.

Responsibilities of investors: fiduciary duty

As noted above, many investors have expressed concern that incorporating more on ESG issues into investment decision-making would lead to lower financial performance. This, they argue, would be a breach of their fiduciary duty to deliver financial returns to their beneficiaries.

Fiduciary duties are imposed upon a person or organisation with discretion to act on behalf of another in a relationship of trust and confidence. In the financial community, this means someone who manages other people's money must act in their interest, not in his or her own.¹⁴⁶ The most important of these duties, which pertain directly to the responsibilities of institutional investors, are loyalty and prudence.¹⁴⁷ The relevant legal texts typically contain procedural requirements that mainly serve to ensure pursuit of highest possible risk-adjusted returns on investments.

A 2005 report by the law firm Freshfields Bruckhaus Deringer commissioned by the UNEP Finance Initiative concluded that responsible investment, defined as the integration of ESG considerations into investment analysis, is "clearly permissible and is arguably required".¹⁴⁸ The report suggests that failing to consider drivers of long-term investment value, which include ESG issues, is actually a failure of fiduciary duty with regard to both loyalty and prudence.

Since that report, there has been progress in better reflecting ESG considerations in investment practice and in recognising the need for responsible investment. A number of countries have introduced regulations and codes requiring institutional investors to account for ESG issues in their investment decision-making. For example, South Africa introduced sustainability considerations, including ESG factors, in 2012 through the voluntary Code for Responsible Investing in South Africa (CRISA) and since 2012 the Dutch pension fund investor APG is integrating ESG factors across all its asset classes and investment processes.¹⁴⁹



Photo credit: Flickr: Dana Smillie/World Bank

Recognition of the link between fiduciary duty and ESG was one of the factors behind the launch of the UN Principles for Responsible Investment (PRI), initially a collaboration between the world’s largest institutional investors and the UN. The PRI has now grown into a membership organisation with more than 1,500 signatories from over 50 countries, representing around US\$60 trillion of assets.¹⁵⁰ The principles outline a range of possible actions for incorporating ESG issues into investment practice as well as a set of six basic tenets, including the statement that ESG factors can be material for investment analysis. PRI’s latest report on progress highlights strong growth in attention to responsible investment but also notes that the majority of asset owners are still focusing on high-level discussions rather than setting requirements for specific strategies or systematically integrating issues from across the ESG spectrum into company valuation.¹⁵¹

The UNEP Inquiry report identified a number of measures related to fiduciary duty that could support integrating ESG issues into investment research and processes. They include:¹⁵²

- Clarify that fiduciary duty requires investors to take account of ESG issues in their investment processes, in their active ownership activities, and in their public policy engagement;

- Strengthen implementation of financial sector legislation and codes, by ensuring and clarifying that they refer to ESG issues, and require investor transparency on all aspects of ESG integration, supported by enhanced corporate reporting on ESG issues;
- Clarify expectations for trustees – for instance, by ensuring their competence and skill, and by supporting the development of guidance on investor implementation processes, including investment beliefs, long-term mandates, integrated reporting and performance;
- Support efforts to harmonise legislation and policy instruments on responsible investment globally, with an international statement or agreement on the duties that fiduciaries owe to their beneficiaries.

Recent OECD research suggests there remain large hurdles to achieve progress in this area (see Box 12).

The understanding of fiduciary duty as it relates to ESG issues is not the only barrier to the full integration of these, including climate change, in investment decisions. There is also a lack of clarity for many investors about what ESG integration means in practice and, in particular, whether active ownership and public policy engagement form part

Managing climate change risk as part of the fiduciary responsibility of pension funds¹⁵³

At the request of the French Presidency of the COP21, the OECD is analysing the governance of institutional investments in relation to ESG factors and risks, in particular those associated with climate change. The work aims to improve our understanding of the extent to which policy and business frameworks support the systematic inclusion of ESG factors in the governance of institutional investments; how institutional investors interpret their obligation towards beneficiaries in terms of ESG analysis; and how ESG analysis is implemented in practical terms.

Preliminary findings include:

- Many institutional investors are not bound by the legal concept of fiduciary duty, in common law as well as civil law jurisdictions. Still, the debate over the interpretation of fiduciary duty is relevant to most institutional investors, as it addresses the core issue of how they understand their responsibilities and how ESG factors fit in. There are evolving views of what constitutes prudent investment and how to assess the portfolio risk of climate change, as well as regulatory developments around responsible investing.
- For institutional investors who are subject to fiduciary duty, legal and regulatory frameworks allow them to incorporate ESG factors in investment governance to the extent that these are expected to have a material impact on portfolio performance. Integrating ESG factors into investment analysis can also be seen as a way to improve the quality of investment decisions.
- Nonetheless, some difficulties remain for investors in reconciling the integration of ESG factors with their financial obligations towards their beneficiaries. These difficulties are largely practical, although several institutional investors also see a challenge in that ESG analysis asks different kinds of questions from traditional financial analysis.
- There is some confusion between integrating ESG factors in the valuation of a security, and ethically motivated investing (e.g. “socially responsible” or “impact” investing). This sense that ESG integration is motivated by ethical or moral, not financial concerns, has probably delayed its acceptance by some institutional investors. New ESG investment strategies and tools are also developing rapidly, making it harder for investors to select the “right” ones.
- There is growing consensus that ESG factors do impact corporate financial performance, but several difficulties in identifying and valuing ESG risks and opportunities have slowed down the adoption of ESG integration. In particular, there are limitations in data availability and valuation techniques, as well as modelling constraints. Most institutional investors are not well equipped to model the discontinuous and extreme risks associated with climate change.
- As a result of these difficulties, ESG analysis usually takes the form of a qualitative input that is used alongside traditional quantitative models. Several institutional investors caution that ESG analysis could be less respected by portfolio managers than financial analysis because it is not quantitative.
- Despite the long-term nature of their liabilities, institutional investors may take a short-term view of their investment performance, because of the prevalence of quarterly reporting cycles for both investors and the companies in which they invest, as well as mark-to-market valuations.

of investors’ fiduciary duties. There is an ongoing debate over the strength of the relationship between ESG issues and investment performance, although most studies point to benefits from fuller assessment of risk. Given the evolving nature of responsible investment practices, there is a wide variation in actual practices, which is compounded by a lack of transparency around responsible investment practices, processes and outcomes.

Enhancing climate risk disclosure in the financial system

Policy-makers and financiers increasingly agree on the importance of climate risk disclosure for accountability and transparency in the financial system.¹⁵⁴ Disclosure is also a tool for risk management that can help companies to better understand climate risks and make smarter investments. Disclosure thus serves a dual

purpose: to inform decisions by external parties, and to support internal management improvements. When combined with new analytical techniques and a broader interpretation of fiduciary duty (as discussed above), disclosure can help companies to integrate climate-related factors into financial decision-making.

There are at least three different types of risks related to climate change and infrastructure investment.¹⁵⁵ Financial disclosure in all of these areas may be warranted, and increasingly investors are interested in how companies are positioning themselves with respect to these risks:

- **Physical risks**, where climate change and extreme weather events can damage property or disrupt trade;
- **Liability risks**, if those suffering from climate-related losses seek compensation;
- **Transition financial risks**, stemming from the structural economic adjustment to a low-carbon, climate-resilient economy – for example, the shift away from fossil fuels to cleaner fuels and energy systems, the shift to smart buildings, new disruptive business models, and shifting consumer values and preferences. This can also be driven by the adoption of government policies to reduce GHG emissions and/or to adapt to physical climate change impacts.

The Bank of England has identified two types of risks relevant to central banks: weather-related natural disaster risks (physical risks) and stranded asset risks (transition risks). It argues that climate-related disclosure across both of these risk areas could facilitate an orderly transition to a low-carbon economy by helping a wide range of investors to better assess their exposure.¹⁵⁶

There is growing momentum on disclosure of climate related risks, in particular in G20 countries and in the EU. GHG emissions reporting is now mandatory in several EU Member States, including the UK, France and Denmark.¹⁵⁷ Fifteen of the G20 countries have a mandatory corporate disclosure scheme, most commonly requiring reporting of direct GHG emissions.¹⁵⁸ However, only Canada, South Korea and the US also have clear disclosure guidelines requiring companies to report exposure to climate risks and strategies to reduce emissions. Moreover, in a number of countries there is uneven progress in the enforcement of these disclosure requirements.¹⁵⁹

Many corporations now use voluntary frameworks for more detailed disclosure. Investors have in many cases actually moved faster than governments – for example, through the creation of mechanisms such as the CDP (formerly the Carbon Disclosure Project) that seek to promote and secure corporate voluntary disclosure related to climate change (see Box 13).¹⁶⁰

Investors typically need a range of information, not just GHG emissions profiles, to understand how environmental risks affect business models and financial performance. Recognising this, regulators are moving to expand disclosure requirements. The EU Non-Financial Reporting Directive, for instance, requires companies with over 500 employees to disclose information on “policies, risks and outcomes as regards environmental matters, social and employee aspects, respect for human rights, anticorruption and bribery issues, and diversity in their board of directors” in annual reports.¹⁶¹

As part of the Energy Transition Act, enacted in August 2015, France now requires companies to report on climate-related financial risks. The law extends carbon disclosure requirements to cover companies’ supply chains and the use of goods and services they produce.¹⁶² The law also obliges financial institutions, asset owners and insurance companies to disclose their carbon footprints, thereby creating awareness and requiring banks and asset owners to incorporate climate aspects into their portfolio monitoring. The Chinese central bank has also proposed mandatory climate disclosure as part of a series of other reforms to help green its financial system.¹⁶³

A promising development, already mentioned above, is the creation of the Task Force on Climate-related Financial Disclosures (TCFD), which grew out of a request by the G20 Finance Ministers to the Financial Stability Board to consider climate-related risks to the financial sector. The TCFD will develop recommendations for voluntary disclosures. A report due in late 2016 will set out the principles for adequate disclosures, a prerequisite for financial firms not only to manage and price climate risks accordingly but also, if they wish, to make lending, investment or insurance underwriting decisions that take into account transition scenarios. Following a public consultation, the report is to be submitted to the G20 (see Box 14).

While voluntary disclosure is an extremely important first step, it is unlikely to be enough on its own. Voluntary disclosures remain very limited: the UNEP Inquiry, drawing on Bloomberg data, found that 75% of 25,000 listed companies assessed did not disclose a

Box 13

CDP and voluntary disclosure

CDP holds one of the world's largest repositories of publicly available environmental data and performance information from companies, cities and other emitting entities. The data are gathered on behalf of 822 institutional investors from over 80 countries, representing US\$95 trillion of assets. Of the 2,345 companies reporting to CDP in 2014, 88% considered climate change a risk to their operations.¹⁶⁴ Many companies, including fossil fuel producers and utilities, use internal carbon prices as part of their planning and business strategy development. In 2015 CDP found 435 companies worldwide doing this.¹⁶⁵

CDP estimates that in 2014, more than 90,000 projects were implemented by almost 1,400 companies reporting to it (59% of the sample), achieving a combined 700 Mt CO₂e of emission reductions. There is some uncertainty around these reductions, however, because companies reporting to CDP are not required to use standardised GHG reporting procedures.

Increasingly, the actions taken by companies are driven by a clear business case that is outside of environmental or social concerns. Among the Fortune 100, for instance, 53 companies reported saving a combined US\$1.1 billion in 2013 from energy efficiency, renewable energy and other emission reduction initiatives – an average of over US\$10 million per company.

In an analysis for the We Mean Business coalition, CDP found that in 2013, the global average reported internal rate of return on low-carbon projects was 11%.¹⁶⁶ The CDP Climate Leadership Index (made up of companies taking the strongest climate action) has outperformed the Bloomberg World Index of top companies by 9.1% over the past four years. These examples provide evidence that actions taken by businesses to reduce emissions do not undermine profitability and, instead, may even enhance it.

single sustainability data point. Participation is better among the world's larger listed companies (with a market capitalisation in excess of US\$2 billion – a total of 4,609 companies): 39% of them currently disclose their GHG emissions.¹⁶⁷

Indeed, the patterns of disclosure illustrate both the strength and limitations of voluntary reporting. The number of companies reporting is a testament to the relevance of the issue and the role of voluntary standards in addressing a regulatory gap and pioneering practices that can subsequently be mainstreamed. Voluntary standards are typically most effective at reaching leaders and companies with high public visibility, but have limited influence beyond those circles. The large number of companies that continue not to report shows that voluntary standards cannot achieve complete and consistent disclosure across entire markets.¹⁶⁸ This suggests that governments could build on the Task Force's work and move rapidly towards appropriate mandatory – and sufficiently detailed – disclosure standards as a matter of corporate governance.

It is also important to coordinate both voluntary and mandatory disclosure schemes across geographies. Existing mandatory schemes vary widely, including in their guidance for calculation and verification requirements. This makes it impossible to compare

results across countries and corporate entities and raises transaction costs for companies operating in multiple jurisdictions. Variations across schemes also hinder investors from considering climate-related issues in their asset valuation and allocation processes, because the transaction costs of doing so are high.¹⁶⁹ A standard maintained by a global body and adopted by governments would reduce costs and improve the quality of disclosure. Indeed, the International Accounting Standards Board and the International Standards Organization provide two such examples of international bodies designed to promote extensive cross-border harmonization.

The more information on significant risks that can be reported, the better. Take stranded assets: changes in technology, regulation or markets can leave assets “stranded” or force their premature retirement, reducing their economic value. This is an increasingly significant financial risk following the Paris Agreement's decisive signal to move to a low-carbon economy. Many countries and companies face substantial stranded asset risks, particularly in high-carbon sectors.

An analysis by the European Bank for Reconstruction and Development (EBRD) and the Climate Policy Initiative calculated budgetary risk arising from policies for a low-carbon transition and found, for example, that under a low-carbon scenario, the

economic value of Russian oil to producers would decline from US\$1.25 trillion now to US\$630 billion in 2035.¹⁷⁰ Of this, the Russian government is at risk for US\$515 billion, with investors at risk for the remaining US\$107 billion. The range of benefits for consumers, such as lower energy prices, is US\$190 billion to US\$360 billion, resulting in a total cost to Russia of US\$260–430 billion, to be shared between the government, consumers and taxpayers. In addition, the value of Russian coal production would fall by US\$64 billion in a low-carbon scenario, from US\$215 billion to US\$151 billion through to 2035. But it is investors that are most exposed, as the industry has been completely privatised. In addition, the second-order effects of curtailed operations, such as unemployment, may have negative implications for the economy and the national budget if social payments have to increase. Consumers are expected to receive a benefit of US\$32 billion, and the estimated total cost to the Russian economy is US\$23 billion by 2035.

Similarly, in Egypt, the analysis shows the value of oil production falls from US\$112 billion in the business-as-usual scenario to US\$88 billion in the low-carbon scenario, with the government bearing US\$18 billion of the value at risk by 2035. However, Egypt has some

of the highest energy subsidies in the world, distorting current markets and creating inefficiencies. As a result, Egyptians would benefit more than most countries from falling oil demand and prices in a low-carbon scenario. The range of benefits for consumers is US\$57–109 billion, resulting in a total potential benefit to Egypt of US\$28 billion to US\$85 billion by 2035.¹⁷¹

Beyond stranded assets, companies also face the risk of stranded technologies, products, and business models – all part of transition risk. For example, the automotive industry is vulnerable, given uncertainty around future requirements for mobility, fleet fuel economy standards, the speed of improvement of new technologies (electric vehicles, batteries, hydrogen fuel cells), and new business models such as ride-sharing. As companies consider future scenarios for their business strategies, the transition risks to various business models of these potential new developments should be incorporated into disclosures.

Physical risks due to climate change will also alter financial performance of companies in many instances, and these need to be accounted for. For example, how will the higher probability of drought or flood events affect corporate operations, across the value chain?

Box 14

The Task Force on Climate-related Financial Disclosures¹⁷²

There has been an increase in demand for useful information for decision-makers on the risks and opportunities from a changing climate. However, the information available today on climate risks at the corporate level is inconsistent and inadequate.

The industry-led Task Force on Climate-related Financial Disclosures (TCFD) is conducting a high-level review of the existing landscape of climate-related disclosures, including current voluntary and mandatory climate-related disclosure regimes, to identify commonalities, gaps and areas for improvement.

The TCFD's initial report proposes seven principles for effective climate-related financial disclosures: 1) present relevant information; 2) be specific and complete; 3) be clear, balanced and understandable; 4) be consistent over time; 5) be comparable among companies within a sector, industry or portfolio; 6) be reliable, verifiable and objectives; 7) be provided on a timely basis.

As part of the next stage of its work, the TCFD will develop recommendations for common standards for voluntary disclosures. Target audiences include preparers of the disclosure information (listed companies and issuers of public securities for financial and non-financial companies) and users of the information (investors, lenders and underwriters). Target locations for this information are mainstream financial filings and investor annual reports. The information and metrics to be disclosed will aim to be financially relevant, efficient, qualitative and quantitative (“through the eyes of management”), historical and forward-looking (scenario analyses), and short-, medium- and long-term.¹⁷³

More complete, consistent disclosure of climate-related risks and opportunities can promote more informed decision-making by the users of disclosures and better risk management by boards and management – which, in turn, will enable a more appropriate pricing of risk, thereby helping promote a more stable financial system.

Box 15

Financial innovation to boost private investment in sustainable infrastructure in Southeast Asia

In a ground-breaking initiative, the ADB recently combined the lending operations of its Asian Development Fund (ADF) with its ordinary capital resources balance sheet to boost its total annual lending and grant approvals to as much as US\$20 billion – a 50% increase from prior levels.¹⁷⁵ Through this action alone, which takes effect in January 2017, ADB assistance to low-income countries will rise by up to 70%. Combined with a commitment to grow the share of spending on climate change to 30% of its portfolio by 2020, these financial innovations could contribute significantly to delivering sustainable infrastructure.

Another example is the issuance of the first climate bond for a geothermal project in an emerging economy, the Philippines, in an example of credit enhancement.¹⁷⁶ The US\$225 million-equivalent local currency bond comes in addition to a direct ADB local currency loan of US\$37.7 million equivalent. The ADB's credit enhancement is in the form of a guarantee of 75% of principal and interest on the bond. This is the first climate bond in the Asia-Pacific region certified by the Climate Bonds Initiative, and the first climate bond for a single project in an emerging market. Credit-enhanced project bonds such as this one, offer an attractive alternative to bank financing, and by mobilising cost-effective, long-term capital can help close the region's infrastructure gap.

Few companies today report on physical risks, yet they have clear implications for financial performance and are increasingly recognised as important by leading companies and regulators.

3.2 Strengthening the role of multilateral development banks and other development finance institutions

Multilateral development banks (MDBs) and other development finance institutions (DFIs) have a key role to play both in directly financing sustainable infrastructure, and in leveraging or “crowding in” private investment. DFIs – notably MDBs, bilateral

development banks and national development banks – can boost the effectiveness of limited public resources by mobilising private finance to fill large gaps in sustainable infrastructure financing. They can help build capacity, prepare projects and structure deals upfront. They can also offer direct financing to mitigate risk for other co-financiers, such as through loan guarantees or other first-loss instruments. Not covering the full cost of investment frees up limited public resources for more projects while encouraging private investment. Through targeted private-sector operations that use blended finance approaches, MDBs and other DFIs can help scale up investments in infrastructure and make them more sustainable (see Box 15).

DFIs have essential expertise and capacity to draw the relevant players to the table to bring a project to closure. Their interventions are even more effective where they build on public-private investment dialogue owned and led by national governments. Such efforts can be usefully complemented by dialogue at the international level, working across providers, also country-led.

MDB financing of infrastructure more than doubled from 2004 to 2013, rising from US\$20 billion in 2004 to about US\$54 billion in 2013. Looking across the bilateral and multilateral portfolios of official development finance (international public concessional and non-concessional finance), the share going to infrastructure is about a third of the total in 2013, and growing. Of the total infrastructure portfolio of official development finance, roughly half is multilateral, and half bilateral.¹⁷⁴ However, by far the largest source of finance for infrastructure in developing countries is domestic – it originates within each country. That is where there is a large opportunity to crowd in private investment from local capital markets.

There are at least five specific ways in which DFIs can make a significant difference. Some of these actions are already being undertaken, but could be done at a larger scale:¹⁷⁷

- Significantly scale up their own direct financing for sustainable infrastructure, thereby augmenting the availability of long-term debt finance and reducing the cost. This can be achieved by borrowing in international and domestic (provider) or local (host country) markets at competitive rates, which will be much lower than what even fairly advanced developing countries can access due to the creditworthiness of the DFIs.

- Crowd-in other sources of long-term debt finance from all sources, including through loan syndication, which allows development banks or other primary lenders to recycle their capital for more sustainable infrastructure investment, thus increasing the number of projects they finance for a given budget allocation.
- Enhance use of well-designed and standardised risk mitigation instruments and credit enhancements – for example, through greater use of loan guarantees, risk insurance or credit line operations. In this context, there is continued scope for MDBs, NDBs, and other DFIs to deepen communication on successful models for financing sustainable infrastructure and the means to replicate these across regions and different institutions.
- Help close the viability gap in financing of sustainable infrastructure – for example, due to high social benefits that are often not reflected in the returns from the projects. This can be done by mainstreaming climate change performance criteria and other thinking related to sustainable development goals into investment criteria and strategies.
- Help developing-country partners plan and direct external development finance to sustainable infrastructure priorities that are tailored to national contexts.

There is a real potential to use DFIs, working in tandem with local financial institutions, to help significantly scale up private financing. Their role can be both to help meet the large upfront financing costs and for long-term take-out financing once the project reaches the operating phase. Banks or local financial institutions are well suited to provide long-term debt finance in the construction phase. But there is also much greater scope to attract institutional investors through use of equity offerings. Local capital markets for financing can provide the large sums that will be needed for take-out finance. This effectively means that local banks lend to infrastructure projects, eventually selling a part of that loan to a third party after the project has become operational, thereby freeing up financing for more projects over time. But this will require concerted action to reduce actual and perceived risks and to develop replicable and scalable financing models that can crowd in private finance and bring down the cost of capital. Demonstrated models include use of mitigation instruments such as loan guarantees or first-loss insurance as well as the use of

blended finance more generally, where local financial institutions are critical actors to financing projects in the construction phase.

Recent work led by the African Development Bank, the Inter-American Development Bank and the OECD highlights the role of DFIs more generally to work with local financial institutions, including national development banks and commercial banks, to build capacity and the level of interest for investment in sustainable infrastructure (see also discussion in Section 4: Energy).

Over the last decade, developing country governments have seen an increase in the set of the financing options they can access to support their national strategies and plans.¹⁷⁸ Governments are using this to their advantage, and approaching donors from a strengthened and more assertive negotiating position and strategy for their borrowing. They are expressing clear preferences for development finance to be aligned to their national priorities, for development needs to be directly identified by them, and for programmes to be delivered as quickly as possible (which can be done by further streamlining safeguards, procurement and bureaucratic procedures).¹⁷⁹ Development partners – including MDBs and other DFIs – should deliver programmes that meet these three priorities to increase the effectiveness of their action and remain relevant to partner country governments.

A review of development cooperation portfolios shows that a small but growing share – about 20% – of overall bilateral and multilateral development finance portfolios targeting climate change objectives also aim to engage the private sector. There is growing knowledge of good practices in this area (see Box 16).¹⁸⁰

The relatively small share of activity targeting the private sector in climate-related development finance suggests significant untapped potential. Providers of development finance can work with and through the private sector, particularly in local contexts and with the support of partner countries, to achieve climate change and sustainable development objectives.¹⁸¹ For example, in bilateral development cooperation, a large part of the portfolio is dedicated to technical assistance for partner country governments or other stakeholders, to develop strategies and policy reforms to implement these goals. This assistance can include identifying policies that create an enabling environment to attract private investment to sustainable infrastructure over the medium to long term.

Box 16

Emerging lessons from development cooperation to engage the private sector for green growth and climate action¹⁸²

Recent OECD and Donor Committee on Enterprise Development work offers a number of recommendations for development cooperation aiming to engage the private sector for climate action and green growth:

Understand the demand for donor support from the private sector in partner countries: How can donors partner with local stakeholders in developing countries to address the barriers that companies face in pursuing green growth and climate action?

Do not distort the market, and have clear exit strategies in place. To drive lasting positive environmental change, these approaches need to promote sound business models and be financially feasible to help create commercially viable opportunities and good quality employment over the near- to medium term.

Build enabling conditions for greener businesses to thrive – for example, by promoting green value chain development. GIZ (the German Federal Enterprise for International Cooperation) and the International Labour Organization, for instance, recently produced a toolkit that supports stakeholders in selecting green value chains.

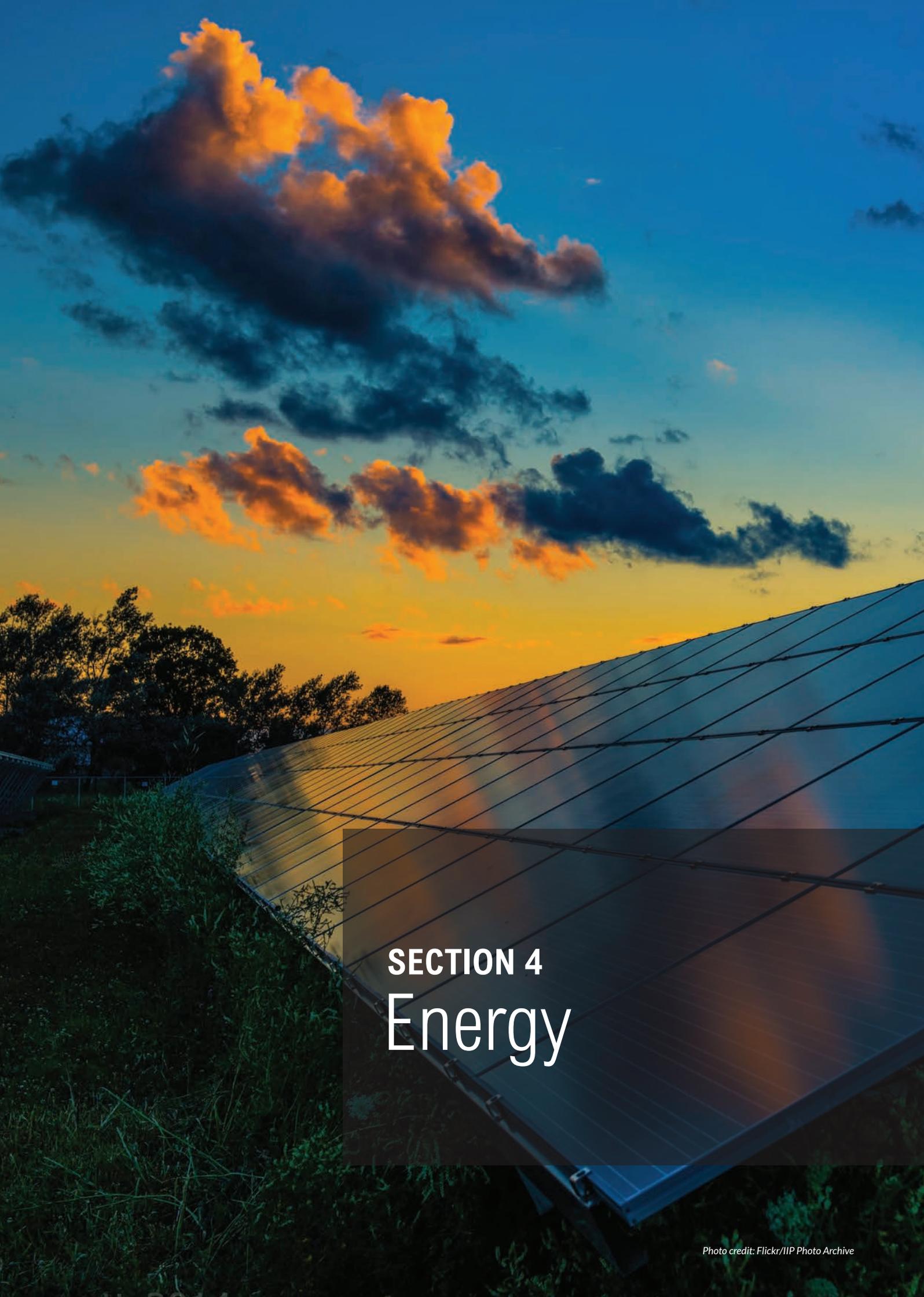
Combine different approaches into a package of activities. For example, technical assistance to support enabling conditions can be paired with tools and specific instruments aiming to leverage private investment in the near-term. An example of the importance of signalling from the public sector to mobilise private investment is the 20x20 Initiative¹⁸³ that helped bring impact investors into land restoration projects in Latin America and is now being extended to Africa through the African Forest Restoration Initiative (AFR100) initiative (see Section 6).

In contrast to bilateral development cooperation more broadly, MDBs and bilateral development banks (often these are separate branches of bilateral development cooperation agencies or ministries) have a much larger share of their portfolio in infrastructure operations. Thus the relative competences of these types of DFIs are complementary to those of others. Better collaboration and recognition of the specialised competence of various types of DFIs can help tackle the full range of financing challenges faced by developing-country governments to finance sustainable infrastructure.

In an example of good practice, DFIs are increasingly committed to mainstreaming climate change considerations within their strategies and operations. Through the Mainstreaming Climate Initiative, for instance, DFIs are working together to explore emerging practices, strategies and share experience.¹⁸⁴ They have identified five key principles:

- Commit to climate strategies,
- Manage climate risks,
- Promote climate smart objectives,
- Improve climate performance, and
- Account for climate action.

Multilateral, bilateral and other development finance institutions should double their investments in financing sustainable infrastructure as quickly as is feasible, scaling up further as warranted. A number are starting to step up their investments already, including through measures to expand their capital base and increase their use of risk mitigation instruments and blended finance to leverage investment. Their efforts should focus on countries to strengthen policies, institutions and capacities to reliably deliver domestic resources and ensure a solid pipeline of bankable projects, as well as approaches that can crowd in private finance. They could have a significant impact by boosting the amount of capital available for sustainable infrastructure and ensuring that they have measures to crowd in private investment (e.g. by taking first losses) rather than crowd it out. The role of DFIs should be to help build capacity to turn the many good projects being put forward into a pipeline of bankable projects. An essential first step is to establish key performance indicators for heads of DFIs and, in the case of MDBs, for country office leads on mainstreaming sustainability thinking into their infrastructure investments and technical assistance. Coupled with in-country leadership to advance domestic policy reforms, this would begin to align incentives to drive action at scale.



SECTION 4
Energy

Energy is expected to account for about 28% of total core infrastructure investment over the coming 15 years, or around US\$25 trillion (see Figures 3 and 4). Energy efficiency investment adds nearly this amount again, if not more.¹⁸⁵

Building sustainable energy infrastructure provides a triple win: it boosts growth, reduces air pollution and greenhouse gas emissions, and expands and improves energy access. It helps avoid the risks of high-carbon assets, and plays a key role in building resilience and overcoming poverty.

Yet a great deal of unsustainable infrastructure continues to be built. Worldwide, the equivalent of 1,500 coal plants are estimated to be in construction or are planned.¹⁸⁶ The public sector accounts for more than half of investment in coal-fired power.¹⁸⁷ And the risk of stranding is significant: globally, an estimated US\$1.1 trillion of current energy-sector assets, particularly coal mines, may be stranded in the transition to a low-carbon economy.¹⁸⁸ From a human health and environmental perspective, there may be

an even greater risk if the power plants continue to go ahead, namely, that the political economy around vested interests could lock in business-as-usual energy production, even where it is economically suboptimal.

More than 80% of the new coal power plants due to start operation between 2015 and 2020 are in just six Asian countries: China, India, Vietnam, Indonesia, the Philippines and Pakistan (see Table 3). China and India are expected to together account for two-thirds of new global capacity to 2020. If all these plants are built, they would lock in over their lifetimes a significant share of the global carbon budget that the world cannot exceed if it is to reliably meet the 2°C goal¹⁸⁹ and would surpass the International Energy Agency’s (IEA) projected sector capacity constraints for fossil fuel power generation (see Table 3).

Table 3
Installed capacity (GW) of coal-fired power plants without carbon capture and storage in select Asian countries and its compatibility with climate stabilisation targets

Country/region	Installed capacity			4°C scenario				2°C scenario			
	2015	2020	2015-2020	2020	2030	2040	2050	2020	2030	2040	2050
China	891	1,054	163	999	1,097	1,120	1,045	934	943	470	145
India	193	296	103	197	251	305	370	181	135	81	30
Indonesia	25	49	24	No estimate available				No estimate available			
Vietnam	11	36	25								
Philippines	6	13	7								
Pakistan	0	6	6								
6 country total	1,126	1,454	328								
ASEAN	No estimate available										
World	1,927	2,334	407	2,155	2,160	2,113	2,120	1,987	1,612	718	271
Source	GCCPT calculations based on Platts March 2016			IEA, Energy Technology Perspectives 2015. 4 degree scenario includes CCS from 2025 for coal and gas. 2 degree scenario includes CSS from 2020, for coal, gas and biomass. (Data here only shows coal without CCS)							
* Notes	Only plants which are operational and with stated commissioning date by 2020 are included, net of plants scheduled to be retired Indonesia country presentation: 29 GW in 2015 Pakistan country presentation: 8 GW in 2020 and 16 GW in 2030 Philippines country presentation: 5 GW in 2015, 10GW in 2020 and 22 GW in 2030 Vietnam country presentation: 11 GW in 2015 and 55 GW in 2030 (2016 Revised Power Sector Development Plan VII)										

Source: World Bank Group GCCPT calculations based on Platts UDI World Electric Power Plants Database (March, 2016) and on International Energy Agency, Energy Technology Perspectives 2015.¹⁹⁰

Replacing fossil fuel energy sources and building new clean energy systems on a large scale requires system-level innovation, including new technologies for energy efficiency and demand-side management. We need not only renewable energy capacity, but also ways to manage the intermittency of wind and solar PV generation, including energy storage and “smart grid” infrastructure. The sustainable energy infrastructure required will vary by country and shift over time, but overall, transformative investments are needed in off-grid, distributed clean energy systems; storage, transmission and distribution systems for on-grid renewable energy; and information technologies that support efficiency and flexibility in system management.

Investment in energy efficiency is also essential. Energy efficiency is a clean energy solution that is often neglected, yet it is a highly cost-effective way to manage demand and reduce the investment requirements for overall energy supply (see Box 17). In developed countries, energy efficiency is already the biggest source of “new” energy supply.¹⁹¹ Increasing energy efficiency in industry, buildings and transport could achieve up to half of the emission reductions needed globally to peak greenhouse gas emissions by 2020 according to the IEA.¹⁹² And it is leading to savings: energy efficiency investments in IEA member countries since 1990 have avoided US\$5.7 trillion of energy expenditure, and the IEA estimates further investments could boost global GDP by US\$18 trillion by 2035, increasing growth by as much as 1.1% per year.¹⁹³ Developing countries also have a lot to gain by managing energy demand. For example, India’s 2030 energy demand would be 40% higher in a low-efficiency scenario than in one with very high energy efficiency; the difference is equivalent to India’s entire current usage. Notably, energy efficiency measures are estimated to create up to three times as many jobs as fossil fuel supply investments per dollar of investment.¹⁹⁴

Shifting to a sustainable energy system can create a virtuous cycle of low-carbon, climate-resilient growth across a broad range of sectors.¹⁹⁵ The first step is to adopt policies to shift investments away from fossil fuels and high-carbon technologies and towards clean

energy and energy efficiency. This, in turn, reduces the costs associated with fossil fuels. For example, in the US, coal transportation accounted for 38.8% of total freight tonnage in 2014.¹⁹⁶ Implementation of low-carbon growth policies, in the US and globally, would reduce the need for coal transportation, and promote a shift of higher-value freight from road to rail. The reduced need to extract, process and distribute fossil fuels – and to build and maintain related infrastructure – would also yield significant savings that can be invested in supporting low-carbon growth.

A key recommendation of the Global Commission’s 2015 report was to scale up commitments by development banks working with governments and the private sector to invest at least US\$1 trillion per year by 2030 in clean energy, including energy efficiency.¹⁹⁷ Ensuring access to modern energy services is also critical for developing countries, yet recent analysis suggests that development finance is not yet targeting key outcomes such as decentralized energy access.¹⁹⁸ Three energy-related goals – on renewable energy, energy efficiency and clean energy access – are embodied in SDG 7 (“ensure access to affordable, reliable, sustainable and modern energy for all”) and championed in the UN Secretary-General’s Sustainable Energy For All initiative (SE4All).¹⁹⁹ Energy infrastructure investment needs to reflect these three priorities, tailored to local circumstances.

There is enough capital in the world to meet sustainable energy infrastructure requirements. The challenge is to ensure that the right conditions – including well-functioning energy markets – are in place to attract it, both domestically and internationally.²⁰⁰ In this section we focus on three core action areas: fundamental price distortions; the lack of investment frameworks, capacities and policies for incentivising sustainable infrastructure; and the need for investment in clean technology and deployment to reduce upfront investment costs.

Financing energy efficiency: barriers and solutions

There are a number of barriers and market failures that drive the gap between potential and current uptake for investment in energy efficiency. One is misaligned incentives, such as the “tenant-landlord” problem, where the landlord might pay for efficiency improvements, but the tenant reaps the benefits of lower energy bills. Others include the lack of upfront capital by relevant parties (e.g. households and small businesses); the complexity, risk and uncertainty associated with these measures; a lack of awareness of the benefits they can deliver; and potential “hidden costs”, such as the effort required to research and install energy efficiency measures.

Financing for energy efficiency may also not be happening at the scale needed due to difficulties in capturing the financial value of investments. Instead of new revenue, these investments generate savings, and unlike new revenue, the savings often cannot be directly measured or isolated.

Moreover, most energy efficiency loans are tied to the creditworthiness of the building owner, meaning financiers have to vet each building owner individually. This increases transaction costs and reduces the supply of external finance. Many energy efficiency investments are not purely for energy efficiency, but are integrated into more general investments, such as in the construction or refurbishment of buildings and facilities. Accordingly, a large portion of energy efficiency investments are made by building owners (households or businesses) from their own resources, not from external financial investors.

The US Property-Assessed Clean Energy (PACE) programmes allow municipalities and counties to form special tax districts known as “Clean Energy Assessment Districts”. PACE assumes the financial risk, making loans to property owners who adopt energy efficiency measures or install small renewable energy systems, with no down payment required. The loans are repaid over 15–20 years by making additional annual payments on property tax bills. PACE saves consumers money by lowering energy costs, and it creates jobs: for every US\$1 million spent on PACE projects, 15 new jobs are created, as well as US\$2.5 million in economic output.²⁰¹ The programme in New Jersey, for example, is an investment opportunity of about US\$8 billion, capable of creating 85,000 new jobs, while lowering the state’s carbon emissions by 14%.²⁰²

Similarly, India’s Energy Efficiency Services Limited (EESL), founded in 2009 and promoted through the Ministry of Power, facilitates the implementation of energy efficiency projects. The largest national project is converting street lights to energy-efficient LEDs, and also providing LED lights to households. EESL is a joint venture of four public entities: NTPC Ltd, Power Grid Corporation of India Ltd, Power Finance Corporation Ltd and the Rural Electrification Corporation Ltd. Over 100 cities have signed up. EESL also provides energy services and offers consulting and expertise to utilities and financial institutions.²⁰³

Energy efficiency finance is seeing significant innovation. Financing models have been developed to cater better to the wide diversity of projects and to overcome the range of contextual hurdles they face in different countries. As highlighted in Box 21 below, the EBRD has made particular progress as a development finance institution in providing finance for energy efficiency improvements. Specialised energy efficiency entities, such as energy service companies (ESCOs), could play an increasingly important role in many countries in implementing these models.

There are also a number of high-level initiatives promoting investment by mobilising financial institutions. For instance, the SE4All initiative aims to double the global rate of improvement in energy efficiency by 2030.

Finally, international cooperation can help catalyse the financing and political support to make the necessary advance. The International Partnership for Energy Efficiency Cooperation (IPEEC) coordinates six G20 task groups including one dedicated to energy efficiency finance, which has the aim to enhance capital flows for energy efficiency investments.²⁰⁴

4.1 Addressing the fundamental price distortions

Fundamental price distortions are holding back the transformation of energy markets worldwide.

Removing these distortions would level the playing field and remove many barriers to investment in clean energy infrastructure and in continued innovation. It would also incentivise greater energy efficiency and promote sustainability in energy systems.

Box 18

Understanding the full cost of fossil fuels

If countries are to invest in least-cost energy pathways, their planning processes need to account for the full range of costs and benefits of different options. Yet many energy system plans are based on outdated prices for renewable and energy efficiency technologies. They also reflect incomplete assessments of the local costs and benefits, as well as existing price distortions. As a result, many energy system investment plans still prioritise fossil fuels over clean energy.

A crucial cost that is often neglected is local air pollution. The risks to human welfare posed by local air pollution, in terms of economic and social costs, are increasingly well documented and far greater than previously understood.²⁰⁵ Outdoor air pollution, much of which is associated with fossil fuels, is linked to nearly 4 million premature deaths per year.²⁰⁶

China and India both face major challenges. In China, PM2.5 pollution from fossil fuel combustion and cement manufacture has been linked to a median estimate of 1.23 million premature deaths in 2010.²⁰⁷ Updated estimates indicate air pollution killed around 1.6 million people in China in 2013, with an estimated 366,000 deaths from coal pollution alone. In India, the air pollution toll in 2013 stood at 1.4 million deaths.²⁰⁸ The problem is so severe that curbing local air pollution has become a policy priority. In Delhi, the local air pollution was so severe in 2015 that doctors were prescribing that patients with serious respiratory problems simply move out of the city.²⁰⁹

In Europe, research by the Health and Environment Alliance has shown that the impacts of coal plant emissions – mainly due to respiratory and cardiovascular conditions – account for more than 18,200 premature deaths, about 8,500 new cases of chronic bronchitis, and over 4 million lost working days each year. Adding emissions from coal power plants in Croatia, Serbia and Turkey, the figures for mortality increase to 23,300 premature deaths per year, or 250,600 life years lost.²¹⁰

The economic costs associated with the health impacts of air pollution are also significant. Analysis for the Global Commission shows that the health and mortality burden of air pollution can be considerable, amounting to as much as 4% or more of GDP in some countries.²¹¹ Recent analysis by the OECD²¹² has found that globally, if we continue with business-as-usual, air pollution-related healthcare costs alone are projected to increase from US\$21 billion in 2015 (using constant 2010 US\$ and PPP exchange rates) to US\$176 billion in 2060. By 2060, the annual number of lost working days, which affect labour productivity, are projected to reach 3.7 billion (from around 1.2 billion today) at the global level. The annual global welfare costs associated with premature deaths from outdoor air pollution are projected to rise from US\$3 trillion in 2015 to US\$18-25 trillion in 2060. In addition, the annual global welfare costs associated with pain and suffering from illness are projected to be around US\$2.2 trillion by 2060, up from around US\$300 billion in 2015.²¹³ Thus, welfare costs of air pollution that are in the range of a few trillion dollars today are expected to be an order of magnitude higher by 2060, unless we make a major shift in the way we use energy and control air pollution. Considering the indirect costs of air pollution raises the costs even more: roughly doubling the costs of air pollution in the near-term and adding another order of magnitude of costs in the longer term due to a slowdown of economic growth.

Analysis by the IMF on the damages and costs caused by fossil fuels – through impacts such as air pollution, congestion, traffic accidents and climate change – shows that coal has the largest negative impact on human health through the pollution that it causes, and yet coal's use is pervasively undercharged in terms of fuel taxes and carbon pricing.

Because fossil fuels are such a big part of the problem, replacing them with clean energy options can sharply reduce air pollution. A recent analysis found that doubling renewables in the global energy mix, instead of continuing with business-as-usual, could save up to 4 million lives annually by 2030.²¹⁴ Moreover, the IMF estimates that removing subsidies and

charging for externalities associated with fossil fuel use could cut global CO₂ emissions by more than 20%, and cut premature deaths caused by air pollution by more than half.²¹⁵

Integrating the full costs of air pollution on human health and productivity into energy and transport investment decisions would also help level the playing field between fossil fuels and clean energy options. For example, in large parts of Southeast Asia, coal-fired power costs as little as US\$0.06-0.07 per kWh, but even conservative accounting for air pollution adds US\$0.04 per kWh, bringing coal-fired power costs to US\$0.10-0.11 per kWh and removing its price advantage over renewable power sources.²¹⁶

Along with air pollution and CO₂ emissions, the damages from the full life cycle of coal include land disturbance, fatalities in extraction and transport, and methane and mercury emissions. Factoring all this into estimates of the cost of coal can double or triple its price; for example, in cost estimates based on coal from the Appalachian region in the US, these costs add close to US\$0.18 per kWh. This makes wind, solar and other forms of non-fossil fuel power generation, along with investments in energy efficiency, economically competitive.

While there are limitations to these estimates, it is clear that air pollution imposes a very serious cost on society, and it must be duly accounted for in economic assessments to avoid making irresponsible investment choices.²¹⁷ The benefits of reducing air pollution can also be enjoyed in the near term, and accrue locally, mostly to the benefit of the country taking action. Governments should incorporate these cost estimates into the analyses that guide public investment decisions. Regulatory or price-based policies can ensure that the private sector does the same.

Fossil fuel subsidy reform

Fossil fuel subsidies amounted to approximately US\$550 billion in 2014. This includes the underpricing of fuels in many emerging and developing economies amounting to around US\$493 billion²¹⁸ and other forms of support for the exploration, production and consumption of fossil fuels in OECD countries and key emerging economies amounting to more than US\$60 billion.²¹⁹ These amounts represent a reduction from previous years, partly reflecting recent progress in subsidy reform made by a number of countries and partly due to continuing low oil prices.

When uncompensated environmental damage associated with energy consumption is included (e.g. from air pollution, traffic congestion and climate change), as the IMF does, the estimates increase to about US\$4.9 trillion in 2013, or 6.5% of global GDP.²²⁰

In the last three years, 28 countries have launched or stepped up their efforts to reform fossil fuel subsidies. Reform efforts have gained momentum through international forums such as the G7 and the G20 as well as through Asia-Pacific Economic Cooperation (APEC), with support from leading international organisations such as the OECD, the World Bank, the IEA, the IMF and the Organization of the Petroleum Exporting Countries (OPEC). G7 and G20 members

have made commitments to rationalise and phase out “inefficient” fossil fuel subsidies over the medium term. In May 2016, the G7 countries and the EU reiterated their commitment and for the first time set a deadline, encouraging all countries to phase out these subsidies by 2025.²²¹ North American leaders also committed to a phase-out by 2025 when they met in June 2016. The Commission calls on the G20 to also adopt a clear deadline for the phase-out of fossil fuel subsidies.

Many countries have started to voluntarily report subsidies they deem inefficient.²²² Some G20 members have agreed to undertake reciprocal peer reviews of their subsidies and progress on reform. China and the US volunteered to go first, and the reports were delivered to the September 2016 G20 Summit. The next rounds will involve Germany, Mexico and Indonesia.²²³ A similar peer review process has commenced in APEC, starting with Peru in 2014, and continuing with New Zealand in 2015 and the Philippines in 2016. Low oil prices have provided an important opportunity for oil-importing countries to reform consumer subsidies without raising prices for consumers. Indonesia and India, for instance, have taken advantage of low oil prices to accelerate their reforms.



Photo credit: Flickr/IIP Photo Archive

Subsidies to energy and fuel often particularly benefit middle- and high-income households – an IMF review of fossil fuel subsidies in developing countries, for example, found that on average only 3% of gasoline and 7% of diesel fuel subsidies reach the poorest 20% of households,²²⁴ and the richest 20% of households capture, on average, more than six times more in fuel subsidies than the poorest 20%.²²⁵ As such, reforms can be progressive and the savings can be channelled into investments that more directly benefit the poorest and most vulnerable in society, for example through better targeted income support and social safety nets, and through investments in pro-poor infrastructure such as off-grid renewable energy solutions and energy efficiency.

Export credit agencies also provide support to fossil fuel production. Between 2009 and 2013, OECD countries' export credit agencies provided US\$9.1 billion to support coal power – 95% of it from just five countries: South Korea, Germany, France, the US and Japan.²²⁶ Reform of these arrangements offers another pathway for countries to demonstrate their commitment to phasing out fossil fuel subsidies, for example by restricting preferential terms for new coal power

stations, with a timetable for phasing them out entirely, adjusted to different countries' circumstances.²²⁷

Participants in the OECD's Arrangement on Officially Supported Export Credits recently finalised new rules that move in that direction, with restrictions on official export credits to less-efficient plants. The rules take effect on 1 January 2017 and will remove support for large sub-critical and super-critical coal power plants, but still allow support for smaller sub-critical plants in poorer developing countries and for mid-sized super-critical plants in countries facing energy poverty challenges. Non-government export credit providers are also encouraged to follow the rules, which are subject to review starting in 2019.²²⁸

Subsidies to fossil fuels and power generation can take other forms as well. For example, the EU has capacity mechanisms in use to balance supply in the grid given the rising share of power from variable renewables. But capacity mechanisms do not discriminate between dirty and clean sources and may subsidise continued use of fossil fuels. For example, in the UK, such mechanisms transferred roughly US\$1 billion over 2014 and 2015 to diesel- and coal-fired power producers.²²⁹

Signs of progress in phasing out fossil fuel subsidies

A number of countries have made progress in recent years in reducing or phasing out their fossil fuel subsidies and support policies, often complemented by more targeted approaches to supporting poor households. There is much that still needs to be done, but some of the recent progress by G20 countries includes:

- **Indonesia has phased out US\$15 billion in consumption subsidies.** Indonesia almost completely removed most petrol subsidies and made progress in reducing diesel subsidies, saving the public a total of just over US\$15 billion in 2015. The increase in prices of gasoline, diesel and electricity were offset by a more targeted US\$2.6 billion compensation package for the poor.²³⁰
- **Canada is taking action to phase out subsidies, including for tar sands production.** Canada is phasing out several subsidies to oil, gas and mining, including ending targeted support to tar sands such that they are now subject to the same tax regime as other oil, mining and gas development. It is also phasing out the Atlantic Investment Tax Credit, which applies to oil, gas and mining.²³¹
- **India is phasing out fossil fuel subsidies and in 2016 doubled its clean energy 'cess' on coal.** In 2010, the Indian government sought to liberalise the price of petrol, and in 2013 it began a phased deregulation of diesel prices. This has already resulted in a significant decrease in India's budget deficit, as well as in the share of diesel vehicles in India's passenger car fleet.²³² Other reform opportunities exist, for example to reform kerosene lighting subsidies and to re-allocate savings to offset or eliminate tariffs/VAT on solar lighting products. In January 2015 some important steps were taken: India's Finance Minister announced a new phase of subsidy reform for LPG and kerosene, combined with an increase in excise duties on petroleum and diesel. In 2016, the Indian government proposed to double the cess on coal, lignite and peat to INR 400 (US\$6) per tonne.²³³
- **Germany is on track to end coal subsidies by 2018.** In 2007, Germany formally committed to phasing out support to its domestic hard coal industry by 2018. To ease this transition, the government provides support for early retirement schemes for those working in coal production and shares the costs of closures and inherited liabilities with the industry to manage the impacts of reform.²³⁴
- **Russia is reforming its tax policies around fossil fuel production.** Taking advantage of low oil prices, Russia has phased out some tax breaks for fossil fuel producers and Russia's Ministry of Finance began exploring in late 2015 potential tax increases for oil and gas production and export. Russia has also increased excise taxes on transport fuels.²³⁵
- **Saudi Arabia raised fuel prices by 66% in 2016 as part of a wider subsidy reform process.** The Saudi government raised the price of gasoline by two-thirds, and increased electricity and gas tariffs. The Ministry of Finance indicated in the annual budget statement that subsidy cuts aim "to achieve efficiency in energy use, conserve natural resources, stop waste and irrational use".²³⁶
- **Mexico initiated fuel pricing reforms and introduced a carbon tax in 2013.** The government has gradually increased petrol and diesel prices since 2013, and is working to better target energy subsidies in order to bring prices more into line with the true costs. In 2013, the Mexican congress approved the introduction of a carbon tax, and approved increases in the retail price of petrol and diesel through to 2017, in line with overall inflation. It is projected that from 2018, petrol prices will be liberalised and determined by the market.²³⁷
- **Brazil raised prices of transport fuels in 2015.**²³⁸
- **The US and France restrict international public finance for coal.** The US export credit agency was one of the first to significantly curtail support for coal-fired power plants, and its Overseas Private Investment Corporation (OPIC) has shifted its financing away from fossil fuels and towards renewable energy. Guidelines from the US Treasury restrict US support for multilateral development bank funding of coal-fired power projects.²³⁹ France's overseas development agency and export credit agency no longer support coal-fired power stations without carbon capture and storage.²⁴⁰

Pricing carbon

For the market to reflect the full costs of GHG emissions from burning of fossil fuels, countries should introduce meaningful and rising carbon prices in tandem with subsidy reform.²⁴¹ As noted in Section 2, around 40 countries and 20 cities, states and regions, have implemented or scheduled an explicit price on carbon, covering an estimated 7 Gt CO₂e, or about 13% of annual global greenhouse gas emissions.²⁴² This is triple the coverage of a decade ago.

Momentum continues to build. China plans to implement the world's largest emissions trading scheme next year, expanding its current 7 pilot trading systems to the national level. The French government has indicated it will seek to legislate a carbon price floor of €30 (US\$33) per tonne of CO₂,²⁴³ it has also adopted a carbon tax on transport, heating and other fossil fuels.²⁴⁴ In July 2016, Canadian Environment Minister Catherine McKenna called for a national carbon price by the year's end.²⁴⁵ This came on the heels of the approval of a cap-and-trade system in Ontario in May 2016, with the first auction to be held in March 2017 and a plan to link to Quebec and California's joint carbon market in late 2017 or 2018.²⁴⁶

However, carbon prices are generally too low: less than US\$10 per tonne CO₂e for about three quarters of covered emissions.²⁴⁷ This is not enough to bring about transformative change. Still, the Paris Agreement has shifted expectations. A recent survey of members of the International Emissions Trading Association (IETA) found that 82% of respondents expect carbon markets to grow because of the Agreement.²⁴⁸ They also suggested that achieving the Paris goals would require a carbon price of US\$45.

Through the Carbon Pricing Leadership Coalition (CPLC), meanwhile, governments, industry leaders and international organisations are working together to increase knowledge on how to design and implement successful carbon pricing systems.²⁴⁹ As part of this effort, the World Bank, the OECD and the IMF have developed a set of principles for successful carbon pricing, based on lessons from carbon pricing experiences around the world. The CPLC is supported by a Carbon Pricing Panel, made up of sitting leaders of countries that have already taken action on carbon pricing and are personally advocating for other leaders to follow.²⁵⁰ Given the critical importance of doing away with perverse subsidies and pricing

carbon properly, the Global Commission welcomes the emerging coalitions of governments, investors and businesses – including through the CPLC and the G20 – that have the potential to accelerate action globally on fossil fuel subsidy reform and carbon pricing, including by highlighting evidence of good practice and building multi-stakeholder partnerships for reform.

Beyond carbon taxes and emissions trading, another way that countries are pricing carbon is through fuel taxes more broadly, in particular transport taxes, which are generally already widely accepted.²⁵¹ For example, Vietnam adjusted taxes, including on transport fuels, to better reflect carbon content, and thereby boosted investment and domestic demand for goods and services.²⁵² Transport fuel taxes, however, may reflect a range of externalities beyond climate change, including congestion, road damage and local air pollution. A tax that reflects all of this will be higher per unit of fuel than if only taxing carbon content. However, current transport and energy taxes generally do not reflect the full social costs of the use of these fuels. Recent analysis shows that OECD countries inconsistently tax different forms, uses and users of energy relative to environmental and other social costs.²⁵³ Of particular note is that there is often a very low or zero tax rate on coal, despite its greater contribution than other fuels to GHG emissions and air pollution per unit of energy. In all but the US, the tax on diesel in OECD countries is lower than the tax on petrol, despite diesel's much higher air pollution impacts (see also Box 24 in Section 5). Adjusting fuel taxes is a low-cost opportunity for reforms to ensure, where possible, that tax rates reflect the external costs associated with different forms of energy and energy use.

Other policies, such as fuel standards or feed-in tariffs, may be warranted if they tackle specific market failures or political or behavioural barriers that explicit carbon prices do not. These create an implicit price on carbon associated with compliance by industry and consumers. Enforcement measures are an essential part of the policy framework to ensure the implicit price is felt. Every climate policy that regulates carbon can be expressed as a marginal cost per tonne of emissions reduced, which is equivalent to a carbon price. In many countries, the implicit carbon price associated with policy instruments is much higher than explicit carbon prices.²⁵⁴

4.2 Strengthening investment frameworks, institutional capacity and policies

This includes planning, public investment management and policies to improve the enabling environment for private investment in sustainable energy infrastructure.

National strategies for sustainable energy infrastructure - policies, planning and public investment management

Countries need to articulate a clear and comprehensive national strategy for sustainable energy and related infrastructure, and embed it in an overall policy strategy for sustainable and inclusive growth and development. Such planning is particularly important in developing countries, where national development plans are used to guide development cooperation and the allocation of official development assistance (ODA).

A key part of this is aligning national investment and climate policies, and enhancing the coherence and predictability of policies that affect broader investment frameworks. Ideally, a single integrated strategy for low-carbon, sustainable development should map to sector plans, national and subnational planning to guide investment. Importantly, this also helps prepare a project pipeline and incentivise private investment in clean energy infrastructure.

The development of dedicated energy transition plans can dramatically accelerate the shift to a clean energy mix, in a way that delivers clean and resilient energy access. The Global Commission calls on all countries to develop transition plans to accelerate a scale-up of clean and resilient energy solutions and a phase-out of coal, in a way that delivers on energy access goals and facilitates a “just transition” for workers. The Commission welcomes the initiative of the International Trade Unions Congress (ITUC), supported by business and civil society, to establish a new Centre focused on dialogue between governments, employers, workers and civil society around how to ensure a just transition towards clean energy systems.

A comprehensive domestic investment policy framework needs to cover the full range of policy fields that are critical for creating an enabling environment for clean energy investment, including investment promotion and facilitation, trade, competition and tax policy; corporate governance, policies for enabling responsible business conduct and public governance; and issues relevant to finance and financial markets policy.²⁵⁵ Ensuring that such a framework leads

to green investment requires specific policies and measures. In particular, environmental considerations must be appropriately integrated into investment decisions, for instance by agreeing on and applying a standard for assessing the life-cycle emissions and climate vulnerability of energy infrastructure investments to ensure they align with long-term climate goals. The culture and incentives for financiers has started to change but will need to go further to prioritise and value more sustainable long-term investments over a narrow focus on short-term gains.

The OECD has proposed a non-prescriptive checklist for clean energy investment policy frameworks, with the aim to strengthen investor protection and transparency, avoid discrimination, ensure stable and predictable incentives and avoid policy uncertainty, strengthen competition policy and electricity market design, and enhance public governance of energy systems.²⁵⁶ Policy reforms will also be required to create incentives for new business models to emerge, for example for integration of centralised and decentralised energy, wireless platforms for customer services and payments, and connecting utilities functions with small and medium size enterprises to provide energy services including energy efficiency.

Several countries are already reforming their domestic investment policies to support low-carbon and climate-resilient investments. For example, Colombia is working to mainstream climate action across its national development plan and, amongst other proactive measures, has established a focused programme on public-private collaboration, with priority attention to investment in infrastructure and achieving environmental sustainability. It has also put a range of fiscal incentives in place for investment in low-carbon technologies.²⁵⁷ Jordan is aggressively pursuing policy reforms to scale up clean energy investment, including in energy efficiency.²⁵⁸ In the new 2015 Arab Future Energy Index, Jordan ranked second for renewable energy trends and third for energy efficiency.²⁵⁹

However, capacities in the public sector in developing countries for sustainable energy investment planning and undertaking necessary policy reforms are often weak and urgently need to be strengthened. Even where capacity is higher, little attention may be paid to sustainability. Appropriate technical, legal and financial skills, both inside and outside government, are frequently lacking. When these skills are present, within the government or through consultants, projects are likelier to be prepared and reach financial close and implementation without costly delays.²⁶⁰

Building such institutional capacity and setting in motion relevant policy reform processes has a cost, takes time and cannot succeed without high level commitment and leadership from the government. It likely entails staff training, data collection and analysis, changing legislation and regulations, and capacity for enforcement. In developing countries, external support can play a pivotal role to help deliver enabling policy reforms and to strengthen capacity to finance sustainable infrastructure. For example, ODA, particularly where it can be programmed in across multiple years to ensure continuity, can help to fill the financing gap in this area for poorer developing countries.

Meeting large sustainable energy infrastructure needs will require determined efforts to tap any available scope for additional domestic resource mobilisation through tax and expenditure policies. It will also require better use of government balance sheets. Given the significant potential for private investment in the clean energy space, a key focus of public-sector investment should be

to catalyse private finance – and to fill gaps where the private sector is unlikely to step in.

There are several ways to mobilise public resources for clean energy and other purposes, including by removing excessive and regressive tax exemptions, taxing GHG emissions and other externalities, removing fossil fuel subsidies, and adjusting fuel taxes. For example, revenue from the Indian government's Clean Environment Cess, effectively a tax on coal of about US\$6 per tonne (INR 400), raised about US\$1.9 billion (INR 13,000 crores) for the National Clean Energy Fund by 2015, financing research and innovation.²⁶¹ Similarly, the strain of large fossil fuel subsidies on the Nigerian budget prompted the Nigerian government to make efforts to reform electricity subsidies in 2008 (through a 15-year plan to achieve cost-reflective tariffs), followed by petrol in late 2011, thus generating a double win by aligning incentives for a low-carbon economy and creating more fiscal space for public spending.²⁶²

Box 20

Sustainable procurement for clean energy infrastructure: Italy and South Africa

Sustainable procurement is a way to shift public finance into clean energy and build markets for clean energy technologies and services. For example, this has occurred in Italy through Consip, which is the central purchasing body, wholly owned by the Italian Ministry of Economy and Finance. It set out to improve the procurement of heating services, which accounted for 41% of national energy expenditure (about €3.4 billion [US\$3.7 billion] annually) and about 5% of the Italian energy market. Consip's goal was to save 5–10% in energy use and costs through energy performance contracts.²⁶³

The agency conducted a thorough market analysis, including a consultation through online surveys addressed to businesses and the main trade associations in Italy. Suppliers were invited to provide input on Consip's planned approach. The result was a framework contract, open to all public administrations, that includes improved energy efficiency, consumption reduction and CO₂ emissions avoidance. The idea was to motivate suppliers to optimise energy consumption and resource management to improve their profitability. The initiative saved public administrations 27% on contracts worth about €800 million (US\$880 million), covering about 6,000 buildings.

Another example is South Africa's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), which replaced feed-in tariffs for renewable energy.²⁶⁴ The REIPPPP has successfully channelled substantial private-sector expertise and investment into grid-connected renewable energy in South Africa at competitive prices. The first three bid rounds, held over 2.5 years, attracted a wide variety of domestic and international project developers, sponsors and equity shareholders. A total of 64 projects have been awarded to the private sector, with more than 100 entities participating in the contracts. Banks, insurers, DFIs and even international utilities are involved. Notably, 86% of the debt finance has been raised within South Africa. The first projects are already operating, and investments totalling US\$14 billion have been committed, to generate nearly 4 GW of renewable power. Over the three rounds, average solar PV tariffs decreased by 68%, and wind by 42%, in nominal terms.

REIPPPP demonstrates that private sponsors and financiers are more than willing to invest in renewable energy if the procurement process is well-designed and transparent, transactions have reasonable levels of profitability, and key risks (programme design, programme management and market risks) are mitigated. REIPPPP also highlights the need for effective programme champions with the credibility to interact convincingly with senior government officials, effectively explain the program to stakeholders, and communicate and negotiate with the private sector.

Tax revenues relative to GDP are much lower in emerging and developing economies than in advanced economies, so there may be considerable scope for greater revenue mobilisation through tax reform and tighter tax administration. Improved taxation has many benefits, including establishing a revenue base for further investment and strengthening the public balance sheet.

As part of public investment management, it is in governments' self-interest to improve procurement principles and practices, and devise means to integrate sustainability parameters, particularly at the sector level in the case of energy (see Box 20 for examples).

Strengthening local finance institutions

There is an increasing recognition of the role that local financial institutions (LFIs) play in promoting private investment in sustainable infrastructure, including energy efficiency. These can be commercial or public entities; for the latter, a key role is to catalyse engagement with commercial banks.

LFIs have unique competitive advantages for driving the uptake of sustainable investment solutions, including in-depth knowledge of local markets, a good understanding of customers' demands, tailored product offerings for local requirements and an ability to provide financing in local currency. However, several barriers to the deployment of green finance through LFIs hold back their potential to drive investment, in particular perceived or actual high risks of sustainable low-carbon projects, low risk appetite by banks and low availability of long-term finance.²⁶⁵

These barriers can be addressed by building internal knowledge, awareness and capacity within local banks; fostering changes in their internal culture; sharing knowledge among LFIs; and appropriately accounting for, documenting and pricing the benefits of green investments. Governments can implement policy and regulatory reforms to support this shift. MDBs can play a role in finding solutions at the regional level, by connecting LFIs with green finance resources, providing technical assistance, raising awareness and fostering collaboration.

One area in which LFIs play an increasingly active role is in financing energy efficiency investments in their own countries. They are typically active in sectors where market failures are well known and have substantially limited private sector investment. Two examples in Europe are:²⁶⁶

- **Germany's KfW "Energy Efficient Construction and Refurbishment" programme** provides concessional loans and grants for energy-efficient construction and refurbishment activities in the German residential sector. To qualify, projects must achieve greater efficiency than is required by the German Energy Savings Ordinance. In 2013, KfW invested €4.1 billion (US\$4.5 billion) in residential retrofits. Between 2006 and 2013, it has provided more than €50 billion (US\$55 billion) in loans and grants covering 3 million housing units.
- **The European Energy Efficiency Fund (EEEF)** is an innovative public-private partnership, which acts as a risk-sharing facility, working with financial institutions to provide market-based finance to local authorities and energy service companies for commercially viable energy efficiency, renewable energy and clean urban transport projects related to public-sector activities across the EU. It contributes with a layered risk-return structure to enhance energy efficiency and foster renewable energy in the form of a PPP, primarily through the provision of dedicated financing via direct finance and/or partnering with financial institutions. Deutsche Bank acts as the fund's investment manager, sourcing, evaluating and preparing proposals, but final decisions about investments are made by the fund's governing bodies. By the end of 2015, ten projects have received financing of almost €117 million for projects worth a total of almost €220 million. These have generated CO₂e savings of 181 Mt and primary energy savings of 20 GWh.²⁶⁷

Catalytic use of domestic and international public development finance

Domestic and international public finance can be catalytic in attracting private finance at the scale required. Deployed at the right time, at the early stages of infrastructure projects, public investment can drive the global clean energy revolution. National or subnational planning, with clearly established priorities, can be effective in guiding such investments.

As discussed in Section 2, national development banks (NDBs) are increasingly active and have the potential to grow their activities in sustainable energy infrastructure by creating or expanding green banking "windows". Green investment banks, essentially NDBs with a green mandate, are also increasingly being established, in particular where countries do not



Photo credit: Flickr/IIP Photo Archive

have an NDB (see Section 3). The creation of a green banking window or a green investment bank can signal to domestic and international markets that a country or region is seeking to become a leader in scaling up private low-carbon investments.²⁶⁸

In Mexico, for example, Nacional Financiera (NAFIN) is a key local partner in the implementation of the government's low-carbon development strategy and in accelerating private investments in low-carbon technologies. The Renewable Energy Financing Facility (REFF) was established within NAFIN to fill the financing gap for sustainable infrastructure by providing direct loans to renewable energy project developers, with maturities in the 10- to 15-year range and fixed interest rates. The fund also offers contingent credit lines to cover transitory cash-flow shortages during the project life cycle, up to the volume needed to service senior debt.²⁶⁹

Recent analyses confirm the need for energy sector investments on the scale of about US\$1 trillion per year, as previously recommended by the Global Commission.²⁷⁰ For energy efficiency alone, if development banks, bilateral aid organisations, and climate finance organisations dedicated US\$10–15 billion a year to finance sustainability premiums for energy efficiency, this could leverage private capital that could increase the value of energy-efficient infrastructure by up to US\$176 billion a year.²⁷¹ Over 15 years, that means there would be US\$2.6 trillion in sustainable energy-efficient projects that would have not otherwise have been built sustainably.²⁷²

One example of a successful partnership to promote energy efficiency is Commercialising Energy Efficiency Finance (CEEF), a risk-sharing programme of the International Finance Corporation (IFC) and the Global Environment Facility (GEF) that provided guarantees to investments in Eastern Europe.²⁷³ Another is the China Utility-Based Energy Efficiency Program (CHUEE), which has provided US\$512 million in loans to 78 companies without a default loss and is now scaling up by partnering directly with medium-sized financial institutions in China.²⁷⁴ A third is the European Bank for Reconstruction and Development (EBRD) Sustainable Energy Initiative, a strong example of the role DFIs can play in promoting energy efficiency and renewables (see Box 21).²⁷⁵

Another potential source of innovative or catalytic climate finance is the Green Climate Fund's (GCF) private-sector facility. Although it has not yet disbursed any funding, it has approved eight innovative projects spanning adaptation and mitigation and engaging with a variety of partners from both the public and the private sector, and more projects are expected to be approved in the coming year.²⁷⁶ One example, already approved for funding, is the KawiSafi Venture Fund for East Africa, an initiative of Acumen, a non-profit impact investment organisation.²⁷⁷ The fund will work with clean energy companies to deliver climate change mitigation, adaptation and local development benefits, starting in Rwanda and Kenya. Acumen will directly invest US\$5–7 million and hopes to use seed funding from the GCF to catalyse investment to grow the fund to US\$100 million.

EBRD Sustainable Energy Financing Facilities (SEFFs)²⁷⁸

In 2015, the EBRD launched its Green Economy Transition (GET) approach, which combines green investments with technical assistance and policy dialogue – a proven business model. Under the GET, the EBRD reaches small- and medium-sized businesses, corporate clients and retail clients through Sustainable Energy Financing Facilities (SEFFs) by extending credit lines to local financial institutions which, in turn, lend funds to their clients.

SEFFs provide financing for key types of sustainable energy projects, including energy efficiency and renewable energy; others finance resource efficiency investments that optimise water and material consumption and minimise waste. EBRD has also developed a SEFF to support investments that improve the resilience of clients' businesses to the effects of climate change.

SEFFs are accompanied by technical assistance in the form of a programme support team. This team provides expert guidance to partner financial institutions on designing financial products for green projects. In addition, the team supports partner banks with marketing and promotion, training bank staff and monitoring the development of these new business areas. The team also helps end-borrowers turn project ideas into bankable green investments.

Since 2006, cumulative EBRD financing of SEFFs has reached more than €3.4 billion (US\$3.7 billion) in over 100,000 sub-projects. The EBRD now works with more than 100 partner financial institutions in 24 countries, including large international banks and small banks in Central Asia and the Caucasus. The SEFF portfolio of projects is estimated to avoid more than 6 million tonnes CO₂e of emissions per year. SEFFs play an important role in developing new green financing markets, from significant renewable energy or industrial energy efficiency projects, to very small residential energy efficiency investments, and by setting an aggregation frame. Some examples are:

The €585 million (US\$642 million) Turkey Private Sector Sustainable Energy Finance Facility (TurSEFF) provides credit lines to local financial institutions to lend to the private sector for energy efficiency and small-scale renewable energy investments. Since TurSEFF's launch in 2010, partner banks have financed 13 landfill gas power plants for a combined amount of €15 million (US\$16.5 million). Over half of the facility's GHG reductions now derive from methane abatement in landfills. TurSEFF has also financed energy efficiency improvements in businesses, and wind, solar and hydroelectric power. Arel Cevre, for example, received a loan of €0.7 million (US\$0.8 million) under TurSEFF to fund a 2.83 MW landfill gas power plant in Isparta, Turkey. The new plant is expected to produce on average 21.06 GWh of green electricity annually and has a payback period of 1.7 years. It is anticipated to generate average net revenues of €2.3 million (US\$2.5 million) per year from electricity sales.

The €60 million (US\$66 million) Western Balkans Sustainable Energy Financing Facility (WeBSEFF) has extended credit lines to eight partner banks in the Western Balkans to lend to businesses and municipalities investing in sustainable energy projects. For example, this helped a Macedonian sweets producer obtain €970,000 (US\$106,000) in EBRD financing via Ohridska Banka. The project is expected to reduce the company's energy consumption by more than 30% and improve overall efficiency. As a result, the company expects to save €262,000 (US\$287,000) per year, representing a payback period of 3.6 years. Its CO₂ emissions are expected to decrease by 490 tonnes per year.

Emerging role for philanthropic and impact investors particularly in off-grid solutions

Philanthropic and impact investors help bridge the gap between patient capital and venture capital, and can be transformative in scaling up sustainable energy investments, especially in low-income countries. This is where equity impact investments play a key role,

especially with off-grid technologies. Not only are impact investors usually more patient with capital, but equity investments do not require collateral.

For example, several impact investors have funded Fenix International, a venture-backed California company focused on expanding energy access in developing countries through renewable technologies. The company's ReadyPay Power enables customers to

purchase the system in micro-installments that fit their income, using their mobile phones to pay as little as US\$0.25 per day. ReadyPay helps low-income people overcome financial barriers to access clean energy, and enables them to power lights, phones, radios and appliances. The programme recently won the Development Assistance Committee Prize for Taking Development Innovation to Scale after providing paid power to more than 22,000 households in Uganda, benefitting over 136,000 people.²⁷⁹

In rural Kenya, Vulcan Impact Investing owns 10 solar-powered micro-grids that serve 21,000 people, operated in partnership with SteamaCo.²⁸⁰ Not only does this replace energy from harmful sources such as kerosene and diesel, but it also provides a sustainable energy source to drive economic activity. Several off-grid companies that started with impact investing have attracted larger-scale commercial investment, such as M-KOPA in Kenya and Mobisol in Tanzania. Through M-KOPA, nearly 400,000 customers in Western Africa have made a small deposit for a home solar system, then paid the rest of the balance back through a widely used mobile banking service based on the amount of energy they use.²⁸¹ Mobisol, a Berlin-based company offering customers in low-income countries solar home systems via affordable installments made from mobile phones, has installed 50,000 solar home systems to date in households and businesses in East Africa, which have allowed its 250,000 beneficiaries to access clean, affordable energy.²⁸² These examples confirm the role of philanthropic and impact investors as those who can help catalyse investment, not just in off-grid renewables, but in new sustainable technologies more generally.

In India, where access to debt capital is generally low, off-grid companies face prohibitively high interest rates of 13–18% in the domestic market. Local banks are usually unwilling to lend to them, as the loans are too small, and international debt is also out of reach due to regulatory requirements. Therefore, most investments in off-grid energy – ranging from US\$100,000 to US\$5 million – have been from equity impact investors and development banks.²⁸³ Examples include Firstlight Ventures investment in Promethean Power Systems, Anthro Power and Excellent Renewable, and Ennovent's investment in Barefoot Power. However, impact investors can find it difficult to access the Indian market, especially as they may have a hard time approval from the Reserve Bank of India to lend in the Indian market.

Tailored instruments to attract private investment: project preparation and construction

Private finance is best suited to the operational phase of sustainable infrastructure investment, but there are good opportunities to bring in private finance during project preparation and construction as well. Tailored instruments that manage the challenges of this phase, especially those related to risk-return profiles, are critical. Options include turnkey contracts, construction guarantees, targeted credit enhancements, availability payments, mezzanine financing to first-loss protection, partial risk guarantees against policy risk and exemptions from reserve requirements.

Public finance can also be used to blend concessional and non-concessional finance from public and private sources for project preparation or construction. Blended finance is the strategic use of official development finance to mobilise additional public or private finance. This may be needed to finance the upfront premium for sustainable infrastructure projects and to draw in private finance and investors.

DFIs can play a pivotal role here in pioneering and scaling up use of blended finance, creating viable and replicable financing models. In addition to use of official finance for guarantees or insurance, syndicated loans or project bonds also provide a means for co-investing across public entities, such as local banks, NDBs or MDBs, and can also attract private investors to the early project stages.

DFIs – multilateral, bilateral and national – can come in at the early stage to help with project preparation and construction and draw down the costs for the private sector. A few examples of such strategies include:

- **The Central Bank of Lebanon (BDL)** reduces the cost of financing investments in specific economic sectors by exempting banks from part of the required reserve requirement. BDL is working with the Ministry of Power, the United Nations Development Programme (UNDP), the EU, and the Lebanese Center for Energy Conservation (LCEC) to provide low-cost finance and medium- to long-term maturities to potential investors in green technology, specifically in energy efficiency and renewables. BDL, UNDP and LCEC have agreed to develop a vehicle to finance energy efficiency and renewable energy, called NEEREA

(National Energy Efficiency and Renewable Energy Action), and will work with international donors and organisations to support NEEREA, and to raise awareness and build capacity among Lebanese commercial banks and consumers.²⁸⁴

- **The Clean Energy Investment Accelerator (CEIA)** seeks to develop a network of blended capital facilities that will provide early-stage working capital to renewable energy and energy efficiency project developers in emerging markets, at below-market interest rates. The CEIA is a revolving loan facility developed by Alotrope Partners that leverages philanthropic and other sources of concessionary capital (government and multilateral), alongside private equity and debt, to fill critical gaps in clean energy finance. It targets early-stage project preparation, clean energy business development and the demonstration of new low-carbon technologies.²⁸⁵
- **MDB guarantees:** The targeted application of MDB guarantees can make or break large-scale infrastructure projects. Such was the case with the €625 million (US\$685 million) Lake Turkana Wind Power Project (LTWP), whose success depended on a €20 million (US\$22 million) guarantee from the African Development Bank (AfDB) and Standard Chartered Bank. LTWP aims to provide 310 MW of reliable, low-cost wind power, around a 10-15% increase in Kenya's total installed capacity of around 2,300 MW. The LTWP site is more than 428 km away from the nearest substation, so a transmission line must be built to deliver the power to the national grid. The state owned Kenya Electricity Transmission Company (KETRACO) agreed in 2013 take responsibility for the US\$185 million transmission line, which was critical to the success of the wind farm. After the World Bank withdrew its partial risk guarantee in late 2012, the project was delayed for more than two years—a real-life demonstration of the integral role of guarantees in bringing projects to completion. At the end of 2014, the AfDB and Standard Chartered stepped in with guarantees to cover loss of revenue attributable to transmission line delays. Construction began in 2015 and is expected to finish in 2018. “By reducing the risk profile,” noted the AfDB, “the partial risk guarantee will accelerate financial closure and reduce the overall cost of capital to the project.” In effect, by reassuring investors, this €20 million guarantee is helping the project reach its €625 million financing target.²⁸⁶

- **UNDP technical assistance for de-risking investment:** The UNDP, working in partnership with the government of Tunisia, has demonstrated an approach to understand drivers of financial risk and assess alternative actions to de-risk renewable energy investment.²⁸⁷ Policy, legislative, regulatory, institutional and financial barriers, and low awareness of the performance of new renewable technologies, drives up the cost of financing them. The cost of equity for large-scale wind energy and solar PV in Tunisia is estimated to be as high as 15%, compared with 8% in Germany (2015), which in turn inhibits investments at national and local levels. With support from the Global Environment Facility, UNDP is providing technical assistance to the government of Tunisia to support policy reforms and use of public instruments to de-risk investments. Modelling efforts suggest that public support for de-risking could be promising. For example, it is estimated that a public investment of €145 million to 2030 would help leverage US\$1 billion (€935 million) in private sector investment, and significantly lower the cost of solar power for consumers.²⁸⁸

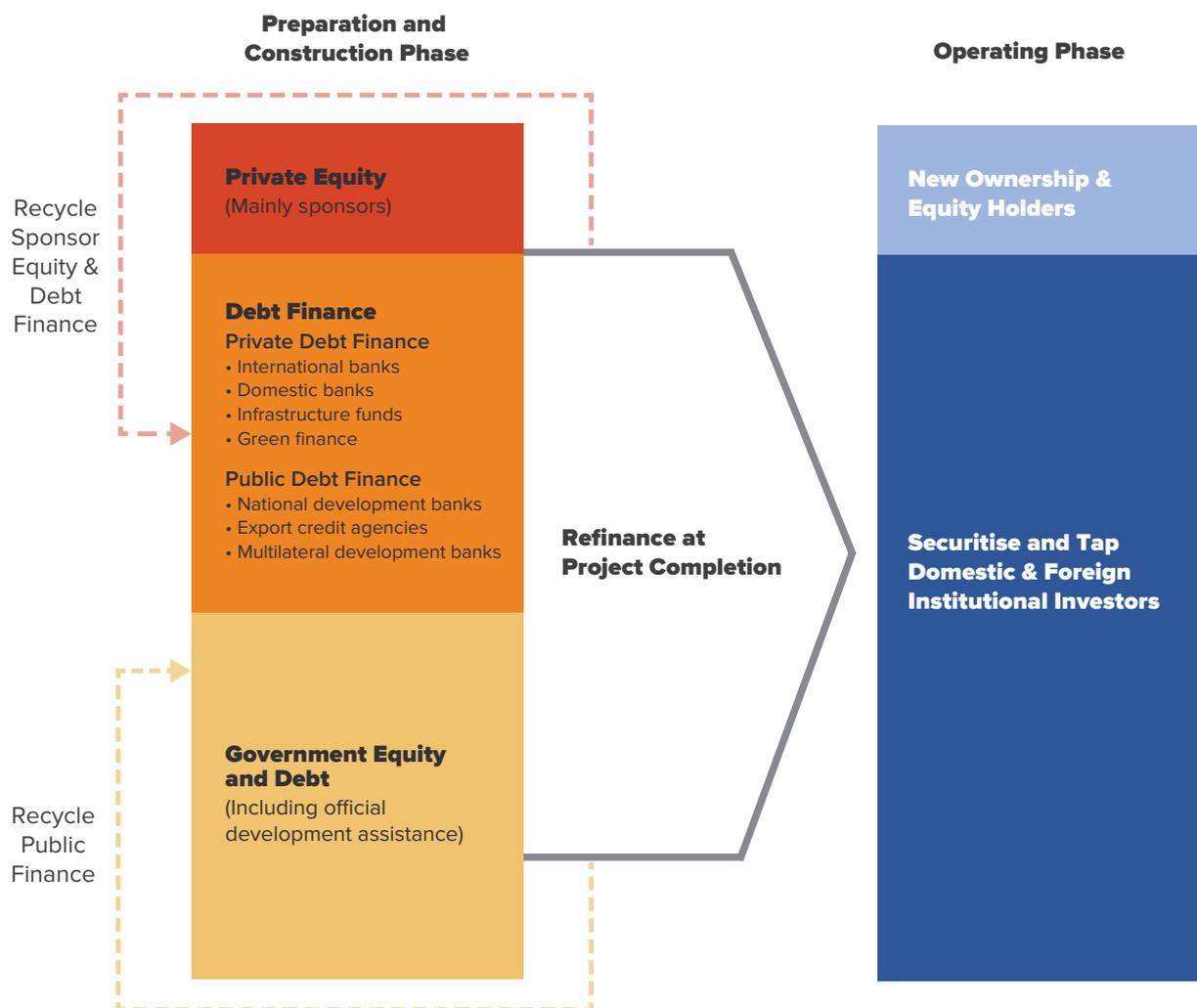
Given the increasingly commercial viability of solar technologies, it is now possible to attract private capital to early stages of project development in some markets. Wunder Capital is an innovative example of this for small solar projects in the US. It is a financial technology company that develops and manages solar energy investment funds. There was a gap in the market for smaller project funding, as transaction costs are prohibitively high for lenders; any deal under US\$2 million can cost more to prepare than the expected loan revenue. To overcome this, Wunder is structuring diversified funds that hold solar project assets, then marketing them to specific institutional investor classes, thus accessing private capital for early stages of solar projects.²⁸⁹ Wunder just launched a bridge fund that issues asset-backed project loans to the US solar industry and is expecting to deliver a return of up to 11%. As the minimum threshold for investment is low, there is also potential for crowdfunding with this type of business model.

Tailored instruments to attract private investment: operating phase

The generation of more certain cash flows in the operating phase opens up the prospect of replacing bank debt with bond finance that can be held by both domestic and foreign institutional investors: pension funds, insurance companies, private equity

Figure 10

Infrastructure Financing Requirements for Emerging Markets and Developing Countries



Source: Bhattacharya et al., 2016

and sovereign wealth funds. This refinancing allows for a recycling of equity and bank finance that can be used for new investments (see Figure 10). In the operational phase, a key approach is securitisation of infrastructure loans once there are reliable, operating revenue streams, where the use of labelled green bonds or YieldCos provides a way to achieve this. Both green bonds and YieldCos can be used to develop infrastructure as an asset class to attract institutional investors (see discussion in Section 3).

Green bonds can be used to attract private capital and, in particular, long-term finance to sustainable infrastructure markets. They are especially attractive once the investment is operating, hence avoiding risks associated with preparation and construction phases. Green bond markets are expanding and

diversifying rapidly. The amount of green bonds for sustainable infrastructure has quadrupled or more since 2012, reaching US\$42 billion in 2015.²⁹⁰ The Climate Bonds Initiative and HSBC expect the labelled green bond market to rise to US\$100 billion of green bond issuance in 2016, and estimate the total market currently at US\$118 billion outstanding.²⁹¹

Bonds are familiar instruments for the investment community, but there are concerns around the credibility of green bonds. Measures to tackle these issues need further coordination and work (see Section 3). Several factors are likely to drive continued rapid growth of green bond markets, but government policy is needed to ensure the potential of this market is fully realised and barriers do not get in the way.²⁹²

Box 22

Case studies on green bonds

In India, the first corporate green bond was issued by Yes Bank in February 2015. The US\$161.5 million (INR 10 billion) bond will finance renewable energy projects. Following the success of the Yes Bank issue, the Export-Import Bank of India issued a larger US\$500 million green bond. The green bond will finance renewable energy and transport projects. India was first of the biggest emerging economies to issue green bonds, ahead of China.²⁹³

China is now a leader in the labelled green bond market – the largest country of issuance to date in 2016. It has announced it will issue US\$46 billion of labelled green bonds in 2016.

The BRICS New Development Bank, founded by Brazil, Russia, India, China and South Africa to finance sustainable development in emerging markets and developing countries, commenced operations in 2016. It has already made several loans; its first bond issue will be five-year yuan-denominated green bonds, and will be used to finance sustainable energy projects. Its first loans are US\$300 million to Brazil, US\$81 million to China, US\$250 million to India and US\$180 million to South Africa; all are on renewable energy.²⁹⁴ Future bond issuance could be in local currencies to help local investors avoid exchange rate risk.

There is a role for the public sector to create and develop a market for green bonds to tap into investor demand and ensure the market meets its potential.²⁹⁵ To facilitate the market, common standards for green bonds should be agreed internationally.

In addition to stronger and uniform standards (see Section 3), a number of factors could help to drive future growth of green bonds markets: successful implementation of the Paris Agreement, the success of green bond issues to date, tighter spreads compared to other bonds, and growing interest from emerging markets keen to grow local green bond markets.²⁹⁶ Green bonds could also benefit from investors' growing desire to publicly demonstrate a commitment to the environment. There is potential as well for issuers in the US\$600 billion unlabelled "green" bond market (where bond proceeds are invested in green projects but are not labelled green) to shift to issuing explicitly labelled green bonds. Integrating credit ratings

and third-party "green" ratings could be a way to streamline the market and facilitate mainstreaming of green aspects in bond markets based on tools that private investors are familiar with.

YieldCos, which own portfolios of low-risk, long-term projects, are equity vehicles that can go a step further than bonds by effectively bundling equity and debt together in one package. By bundling projects together, the project finance premium for single projects can be avoided or reduced. The first renewables-focused YieldCos went public in 2013, though similar funds have existed for longer; in 2015 there were 15 renewables-focused YieldCos in the US, Canada and Europe, with a total market capitalisation of well over US\$20 billion.²⁹⁷

YieldCos and similar closed-end investment funds (the terminology varies across countries) are publicly-traded companies that own portfolios of operational renewable energy projects, paying dividends to shareholders from the projects' revenues. Most funds aggregate solar and wind assets. Some also include hydropower, biomass and cogeneration assets. Most YieldCos have been created by renewable energy developers, selling their projects into the YieldCo upon completion. For an investor, a YieldCo or similar pooled investment vehicle can be a way to achieve the same cash flow that would come from directly owning a renewable energy project, but through a liquid, publicly traded instrument.

Because these instruments are exchange-traded, they avoid some of the liquidity risk and transaction costs associated with direct clean energy investments; they therefore have the potential to open up clean energy infrastructure investments to a wider range of investors, increasing the supply and reducing the cost of capital.

However, neither green bonds nor YieldCos are without drawbacks: as noted in Section 3, there are some questions about the extent of emission reductions from green bonds backed by larger institutions, and YieldCos do not yet have a long track record from which to judge their performance. Some of the larger YieldCos have developed an expectation of rapid future growth, making them possibly riskier investments. Still, the growing market for these instruments shows there is high demand among private investors for liquid investment opportunities in clean energy. Scaling up the use of pooled investment vehicles and extending their use across different markets and technologies appears to be a promising strategy to draw more private investment into clean energy.²⁹⁸

4.3 Boosting investment in innovation

Investment in research, development and deployment (RD&D) can encourage innovation, help to overcome incumbent technology advantage, and lower financial risks associated with investment in existing or new clean technology, thus reducing the upfront costs of energy infrastructure.²⁹⁹ Over the next 15 years, when key infrastructure systems will be built and locked in for decades, a pressing challenge is to rapidly deploy existing state-of-the-art technologies and business models or those that can rapidly be demonstrated at commercial scale, even as we also invest in next-generation technologies for the longer term.

There is an urgent need to scale up RD&D investment and create a culture of innovation across the energy system. Energy-sector public RD&D is less than half what it was in the late 1970s in real terms, and still often goes to fossil fuel exploration and production.³⁰⁰ Previous recommendations from the Global Commission were that R&D for clean energy should be tripled to well over US\$100 billion a year by the mid-2020s.³⁰¹ To be effective, a scaling up of R&D spending on clean energy should be accompanied by a phase-out of public R&D spending on fossil fuels.

Sustainable energy innovation requires significant expenditures and a wide variety of expertise, so investments here are particularly conducive to collaborative governance. Indeed, over the last two decades, the number of global public-private partnerships for energy RD&D has grown exponentially.³⁰²

Smart and collaborative R&D investments can be particularly powerful at the multi-country or global level. A long-standing example is the IEA's Technology Collaboration Programmes (TCPs, also formerly called Implementing Agreements). There are now 39 TCPs, involving about 6,000 experts from government, industry and research organisations in 51 countries, covering a wide range of clean energy technologies and practices, including energy efficiency, renewable energy and energy storage or battery technologies as well as state-of-the-art fossil fuel and nuclear technologies.³⁰³ They develop and share knowledge across borders and identify and build on synergies in their research. Since 2007, non-IEA member countries, including China and India, have increased their participation.³⁰⁴

TCPs help achieve economies of scale and promote knowledge diffusion and collaboration.³⁰⁵ A recent analysis using nearly 40 years of patent data from 33 OECD countries found that bringing researchers together through TCPs boosts co-invention on wind and fuel cells, and especially on biofuels, solar photovoltaics and carbon capture and storage. What kinds of environmental policies are in place can also matter. Key features include stringency and predictability as well as flexibility – that is, policies that are not prescriptive but give firms incentives to look for the best technology solutions.

Several other multi-partner, public-private global initiatives have recently launched and are working to boost R&D and deployment with climate change as a central theme. Examples include:

- **Mission Innovation**, with 21 members (including Australia, the US, the UK, Brazil, Chile, China, the EU, Indonesia, India, Japan and Mexico) committing to doubling public investments in clean energy research and development over the next five years.³⁰⁶
- Bill Gates' **Breakthrough Energy Coalition**, which brings together 28 major individual investors from 10 countries, with a collective net worth of more than US\$350 billion, to provide capital for research on high-risk but promising clean energy technologies.
- **The Global Innovation Lab for Climate Finance** supports the identification and piloting of cutting-edge climate finance instruments that can drive investment and unlock new opportunities for renewable energy, energy efficiency, and adaptation efforts in developing countries. In just over a year of operation, it has already directed more than US\$500 million to these areas in developing countries, and its model has been replicated in India with the India Innovation Lab for Green Finance.
- **Finance for Resilience (FiRe)**, managed by the Climate Policy Initiative, is a platform used to crowdsource funding for ideas that accelerate finance for clean energy, low-carbon infrastructure and sustainable cities. The platform targets large-scale ideas which aim to generate investment of over US\$1 billion per year.

Bilateral collaborations are also making an impact. The US-China Renewable Energy Partnership, for example, was launched in 2009 to increase the deployment of renewable energy technologies, improve energy security, and expand business opportunities in both countries. Similarly, the US-India Partnership to Advance Clean Energy (PACE), also launched in 2009, has worked to decrease barriers to the deployment of wind and solar power, thus growing the Indian market for clean technologies and services.³⁰⁷ Building on this experience, in June 2016 the US and India announced a strengthened and expanded partnership to advance clean energy, including access to off-grid solar energy.³⁰⁸

In developing countries, decentralised renewable energy systems can far more rapidly bring modern energy services to rural areas and even to the urban poor than investment in a central grid. Efforts are needed to test and disseminate different business and finance models, such as pay-as-you-go solar, to learn what works best in each setting (see discussion in Section 4.2). Companies such as Tesla continue to push new clean technologies forward while social enterprises such as Mobisol, M-KOPA, Solar Now and Greenlight Planet³⁰⁹ accelerate rapid diffusion

of new technologies and business models to finance them. Greater public-private collaboration can accelerate investments and diffusion, particularly in lower-income countries (see also discussion on impact investors below). The expanded use of patent pools, including financing and technical support for these, can also help to make low-carbon and climate-resilient energy technologies available to lower-income countries, and ensure they have the capacity to adopt and adapt them.³¹⁰ Rather than belatedly adopting technologies developed elsewhere, often at significant expense, emerging and developing countries can seize the opportunity to develop their own, locally-adapted solutions, which can in turn help lower emissions, improve resilience and overcome poverty. As a form of South-South cooperation, solutions like mini-grid systems can be developed, exported, and shared with other developing countries.³¹¹

Leadership and investment from infrastructure corporations will also be essential to drive innovation, including in business models that can drive breakthroughs for rapid dissemination of new products and technologies and create new markets. Some emerging initiatives offer promise (see Box 23 below).

Box 23

GE's Ecomagination ³¹²

GE's Ecomagination is a striking example of corporate innovation in environmental sustainability. 2015 marked its 10th anniversary, with a cumulative US\$17 billion in cleaner technology R&D spending that has generated US\$232 billion in revenue while reducing corporate-wide GHG emissions by 12% and freshwater use by 17%. The company has pledged to accelerate its actions to spend another US\$10 billion in cleaner technology R&D by 2020 and achieve cumulative GHG emission and water reductions of 20%.

Ecomagination now includes a range of innovative partnerships, notably with Intel, Walmart, Masdar City, Statoil, Total, the mining and oil company BHP Billiton, and the water engineering company MWH Global. Many of these partnerships focus on reducing the emissions and energy intensity of industrial operations. In the case of Walmart, the goal is commercial applications at scale, where the partnership focuses on developing and demonstrating next-generation energy efficiency, renewables and digital solutions.

With results documented by an external auditor, the initiative has been more than just a research venture for clean energy and related digital technologies. Ecomagination has also helped to transform the company, setting out a vision that has helped to make it one of today's leading green brands.

Right photo credit: Mariana Gil/EMBARQ Brasil



SECTION 5
Cities

By 2050, two-thirds of the global population will live in cities, and over 70% of the global demand for infrastructure over the next 15 years is expected to be in urban areas.³¹³

This means that how cities develop is important both for growth and for climate change. The Sustainable Development Goals recognise the centrality of future urban development to achieving sustainability goals, in setting out Goal 11 to make cities inclusive, safe, resilient and sustainable.

Given the rapidity of urbanisation and the long-lived nature of urban infrastructure, the decisions made today by national and city decision makers – in partnership with private investors – will determine our economic future and climate security for the second half of the century. According to recent research, the urban infrastructure investment decisions taken just over the next five years will determine up to a third of remaining global carbon budget.³¹⁴

With growing numbers of poor people now concentrated in urban and peri-urban areas, investment in better urban infrastructure – designed to meet the needs of the poor – can also offer huge resilience dividends. This includes providing access to electricity and clean water, alongside of building schools and health clinics where the broader benefits of a sustainable infrastructure agenda include helping to keep children healthy and in school while building better livelihoods for their parents. Sanitation systems and sewers also build resilience, because during floods, lack of adequate sanitation is closely linked to disease outbreaks. Public transit, district heating and building efficiency also all have poverty reduction benefits for the poor because they increase access and reduce costs of services to the poor, while also providing global benefits by reducing greenhouse gas emissions and future climate risk. Finally, improved flood management systems build resilience for all, but will disproportionately benefit the most vulnerable populations, including the urban poor who often settle in flood plains. Getting infrastructure right in cities is fundamental if we are to build future prosperity, reduce poverty, strengthen resilience to climate change and extreme events and reduce greenhouse gas emissions and pollution.

Why urban infrastructure needs to be sustainable

In many countries, urban development has followed a sprawling, inefficient model that leads to congestion, car-dependency, high resource use and high GHG emissions. Yet an alternative is starting to emerge – one focused on compact, connected and sustainable urban growth to create cities that are economically dynamic, vibrant and healthy. Such cities are more productive, socially inclusive and resilient, as well as cleaner, quieter and safer. It is a win-win for the economy, the people and the environment.

Investing in sustainable urban infrastructure that supports compact, connected, resilient and sustainable growth in cities could yield high returns on multiple levels:

- Compact urban development could reduce global urban infrastructure requirements by more than US\$3 trillion from 2015 to 2030, and favour public transport over dependence on personal motorized transportation, which in turn limits GHG emissions and improves local air quality.³¹⁵
- Investing in public transport, building efficiency and better waste management could save cities around US\$17 trillion globally by 2050 (based on energy savings alone) and further reduce emissions and build resilience.³¹⁶

By contrast, development through sprawl raises the costs of infrastructure and consumer goods, needlessly emits GHGs, and contributes to unsafe roads and poor health. Sprawl is estimated to cost the US economy alone more than US\$1 trillion every year.³¹⁷

Building urban resilience is complex, particularly for rapidly growing cities but it is increasingly part of the agenda for cities around the globe. The more resilient a city is to shocks and stresses, the greater the likelihood that the city will “bounce back” to its normal state and citizens will resume their lives and livelihoods with the least loss to property and life.³¹⁸ Cities can increase their resilience each time a shock or stressor affects

them by “building back better” to be more prepared for future events. Low income countries in particular are facing the challenge of pursuing development pathways (including substantial investment in infrastructure) while facing growing adverse impacts of climate change. Ensuring that investment in infrastructure takes climate change risk into account, including higher risk from natural hazards such as extreme temperatures, floods and droughts, will determine its sustainability. On the other hand, poorly constructed infrastructure in rapidly urbanising areas intensifies climate risks and vulnerability to climate impacts.

Many cities are also working hard at sharing what has worked and what has not, and learning from each other. For instance, Rotterdam is helping city officials in Ho Chi Minh City, which is topographically similar, create and implement a Climate Adaptation Strategy through the Connecting Delta Cities Network and develop financial resources and technical capacity.³¹⁹ Global networks like the C40 Cities Climate Leadership Group, the Connecting Delta Cities Network and CityLinks can play a major role in this.

Demand for sustainable urban infrastructure

The expected rapid growth in urban population will be most pronounced in emerging and developing countries, along with expected growth in economic output, energy consumption and carbon emissions. This growth will be led by large and fast-developing cities in emerging and developing economies, particularly in China, India, Southeast Asia and sub-Saharan Africa.

Rapid urbanisation will create significant demand for infrastructure and in urban areas, where the local benefits are near-term and visible, there is demand to make that infrastructure sustainable. Urban infrastructure investment is expected to make up roughly two thirds of the total investments in infrastructure to 2030, about US\$4.1–4.3 trillion per year.³²⁰

These estimates still do not consider the investments needed to adapt urban infrastructure to climate risks, which is crucial. With their dense populations and, particularly in developing countries, often large clusters of people living in marginal areas, cities are highly vulnerable to climate change and extreme

weather events. The risks are especially great for the 75% of the world’s large cities that lie on a coastline and are thus exposed to sea-level rise and storm surges.³²¹ Estimates of capital costs required for urban infrastructure adaptation range from US\$11–20 billion per year,³²² to as much as US\$120 billion per year by 2025–2030,³²³ indicating deep uncertainty on the numbers.

The supply of urban infrastructure finance

Despite the critical importance of infrastructure for urban development, financing smarter, more sustainable urban infrastructure remains an immense challenge, particularly in emerging and developing economies, and particularly when it comes to large-scale projects. Competitiveness, population and business growth, and public safety drive infrastructure finance demand, though the sources of finance vary as do the specific trends that shape its supply.

Finance for sustainable urban infrastructure is hindered by many of the same barriers faced by sustainable infrastructure in general, including market failures, short-term thinking, and a lack of bankable projects and capacity at the urban level to prepare projects. Many cities around the world are constrained in their ability to retain local revenue sources, take on debt, invest in major projects and engage in public-private partnerships. Many projects are also hampered by the fact that they involve public goods. The scale of the capital investments – especially for transport systems such as bus rapid transit (BRT), light rail, and underground rail systems – often far exceeds the ability of national and local governments. However, when public capacity to partner with the private sector is in place, public financing can crowd in private finance and investment and enabling conditions can incentivise it. In developing countries, international development finance can play a key role.

There are also financing challenges that are specific to urban infrastructure (see Table 4). National and local policies may not always be aligned, creating conflicts and, for investors, regulatory uncertainty. Cities often have limited capacity to plan, budget, and ability to secure finance for and oversee such large projects. As indicated in the sub-sections that follow, a number of opportunities exist to address these challenges.

Table 4

Supply of sustainable urban infrastructure finance: drivers and trends

	Sources	Drivers and trends
Public sector	National governments and development banks	Serious budgetary deficits, significant debt levels and reduced spending on infrastructure in advanced economies, but rising investment in emerging and developing economies Limited capacity and expertise related to sustainable urban infrastructure and land use planning Lack of clear policies or defined standards for sustainable infrastructure projects Limited policy alignment across the national to local levels. Where policy alignment and standards for environmental sustainability are not in place, this constrains viable funding models to ensure recovery of capital costs
	Municipal budgets	Constrained by limited institutional capacity to raise funds to finance infrastructure, including limited fiscal capacity to collect taxes and limited access to debt or equity markets
	Local, public access to capital markets and debt financing: <ul style="list-style-type: none"> • Municipal green bond markets • Investment platforms 	Intra-governmental partnerships to tackle challenges of creditworthiness Limited local public finance, sometimes combined with national or external public resources, to catalyse private investment (e.g. via investment platforms)
	International development finance, including official development assistance (ODA)	Demonstrated potential for provision of both financial and technical assistance in sustainable urban infrastructure Rising share of sustainable urban infrastructure in development portfolios, but still relatively modest. Growing engagement and awareness of development cooperation providers but the capacity and expertise is lacking within these institutions to constrain relevant investments and activities
Private sector	Private finance <ul style="list-style-type: none"> • Commercial banking and local capital markets loans • Green infrastructure bonds • Securitisation/equities • Public-private partnerships • Privatisation 	Limited participation from private sector investment in sustainable urban infrastructure but the potential exists Participation is constrained by limited expertise and experience with municipal infrastructure and unfamiliarity with local policies and business environments, which in turn requires extra due diligence and raises transaction costs (Mis)alignment of policy incentives for private engagement – for instance, taxation or pricing of resource use, land or assets that do not value energy or resource efficiency ranging from energy efficiency in buildings or watershed protection Absence of responsible investment codes or mandatory obligations to disclose the climate performance of infrastructure projects Difficulty to predict and guarantee revenue streams (e.g. public transport; regulated water markets)

In the three sections that follow, we examine how the three key action areas discussed in Section 2 apply to sustainable infrastructure in cities.

5.1 Addressing the fundamental price distortions

Fossil fuel subsidies, property and other taxes, and other price distortions often incentivise inefficient, high-carbon land use and infrastructure, for example by promoting urban sprawl and artificially reducing the cost of using private vehicles. By making it easier and more inexpensive to commute long distances in private vehicles, these price distortions also reduce public transport use. Germany, for example, spends about €6 billion (US\$6.60 billion) per year on a commuter tax allowance, and subsidies to company cars in OECD countries are estimated at €19–34 billion (US\$21–37 billion).³²⁴ Fuel subsidies also discourage adoption of low-carbon and fuel-efficient vehicles. The average car in the Middle East, for example, uses 60% more fuel per kilometre than the average car in the OECD, due in part to high subsidies for petroleum.³²⁵

Evidence suggests that higher fuel prices could lead to more compact urban development. For example, in the US, a 10% increase in fuel prices was found to lead to a 10% decrease in construction in locations with relatively long commutes.³²⁶ Land use regulations such as density standards and parking requirements can also influence the compactness of a city.

Sustainable urban transformation requires reforming environmentally harmful subsidies and aligning fiscal policies to stimulate investment in sustainable infrastructure, land use and innovation. Key targets for reform include subsidies for car use, such as company car and parking tax credits, as well as subsidies for petrol and diesel (see Box 24). Some of these policies, which have large implications for urban areas, require national-level action.

National and local governments are increasingly working together to align fiscal policies and reform regulations to attract financing for sustainable urban infrastructure. Adjusting policies can both incentivise changes in corporate and consumer behaviour to take account of sustainability. They can also give a much-

Box 24

Internalising the external costs of air pollution on human health and productivity: The case of diesel

Urban smog has large human health costs in major cities around the world. Use of individual and freight vehicles in cities is a major source of air pollutants (particulate matter, or PM, and nitrogen oxide) that lead to hazardous urban smog. In Beijing in 2014, motor vehicles were found to produce 20–22% of PM_{2.5} emissions, which are particularly harmful to human health.³²⁷ Regulating car use in Beijing has had good results: restricting the number of cars on the road since 2008 has driven the concentration of particle air pollution down by 31%, and reduced asthma-related doctor visits by 50%. These regulations have also encouraged ridership of the growing public transit system in Beijing.³²⁸

An example of misalignment in tax policy is the difference between tax rates on diesel and gasoline for road use in many countries. As compared to gasoline, diesel emits higher levels per litre of harmful local air pollutants such as nitrogen oxide, sulphur dioxide and particulate matter, as well as carbon dioxide. This implies that the level of tax for a litre of diesel should be higher than that for a litre of gasoline, to reflect relative environmental costs. Yet OECD analysis shows that diesel fuel is taxed at lower rates than gasoline, both in terms of energy and carbon content, in all but one of 34 OECD countries: the US.³²⁹ This difference is not justifiable from a human health, environmental or economic perspective.³³⁰ Indeed, diesel air pollution kills more people in France each year than road accidents. Diesel vehicles are often more fuel-efficient, but this means that social costs such as congestion, noise, accidents and infrastructure wear are higher per litre than for gasoline. In urban areas, the health effects of high penetration of diesel vehicles are particularly harmful. The benefits of reducing the health burden from diesel fuel in urban areas use suggest an urgent need for governments to revisit regulations and policies in place for diesel vehicles, including those policies in OECD countries that favour diesel vehicles.³³¹

See also Box 18 in Section 4 on PM_{2.5} and the full costs of fossil fuels.

needed boost to local revenues, and thus improve the local balance sheet, help close deficits and boost local creditworthiness (see below). They can also directly enable increased public investment in sustainable urban infrastructure, including for upgrades and maintenance.

National, regional and city-level infrastructure funding can be redirected away from traditional high-carbon and sprawling urban development. This would significantly reduce the investment gap and release funds for sustainable urban infrastructure, such as mass transit. For example, Bogotá’s BRT system was partially financed by funds that had initially been allocated to urban highway programmes. Similarly, Curitiba, Brazil, is converting a highway into a BRT corridor, complemented by higher-density, mixed-use spaces and green areas – an investment of US\$600 million.³³² This type of affordable and accessible public transport benefits the urban poor by providing access to jobs, education and wider economic opportunities with less spending on transport. In Brazil, for example, lower-income households in more compact cities only spend 10% of their income on transport, which is much lower than the national average.

Leveraging existing assets at the city level: land-based financing and user charges

Cities can leverage the value of their existing assets, mainly land and property, to generate revenue for

smarter, more sustainable infrastructure investment and to correct market distortions.

User charges and fees can encourage the use of more sustainable infrastructure and are also a way to raise money for infrastructure maintenance and upgrades. They are most suitable for infrastructure amenable to the collection of charges and fees, such as transport and utility infrastructure. One prominent example at the urban level is congestion charges, which can effectively reduce car use and promote public transit by charging for driving a vehicle within a charging zone at a specified time period. This reduces the traffic flow, encourages public transport use, and reduces GHG emissions and local air pollution. London, Milan, Stockholm, Seoul and Singapore have successfully implemented congestion charges and achieved some excellent results in reducing travel time, emissions and accidents (see Table 5), while raising capital for improvement of public transport infrastructure. Beijing and other Chinese megacities are planning to implement similar congestion charges. Well-designed utility fees for energy, water and waste will also raise finance for urban infrastructure while incentivising energy savings and encouraging sustainability.

Property taxes and similar levies, when designed to favour compactness and connectivity in cities, encourage investment in sustainable infrastructure

Table 5
Effects of congestion charges in two European cities

	Travel			Emissions			Safety	Economics	
	Travel Volume	Travel times	Public transit ridership	CO ₂	NO _x	PM ₁₀	Accidents	Surplus ⁷ per year (million US\$)	Hours saved per day
London ¹	-21% ³	-30%	+18%	-16.4%	-13.4%	-15.5%	-33% ⁵	110–150	12,000
Stockholm	-20% ⁴	-33%	+5%	-13%	-8%	-13%	-(9-18)% ⁶	80	30,000

Source: van Amelsfort and Swedish, 2015.³³³

Notes: 1. The Congestion Charge in London is an £11.50 (US\$15) daily charge for driving a vehicle within the charging zone between 07:00 and 18:00, Monday to Friday. 2. The congestion tax is different depending on the time of the day in Stockholm, but the maximum amount payable per day is SEK 105 (US\$12) per vehicle on weekdays; 3. Change in travel volume over 2003–2008. 4. Change in travel volume across the cordon. 5. Change in number of accidents over 2003–2014; 6. Inconclusive from measurements, but from modelled impacts 9–18% reduction of accidents anticipated for different roads. 7. Surplus refers to how much worse or better off all travellers are when introducing charging for society as a whole – the charges are not lost, but become revenues and can be spent on creating benefits for citizens somewhere else in the economy.

and discourage urban sprawl; they also generate long-term revenues for infrastructure maintenance and expansion. In most emerging economies and developing countries, property taxes contribute a small percentage of local revenue, and they are also under-utilised in many developed countries (e.g. Europe). Property tax reforms can increase local revenues. For example, Bangalore started a series of schemes to improve the assessment of property taxes in 2000. Within the first year, its property tax collection increased by a third.³³⁴ In most OECD countries, property taxes are local governments' main source of revenue, though in most North American cities (such as Toronto and New York City)³³⁵, the property tax rates favour residential single-family homes over multi-residential properties, providing disincentives to good urban density.

Development-based land value capture can help cities generate revenues for transit infrastructure, both for the initial investment and long-term operation and maintenance, while also promoting compact and transit-oriented urban development. This can be done either by taxing the increased value of land due to public spending on infrastructure servicing it, or through specific levies designed to recover the costs of infrastructure (e.g. betterment levies – see below). Successful examples are found in both advanced economies (including in Hong Kong, Tokyo, London and New York City) and emerging economies (such as in Delhi, Nanchang and São Paulo). One of the most successful case studies of development land value capture is Hong Kong's "Rail plus Property" model. This model allows both government and the developer/operator of the Mass Transit Railway network to capture the increase in property values along transit routes while maintaining the dense and efficient urban form. The Mass Transit Railway has over 4 million passenger trips a day, and in 2012 generated a net profit of US\$869 million for the operator (which has a 77% government ownership share) as a result of high ridership and efficient operation. The government also received significant financial returns on its overall investment – about US\$18 billion over 25 years from 1980 to 2005 – while maintaining a compact and connected city.³³⁶

Many rapidly growing cities in emerging economies and developing countries, such as Nanchang and New Delhi, have favourable conditions for development-based land value capture, including strong economic growth, expanding urban population, rising incomes, and increasing motorisation and congestion. These conditions all cause land value to appreciate, particularly near transit stations. São Paulo, for

example, has raised more than US\$1.2 billion in six years using related instruments. Land value capture schemes also require strong institutional capacities in local government.

Betterment levies can not only help recover the cost of sustainable infrastructure after it has been built, but also can be used to fund expansion or upgrading of infrastructure. For example, Colombia established a *contribución de valorización* (contribution to betterment) in the early 1990s that has helped significantly to finance infrastructure in Bogotá, including funding about US\$1 billion of public works between 1997 and 2007, and almost half of the arterial road network that includes the bus lines and dedicated stations of the city's BRT system.³³⁷ In recent years, Bogotá has simplified the betterment levy into a general infrastructure tax by collecting citywide valorisation fees to finance urban infrastructure improvement. Betterment levies require strong institutional capacity of local governments: not only to collect taxes and manage projects, but also to clearly calculate and communicate the potential economic and environmental benefits of any infrastructure project to property owners.

Land sales and leases of government-owned property offer a one-off opportunity to generate upfront capital for sustainable infrastructure investment. In countries that do not have an effective land valuation system, land sales are mostly auction-based. For example, Cairo raised US\$3.12 billion through the auction of 3,100 hectares of desert land for a new town in 2007. The amount generated was about 117 times greater than Egypt's total property tax revenue, and about one tenth of Egypt's annual national revenue. The funds are being used to reimburse costs of internal infrastructure and to improve road connectivity in the Cairo metropolitan area. Similarly, an auction of 13 hectares of land in the new financial centre in Mumbai generated US\$1.2 billion in 2006, more than 10 times the total fiscal spending of the Mumbai Metropolitan Regional Development Authority in the previous year.³³⁸ The funds are being used primarily to finance metropolitan regional transportation projects. While a potentially useful mechanism to raise upfront resources for smarter urban infrastructure, land sales require a coherent legal framework, strong institutions and enforceable property rights to ensure the effectiveness as a financing instrument. Moreover, once the land is sold, it can be challenging to incentivise sustainable infrastructure development and incorporate its development into integrated city planning.

Leases can leverage finance for new infrastructure assets that are systematically tied to a city's land use plan by allowing developers to lease government-owned land for construction, but with conditions attached. This is used extensively in China. This approach makes it possible to specify sustainability targets, such as establishing energy efficiency targets through rental agreements.

5.2 Strengthening investment frameworks, institutional capacity and policies

There is large potential to enhance sub-national-level institutional capacity to plan better, generate revenues, direct public investment and attract private investment to meet the growing demand for sustainable infrastructure in cities. City authorities will have more influence and impact when they are recognised and supported by their counterparts in national government.

Promoting institutional and fiscal reforms to improve coordination and support local investments

Localising public investment decisions can unleash knowledge and creativity for change, but this can only be achieved if there is good coordination within governments and across levels of government, including on funding, financing, investments and increasing sustainable procurement. Often cities receive very limited funding, and national and state- or province-level legislation may also restrict the city government's power and its ability to raise revenue. When infrastructure challenges extend beyond a city's administrative boundaries, collaboration is also crucial, as planning for and funding solutions will need to involve governments across the greater metropolitan area.

At the national level, a key first step to filling the finance gap for sustainable urban infrastructure is to align fiscal systems to ensure they can respond to and meet cities' needs. It is also essential to build capacity at the local level to support transformative planning approaches and private sector engagement.

At the regional and subnational scales, integrating land use planning with infrastructure planning is a central tool to improve coordination and outcomes. For example, it is important to manage urban expansion in a way that limits the need to drive private cars and

promotes safe, affordable, accessible and sustainable transport systems.³³⁹ It may also be necessary to consider land use needs for distributed renewable energy systems, and/or to consider the need for flood risk management infrastructure, including buffer zones along rivers and on coastlines, when developing land use plans and regulations.

One effective strategy is to integrate land use and transportation planning. This can be done through sector-specific, metropolitan-level agencies, such as in Singapore (see Box 25) or with London's Transport for London, or through an agency that integrates all elements of urban growth, such as the Instituto de Pesquisa e Planejamento Urbano de Curitiba (IPPUC) in Brazil. The IPPUC prioritises mixed-use development and dedicated high-capacity bus lanes, the backbone of Curitiba's successful BRT system. Key factors in IPPUC's success include an ability to leverage dedicated funding sources and a long-term vision, which has been supported by a succession of civic leaders. Another example of integration is Denmark's "Station Proximity Principle," which requires new offices over 1,500 m² to be located within 600 metres of a rail station, reinforcing Copenhagen's efficient, compact urban form.

Several developing countries have been able to overcome structural bottlenecks and create an effective investment system for more sustainable urban development. For example, Colombia's decentralised model with relatively linked up planning authority and funding has worked effectively (see Box 26). However, in most countries, structural problems and lack of coordination between levels of government and across municipalities in the same region often constrain the levels of public investment, especially at subnational levels.

Development cooperation, including through multilateral development banks and other development finance institutions, can play an important role by providing technical assistance to national and local governments on long-term integrated land use and infrastructure planning. The Asian Development Bank (ADB) Future Cities Programme, for example, is looking to develop long-term engagement with cities in the context of an integrated plan that considers environmental, social, and economic infrastructure and investment priorities.³⁴⁰ Through bilateral development cooperation, Germany also has made a strong commitment to climate-smart infrastructure and development.³⁴¹

Box 25

Integrated land use and transport planning: Examples from Singapore and Parkmerced, San Francisco³⁴²

Singapore's Land Transport Authority (LTA) is an excellent example of the benefits of integrated land use and transport planning. Established in 1995 under the Ministry of Transport through the merger of four government agencies, it achieved a high degree of integration by removing administrative boundaries. The LTA is responsible for planning, operating and maintaining land transport infrastructure and systems, including road safety, vehicle licensing and electronic road pricing.³⁴³ In order to reduce carbon emissions, the LTA constantly improves and expands its current public transport network, complementing it with parking policies and electronic road pricing. This has led to a shift from private to public transport use over recent years. In 2012, 63% of trips during morning and evening peak times were on public transport, up from 59% in 2008. To increase this number even further, the LTA aims to make the transport system even more accessible and competitive. By 2030, the goal is for 80% of households to be within a 10-minute walk of a train station, 85% of public transport journeys (less than 20km) to be completed within 60 minutes, and 75% of all journeys in peak hours to be via public transport. The LTA's investments mainly stem from government grants and operating income, such as management fees from the government.

In San Francisco, the Broadscale Group has established a first-of-its-kind partnership with Uber to bring Car Free Living, a multi-modal transportation program, to Parkmerced, a large residential community. The business model is being tested here and could ultimately be rolled out, if successful, to communities and developments around the world. The program incentivises urban dwellers to use public transit and an array of new mobility services instead of a private car – benefiting residents, property owners, and cities at large. Broadscale Group is a new model of investment firm working with leading corporations and other strategic partners to invest in and commercialise promising market-ready innovations, in this case it is operationalising a new form of integrated urban development and land use planning. The aim is to test the approach, and as appropriate to learn from it, replicate it and deploy it globally.³⁴⁴

Prepare project pipelines for sustainable urban infrastructure

Cities often need to build institutional capacity and expertise to prepare and package infrastructure projects into attractive bankable projects for private investors. International support and technical assistance are very valuable in helping cities to strengthen infrastructure project preparation. For example, the Cities Development Initiative for Asia (CDIA) is supporting mid-sized Asian cities to prepare bankable infrastructure projects and bridge the gap between their development plans and implementation. With CDIA's assistance, more than US\$5 billion of large-scale urban infrastructure investments are under development at a cost of around 0.25% of the investments under preparation. The C40 Cities Climate Leadership Group also set up C40 Cities Finance Facility (CFF) to support focus cities in developing and emerging countries to prepare and deliver sustainable, low carbon and climate adaptation projects. The CFF aims to unlock US\$1 billion of new low-carbon and resilient infrastructure in developing country megacities, while simultaneously working to build

the capacity and skills of city officials and share new knowledge globally.

Spatial and infrastructure planning also needs to be significantly strengthened, at both the national and local levels, and coordinated between them. The World Bank estimates that only 20% of the world's largest 150 cities have the basic analytics for low-carbon urban planning,³⁴⁵ which in turn limits their ability to build viable project pipelines within a broader system perspective. A large number of developing countries where rapid urbanisation is taking place lack national plans to manage or guide urban expansions. Misalignment between national and local governments in urban planning further complicates the problem.

Coordination between national and city policy frameworks ("vertical" governance) is critical for effective and strategic land use and transport planning (see Box 25) as well as for project preparation. India, for example, recently developed a National Urban Transport Policy, integrating transport and land use planning as a single strategic goal. The central government covers half the costs of preparing



Photo credit: Marta Obelheiro, EMBARQ Brasil

integrated transport and land use plans.³⁴⁶ South Africa, meanwhile, has used national legislation to create an Integrated Development Plan (IDP) that provides an overall framework for development for local municipalities and coordinates national, provincial and local government policy. The IDP takes into account economic, social and environmental considerations for the area as a whole, including what infrastructure is needed and how the environment should be protected. This helps local municipalities build capacities in planning and deliver sustainable infrastructure projects while attracting additional funds – for instance, from national government and the private sector.³⁴⁷

Boost public investment

The scale of necessary sustainable urban infrastructure investments, which have large public good characteristics, underscores the need to boost capacity for public investment at local levels.

Raising public investments to meet growing demand from urbanisation will benefit from devolving some of the authority for planning and revenue raising to subnational governments and by improvements in tax administration as well as by broadening the tax base.³⁴⁸ A large number of fiscal measures are available to strengthen the balance sheet and generate revenues to support sustainable urban infrastructure investment,

because as noted above, local governments often earn most of their revenue from local property taxes. However, national and subnational governments will need to work closely together to align policies.

The extent to which local revenues and budgets can cover sustainable infrastructure investments varies widely. In advanced economies, local governments are responsible for an estimated 70% of public spending in urban areas and roughly 50% of public spending on the environment and infrastructure, with the other share often occurring in partnership with other levels of government.³⁴⁹ In Latin America, a 20-year decentralisation trend has strengthened the fiscal bases for cities while helping to improve governance and building capacity for environmental innovation.³⁵⁰ In Africa and Asia, however, a high proportion of urban governments still have very limited investment capacities, as most of their limited budgets go to salaries and other recurrent expenditures.³⁵¹ There are large national differences in annual expenditure per person by local governments, ranging from more than US\$6,000 in some high-income nations to less than US\$20 in most low-income nations.³⁵² For cities in low-income countries, external development finance is likely to be a key to bridge the gap in expenditures.

Subsidies and grants, in the form of national-local financial transfers may also help to boost local investment and sustainable growth as part of an

economy-wide national effort. One example of this is in the US, where the federal government provides grant funding to state and local governments to support infrastructure investment, historically covering about 15% of overall investments, as well as favourable tax treatment of debt financing accessed by these same local governments.³⁵³

Increasing access to capital for investment

Filling the financing gap for sustainable urban infrastructure will require both public and private investment. There are multiple ways to attract private investment, including through fiscal measures, improving creditworthiness, municipal green bonds, resource pooling, and investment platforms.

Fiscal measures can also be designed to explicitly incentivise private investment. One example would be to ensure favourable tax treatment of municipal bonds that help finance local sustainable infrastructure investments (see below).

A key to accessing capital markets is to improve the creditworthiness of municipal governments.

Improving creditworthiness can allow cities to both access commercial capital markets and special donor funds for loan-based finance for urban infrastructure investments. Yet only a small number of the largest 500 cities in developing countries are currently deemed creditworthy: around 4% in international financial markets and 20% in local markets.³⁵⁴ This is centrally related to the weak revenue bases that often characterise municipal budgets.

The World Bank estimates that investing US\$1 in efforts to improve city creditworthiness can leverage more than US\$100 in private investment for sustainable urban infrastructure.³⁵⁵ For example, with technical assistance from the Public-Private Infrastructure Advisory Facility (PPIAF), Kampala's government managed to set out a strategic plan to improve its governance and financial management. In successfully implementing the plan, Kampala has gained a reputation of being an effective, reform-minded and innovative authority. It improved its creditworthiness, achieving an "A" rating (investment grade) at the national scale for long-term debt instruments, increasing locally generated revenue by 83% within a year and almost doubling its borrowing allowance for large-scale urban infrastructure.³⁵⁶ This helped underpin its ability to develop viable sustainable infrastructure projects such as BRT.

Similarly, Lima improved its credit rating with technical assistance from PPIAF, and obtained a commercial bank loan of US\$70 million in 2010 that is partially backed by the International Finance Corporation (IFC). The maturity of this loan was double that of the city's previous debts, allowing long-term investment in Lima's urban infrastructure, including in Lima's BRT system.³⁵⁷ Following the example of Lima, other Latin American cities/regions have improved their creditworthiness and obtained credit ratings. For example, Barranquilla, Colombia, obtained some commercial bank loans to co-finance its BRT system.³⁵⁸

Municipal green bonds are another way to attract capital. The municipal green bond market, valued at about US\$6 billion in 2015, is a relatively small (around 15%), but fast-growing part of the climate-related bond market.³⁵⁹ Issuing municipal green bonds can help cities invest in sustainable infrastructure, particularly in emerging and advanced economies. Major players in these markets are multilateral development banks and investment banks. For example, urban projects account for an estimated 20–25% in the World Bank's green bonds portfolio.

While advanced economies have issued the majority of municipal green bonds to date, growth in emerging economy markets is setting the stage for change (see Box 26). The lower credit ratings of cities of low-income developing countries limit the scope for use of municipal green bonds, but there are examples of them partnering with development finance institutions to crowd in private investment (see below). Smaller cities, accounting for 35–65% of the urban population, also typically face more significant challenges in access to long-term capital markets due to limited financial infrastructure and capacity. In such cases, short- or medium-term loans from municipal development funds or national development banks can help fill the gap,³⁶⁰ as illustrated in the FINDETER example in Colombia below (see Box 26).

In sum, municipal governments, national governments and international actors, along with credit rating agencies and other private sector advisors, need to each do their part and work together in order to allow cities to establish creditworthiness and raise their scope for borrowing on long-term capital markets. Concerted action is required by sub-national and national governments to develop clear legal and regulatory frameworks that not only help to appropriately manage and rate credit risk, but that also provide an enabling policy environment for municipal

Examples of municipal green bonds and municipal development funds

Most well-established examples of green municipal bonds come from more advanced economies. For example, the Qualified Energy Conservation Bond and Clean Renewable Energy Bond used in the US collectively raised US\$5.6 billion between 2006 and 2011 to help local governments finance sustainable infrastructure projects.³⁶¹ Mainly driven by municipal green bonds, the green-labelled market in the US continues to grow exponentially, with US\$10.5 billion in bonds issued in 2015, up 47% from 2014.³⁶²

Emerging economies have begun to enter the market, and started to yield some good results. Johannesburg, for example, recently issued a green municipal bond with a target value of US\$136 million. The bond was oversubscribed and will earn investors a 185-basis-point return above sovereign bonds. The city now is working with C40 Cities and the Climate Bonds Initiative to share its successful model with other C40 Cities.³⁶³ Similarly, in Brazil, municipal governments in São Paulo, Rio de Janeiro and Curitiba have obtained about US\$3.8 billion for urban redevelopment projects by issuing more than 10 million securitisation bonds known as CEPACs (certificados de potencial adicional de construção/certificates for additional construction potential) that permit additional building rights in special development districts and could potentially increase the density of those areas.³⁶⁴

Ahmedabad went through the process of obtaining a credit rating in 1995 using India's national methodology, and received a rating for bond offering. The city was then able to issue a municipal bond worth about INR 1 billion (US\$15 million).³⁶⁵ This is India's first municipal bond without a state guarantee. With fiscal and management improvement, such as a credible accounting mechanism and improved tax collection, Ahmedabad achieved a fiscal surplus from a deficit position.

As an alternative route to accessing finance for sustainable urban infrastructure investment, the government of Colombia set up Financiera de Desarrollo Territorial (FINDETER) in 2009 as a quasi-public financial institution that facilitates commercial banks to finance municipal governments by lowering the costs of loans. It has a AAA local credit rating that helps access less expensive financing. FINDETER financed about US\$4 billion in loans in over 700 municipalities over the five years from 2006 to 2010 while maintaining bad debt below 2%.³⁶⁶ In 2012, FINDETER in partnership with the Inter-American Development Bank, created the Platform for Sustainable and Competitive Cities. Within two years, seven urban sustainability projects had received financial and technical assistance, and six more were in the pre-investment phase. This initiative demonstrates the potential to rapidly scale up solutions through local-national-international partnerships.³⁶⁷

Source: LSE cities background paper; FINDETER: World Bank, 2013. Planning, Connecting, and Financing Cities—Now: Priorities for City Leaders; Climate Bonds Initiative.

borrowing and bond issuance. Municipal governments need to improve their fiscal management, national governments need to provide adequate support and international development institutions need to strengthen and scale up technical assistance.

To reduce transaction costs for investors, **investment platforms** can be set up at both the municipal and national level to attract private finance at scale to cities. Some megacities have set up exchanges or investment platforms that match infrastructure projects and the needs of potential private-sector investors. For example, the Chicago Infrastructure Trust was set up in 2012, with the city paying US\$2.5 million of the running costs, and a pledge from private financial institutions to invest US\$1.7

billion in the scheme.³⁶⁸ Smaller cities can also benefit from regional and national platforms, such as the West Coast Infrastructure Exchange in the US and the Green Investment Bank in the UK (see also green investment banks in Section 3). In 2009, London set up the London Green Fund, a £120 million (US\$170 million) fund for investment in schemes that would cut carbon emissions, including in waste, energy efficiency, decentralised energy and social housing projects through three urban development funds. As of mid-2015, it had invested £97 million (US\$137 million) in 16 projects.³⁶⁹

Resource pooling is an alternative way for smaller cities to establish an investment platform to access

capital markets. India, for example, after using a national methodology to establish municipal credit ratings, took this a further step by releasing Pooled Finance Development Fund Guidelines that include special mechanisms to pool smaller cities' resources and allow them to jointly access credit. In South Africa, municipal pooled financing mechanisms are also currently under discussion as funding options.

Developing public-private partnerships

Cities in developing countries increasingly welcome public-private partnerships (PPPs) as an instrument for bridging the infrastructure investment gap, particularly given their limited access to capital markets (see Box 2 in Section 2 for more information on PPPs).³⁷⁰ For example, several mass rapid transit PPPs have been developed or are under development in India, such as for metro in Mumbai, Hyderabad and Chennai. Bangkok's Skytrain and Bogotá's TransMilenio BRT system also used PPPs to attract private investment. Similarly, water PPPs are used in developing countries such as Colombia and various western African countries, and have significantly improved efficiency and service quality, especially by reducing water rationing.³⁷¹ There are further successful PPP projects in cities in advanced economies, such as bike-sharing schemes in many European cities, a waste management programme in Sydney, and building energy efficiency projects in cities such as Berlin and London.³⁷² Indeed, in some countries PPPs account for a sizeable portion of investment in infrastructure – for example, 5% in Australia and 10% in the UK.

However, PPPs can pose challenges. As discussed in Section 2, sometimes it is difficult to collect high-enough user fees to fully cover the cost of operating and maintaining infrastructure. Often this results in deferred or inadequate maintenance, so the infrastructure and the quality of services provided degrade over time, making cost recovery even more difficult. PPPs can further complicate matters because they involve long-term commitments (typically 20–30 years), often with revenue guarantees. The Colombian government, for example, provided guarantees on toll road revenues under long-term purchase agreements, but it overestimated the demand and underestimated the risks. The government had to pay the US\$2 million difference. Similarly, the Korean government has had to pay millions of dollars every year for a privately financed road linking Seoul to Incheon airport.³⁷³ Another failed example is the privatisation

of the water supply system in Cochabamba, Bolivia, which resulted in households paying up to 20% of their income for water bills.³⁷⁴

Political risks and risks of weak governance can mean uncertainty around the contractual relationships and can mean that the public sector takes on an inordinate share of financial risk, absorbing high costs in the case of failure. In the case of cities in developing countries, national government and international actors may work together to provide necessary support and sufficient technical assistance.

In summary, to be effective, PPPs need to work well for both the public and private sector. Success is contingent on a well-designed framework, which requires strong administrative capacity and expertise in government, and a well-implemented contractual agreement with a fair balance of risks and returns between local governments and private actors.

Leveraging ODA and climate finance for action at the urban level

MDBs, international climate funds, and other development assistance providers – notably development finance institutions (DFIs) – can play a key role in shifting and scaling up sustainable urban infrastructure investment, mainly by supporting policy and institutional reforms in developing countries, building knowledge platforms of best practices, and establishing platforms for international cooperation. In developing countries they also provide essential concessional finance. The eight largest MDBs, for instance, have committed to investing US\$175 billion by 2020 in sustainable transport.³⁷⁵ Climate and environment funds are also starting to work at the urban level. For example, the Global Environment Facility started a new Sustainable Cities Integrated Approach – a US\$140 million programme that is expected to leverage US\$1.4 billion in co-finance – to encourage intelligent urban development in 22 pilot cities.³⁷⁶

MDBs and other channels of development finance – domestic and international including concessional finance – can work together to enhance investments for large-scale infrastructure. For example, the Clean Technology Fund (CTF) recently approved a US\$100 million concessional loan through the ADB to finance improvements of a new metro line in Hanoi, including station and depot facilities, infrastructure to ensure integration with non-motorised forms of



Photo credit: Flickr: Graham Crouch/World Bank

transit and the existing public transport system, policy development to improve station access management, and ticket pricing. Its funding sits alongside US\$1.43 billion in financing for the metro line itself from the Vietnamese government, the ADB, the European Investment Bank (EIB) and the French Agency for Development (AFD) and the French government.³⁷⁷

Through use of concessional financing to support syndicated loans, loan guarantees or other instruments designed to de-risk investment, DFIs can also boost the use of debt finance instruments by municipalities, support access to capital markets, and catalyse private investment. DFIs are also able to partner with local financial intermediaries and institutions, which can provide local knowledge and avoid information asymmetries that can hinder efforts to

finance sustainable urban infrastructure. A successful example is the Tamil Nadu Urban Development Fund, India's first financial intermediary, which has several innovative financing schemes, including bond issuance for smaller urban areas. Various international players such as the World Bank, the ADB, the Japanese International Cooperation Agency, and KfW Development Bank (Germany) are supporting it.³⁷⁸

Working through and with DFIs not only provides cheaper-than-market concessional finance to blend with non-concessional finance, including from private-sector investors interested in sustainable urban infrastructure, but also reduces the associated risks. For example, the ECOCASA project in Mexico, financed by the Clean Technology Fund, is providing US\$52 million in concessional finance to provide

incentives for private developers to invest in highly efficient and low-cost housing construction.³⁷⁹ As of July 2016, ECO CASA had helped build more than 16,000 houses, expected to save 630,000 tonnes of CO₂ over 40 years relative to conventional housing.³⁸⁰

In some cases, DFIs through use of concessional official development assistance (ODA) as well as non-concessional development finance are the most viable sources of funding for sustainable and climate-resilient urban infrastructure. They also provide essential technical assistance to plan for it. This is partly because the resulting benefits include a large share of public goods. For example, the ADB, in partnership with the US Agency for International Development (USAID), the UK Department for International Development (DfID) and the Rockefeller Foundation, has leveraged US\$150 million for the Urban Climate Change Resilience Trust Fund to support advanced resilience planning in Asian cities and help ensure that resilience measures are implemented.³⁸¹ Another example is a project in Haidong City, China, financed by a US\$150 million ADB loan. It aims to improve urban water resource and flood management by combining “grey” infrastructure with natural infrastructure in the Huangshui River watershed, including taller flood embankments that can accommodate projected climate change impacts, and a more integrated and holistic approach to flood management with riverside greenbelts, wetland rehabilitation and forestry.³⁸²

5.3 Boosting innovation

Cities are important test beds for numerous clean technologies that can facilitate the transition to a low-carbon economy. It is not only possible, but also economically and socially viable for cities to embrace clean energy to power their homes and businesses.

Sustainable urban infrastructure and development challenges are receiving increasing attention from the private sector, relevant professional associations (e.g. architects, municipal planners and engineers), and researchers. The scale and pace of these efforts can benefit from collaborative partnerships with the public sector, notably through public grants and subsidies, to share information and ensure the results meet the needs of city governments.

Some cities are already making strong efforts focused on dissemination of sustainable urban infrastructure. Many cities in advanced economies are taking the lead in enhancing urban inter-modality through

infrastructure, information and fare integration. In London, more than 70% of people use their smartphones to get updates on traffic conditions, plan their journeys, or top up their travel cards.³⁸³ Helsinki is developing a programme that enables people to book and pay for all kinds of trips, aiming to drive down the demand for private cars to zero by 2025.

Emerging and new cities in the developing world now have important opportunities to advance sustainable urban infrastructure and “leapfrog” unsustainable and outdated technologies, just as many have already brought mobile telephone service to areas that never had land lines.

Some of the most promising innovations right now involve decentralised renewable energy. Early and rapid deployment of renewable energy can bring significant savings in infrastructure and transmission costs, while increasing resilience and reducing emissions. Public subsidies and incentive mechanisms, at least in the short term, will often be essential to overcome market biases against new technologies and practices for urban sustainability.

Small, decentralised solar systems built within cities have lower transmission costs and provide more stable power in the face of extreme weather events. For example, ReadyPay in Uganda and Azuri PayGo Energy, operating in 11 countries in sub-Saharan Africa, are demonstrating new pay-as-you-go business models to power thousands of homes via clean distributed solar power while tackling the massive problem of energy access for the urban and rural poor. These financing solutions provide affordable micro-financing that rely on innovative information technology platforms, working from smartphones, to build credit histories over time and scale up investments in a manner that is tailored to individual needs and financial capacity.³⁸⁴ While much of this activity currently targets rural village electrification, a large untapped potential exists for urban populations, including in rapidly growing cities in Africa.³⁸⁵ In South Africa, EnerGcare is a clean energy services model that is being tested in low-income urban areas and has, to date, introduced over 3,000 of its range of renewable and energy efficient products to residents of three townships, reaching over 50,000 people.³⁸⁶ A common feature of these initiatives is their use of partnerships and the blending of public development finance, private venture capital and other private investors. In addition, local and national governments and businesses (such as state-owned

utility companies, clean energy product suppliers) can partner to test and demonstrate new business models, including exploring microcredit opportunities, and to boost markets and deployment of clean energy products and systems.

California has also adopted community solar, an innovative solar energy deployment model that allows urban communities to jointly own or lease solar systems.³⁸⁷ It is estimated that if similar schemes or solar energy models are adopted in other US cities, community solar could account for up to half of the distributed solar market in 2020 in the United States. Through the California Solar Initiative, the state also subsidises rooftop solar installed by individual homeowners and businesses, largely benefiting cities. The programme collects funds through ratepayer charges that are then used to co-finance the upfront costs of solar. Consumer investments in distributed solar and energy efficiency have become increasing cost-effective, particularly as prices for solar have dropped dramatically in the last years. They have led to lower demand for centrally delivered power in the state, which has in turn saved ratepayers the cost of investing in new transmission and power generation capacity.³⁸⁸ The current solar subsidy programme was launched in 2007 and will run through 2016; it has

a total budget of US\$3.3 billion or roughly US\$372 million per year, with a goal to encourage Californians to install 3,000 megawatts by the end of 2016.³⁸⁹ The California Solar Initiative also has a relatively large research and development programme, with a separate budget of about US\$9 million per year, aiming to boost the capacity to achieve the CSI goals and help keep the state at the forefront of the nation's technology for solar.

Options that combine natural and built infrastructure to deliver urban resilience are also an essential part of urban sustainability solutions. Urban flood control infrastructure and land use choices can build resilience by letting the water in, in a controlled manner, rather than building ever-higher dykes. A prime example is the Dutch "Room for the River" programme.³⁹⁰ This is part of a broader trend in Europe to build waterfront parks, vegetation-lined channels and various other types of infrastructure that double as recreation spaces and flood control. It is also possible to control runoff for flood prevention and while conserving water for droughts.³⁹¹



SECTION 6
Land Use

The land use sector incorporates all of the natural capital stocks and ecosystem services that provide the world's people with benefits such as water filtration, food, fibre, fuel and livelihoods.

Enabling financing for and better provision and management of “natural infrastructure” is therefore critical to delivering on our global aims of inclusive growth and climate action. Global demand for food, fuel and fibre is growing rapidly, increasing pressure on natural capital and ecosystems and exacerbating climate risks. By 2050, agriculture will need to supply 70% more food than today to feed a growing population and deliver on Sustainable Development Goal (SDG) 2: ending hunger, in a way that does not harm the soil, water, biodiversity, ecosystem services or climate upon which human well-being and development depend.³⁹²

Wood products are also increasingly in demand, propelled by the emerging and developing countries. One 2012 projection is for a tripling in demand by 2050, while a widely accepted and more recent projection forecasts increases from 28% (for sawnwood) to 192% (recycled paper products for pulp) to 2060.³⁹³ Although the majority of tree removals in 2015 still came from natural forests, planted forest area increased by 66% from 1990 to 2015, and now accounts for 7% of the world's total forest area.³⁹⁴ Of the estimated 264 million hectares (ha) of planted forests in 2010, roughly three-quarters had commercial wood product production as their main purpose.³⁹⁵ These plantations are highly concentrated in a small number of countries, including China, the US, Russia, Japan and India.³⁹⁶ On a smaller scale in terms of total area but a larger scale proportionately, plantations of major tree crops are growing in tropical forest countries such as Indonesia, Malaysia, Brazil, Cambodia, Colombia, Liberia and Peru.³⁹⁷ Remote sensing shows that more than half the tree cover of peninsular Malaysia, for example, now consists of tree plantations, and plantations constitute nearly 16% of tree cover in Indonesia.³⁹⁸

Meeting the surging demand for food, fibre and fuel will require major changes to land use and water management practices. More than 25% of the world's agricultural land is now severely degraded, and at least another 8% is close to being so.³⁹⁹ About 12 million ha of productive land are lost each year due to unsustainable farming practices,⁴⁰⁰ and about 7.6 million ha of forest are permanently converted each year to other uses.⁴⁰¹ Global fresh water withdrawals

have increased sevenfold since 1900, and 70% of current global water use is for agriculture, ranging from 21% of withdrawals in Europe to 82% in Africa. Water scarcity is becoming a serious problem in some regions: in 2011, 41 countries were considered “water stressed”.⁴⁰²

Estimates suggest more than 15 million ha of land continue to be degraded each year – primarily in developing countries – to the point that they can no longer produce economic goods or provide ecosystem services. Land use practices – including, but not only, deforestation and the conversion of land into agricultural uses – were also responsible for around 24% of man-made global GHG emissions in 2010.⁴⁰³ Agriculture accounted for 13% of all global GHGs, with over half of this coming from livestock directly. Land use change, such as deforestation, accounted for 11%.⁴⁰⁴

It is not possible to successfully combat climate change without transforming the way that land is used. Deforestation and forest restoration, land rehabilitation, livestock emissions abatement, improved soil and water management, and changing cropping practices are investible activities, provided that the right incentives for behaviour change are in place. Overall, research for the Global Commission has estimated that land use interventions could deliver between 15–35% of the emissions reductions needed globally to put us on a 2°C pathway by 2030.⁴⁰⁵

Land use not only has strong emission reduction potential – it is also the only sector that can currently remove carbon from the atmosphere on a large scale. Conserving and restoring forests and rehabilitating degraded lands are critical if we are to maintain and increase carbon storage – both above and below ground – as well as other crucial ecosystem services. Agricultural practices also play a key role in maintaining, enhancing or reducing soil carbon sequestration. Recognising this, France launched the “4 for 1,000” initiative at COP21 to emphasise that the world's soils store 1,500 Gt CO₂e, and increasing this by 0.4% per year, which is technically feasible, would compensate for a massive amount (4.3 Gt CO₂e) of other emissions.⁴⁰⁶

Land use, natural capital and green infrastructure

Land is natural capital, and as such, it has significant and complex interconnections with built infrastructure. It can effectively serve as natural infrastructure, such as when wetlands provide a buffer from floods, and sand dunes protect from storm surges in coastal areas. But built infrastructure – from roads, to dams, to agricultural facilities – can also take a serious toll on the land and the natural resources it holds.⁴⁰⁷ For example, a meta-analysis of the relationship between road development and deforestation in tropical developing countries found that new roads were highly associated with significant new deforestation.⁴⁰⁸ Yet new road infrastructure is projected to grow globally by 60% (25 million km) over 2010 levels by 2050, with 90% of additions occurring in developing countries.⁴⁰⁹ Already, 43% of global road infrastructure is in developing-country areas that have relatively higher environmental sensitivity.⁴¹⁰

However it is also possible to develop incentives – such as regulatory enforcement measures, fiscal policies and subsidies – that encourage people and businesses to value the natural resources and the potential uses of land as an integral part of the real economy,⁴¹¹ weighing the short-term opportunity costs of converting natural resources against the long-term loss of ecosystem services or capital stock.⁴¹²

Humans already place a high value on the natural infrastructure services that landscapes provide, though they may fail to capture these values economically (see Box 27). For example, natural infrastructure strategies (such as using wetlands as flood buffers instead of building flood walls, or revegetating a slope to prevent landslides) are more beneficial and make better economic sense than human-built “grey infrastructure” alternatives. Natural infrastructure may be more robust to climate change impacts and variability, and it is easier to adjust and adaptively manage than “grey” infrastructure, which is often socially and economically difficult to reverse or remove once built.⁴¹³

Box 27

Landscapes as a form of infrastructure

- *Water filtration:* Forests are important for maintaining clean, stable drinking water supplies for downstream cities and other users.⁴¹⁴ Rainwater percolates through forest soils before entering groundwater, filtering out impurities. Leaves and forest floor debris prevent sediment from entering streams and lakes. A US study found that drinking water treatment costs decrease as the amount of forest cover in the relevant watershed increases. In fact, the share of forest cover in a US watershed accounts for about 50–55% of the variation in water treatment costs.⁴¹⁵
- *Landslide prevention:* Through their roots and forest floor debris, forests on slopes can hold soils in place and thereby prevent landslides during heavy rains. In Switzerland, the benefits of protected forests are estimated at US\$2–3.5 billion per year due to avoided costs of avalanches, landslides, rock falls and flooding.⁴¹⁶
- *Flood mitigation:* Forests and forested wetlands can affect the timing and magnitude of water runoff and water flows by acting as “sponges”. Water is stored in porous soils and debris, and then is slowly released over time. Through this process, forests can lower peak flows during heavy rainfall or flood events.⁴¹⁷ In the Upper Yangtze River Basin in western China, for instance, flood mitigation provided by forests saves an average of US\$1 billion annually from avoided storm and flood damage.⁴¹⁸
- *Coastal protection:* By serving as “speed bumps” for incoming storms, some coastal forests can attenuate the impact of storm surges and thereby avoid costly damage. In Vietnam, the restoration of 18,000 ha of mangrove forests resulted in annual savings of US\$7.3 million in sea dyke maintenance and storm surge protection, an estimated cost avoidance of US\$405 per hectare.⁴¹⁹
- *Air quality improvement:* Forests can improve local and regional air quality. Trees can trap or absorb air pollutants emitted by power plants, factories and vehicles – such as sulphur dioxide, nitrogen dioxide, and small particulate matter – that can trigger asthma or other respiratory problems.⁴²⁰ The lack of systemic consideration of land use or “natural” infrastructure enhancement in grey infrastructure planning, natural resource assessments and policy-making can lead to inefficient use of scarce finance and to incoherent policies. Integrated systems for climate, land use, energy and water management can remedy these shortcomings.⁴²¹

More effectively recognising and emphasising the benefits of natural infrastructure for climate mitigation and adaptation in particular could increase access to dedicated climate finance.

The annual cost of degradation of productive landscapes is presently estimated to be on the order of US\$100 billion.⁴²² Most of the world's degraded land is inhabited by poor people with few other opportunities for livelihoods, and land degradation further undercuts their development opportunities. Hence, strengthening investments in land use can contribute to achieving the SDGs. For example, restoring just 12% of degraded agricultural land in developing countries could boost smallholder farmers' incomes by US\$35–40 billion per year and feed 200 million people per year within 15 years.⁴²³ Initiating forest restoration of at least 350 million ha by 2030, meanwhile, could generate US\$170 billion per year in net benefits from watershed protection, improved crop yields and forest products.⁴²⁴

The land use challenge is most important for developing countries, which currently account for the majority of GHG emissions from land use.⁴²⁵ These are also the parts of the world where infrastructure investment choices are most important in terms of magnitude and impact on growth rates. To grow sustainably and build resilience, developing countries will need significant investment in both conserving and restoring natural infrastructure, combined with other investments in grey infrastructure.

Reconciling near-term growth with sustainable, resilient and equitable development requires a whole “landscape” approach⁴²⁶ that associates increased access to new grey infrastructure with better governance of natural resources. Integrated system planning for natural and grey infrastructure investment, which has been done successfully with water and sanitation in a number of places, for example, can deliver large benefits. As laid out in *Better Growth, Better Climate*, prospering via land use requires both “producing” and “protecting” at the same time. Infrastructure – grey and green – is central to this.

The sustainable land use investment gap

Reversing land degradation is crucial to achieving the kind of growth we need, and will require massive investments in landscape rehabilitation and protection, particularly in developing and emerging countries. Rehabilitation is important, but it is not cheap. Typical out-of-pocket rehabilitation cost for forests in formal

projects in developing countries are about US\$1,000–3,000 per ha, exclusive of land costs, and depending on species, method, natural conditions and scale of operations.⁴²⁷ As a gross estimate, exclusive of land values, restoring 350 million ha of forest landscape over the next 15 years would cost between US\$350 billion and more than US\$1 trillion, or US\$23–67 billion per year. This scale of finance is even more challenging because it might take decades for trees to grow and all the benefits to be realised.

Forest conservation financing has the additional problem that, while some costs can be recouped through expanded ecotourism and support for green infrastructure from water companies and cities, most of the returns to forest conservation are not directly market-mediated. Cooperation is required to monetise payments for valuable ecosystem services, and especially for transfers across national borders, as only some incur the cost of conservation, but all benefit.

Agricultural land restoration can cost even more per hectare than forest restoration, depending on the extent of the project and the infrastructure used. However, the economic benefits tend to come much sooner than for pure forests. *Better Growth, Better Climate* recommended putting 150 million ha of degraded agricultural land into restoration by 2030, or about 12% of all degraded agricultural land. Even at a simple estimate of US\$1,000 per ha, at the low end of the forest restoration project cost range, 150 million ha of agricultural land restoration would add US\$150 billion in cost.

Independent estimates of global land restoration needs are in the range of US\$200–300 billion per year, a figure in tune with the estimates above.⁴²⁸ Comparing this with current investment flows on the order of US\$50 billion per year,⁴²⁹ this leaves a global shortfall of about US\$150–250 billion per year. The vast majority of the required new investment in conserving forests and restoring degraded lands will be required in developing countries, since that is where almost all net new landscape degradation, forest or agricultural, is occurring.⁴³⁰ Roughly 80–90% of the current flows for land conservation and restoration in developing countries are from private sources, including farmers themselves. This suggests a large potential for the public sector to partner with companies and other investors from the private sector in scaling up investment.⁴³¹

Beyond investment in forestry and agriculture, the provision of secure and clean water resources is a significant driver of land use investments today. Recent studies estimate that the global community invests about US\$12.3 billion per year to protect, manage and restore natural infrastructure to secure water resources.⁴³²

Policies and incentives can transform how natural capital is allocated and used

Sustainable approaches to land use in rural areas, especially in developing countries, will generally need to contribute to several objectives: increasing agricultural productivity for overall economic growth, poverty alleviation, and food security; ensuring resilience and security of livelihoods for people living on the land; and managing forests and soil to capture and store CO₂ to help limit climate change while also delivering essential ecosystem services for adaptation.

New policies and incentive structures can capture the true value of natural capital, reallocate resources and incentivise new investments in sustainable land use management and use. For example, countries can reform price-distorting subsidies (e.g. on water and fertilisers) and tax structures that favour business-as-usual agricultural practices, and redirect resources to provide extension services for farmers (particularly in developing countries) to improve climate resilience. There are also various approaches to payments for ecosystem services for land use management – including REDD+ – that can deliver a range of mitigation, adaptation and local socio-economic benefits where markets do not yet exist, or are unlikely to take hold without policy intervention.

The following sections explore different areas of action, investment frameworks and policy options to help deliver finance to support better land use and thus help achieve both development and climate goals.

Box 28

How smarter fiscal policies can incentivise better land use: the case of Indonesia⁴³³

Indonesia's land use sector contributes nearly half of its GDP; it is also the leading driver of deforestation and GHGs. Reducing deforestation and degradation (REDD+) lie at the heart of Indonesia's plans to reduce emission by 29% by 2030, but analysis suggests fiscal policies currently support unsustainable land use and management. Opportunities for progress include:

- Taxing production area, rather than volumes or profits, may encourage new methods to achieve higher productivity per hectare of land; 93.5% of all land use revenue (IDR400 trillion) in Indonesia comes from taxing profits instead of taxing land area. Taxing land area would create an incentive for producers to use land more efficiently.
- Aligning tax revenue allocations to local governments with land management decisions, and reducing dependence on business models that encourage land expansion. Local and regional governments now depend heavily on land-based taxes (such as land and building permits) for their revenue, so land conversion is in their interest. Value-added taxes, corporate and export taxes from agricultural production, which raise significantly higher revenues, go to the national government and are not recycled to regions. Returning these revenues to regions could incentivise local practices that promote efficiency and sustainability of land use.
- Where earmarking mechanisms exist, linking revenue use to performance and returns, such as compliance with protected areas, yield improvements, or payment for ecosystem service (PES) schemes, could incentivise regional and local governments to implement sustainability programmes or meet sustainability targets in order to access regional funds. In Indonesia, the central government-managed Adjustment Funds can be earmarked, and have enjoyed successive replenishments, though no earmarking currently prioritises sustainable land use management. This is an opportunity to be realised.

6.1 Addressing price distortions and market failures

Improving governance is fundamental to addressing land use challenges, especially in developing and emerging economies. The quality (or lack) of governance can determine the impact of regulatory and investment-based incentive policies.⁴³⁴ Key elements include clear, enforceable property rights and land tenure; ensuring that local communities are properly engaged and informed; building local customs into national legislation; and implementing robust monitoring and enforcement systems. Policies that guarantee secure land tenure are especially important to catalyse investment, as appropriate land tenure protects the investment asset, reduces risks, and provides a critical form of collateral for credit.

Reforming subsidies and other incentives for unsustainable land use

In scaling up the amount of finance for sustainable land use, the main challenge is not a lack of funding, but how to ensure that the funding is channelled in a desirable way, and that investments are coordinated and do not work at cross purposes.⁴³⁵ Pricing reforms, including the reform of harmful subsidies, could create new financing opportunities and remove distortions that currently encourage the wasteful use of resources. Governments spent an estimated US\$1.1 trillion subsidising consumption of resources such as water, energy and food in 2011.⁴³⁶

An essential first step is to reform subsidies for agricultural commodities and agricultural inputs to align prices to promote climate-smart and resilient land use and development. Developing countries have subsidised agriculture for a long time, but more recently subsidies have grown rapidly in the main emerging economies in Asia, primarily in the form of input subsidies, and in some developing countries in Africa.⁴³⁷

Subsidies based on inputs such as pesticides, nitrogen fertilisers, electricity (to pump irrigation water), and agricultural vehicle diesel, can create incentives for overproduction or overuse of environmentally harmful inputs. Market price support also artificially reduces prices for agricultural commodities without taking into account the cost of agriculture-related environmental externalities, such as the loss of fertile topsoil.

Many countries subsidise these key agricultural inputs, but a growing body of evidence suggests these subsidies often do not reach those most in need and

can lead to waste and environmental damage.⁴³⁸ For example, while synthetic fertilisers are critical to agricultural intensification, they are also subject to overuse, particularly when subsidised, degrading the quality of water and land over time. There are many other examples of subsidies with counterproductive results. What is obvious is that when subsidies are not specifically tailored to drive positive land use impacts, they can in fact have negative impacts, and may run at odds with subsidies or measures designed to incentivise sustainable land use.

Multiple studies have attempted to quantify the extent of agricultural subsidies. OECD countries spent an estimated US\$266 billion to support farming in 2012.⁴³⁹ While progress has been made to shift this support away from the most damaging subsidies, the total number and volume remains significant.⁴⁴⁰ Meanwhile, agricultural subsidies in China rose to US\$73 billion in 2012, or 9% of agricultural output, with at least US\$18 billion of the payments based on input use.⁴⁴¹ India provided roughly US\$28 billion in input subsidies to nitrogenous fertilisers and electricity for pumping agricultural water in 2014,⁴⁴² but the government has recently taken measures to slash subsidies to fertilisers, bringing these to US\$10.4 billion per year in 2016-17.⁴⁴³

A number of countries in Africa have subsidised fertiliser in an attempt to increase its usage, which can be beneficial under some conditions – such as when soils are nitrogen-deficient and when there are market challenges such as volatile international fertiliser prices, low commercial development, thin input markets, lack of knowledge and illiquidity.⁴⁴⁴ In such cases, the key is to have a clear exit strategy in place that can help avoid locking in subsidies beyond their usefulness.

Phasing out direct agricultural input subsidies would incentivise better, more targeted use of inputs, reduce associated pollution and GHG emissions and save taxpayers' money. For instance, more efficient use of fertiliser in China alone has the potential to reduce GHG emissions by 200 million tonnes of CO₂e per year⁴⁴⁵ and more efficient use of water in India could reduce close to 100 million tonnes of CO₂e per year.

Subsidies can also undermine conservation. A recent ODI study found Brazil and Indonesia spent more than 120 times more in subsidies to the palm oil, timber, soy, beef and biofuels sectors between 2009 and 2012 than the US\$346 million they received in international conservation aid. Thus, for every US\$1 they received

In the state of Gujarat, free groundwater and subsidised electricity to pump it contributed to severe groundwater overdraft, as well as poor power supply for farmers and other rural residents. But any efforts to price groundwater and electricity to reflect their value met great resistance by farmers.

An alternative approach, the Jyotigram Scheme, was introduced in 2003. Instead of providing subsidies by default, the scheme providing limited subsidies where needed, and priced electricity where possible. Villages are given 24-hour, three-phase power supply at metered rates for domestic use and in schools, hospitals and domestic industries. Farmers operating tube wells continue to receive free electricity, but for 8 hours rather than 24 and on a preannounced schedule designed to meet their peak demands.

This separation of agricultural energy from other uses and the promise of quality supply of power proved sufficient to gain political and social backing for implementation of the subsidy reform. The Jyotigram Scheme has now radically improved the quality of village life, spurred non-farm economic enterprises, and halved the power subsidy to agriculture. And while groundwater itself is still free, the programme has indirectly raised the price of groundwater supply, thus providing a signal of scarcity and reducing groundwater overdraft.

to preserve their rainforests under the United Nations REDD+ scheme, they gave more than US\$120 to sectors that are driving deforestation.⁴⁴⁷

International financial support can play an important role in helping countries achieve their own goals in domestic subsidy reform to reduce deforestation. For example, REDD+ readiness finance can be used to help identify, quantify and reform subsidies, and REDD+ finance could also be linked to subsidy reform. For instance, Brazil's reform of rural credit is notable for making a successful contribution to reducing forest loss, demonstrating that controlling credit availability using policy and governance can have a significant impact on forest loss.⁴⁴⁸ Brazil's leadership, backed by significant REDD+ finance from Norway, has delivered strong results that contributed to a rapid expansion of protected forest areas since 2000, a real decline in deforestation rates – from a high of 28,000 km² per year in 2004 to roughly 5,000 km² per year in 2013/2014 – and to a more than 40% decline in GHG emissions in Brazil over the 2000–2012 period. This all coincided with an increase in economic growth of about 30% between 2000 and 2013.⁴⁴⁹ Maintaining these gains will require ongoing commitment and leadership from the Brazilian government.

The negative impacts of subsidies can also be transboundary. For example, US subsidies on biofuels – mostly corn ethanol – have been shown to have a knock-on effect on food prices in Mexico.⁴⁵⁰ Efforts to

reform harmful subsidies also need to look at effects beyond national borders and consider trade and supply chain impacts, in order to ensure policy coherence.⁴⁵¹

Other pricing reforms to address market failure and deliver environmental sustainability in land use

The services provided by forests and ecosystems are often not properly valued in economic decisions, even when they have tangible economic impacts in neighbouring spaces.⁴⁵² For example, preserving trees on slopes is important for preventing erosion and landslides. Yet if people upslope cut down trees, it is the people downslope who suffer the consequences. This gives rise to market failures, because people upslope have no incentive to protect the trees, even though they are very valuable to others. Incentive systems combined with cooperative approaches across those dependent on a common set of natural resources can be used to encourage investment in activities that preserve ecosystem services, including delivering the dual benefits of emission reduction and protection of natural assets. It is important to note that market solutions like these work best when backed by secure land tenure and functioning governance structures to enforce the rule of law.

Payments for ecosystems services (PES) schemes provide payments or other incentives to farmers, landowners and other land users to provide ecosystem

services such as water filtration or CO₂ capture from trees, other vegetation and soil. While it is clear that PES will never be large enough to compensate fully for the forgone short-term market value of resource exploitation, particularly in tropical rainforest, they can help land use authorities to win land users' support for policies to protect natural capital.⁴⁵³

PES often provide uniform per-hectare payments for protecting an important natural habitat. Since 1997, Costa Rica's PES programme has helped to conserve nearly 1 million ha of forest through payments for protection (90% of the area), reforestation (6%), sustainable management (3%) and more recently, regeneration (1%).⁴⁵⁴ Mexico initiated its Payments for Hydrological Environmental Services Program in 2003, paying out US\$489 million between 2003 and 2011 to more than 5,000 landowners who adopted good land management practices. The programme has preserved more than 3.2 million ha of forests.⁴⁵⁵ Reverse-auction mechanisms, used in Australia for old-growth forests, in Indonesia to reduce soil erosion and in the US to improve agri-environment practices, have been shown to help improve the cost-effectiveness of PES.⁴⁵⁶

REDD+ can be seen as a form of international PES, to provide financing to support the delivery of climate mitigation and other global public goods benefits of reducing deforestation and forest degradation. Though progress to date has been slow, and the amount of forest finance and PES funding needed is 100 times what is currently available, REDD+ and other PES schemes have considerable potential to help catalyse the transition to a low-carbon economy and development cooperation and finance has a role to play here.⁴⁵⁷

REDD+ has made significant strides in recent years, developing an appropriate international policy framework, building the necessary capacity for implementing its programmes and piloting performance-based funds (e.g. the World Bank's Forest Carbon Partnership Facility Readiness Fund and Carbon Fund).⁴⁵⁸ As a result, payments for verified emissions reductions are increasing, and REDD+ offsets now account for 80% of all transactions of forest carbon offsets.⁴⁵⁹ As the first country to submit its forest reference emissions levels for payments under REDD+, Brazil has received around half of the total approved international finance from REDD+ (through the Amazon Fund). Among others, Norway has provided US\$1 billion

to Brazil through REDD+ for validation of national reforms to tackle deforestation.⁴⁶⁰ In December 2015, Norway, Germany and the United Kingdom together pledged US\$5 billion to REDD+.⁴⁶¹

Over the past five years, a number of tropical forest nations have entered into REDD+ agreements with developed nations and multilateral development banks with explicit carbon prices. Brazil, Guyana, Guatemala and Peru have all used a carbon price of US\$5 per ton of CO₂e, and Indonesia is moving in that direction.

These payment and pricing schemes, with international support, can occur on a variety of scales: from global trading platforms for carbon emission reductions to local watershed initiatives for slope protection, water supply and purification. A common characteristic is that they create a market for ecosystem services – though in some cases, the payments go beyond ecosystem services. Yet most of the needed new investment will have to come from domestic sources such as local landowners and farmers, and from greatly expanded investment from the international private sector.

Colombia has in place a well linked up system of providing funding to localities to do sustainability planning, and over time has combined it with disaster risk reduction. One longstanding programme trains women living in or near high risk zones to be "Slope Guardians" (*Guardianes de Ladera*): to maintain slope vegetation, control drainage channels, monitor slope stabilisation work, report problems and changes in land use, keep an updated register of families in high-risk areas, and raise neighbours' awareness. The women receive ongoing training and earn about US\$400 per month for a service that is highly valued within their communities.⁴⁶²

Creating markets for ecosystem services can be facilitated by complementary measures such as eco-labelling and certification schemes, which inform consumers of the products' green qualities, and also by green public procurement, which stimulates demand for these products.⁴⁶³ Consumers are willing to pay a premium for these goods and services, which generates revenue; one study estimates that certified products related to sustainable land use could generate US\$10.4–30 billion annually by 2020.⁴⁶⁴ This demand provides a financial incentive for producers to adopt green production methods and approaches.



Photo credit: Flickr/ADB

6.2 Strengthening investment frameworks, institutional capacity and policies

Investing in restoration of degraded agriculture and forest lands is a key aspect of natural infrastructure investment to help achieve food, water and energy security goals. The large finance gap of US\$150–250 billion per year in agricultural and forest landscape restoration and conservation investment suggests the urgent need for major new leadership in achieving scale-up of investments and policies designed to halt further landscape degradation and to restore degraded landscapes. Most of this investment will need to be on a for-profit basis by private-sector actors. However, achieving these levels of private investment will require much more attention from governments and public-sector financial institutions to establish enabling policy conditions and to provide catalytic public finance.

The capacity-building needs, start-up costs, and risks associated with restoration and conservation

investments in agricultural and forest landscapes in developing countries will keep private investment low, unless public and philanthropic entities can bear a larger share of those costs. And the necessary public support will only happen if public financial institutions, both domestic and international, can make a rock-solid case that supporting such private investments is the most efficient way to achieve the desired environmental and social impacts at scale. This will require a new focus on improving project design for impacts, developing and using accepted metrics, and putting in place procedures for demonstrating impact transparently. More also needs to be done to support larger public-private partnerships for impact.

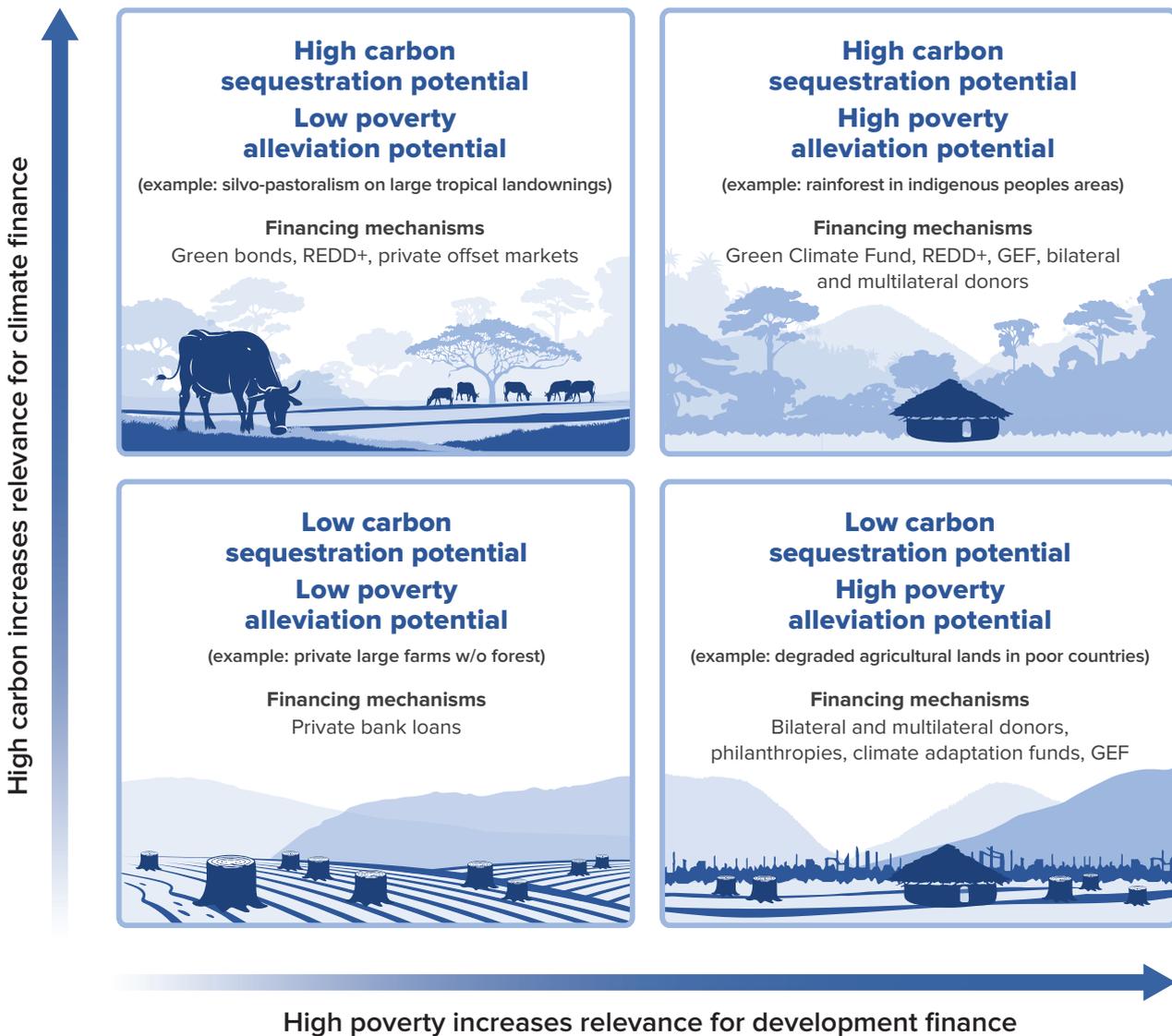
Scaling up and shifting public investment

Public investment will continue to be a key part of the solution to financing sustainable land use, but it will have to become a smaller share of such investment over time. Where it can be most powerful is in catalysing and leveraging private investment to drive change.

Figure 11

Infrastructure Financing Requirements for Emerging Markets and Developing Countries

Scaling up investment in landscape approaches, conservation and restoration will require blending various proportions of public development and public climate finance with private capital, depending on the underlying context of relative poverty and relative potential to sequester carbon.



In developing countries, where domestic resources are limited, international public finance is vital. There are two main types of international public finance today that can support sustainable land use investment: traditional development finance, targeting the agriculture and forestry sectors for growth and poverty alleviation, and climate finance, for adaptation and mitigation.

It is useful to consider where development or climate-themed finance mechanisms are most likely to be needed. The mix of the two kinds of finance depends primarily on the wealth of the recipients and the scope for mitigation of and/or adaptation to climate change, which in turn affects whether the public goods being sought are primarily social or environmental. Figure 11 depicts these relationships for mitigation.

Public development investment to support policy reforms and national programmes for natural infrastructure is critical to capacity-building for climate-smart agriculture and forestry. Good practice among development cooperation providers is to work through and with national governments to ensure country ownership and tap into local knowledge while also strengthening it. That, in turn, can facilitate greater access to finance through local counterparts or intermediaries and internationally.

A number of governments are using REDD+ programmes to finance efforts to halt deforestation or restore forests. As noted above, REDD+ facilitates international support for countries' commitments to maintain more forests. A recent analysis of international public project finance found US\$5.8 billion per year in commitments for land use mitigation and adaptation activities in developing countries, representing just over 4% of total public international climate finance tracked in 2012 and 2013.⁴⁶⁵ Official development finance commitments to agriculture and forests in developing countries for all purposes is on the order of US\$11 billion per year, so only about half of this is addressing climate change as an objective and of this about one-third is targeting REDD+.⁴⁶⁶ But this is not nearly enough to halt global deforestation and reverse emission trends from unsustainable land use.

There is a disconnect between the ways that climate-smart landscapes will need to be managed and the current financing systems available to support them. Funds for agricultural development, food security, climate mitigation and climate adaptation generally come from different sources even though these goals are inextricably linked in agricultural systems. In addition to seeking extra sources of public financing, the efficiency of existing funding sources can be improved. Some of the public sources of climate finance need to be integrated with those supporting agricultural development and forest restoration, to create a single mechanism that could flexibly support climate-smart agriculture. Similarly, development finance aimed at supporting food security and combating desertification may also have climate benefits. A recent review found more scope for REDD+ funds to be used in ways that deliver not just on climate change but on other sustainable development goals, such as poverty reduction.⁴⁶⁷

For example, as a multilateral climate fund of US\$280 million, the BioCarbon Fund Initiative for Sustainable

Forest Landscapes, was created in 2013. It seeks to reduce GHG emissions from land use through REDD+ and sustainable agriculture, as well as smarter land-use planning, policies and practices. The initiative will deploy results-based finance to incentivise changes at the landscape level. Its programmes will cover a variety of geographies and will transform large rural areas by protecting natural forests, restoring degraded lands, and enhancing agricultural productivity, thereby improving livelihoods and local environments.

Similarly, Investment in Forests and Sustainable Land Use (IFSLU) was recently set up by UK Department for International Development (DfID) to support public-private partnerships and initiatives that demonstrate how the private sector can contribute to reducing deforestation. A range of related activities will help address the policy environment.⁴⁶⁸

Another example of bringing development and climate finance together is the US\$2.7 billion Great Green Wall for the Sahara and the Sahel Initiative, which brings together more than 20 African countries, international organisations, research institutes, civil society and grassroots organisations and has become Africa's flagship initiative to combat the effects of climate change and desertification. The initiative supports local communities in the sustainable management and use of their forests, rangelands and other natural resources, aiming to contribute to food security, livelihoods, and climate change mitigation and adaptation. Already, about 120 communities in Mali, Burkina Faso and Niger have created a green belt on more than 2,500 ha of degraded and arid land, planting over 2 million seeds and seedlings from 50 native species.⁴⁶⁹

Risk of natural disasters and uncertainty are central to any investment calculation – especially in land use, where major uncertainties abound. Risks have known distributions and in theory can be insured against with reasonable premiums. Uncertainties, however, lead risk-averse actors (including insurance companies) to assume worst-case scenarios, raising costs all around. The issue of uncertainty is particularly prominent for land use because of the potentially large impacts of climate variability and climate change on temperatures, precipitation and even pests and diseases. Land use – especially agriculture – is the most climate-sensitive sector of all. Thus, difficulties in estimating true risks lead to

Managing watersheds as a key natural infrastructure investment⁴⁷⁰

Managing watersheds for specific water services represents the largest portion of natural infrastructure investments to date. A wide range of players have initiated promising efforts to protect and enhance water systems across the globe, with multiple benefits:

- **Reducing reservoir sedimentation:** Deforestation and other land use changes increase soil erosion, which can clog up reservoirs and lower their capacity to store water and generate power. To reduce sedimentation and avoid costly reservoir dredging, the Costa Rican hydropower company Enel Latin America, in partnership with the national government, is helping finance reforestation efforts upstream of its hydropower reservoirs. In addition to increasing efficiency and extending the lifespan of Enel's power facilities, the effort has provided more reliable streamflow, reduced GHG emissions, and compensated landowners for opportunity costs.⁴⁷¹
- **Regulating water flow:** Several communities and corporations have invested in restoring forests for their key role in regulating aquifer and stream recharge to secure reliable water supplies. For example, as part of a PPP between the São Paulo (Brazil) water utility, the Nature Conservancy and private companies, landowners in São Paulo's watershed are paid US\$95 per hectare to protect or restore forests. Conserving the target 14,300 ha of hydrologically sensitive land around São Paulo is projected to save US\$2.5 million by improving water quality and quantity, reducing sedimentation and increasing the longevity of São Paulo's Cantareira reservoir system.⁴⁷² By supplementing landowners' incomes, the programme also helps alleviate poverty.
- **Purifying water:** Several municipalities have invested in restoring and protecting forested watersheds to improve water quality – at lower costs than if they used only treatment plants or other grey infrastructure. For example, in Ecuador, a Water Conservation Fund (FONAG) funds watershed management projects that will protect one of Quito's water sources for the long term. FONAG now disburses almost US\$1 million a year for conservation projects, raised through fees from water users.⁴⁷³

The benefits of managing natural infrastructure extend beyond forested watersheds. Mangroves, for example, play a key role in mitigating coastal flood damage, while supporting aquaculture and fisheries.⁴⁷⁴ Trees along rivers can shade and regulate stream temperatures at a lower cost than cooling towers.⁴⁷⁵ Protecting floodplains can reduce downstream flood risk, while providing rich agricultural land and valuable habitat for fish and bird species.⁴⁷⁶

For example, a partnership between China Three Gorges Corporation and the Nature Conservancy found that restoring and managing the function of floodplains on the Yangtze River, in combination with improving dykes and other downstream grey infrastructure, would reduce flood risk more effectively and at a lower cost than upstream dams alone. Under the proposed strategy, China Three Gorges Corporation could increase hydropower production valued at up to US\$350 million per year by maintaining higher water levels in the reservoirs, while also releasing a more natural flow that benefits a downstream fish reserve.⁴⁷⁷

pricing and discount rates that are less favourable than they could be. The state of climate science is unlikely to help much, in a practical sense, in the immediate future.

Official development assistance totals devoted to protecting natural infrastructure are hard to assess, but only about 3% of ODA in 2012 went to environmental issues, and 6% to agriculture – in both cases, not much relative to the need.⁴⁷⁸ A comparison between uninsured losses and total ODA (US\$135 billion

disbursed to developing countries in 2014) shows that every second dollar of ODA spent may be washed away by uninsured disaster risk, particularly as the largest share of losses due to natural disasters in developing countries remain uninsured.⁴⁷⁹ These figures suggest that ODA may have an important role to play in terms of increasing capacity for risk assessment, related decision-making, and targeted sectoral risk reduction measures. However, ODA faces challenges in providing financial instruments that help people and businesses

Box 31

African Risk Capacity (ARC) insurance⁴⁸⁰

Rising risk of natural disasters, such as drought and flooding due in part to climate change, particularly in developing countries, highlights the need for innovative public-private initiatives to deliver de-risked finance solutions that work for the poorest countries and populations. A large share of current disaster risks is not insured, particularly in developing countries, so these communities are shouldering the losses directly. A key challenge is to protect the poorest from natural disasters as they often operate outside of the market system and commercial insurance is not a viable option.

ARC insurance is a climate-related, sovereign risk insurance scheme, launched in 2014. It is a specialised agency of the African Union that is helping member states resist and recover from natural disasters. Its primary focus is currently food security, and its main activity is an indexed insurance plan covering rainfall shortages. The aim is to catalyse a transition from the traditional ad hoc, ex-post disaster response system to a more efficient, pre-emptive continental risk management system. ARC Insurance has issued parametric disaster insurance policies to several African governments, starting with Kenya, Malawi, Mali, Mauritania, Niger, Senegal and the Gambia.

ARC uses the Africa RiskView tool, developed by the UN World Food Programme, to estimate crop losses and drought response costs before a season begins and as it progresses, triggering insurance payouts at or before harvest time if the rains have been poor. A cost-benefit analysis, performed by the financial affiliate of ARC, estimates that spending US\$1 on early intervention through parametric insurance from ARC can ultimately reduce the economic impact of drought due to crop losses by as much as US\$4.50.

To qualify for sovereign-level insurance, participating countries must have a contingency plan for how they will use the insurance pay-out as well as institutional mechanisms to manage the funds once allocated. ARC is designed to complement and reduce reliance on external appeals, such as for humanitarian aid, that typically take much longer to disburse and occur only after the disaster has hit. Cost-effective contingency planning is an essential element of national implementation to protect livelihoods and development gains. In early 2015, Mauritius, Niger and Senegal countries were disbursed a total of US\$24 million. In 2016, ARC is planning to expand its coverage to include flood and other extreme event insurance.

ARC Insurance Company Limited (ARC Ltd) is the financial affiliate of ARC. The initial capital behind the insurer was provided by founding members KfW (Germany) and DfID (United Kingdom) in the amount of roughly US\$200 million of public development finance.

in developing countries insure against disasters. Box 31 provides an innovative example of using public development finance to catalyse private investment to mitigate and respond proactively to drought risk.

Scaling up private investment

Even though private investment in sustainable land use is rising – some estimates suggest that it grew by over 600% between 2004–2008 and 2009–2013 – the scale of the challenge to fill the financing gap remains significant.⁴⁸¹ There is a need to increase the amount of money going from primary investors (“limited partners”) into entities such as impact funds that can originate and help develop viable projects.

Green bonds, discussed in detail in Section 3, are increasingly used in the energy sector, and may eventually hold promise for land use as well. However, the proportion of green bonds dedicated to agriculture and forestry is still very small, accounting for only 2.2% of the total US\$42 billion issued in 2015⁴⁸² and less than 1% of all climate-aligned bonds issued to date; it is also not always clear that the proceeds from such bonds in land use are in fact financing greener land use as opposed to other green activities by land users such as renewable energy.⁴⁸³ Clearly uncertainties peculiar to the land use sector are discouraging to investors such as banks and pension funds seeking long-term stable returns with low risk. A majority of the green bonds issued in

agriculture and forestry to date involve paper and pulp companies with Forest Stewardship Council certification.⁴⁸⁴ Forest bonds, though long discussed, have not been issued at significant levels.

The market for private investments in sustainable land use is challenged by a shortage of investment projects with appropriate risk-return profiles and experienced management, and lack of standardised impact metrics. The concept of green bonds in land use restoration (e.g. fixed income investments) is attractive in principle, but only likely to be marketable at scale if well protected against loss by first-loss and impact equity, as discussed below, and if backed by harmonised standards.⁴⁸⁵

Impact investment opportunities related to land use, on the other hand, which achieve social and environmental impacts along with financial returns, are growing and have great potential. Impact investing for land use in developing countries is expected to reach at least US\$6 billion total in 2014–2018, triple the level of the previous five years (see Box 32).

Key barriers need to be overcome to ensure a good supply of deals with adequate collateral, sufficient prospects for future cash flow, and acceptable risk-reward profiles. Investors in rural areas of developing countries tend to face all the usual risks of investment, but also additional concerns about commodity market

Box 32

Impact Investment

Impact investing in restoring and conserving landscapes is a medium- to long-term business, but the financial bottom line matters to impact investors, as in all private investing. Of 42 impact funds identified by IMPACTBase as primarily targeting environmental impacts, only one reported a willingness to accept below-market returns. The investors' targeted internal rate of return⁴⁸⁶ on investments involving real assets (such as land) was 15%, although known cases of below-market rates of 5.5% in environmental impact investing were acknowledged. Fund managers sought internal rates of return of 5–10% in the conservation area. Investments in Africa on average needed internal rates of return of 5% higher than comparable conservation investments in Latin America.⁴⁸⁷ Managing risks is key to increasing investment at any given rate of return.

Initiative 20x20 in Latin America and the Caribbean, which is defined by active participation of private sector impact investors, has achieved particular momentum.⁴⁸⁸ Launched at the Lima Climate Change Conference in December 2014, it aims to bring 20 million ha of degraded agricultural and forest lands into restoration by 2020. The 20 million ha goal for pledges has already been significantly exceeded, and an announcement by an international organisation of an associated small first-loss equity facility is expected to occur very soon.

Initiative 20x20 is facilitating technical support to countries committed to restoration, and the plan is to do the same for the two civil society regional programmes that have submitted restoration pledges. Studies and workshops are targeted at key common issues such as fiscal and regulatory incentives for restoration, monitoring systems, assessments of specific restoration opportunities, and increasing access to seeds for native species.

Private-sector impact investors are actively participating in Initiative 20x20. Permian Global, Moringa Fund, Althelia Climate Fund, Rare, Terra Global Capital, the Forestry and Climate Change Sub-Fund, Sustainable Land Management Partners, EcoPlanet Bamboo, Carana, the EcoEnterprise Fund, the Andes Amazon Fund, and the Amazon Reforestry Fund have earmarked an aggregate of over US\$1 billion for investment in 20x20 projects as of August 2016; others are likely to join over time. Contacts have also been initiated with institutional development and climate finance investors with a regional focus on Latin America, both to explore options for a first-loss risk facility and to boost resources available to impact investors.

There seems little doubt that the 20x20 partnership is facilitating collaboration between those with a stake in degraded land, and international investors who seek impact in addition to returns. Much has been achieved in a short time; the key now is to follow through with effective implementation.

risks, policy risks, political risks, macroeconomic risks, weather risk, and commercial risks, such as poor infrastructure and difficulties in finding trained managers. Differential risks are an often-cited reason why some borrowers pay higher interest rates, and why some projects need to have a higher return than others to attract investors.

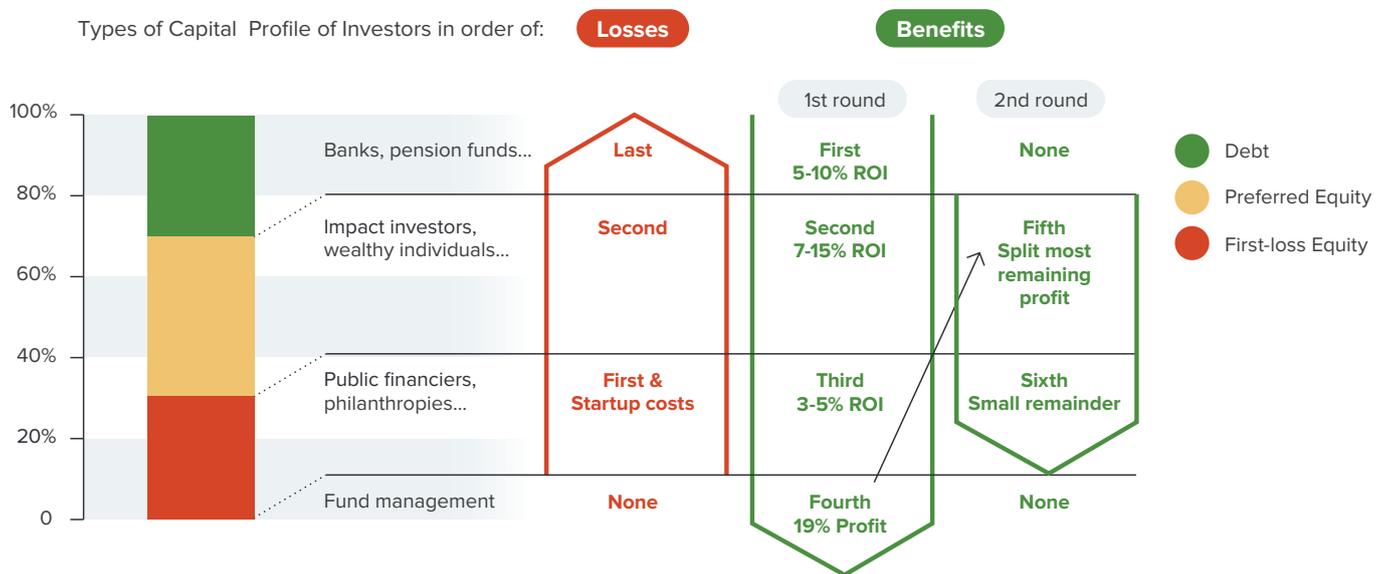
To reduce financial risks, “capital stacking” could play an important role, provided the right transparency and accountability mechanisms are in place. This is a common risk-sharing approach in which institutional or philanthropic investors typically provide first-loss equity, impact investors provide preferred equity, and other private investors provide protected debt equity (see Figure 12). Publicly funded institutional investors can leverage private capital by accepting a first loss for being the junior equity partner in a stacked capital deal. The evidence suggests that pooling risks across institutional investors and developing expertise within

one facility can lead to cost savings.⁴⁸⁹ Capital stacking is relevant to land use, but also more broadly to sustainable infrastructure financing.

Public private partnerships can be created to establish infrastructure funds that attract private investors. By structuring the fund to meet investors’ risk appetite, a limited public investment can be used to attract private capital and boost available resources for investment. The Africa Agriculture and Trade Investment Fund is one example (see Box 33). While still in their infancy, experience from such funds is promising and can be scaled up and replicated for investing in sustainable infrastructure and related business activities.

The AATIF experience highlights useful lessons for others considering blended funds, including the need to match the fund structure to investors’ risk appetite; the opportunities associated with a flexible investment

Figure 12
Capital stacking for impact



Source: Consultations with various investors and IMPACTBase, 2015. IMPACTBASE Snapshot: An analysis of 300+ impact investing funds. Global Impact Investor Network. Available at: <http://www.thegiin.org/cgi-bin/iowa/resources/research/653.html>.

Africa Agriculture and Trade Investment Fund: An Innovated Public Private Partnership to Blend Funds for Sustainable Agriculture Finance Solutions

The Africa Agriculture and Trade Investment Fund (AATIF) is a US\$146 million fund that invests across the entire agricultural value chain in Africa. It illustrates an new type of asset class in the form of a public-private infrastructure fund or structured public-private partnership that is designed to support sustainable infrastructure and related business practices investment. The AATIF uses a first-loss layer (capitalized by Germany's Federal Ministry for Economic Cooperation and Development (BMZ)) and a mezzanine layer (capitalized by KfW and Deutsche Bank) to encourage private investment in the fund.

The mandate is to target direct investments in agricultural cooperatives, commercial farms, and processing companies, and indirect investments in financial and other intermediaries that on-lend predominantly to smallholder farmers. As of June 2015, AATIF had deployed about US\$110 million and its portfolio included four direct investments and four indirect investments, including three investments in financial institutions and one investment in a non-financial intermediary.

Importantly, AATIF's has Social and Environmental Safeguard Guidelines (based on the IFC performance standards) and AATIF partners with an independent Compliance Advisor to ensure that these are enforced and shape projects in the course of their preparation. Parallel to the fund, an associated Technical Assistance (TA) Facility provides grant-based support to projects to help ensure AATIF investments reach their development potential. This Facility is managed by the Common Fund for Commodities and capitalized with EUR 6m from BMZ and AATIF itself. Nearly every investment made by AATIF includes a TA component. These include: grant funding to support research, employee training, and the implementation of Environmental and Social Management Systems (SEMS), among other capacity building efforts. In the future, the Facility also intends to deploy funding for feasibility studies and other project preparation activities.

mandate; the need for consistent and effective communication among stakeholders; and the benefits of streamlined governance and decisionmaking processes. It is also an example of an innovative public private financial partnership to deploy capital to sustainable agricultural practices and trade in Africa. Public-sector finance has an important role in creating the conditions to increase the supply of bankable deals and mobilise private investment at scale. The Global Environmental Facility (GEF) is a successful example. Since 2006, when land degradation became a focal area, the GEF has invested more than US\$876 million in resources for at least 190 projects and programs that encourage use of sustainable land management, leveraging more than US\$3 billion of private co-financing. Similarly, governments and philanthropic organisations sometimes create dedicated global funds or facilities (such as new windows of existing funds) for public co-financing of landscape restoration and conservation, leveraging private investment. Adequate attention and finance should be provided to building

capacity to formulate bankable projects. Transparency and inclusion are also key.

There is not a lot of experience with large risk guarantee funds working on a multi-project basis across countries. International cooperation that combines impact-oriented multilateral public funding for mitigating risk with public and private investment for producing impact could help scale up the amount of total capital for impact considerably.

The different objectives of different types of investors provide an opportunity to improve risk-return profiles for each through collaboration, boosting the overall pool of resources available. Public or philanthropic institutional investors may be most concerned with impact, but worry that their potential concessional funding is too small to meet needs. They may take bigger risks to leverage higher levels of good investment by others. Others, such as pension funds, may be content to have a lower but predictable long-run return on debt that is well protected from loss.

For instance, TIAA-CREF Global Agriculture⁴⁹⁰ is a series of limited partnership investment funds that seek to capitalise on positive macroeconomic fundamentals by investing in agricultural natural resources and related agricultural investments on a global basis.⁴⁹¹ Its investment strategy is designed to gain exposure to an asset class that is characterised by low correlation to other asset classes, provides an effective hedge to inflation, and is expected to benefit from attractive market fundamentals. TIAA-CREF is currently investing in a US\$4.4 billion global farmland portfolio that includes over 800,000 acres on more than 600 properties on four continents:

North and South America, Europe and Australia. The farmland portfolio is part of a broader US\$8 billion Global Natural Resources & Infrastructure portfolio that also includes timber, energy and infrastructure.

Innovative financing in agriculture and food has mobilised about US\$1 billion over the last three years. The number of funds (both public and private), the amount of capital invested, and the number of projects financed all show a positive trend, and there is scope to use creative financing mechanisms to fund interventions that will lead to more sustainable land use practices.⁴⁹²

Box 34

Supply-chain deforestation commitments

In recent years, an important movement has emerged among large companies of taking action and investing across their supply chains to reduce negative environmental impacts. In 2010, the Consumer Goods Forum (CGF) – an industry association representing consumer-facing companies with more than US\$3 trillion in annual revenues – pledged to eliminate deforestation from its members’ supply chains and achieve “zero net deforestation” by 2020.⁴⁹³

The CGF pledge became a primary driver of the 2012 creation of the Tropical Forest Alliance 2020 (TFA), a shared multi-stakeholder platform, including governments, companies and NGOs, to eliminate commodity deforestation.⁴⁹⁴ These developments were partly the result of pressure from local and global NGOs, including biodiversity, environmental and rights-based groups. As such, they demonstrate the power of consumer-based movements to change business models and shift investment from business-as-usual patterns towards sustainable land use.

Over the last few years, most of the world’s major commodity traders – large agribusinesses such as Wilmar, Cargill and Archer Daniels Midland that dominate global agricultural trade – have committed to zero-deforestation policies. While each company’s policy has its nuances, the overall commitment is simple: to stop buying agricultural commodities grown on recently deforested land. The shift has been most rapid in the palm oil industry. In December 2013, the world’s largest palm oil trader, Wilmar International, introduced a groundbreaking “No Deforestation, No Peat Land, No Exploitation” commitment across its entire supply chain.⁴⁹⁵ Since then, other major commodity and consumer goods companies have pledged to break the link between palm oil and deforestation, while also protecting the rights of local communities. Today, it is estimated that the majority of globally traded palm oil is supplied by companies that have committed to responsible sourcing guidelines.⁴⁹⁶

The collective pledge by CGF members, the launching of the TFA, and the cascade of commitments to zero-deforestation policies are very significant. The task now is to make the vision of deforestation-free commodities a reality, by building internal company support, creating plans with aggressive timelines, making sourcing relationships more transparent, and transmitting strong incentives for deforestation-free goods from buyers to sellers.



Photo credit: Flickr/ADB

6.3 Boosting agricultural RD&D investment

Remedying distortions in incentives (Section 6.1) is key to encouraging good behaviours and discouraging bad ones with respect to reducing GHG emissions from land use and enhancing their absorption. It will also be vital to invest in the productivity and sustainability of land use to meet rising needs for food, fibre and fuel. These needs will be met in some fashion, but under business-as-usual it is unlikely that they will be met in a way consistent with even a 2°C pathway. The Global Commission on the Economy and Climate has shown that land use interventions have the potential to generate 30% of the total potential annual mitigation of greenhouse gases by 2030.⁴⁹⁷ To do so, however, requires investment in forward looking R&D in land use sectors to deliver innovative practices and technologies in a timely way, and investments in the rapid deployment of existing low-emission and high-resilience practices and technologies.

Agricultural R&D is largely underfunded, given the urgency of the needs. Data on R&D spending in

agriculture are scant, though some estimates are available. In 2008, governments spent about US\$32 billion globally on R&D in agriculture (including livestock) and agroforestry— including US\$15.6 billion (2005 PPP) in developing and emerging economies. Private-sector funding added about another US\$18 billion (2005 PPP), mostly in developed countries.⁴⁹⁸ More recent figures for advanced countries in 2013 show that only 3% of public R&D in those economies is focused on agriculture, compared with 4.2% for energy, 6.3% for industrial production and 24.9% for defence.⁴⁹⁹

The Consultative Group on International Agricultural Research (CGIAR), which focuses on investing in tropical food crops, is one the oldest and most successful collaborative research initiatives in this field. It is a nearly US\$1 billion-a-year global agricultural research partnership involving 15 research centres around the world, combining public and private-sector funds and partners. CGIAR centres were instrumental in the original Green Revolution. They bring together high-level scientific capacity, significant

and stable funding, and institutional capacity on sustainable agriculture and natural resource management practices in developing countries. This enables them to provide farmers with vital science and technology support. The CGIAR Research Program on Climate Change and Food Security (CCAFS) is the global instrument for promoting research on climate-smart agriculture in developing countries.

Globally and in specific regions, rapid advances in biological sciences are opening up great possibilities for developing new, more productive and resilient crop varieties. New technologies are making it possible to quickly screen huge volumes of material for desired traits and then cross-breed them into seeds, revolutionising the business.⁵⁰⁰ Breeders have developed methods for mapping and labelling portions of plant DNA associated with useful traits such as drought tolerance or pest resistance. This makes it possible to identify the most promising seedlings for further breeding before the plants are fully grown.

Between 2010 and 2014, the EU and the UN Food and Agriculture Organization (FAO) provided €41 million to support the Africa Climate Smart Agriculture (CSA) Alliance, which invests in enhancing productivity and climate resilience while reducing emissions from agriculture.⁵⁰¹ CSA aims to work with 6 million smallholder farmers across sub-Saharan Africa by 2021.⁵⁰² The goal is to boost food and nutrition security for the rural poor, even in the face of a changing climate. CSA practices enable farming communities to sustainably and reliably increase agricultural productivity and incomes, adapt and build resilience to extreme weather events and a changing climate, and where appropriate, contribute to reducing GHG emissions and concentrations.

An active area for research is how to fulfill the rising demand for wood and wood-based commodities, and the role that planted forests may play to help decrease the reliance on clearing natural forests for wood. Projections from various sources suggest that planted forests for wood products will cover from 303 to 345 million ha by 2030, roughly a doubling since 1990, with most of the increase from 2005 occurring in Asia.⁵⁰³ Plantation forests are much less biodiverse than natural forests, and often fail to provide anything like the level of vital ecosystem services provided by intact natural forests.⁵⁰⁴ Enhancing productivity in planted forests can contribute to sustainable afforestation and reforestation strategies, reducing pressures to source wood from natural forests.

Making plantation forestry more sustainable has technical and social components that are complex but relatively well-known.⁵⁰⁵ However, these barriers can be difficult to overcome when it is easier and cheaper to harvest natural forests instead. This highlights the fundamental importance of monitoring and governance in preventing deforestation and encouraging plantation forestry to use more sustainable approaches.⁵⁰⁶ Some potential possibilities can be seen through a pilot project in Vietnam. More than 43,000 households in central Vietnam have received access to micro finance and technical support to establish over 76,500 hectares of plantation forest under a World Bank-supported project. A key component is certification of pilot areas through the International Stewardship Forest Certification process, where the price of certified timber is 30% higher than non-certified timber of the same type.⁵⁰⁷

With respect to agriculture, the Global Alliance for Climate-Smart Agriculture (GACSA) was launched at the UN Climate Summit in 2014.⁵⁰⁸ It is a voluntary alliance dedicated to addressing the challenges facing food security and agriculture in a changing climate by scaling up climate-smart agriculture. Specific goals include sustainable and equitable increases in agricultural productivity and incomes; greater resilience of food systems and farming livelihoods; and reduction and/or removal of GHG emissions associated with agriculture, where possible. GACSA is supported by a Facilitation Unit, hosted by the FAO and financed through a five-year (2015–2019) multi-donor trust fund with contributions pledged from Norway, Switzerland and the US.

As seen above, the most recent estimate of global annual R&D in agriculture and forests, public and private, of all types was of the order of US\$32 billion.⁵⁰⁹ This is much less than similar investments in renewable energy. Of this amount, it is likely that less than one-third or roughly US\$10 billion was for climate-smart agricultural technologies and practices.⁵¹⁰ This may reflect the greater difficulty for the private sector to capture the gains from funded research on climate smart agriculture compared to renewable energy innovations. The fact remains that R&D in the land use sector is underfunded, given that it has the potential to generate 24% of global emissions mitigation potential by 2030. This is a priority area to step-up R&D funding, as well funding for the rapid deployment and spread of existing low-emission and high-resilience solutions.

ENDNOTES

- 1 IMF, 2014. *Is it time for an infrastructure push? The macroeconomic effects of public investment*. In World Economic Outlook, October 2014: Legacies, Clouds, Uncertainties. International Monetary Fund, Washington, DC. 75–114. Available at: <http://www.imf.org/external/pubs/ft/weo/2014/02/>.
- 2 Ibid.
- 3 Bhattacharya, A., Meltzer, J., Oppenheim, J., Qureshi, M.Z. and Stern, N., 2016 (forthcoming). *Delivering on Sustainable Infrastructure for Better Development and Better Climate*. To be available at: <http://newclimateeconomy.report/2015/misc/working-papers/>.
- 4 Hallegatte, S., et al., 2015. *Shock Waves: Managing the Impacts of Climate Change on Poverty*. Climate Change and Development. The World Bank, Washington, DC. Available at: <http://dx.doi.org/10.1596/978-1-4648-0673-5>.
- 5 Granoff, I., et al., 2015. *Zero Poverty, Zero Emissions: Eradicating Extreme Poverty in the Climate Crisis*. London: Overseas Development Institute. Available at: <https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9844.pdf>.
- 6 United Nations Environment Programme, 2016. *Ahead of UN Environment Assembly UNEP Says Cost of Adapting to Climate Change Could Hit \$500 Billion per year by 2050*. Available at: <http://www.unep.org/newscentre/Default.aspx?DocumentID=27074&ArticleID=36171&l=en>.
- 7 Hallegatte, S., et al., 2016. *Shock Waves: Managing the Impacts of Climate Change on Poverty*.
- 8 Bhattacharya et al., 2016. *Delivering on Sustainable Infrastructure for Better Development and Better Climate*.
- 9 This section is loosely based on Bhattacharya et al., 2016. *Delivering on Sustainable Infrastructure for Better Development and Better Climate*.
- 10 For detailed discussion on the benefits and potential risks of gas as a transition fuel, see: Lazarus, M., Tempest, K., Klevnäs, P. and Korsbakken, J. I., 2015. *Natural Gas: Guardrails for a Potential Climate Bridge*. New Climate Economy contributing paper. Stockholm Environment Institute, Stockholm and Seattle, WA, US. Available at: <http://newclimateeconomy.report/2015/workingpaper/natural-gas-guardrails-for-a-potential-climate-bridge-2/>.
- 11 This \$90 trillion figure includes investments in built infrastructure such as in urban, transport, water, waster, telecommunications, and energy systems, including energy efficiency, but not natural infrastructure. See: Global Commission on the Economy and Climate (GCEC), 2014. *Better Growth, Better Climate: The New Climate Economy Report*. The Global Report. Washington, DC. Available at: <http://newclimateeconomy.report>.
- 12 Global Commission on the Economy and Climate, 2014. *Better Growth, Better Climate: The New Climate Economy Report*. Available at: <http://2014.newclimateeconomy.report>.
- 13 Ibid.
- 14 Bhattacharya et al., 2016. *Delivering on Sustainable Infrastructure for Better Development and Better Climate*. Global Commission on the Economy and Climate, 2014. *Better Growth, Better Climate: The New Climate Economy Report*. Available at: <http://2014.newclimateeconomy.report>.
- 15 Bhattacharya et al., 2016. *Delivering on Sustainable Infrastructure for Better Development and Better Climate*. Meltzer, J., 2016. *Financing Low Carbon, Climate Resilient Infrastructure: The Role of Climate Finance and Green Finance*. (forthcoming).
- 16 Bhattacharya et al., 2016. *Delivering on Sustainable Infrastructure for Better Development and Better Climate*. Low income countries are more dependent on external or international development finance that is concessional also known as official development assistance. This can be delivered either through grants or concessional loans. Non-concessional external finance for infrastructure may also be significant particularly in middle income countries and emerging economies. For further discussion, see also Miyamoto & Chiofalo 2015. Official Development Finance for Infrastructure. DOI: <http://dx.doi.org/10.1787/5jrs3sbcrvzx-en>.
- 17 IMF, 2015. *Making Public Investment More Efficient*. IMF Policy Paper. International Monetary Fund, Washington, DC. Available at: <http://www.imf.org/external/pp/longres.aspx?id=4959>.

- 18 Bhattacharya et al., 2016. *Delivering on Sustainable Infrastructure for Better Development and Better Climate*.
- 19 Ibid.
- 20 See: <http://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/programme-for-infrastructure-development-in-africa-pida>.
- 21 Bielenberg et al., 2016. *Financing change: how to mobilize private-sector financing for sustainable infrastructure*. McKinsey Center for Business and Environment. Available at: http://2015.newclimateeconomy.report/wp-content/uploads/2016/01/Financing_change_How_to_mobilize_private-sector_financing_for_sustainable_infrastructure.pdf.
- 22 Bhattacharya et al., 2016. *Delivering on Sustainable Infrastructure for Better Development and Better Climate*.
- OECD, 2011. *Delivering on Green Growth, in Towards Green Growth*. OECD Publishing. Available at: <http://dx.doi.org/10.1787/9789264111318-7-en>.
- 23 Note that this does not include investment needs for natural infrastructure, for which reliable estimates are lacking.
- 24 Medium, 2015. *2015 Shipping Investment Review: China and One Belt One Road*. Pacific Tycoon. Available at: <https://medium.com/@PacificTycoon/2015-shipping-investment-review-china-and-one-belt-one-road-2f484556c106#.5x3sdq4wv> and <http://www.ft.com/cms/s/2/5c022b50-78b7-11e5-933d-efcdc3c11c89.html#axzz4BY25bask>.
- 25 The water and transport (outside of cities) sectors are captured in the investment numbers. They are not examined here in separate sections.
- 26 Buchner, B., Trabacchi, C., Mazza, F., Abramskiehn, D. and Wang, D., 2015. *The Global Landscape of Climate Finance 2015*. Climate Policy Initiative. Available at: <http://climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2015/>.
- 27 Miyamoto, K. and Chiofalo, E., 2015. *Official Development Finance for Infrastructure: Support by Multilateral and Bilateral Development Partners*, OECD Development Co-operation Working Papers, No. 25, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/5jrs3sbcrvzx-en>.
- 28 CPI and CICERO, 2015. *Background Paper for the G7 on Long-term Climate Finance*. Wilkinson, J., Buchner, B., Abramskiehn, D., Mazza, F., Oliver, P., and Stadelmann, M. Available at: <http://climatepolicyinitiative.org/publication/background-report-for-g7-on-long-term-climate-finance/>.
- 29 Ahmad, E., 2015. *Public Finance Underpinnings for Infrastructure Financing in Developing Countries*. Infrastructure Finance in the Developing World Working Paper Series. Washington, DC: Intergovernmental Group of Twenty-Four and Global Green Growth Institute.
- 30 See: <https://pppknowledgelab.org/ppp-cycle/what-ppp>.
- 31 Kennedy, C. and Corfee-Morlot, J., 2012. *Mobilising Investment in Low Carbon, Climate Resilient Infrastructure*. OECD Environment Working Papers, No. 46. Organisation for Economic Co-operation and Development, Paris. Available at: <http://dx.doi.org/10.1787/5k8zm3gxxmnq-en>.
- 32 See: <http://inafrica24.com/modernity/africa-climate-resilient-infrastructure-summit-acris-ii/#sthash.8BmJKvM3.dpbs>.
- 33 New Development Bank, 2016. *BRICS Bank hands \$811m in green energy loans*. Available at: [http://ndb.int/brics-bank-hands-\\$811m-in-green-energy-loans.php](http://ndb.int/brics-bank-hands-$811m-in-green-energy-loans.php). See also recent news: <http://www.reuters.com/article/china-brics-bonds-idUSL4N19Y2C9>.
- 34 de Luna-Martínez, J. and Vicente, C., 2012. *Global Survey of Development Banks*. Policy Research Working Papers. The World Bank. Available at: <http://dx.doi.org/10.1596/1813-9450-5969>.
- Cochran, I., Hubert, R., Marchal, V., and Youngman, R., 2014. *Public Financial Institutions and the Low-carbon Transition: Five Case Studies on Low-Carbon Infrastructure and Project Investment*. OECD Environment Working Papers, No. 72, OECD Publishing. Available at: <http://dx.doi.org/10.1787/5jxt3rhpgn9t-en>.
- 35 de Luna-Martínez, J. and Vicente, C., 2012. *Global Survey of Development Banks*.
- 36 Cochran, I., et al., 2014. *Public Financial Institutions and the Low-carbon Transition: Five Case Studies on Low-Carbon Infrastructure and Project Investment*.

- 37 Standing Committee on Finance, 2014. *2014 Biennial Assessment and Overview of Climate Finance Flows Report*. United Nations Framework Convention on Climate Change, Bonn. Available at: http://unfccc.int/cooperation_and_support/financial_mechanism/standing_committee/items/8034.php.
- Westphal, M., Canfin, P., Ballesteros, A. and Morgan, J., 2015. *Getting to \$100 Billion: Climate Finance Scenarios and Projections to 2020*. World Resources Institute, Washington, DC. Available at: <http://www.wri.org/publication/getting-100-billion-climate-finance-scenarios-and-projections-2020>.
- 38 See: Bodnar, P., Brown, J., and Nakhooda, S., 2015. *What counts: tools to help define and understand progress towards the \$100 billion climate finance commitment*. Available at: <https://www.odi.org/publications/9504-counts-tools-define-understand-100-billion-climate-finance-commitment>.
- 39 OECD, 2015. *Climate finance in 2013-14 and the USD 100 billion goal*. A report by the Organisation for Economic Co-operation and Development (OECD) in collaboration with Climate Policy Initiative (CPI). Available at: <http://www.oecd.org/environment/cc/OECD-CPI-Climate-Finance-Report.htm>.
- 40 Hamilton, K and E. Zindler, 2016. *Finance Guide for Policy-Makers: Renewable Energy, Green Infrastructure. 2016 Update*. Available at: <http://about.bnef.com/white-papers/finance-guide-policy-makers/>.
- 41 See: <http://www.investopedia.com/terms/p/projectfinance.asp>.
- 42 See: www.abundanceinvestment.com.
- 43 Ehlers, T., 2014. *Understanding the Challenges for Infrastructure Finance*. Bank for International Settlements, Basel. Available at: <http://www.bis.org/publ/work454.pdf>.
- 44 Ibid.
- 45 Bhattacharya, et al., 2016. *Delivering on Sustainable Infrastructure*.
- 46 Bielenberg et al., 2016. *Financing change: how to mobilize private-sector financing for sustainable infrastructure*.
- 47 Bielenberg et al., 2016. *Financing change: how to mobilize private-sector financing for sustainable infrastructure*. “Basel III” is a comprehensive set of reform measures, developed by the Basel Committee on Banking Supervision in 2011, to strengthen the regulation, supervision, and risk management of the banking sector. “Solvency II” is an EU Directive that codifies and harmonises EU insurance regulations with a primary focus on the amount of capital that EU insurance companies must hold to reduce the risk of solvency.
- 48 Nassiry, D., and Nakhooda, S., 2016. *Finding the pipeline: Project preparation and low-carbon investment*. Contributing paper for Global Commission on the Economy and Climate Synthesis Report 2016, *Financing Infrastructure for a New Climate Economy*. To be available at: <http://newclimateeconomy.report/2015/misc/working-papers/>.
- 49 Bielenberg et al., 2016. *Financing change: how to mobilize private-sector financing for sustainable infrastructure*.
- 50 Bhattacharya, Amar. Oppenheim, Jeremy., & Stern, Nicholas. (2015). *Driving Sustainable Development through Better Infrastructure: Key Elements of a Transformation Program*. Global Economy and Development Working Paper No. 91. Washington, DC: Brookings Institution.
- 51 Sources: NEPAD-IPPF for Africa and the World Bank for developed countries, cited in Infrastructure Consortium Africa, 2015.
- 52 Nassiry, D. and Nakhooda, S., 2016. *Finding the Pipeline*. Based on a review of relevant literature, including:
World Bank. 2009. *Africa's Infrastructure: A Time for Transformation*. Available at: <http://documents.worldbank.org/curated/en/2009/01/11487313/africas-infrastructure-time-transformation>.
- 53 Nassiry, D., and Nakhooda, S., 2016. *Finding the Pipeline*.
- 54 Briceno-Garmendia, C.M. and Foster, V., 2009. *Africa's Infrastructure : A Time for Transformation*. The World Bank, Washington, DC. Available at: <http://documents.worldbank.org/curated/en/2009/01/11487313/africas-infrastructure-time-transformation>.
- 55 Nassiry, D. and Nakhooda, S., 2016. *Finding the Pipeline*.
- 56 Ibid.

- 57 Bielenberg et al. 2016. *Financing change: how to mobilize private-sector financing for sustainable infrastructure*.
- 58 Ibid.
- 59 Ibid.
- 60 Ibid.
- 61 MSCI, 2016. *MSCI ESG Ratings. The Next Generations of ESG Ratings. More Data, More Context, Better Decisions*. Available at: https://www.msci.com/documents/1296102/1636401/MSCI_ESG_Ratings.pdf.
- 62 For example, see: <https://www.internationalrivers.org/campaigns/nam-theun-2-dam>.
- 63 Cervigni, R., Liden, M. J. R., Neumann, J. L. and Strzepek, K. M., 2015. *Enhancing the Climate Resilience of Africa's Infrastructure: The Power and Water Sectors*. The World Bank, Washington, D.C., and UNECA. Available at: <http://documents.worldbank.org/curated/en/2015/04/24424659/enhancing-climate-resilience-africas-infrastructure-power-water-sectors>.
- 64 For further detail on this number, see Section 4.
- IEA, 2015. *Energy Subsidies*. World Energy Outlook Resources. Available at <http://www.worldenergyoutlook.org/resources/energysubsidies/>.
- OECD, 2015. Tracking Progress in reforming support for fossil fuels." OECD Companion to the Inventory of Support Measures for Fossil Fuels 2015. OECD Publishing, Paris. Available at: <http://dx.doi.org/10.1787/9789264239616-6-en>.
- 65 IEA, 2015. *World Energy Outlook 2015*. International Energy Agency, Paris. Available at: <http://www.worldenergyoutlook.org/weo2015/>. Table 2.3 provides a country-by-country outline of reforms.
- 66 World Bank Group and Ecofys, 2016. *Carbon Pricing Watch 2016*. Advance brief from the State and Trends of Carbon Pricing 2016 report. Washington, DC. Available at: <https://openknowledge.worldbank.org/handle/10986/24288>.
- 67 Rydge, J., 2015. *Implementing Effective Carbon Pricing*. Contributing paper for *Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate*. New Climate Economy, London and Washington, DC. Available at: <http://newclimateeconomy.report/misc/working-papers/>.
- 68 This estimate is calculated using the price-gap method. It adjusts the reference price upwards for countries suffering from water scarcity. For the full calculation see: Kochnar, K., Pattillo, C. A., Sun, Y., Suphaphiphat, N., Swiston, A., 2015. *Is the Glass Half Empty Or Half Full? Issues in Managing Water Challenges and Policy Instruments*. IMF Staff Discussion Note 15/11. International Monetary Fund, Washington, DC. Available at: <https://www.imf.org/external/pubs/cat/longres.aspx?sk=42938.0>.
- 69 Kochhar, et al, 2015. *Is the Glass Half Empty or Half Full? Issues in Managing Water Challenges and Policy Instruments*.
- 70 IMF, 2015. *Making Public Investment More Efficient*.
- IMF, 2014. *Is it time for an infrastructure push?*
- 71 Kennedy, C. and Corfee-Morlot, J., 2012. *Mobilising Investment in Low Carbon, Climate Resilient Infrastructure*.
- 72 Nassiry, D. and Nakhooda, S., 2016. *Finding the pipeline: Project preparation and low-carbon investment*.
- 73 Casado-Asensio, J., A. Drutschinin, J. Corfee-Morlot and G. Campillo, 2016. *Mainstreaming Adaptation in National Development Planning*, OECD Development Co-operation working paper, Paris (2016). Climate Investment Funds, 2014. Learning by Doing: The CIFs Contribution to Climate Finance; and CIFs website: www.climateinvestmentfunds.org (accessed December 2014); Climate Investment Funds, 2012. Pilot Program on Climate Resilience (PPCR) Semi-Annual Operational Report, PPCR/SC.11/3.Rev.1, October 19, 2012 – Meeting of the PPCR Sub-Committee Istanbul, Turkey.
- Nakhooda, S. and Watson, C., 2016. *Adaptation Finance and the Infrastructure Agenda*. ODI Working Paper 437. Available at: <https://www.odi.org/sites/odi.org.uk/files/resource-documents/10489.pdf>.
- 74 This is an initiative funded by the Strategic Climate Fund, one of two Climate Investment Funds.
- 75 Casado-Asensio, J., A. Drutschinin, J. Corfee-Morlot and G. Campillo, 2016. *Mainstreaming Adaptation in National Development Planning*, OECD Development Co-operation working paper, Paris (2016).

⁷⁶ This discussion is based on Bhattacharya, A., Romani, M. and Stern, N., 2012. *Infrastructure for Development: Meeting the Challenge*. Centre for Climate Change Economics and Policy Grantham Research Institute on Climate Change and the Environment. Available at: <http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2014/03/PP-infrastructure-for-development-meeting-the-challenge.pdf>.

For an up to date discussion of these issues in the context of renewable energy and green infrastructure, see also:

Hamilton, K and E. Zindler, 2016. *Finance Guide for Policy-Makers: Renewable Energy, Green Infrastructure*. 2016 Update. Available at: <http://about.bnef.com/white-papers/finance-guide-policy-makers/>

⁷⁷ Bhattacharya, A., Romani, M. and Stern, N., 2012. *Infrastructure for Development: Meeting the Challenge*. Centre for Climate Change Economics and Policy Grantham Research Institute on Climate Change and the Environment. Available at: <http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2014/03/PP-infrastructure-for-development-meeting-the-challenge.pdf>.

⁷⁸ GCEC, 2014. *Better Growth, Better Climate*.

⁷⁹ See White House factsheet: <https://www.whitehouse.gov/the-press-office/2016/06/07/fact-sheet-united-states-and-india-%E2%80%93-moving-forward-together-climate>.

⁸⁰ See: <http://lctpi.wbcsd.org/the-solution>.

⁸¹ Frankfurt School-UNEP Centre/BNEF, 2016. Global Trends in Renewable Energy Investment 2016. Available at: <http://www.fs-unep-centre.org>.

⁸² Bloomberg News, 2016. *China's \$230 Billion Green Bond Thirst to Supercharge Market*. Available at: <http://www.bloomberg.com/news/articles/2016-02-04/china-s-230-billion-green-bond-thirst-to-supercharge-market>.

⁸³ New Development Bank, 2016. BRICS Bank hands \$811m in green energy loans.

New Development Bank, 2016. BRICS Bank to issue \$448 million of yuan green bonds. Available at: [http://ndb.int/BRICS-bank-to-issue-\\$448-million-of-yuan-green-bonds.php](http://ndb.int/BRICS-bank-to-issue-$448-million-of-yuan-green-bonds.php).

⁸⁴ GECE, 2014. *Better Growth, Better Climate*.

⁸⁵ UNEP Inquiry, 2015. *The Financial System We Need: Aligning the Financial System with Sustainable Development. The UNEP Inquiry Report*. UNEP Inquiry into the Design of a Sustainable Financial System. United Nations Environment Programme, Geneva. Available at: <http://unepinquiry.org/publication/inquiry-global-report-the-financial-system-we-need>.

⁸⁶ Carney, M., 2015. *Breaking the Tragedy of the Horizon: Climate Change and Financial Stability*. Speech at Lloyd's of London, 29 September. Available at: <http://www.bankofengland.co.uk/publications/Pages/speeches/2015/844.aspx>.

⁸⁷ IPCC, 2014. *Climate Change 2014: Synthesis Report*. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Core Writing Team, R. K. Pachauri, and L. A. Meyer (eds.). Intergovernmental Panel on Climate Change, Geneva. Available at: <http://www.ipcc.ch/report/ar5/syr/>.

⁸⁸ UNEP Inquiry and 2° Investing Initiative, 2016. *Building a Sustainable Financial System in the European Union. The Five 'R's of Market and Policy Innovation for the Green Transition*. UNEP Inquiry into the Design of a Sustainable Financial System. United Nations Environment Programme, Geneva. Available at: <http://unepinquiry.org/publication/european-union-report/>.

⁸⁹ Ibid.

⁹⁰ See: <http://greenfinance.org.cn/displaynews.php?id=453> (in Chinese).

⁹¹ UNEP Inquiry. 2016. *Green Finance for Developing Countries. Needs, Concerns and Innovations*. UNEP Inquiry into the Design of a Sustainable Financial System. United Nations Environment Programme, Geneva. Available at: <http://unepinquiry.org/publication/green-finance-for-developing-countries/>.

⁹² See: http://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/IFC+Sustainability/Partnerships/Sustainable+Banking+Network/

⁹³ Finansinspektionen, 2015. *Environmental and Sustainability Perspectives in Credit Granting to Companies*. Ref. 15-14755. Stockholm. Available at: <http://fi.se/Folder-EN/Startpage/Supervision/Other-reports/Listan/Environmental-and-sustainability-perspectives-in-credit-granting-to-companies>.

Finansinspektionen, 2016. Climate Changes and Financial Stability. Ref. 15-13096. Stockholm. Available at: <http://www.fi.se/Folder-EN/Startpage/Supervision/Other-reports/Listan/Climate-changes-and-financial-stability>.

- ⁹⁴ UNEP Inquiry and 2° Investing Initiative, 2016. *Building a Sustainable Financial System in the European Union*.
- ⁹⁵ Ibid.
- ⁹⁶ See: <http://www.fsb.org/what-we-do/policy-development/additional-policy-areas/developing-climate-related-financial-disclosures/>. The first report is: TCFD, 2016. *Phase I Report of the Task Force on Climate-Related Financial Disclosures*. Presented to the Financial Stability Board. Available at: <https://www.fsb-tcfd.org/publications/>.
- ⁹⁷ See: http://www.g20.org/English/Dynamic/201602/t20160202_2131.html.
- ⁹⁸ Deutsche Asset and Wealth Management, 2015. *ESG & Corporate Financial Performance: Mapping the Global Landscape*. S11 Special Issue. Confidential report for institutional clients. December.
- ⁹⁹ See: <http://investorsonclimatechange.org/portfolio/global-investor-statement-climate-change/>.
- ¹⁰⁰ For a complete list see: <http://gofossilfree.org/commitments/>.
- ¹⁰¹ See: <http://unepfi.org/pdc/>.
- ¹⁰² Agence France-Presse, 2016. *World's biggest wealth fund excludes 52 coal-related groups*. The Guardian, 15 April. Environment. Available at: <https://www.theguardian.com/environment/2016/apr/15/worlds-biggest-wealth-fund-excludes-52-coal-related-groups>.
- Byrne, B., 2016. *Norway Sovereign Wealth Fund pressures Exxon, Chevron on climate*. ValueWalk, 4 May. Available at: <http://www.valuwalk.com/2016/05/norway-sovereign-wealth-fund/>.
- Doyle, A. and Fouche, G., 2016. *Norway wealth fund turns up climate heat on Exxon and Chevron*. Reuters, 3 May. Available at: <http://www.reuters.com/article/us-exxon-mobil-norway-swf-idUSKCN0XU1BF>.
- ¹⁰³ Mercer, 2015. *Investing in a Time of Climate Change*. Available at: <http://www.mercer.com/content/dam/mercer/attachments/global/investments/mercer-climate-change-report-2015.pdf>.
- ¹⁰⁴ Olson, B. and Friedman, N., 2016. *Exxon, Chevron shareholders narrowly reject climate-change stress tests*. The Wall Street Journal, 25 May. Business. Available at: <http://www.wsj.com/articles/exxon-chevron-shareholders-narrowly-reject-climate-change-stress-tests-1464206192>.
- ¹⁰⁵ See: <https://www.issgovernance.com/proxy-season-preview-u-s-environmental-social-issues>.
- ¹⁰⁶ Byrne, B., 2016. *Norway Sovereign Wealth Fund pressures Exxon, Chevron on climate*.
- ¹⁰⁷ Doyle and Fouche, 2016. *Norway wealth fund turns up climate heat on Exxon and Chevron*.
- ¹⁰⁸ Agence France-Presse, 2016. *World's biggest wealth fund excludes 52 coal-related groups*.
- ¹⁰⁹ See: <https://www.climatebonds.net/market/explaining-green-bonds>.
- ¹¹⁰ Bloomberg News, 2015. *China to Boost \$100 Billion Green Bond Market for Renewables*. 2 November. Available at: <http://www.bloomberg.com/news/articles/2015-11-03/china-to-boost-100-billion-green-bond-market-for-clean-energy>.
- ¹¹¹ Climate Bonds Initiative, 2016. *2015 Green Bond Market Roundup*. London. Available at: <http://www.climatebonds.net/year-2015-green-bonds-final-report>.
- Climate Bonds Initiative, 2016. *Bonds and Climate Change: The State of the Market in 2016*. Report commissioned by HSBC. London. Available at: <https://www.climatebonds.net/resources/publications/bonds-climate-change-2016>.
- ¹¹² Climate Bonds Initiative, 2016. *2015 Green Bond Market Roundup*.
- ¹¹³ New Development Bank, 2016. *BRICS Bank to issue \$448 million of yuan green bonds*. Available at: [http://ndb.int/BRICS-bank-to-issue-\\$448-million-of-yuan-green-bonds.php](http://ndb.int/BRICS-bank-to-issue-$448-million-of-yuan-green-bonds.php).
- ¹¹⁴ Ridley, M., 2016. *Green bonds' growth booms*. HSBC In Brief, 8 February. Available at: <http://www.gbm.hsbc.com/insights/economics/green-bonds-growth-booms>.
- ¹¹⁵ Climate Bonds Initiative, 2016. *Bonds and Climate Change: The State of the Market in 2016*. Climate Bonds Initiative, 2016. *Mid-Year Green Bond Market Roundup*. Available at: <https://www.climatebonds.net/2016/08/climate-bonds-mid-year-green-bond-market-roundup>.

- 116 Buhr, B., 2016. *Green Bonds – 2015 Review*. Societe Generale- Credit Asset Research.
- 117 Climate Bonds Initiative, 2016. *Bonds and Climate Change: The State of the Market in 2016*.
- 118 See: <http://www.climatebonds.net/files/files/CBI%20State%20of%20the%20Market%202016%20A4.pdf>.
- 119 Hamilton, K and E. Zindler, 2016. *Finance Guide for Policy-Makers: Renewable Energy, Green Infrastructure*. 2016 Update. Available at: <http://about.bnef.com/white-papers/finance-guide-policy-makers/>.
- 120 See: <http://www.icmagroup.org/Regulatory-Policy-and-Market-Practice/green-bonds/green-bond-principles/>.
- 121 Climate Bonds Initiative, 2016. *Bonds and Climate Change: The State of the Market in 2016*.
- 122 See: http://www.ceres.org/files/investor-files/statement-of-investor-expectations-for-green-bonds/at_download/file.
- 123 Hamilton, K and E. Zindler, 2016. *Finance Guide for Policy-Makers: Renewable Energy, Green Infrastructure*. 2016 Update. Available at: <http://about.bnef.com/white-papers/finance-guide-policy-makers/>.
- 124 Barclays and MSCI. *Barclays MSCI Green Bond Index*. January 2015. Available at: https://www.msci.com/resources/factsheets/Barclays_MSCI_Green_Bond_Index.pdf.
- 125 This section is based partly on a NCE background paper from the OECD; OECD, 2016. Eklin, K., and Youngman, R., *Green Investment Banks: Innovative Public Financial Institutions Scaling up Private, Low-carbon Investment*. (forthcoming) To be available at: <http://newclimateeconomy.report/2015/misc/working-papers/>.
- 126 Climate Bonds Initiative, 2015. *PBoC Takes Post COP21 Step on Green Bonds. New Definitions, Market Guidance and Disclosure Rules*. 22 December. Available at: <https://climatebonds.net/2015/12/pboc-takes-post-cop21-step-green-bonds-new-definitions-market-guidance-and-disclosure-rules>.
- 127 London Stock Exchange, n.d. *Agricultural Bank of China Green Bond Case Study*. Available at: <http://www.londonstockexchange.com/specialist-issuers/green-bonds/publications/green-bonds-case-study-abc.pdf>.
- 128 Bloomberg News, 2015. *China to boost \$100 billion green bond market for renewables*.
- 129 Bloomberg News, 2016. *China's \$230 billion green bond thirst to supercharge market*.
- 130 UNEP Inquiry. 2016. *Green Finance for Developing Countries*.
- 131 BRPD 2011. *Policy Guidelines for Green Banking*. Available at: <https://www.bb.org.bd/mediaroom/circulars/brpd/feb272011brpd02e.pdf>.
- UNEP Inquiry, 2015. *The Financial System We Need: Aligning the Financial System with Sustainable Development*. The UNEP Inquiry Report. Available at: <http://web.unep.org/inquiry/publications>.
- 132 UK Green Investment Bank, 2015. *Annual Report and Accounts 2014–15*. Available at: http://www.greeninvestmentbank.com/media/44799/gib_annual_report_2015_aw_web.pdf.
- 133 Connecticut Green Bank, 2013. *Connecticut's Green Bank, Energizing Clean Energy Finance*. 2013 Annual Report, Connecticut Clean Energy Finance & Investment Authority. Available at: http://www.ctgreenbank.com/wp-content/uploads/2015/11/CEFIA_AR_2013-final-for-web.pdf.
- 134 UK Green Investment Bank, 2015. *Annual Report and Accounts 2014–15*.
- 135 Clean Energy Finance Corporation, 2015. *Factsheet: CEFCA and the City of Melbourne accelerate sustainability initiatives*. October 2015. Available at: www.cleanenergyfinancecorp.com.au/media/107528/cefcfactsheet_cityofmelb_lr.pdf.
- Clean Energy Finance Corporation, 2015. *Annual Report 2014-2015*. Available at: http://annualreport2015.cleanenergyfinancecorp.com.au/media/1100/cefc-annual_report_2014-15.pdf.
- 136 Connecticut Green Bank, 2015. *Connecticut Green Bank - Investment and Public Benefit Performance from Clean Energy Projects from FY 2012 through FY 2015*. Available at http://www.ctcleanenergy.com/Portals/0/board-materials/3d_CGB_Investment%20and%20Public%20Benefit%20Performance%20Summary_Draft%20Memo_FY%202012-FY%202015_101615.pdf.
- 137 Clean Energy Finance Corporation, 2015. *CEFC has Helped Accelerate \$3.5b in Total Investment Towards a Competitive Clean Energy Economy*. Press Release, Clean Energy Finance Corporation, July 15, 2015. Available at: [http://www.cleanenergyfinancecorp.com.au/media/releases-and-announcements/files/cefc-has-helped-accelerate-\\$35b-in-total-investment-towards-a-competitive-clean-energy-economy.aspx](http://www.cleanenergyfinancecorp.com.au/media/releases-and-announcements/files/cefc-has-helped-accelerate-$35b-in-total-investment-towards-a-competitive-clean-energy-economy.aspx).

¹³⁸ GreenTech Malaysia, 2015. *Malaysian Green Technology Corporation Annual Report 2014*. Available at: <http://oursphere.greentechmalaysia.my/wp-content/uploads/2015/09/MGTC-AR.2014-single-2015.06.08.pdf>.

¹³⁹ See: <http://coalbanks.org/#score>.

¹⁴⁰ Based on Bhattacharya et al., 2016. *Delivering on Sustainable Infrastructure for Better Development and Better Climate*.

OECD, 2016 (forthcoming). *Institutional Investors and Green Infrastructure Investment*. A Policy Brief prepared Contributing Paper to this Report of the Global Commission on the Economy and Climate. It was prepared by Chris Kaminker, Environment Directorate, OECD, and draws on the Reports references above. To be available at: <http://newclimateeconomy.report/2015/misc/working-papers/>.

¹⁴¹ Kaminker, C., Kawanishi, O., Stewart, F., Caldecott, B. and Howarth, N., 2013. *Institutional Investors and Green Infrastructure Investments*. OECD Working Papers on Finance, Insurance and Private Pensions. Organisation for Economic Co-operation and Development, Paris. Available at: <http://www.oecd-ilibrary.org/content/workingpaper/5k3xr8k6jb0n-en>.

¹⁴² Prequin, 2015. *Infrastructure Spotlight*. June. Available at: <https://www.prequin.com/docs/newsletters/inf/prequin-infrastructure-spotlight-june-2015.pdf>.

¹⁴³ Kaminker, C., Kawanishi, O., Stewart, F., Caldecott, B. and Howarth, N., 2013. *Institutional Investors and Green Infrastructure Investments*. OECD Working Papers on Finance, Insurance and Private Pensions. Organisation for Economic Co-operation and Development, Paris. Available at: <http://www.oecd-ilibrary.org/content/workingpaper/5k3xr8k6jb0n-en>.

¹⁴⁴ OECD, 2016. *Progress report on approaches to mobilising institutional investment for green infrastructure*. To be available at: www.oecd.org.

OECD database, which builds on the OECD's Mapping Channels report for the G20 last year and its policy recommendations.

OECD, 2016. *Progress report on investment governance and the integration of ESG factors*. To be available at: www.oecd.org/.

OECD, 2016 (forthcoming). *Institutional Investors and Green Infrastructure Investment*.

¹⁴⁵ Table taken from <http://blogs.worldbank.org/psd/institutional-investment-infrastructure-view-bridge-development-agency>.

¹⁴⁶ UNEP Inquiry, 2016. *Fiduciary Duty in the 21st Century*. UNEP Inquiry into the Design of a Sustainable Financial System. United Nations Environment Programme, Geneva. Available at: http://ec.europa.eu/environment/enveco/resource_efficiency/pdf/FiduciaryDuties.pdf.

¹⁴⁷ Loyalty: fiduciaries should act in good faith in the interests of their beneficiaries, should impartially balance the conflicting interests of different beneficiaries, should avoid conflicts of interest and should not act for the benefit of themselves or a third party. Prudence: Fiduciaries should act with due care, skill and diligence, investing as an 'ordinary prudent person' would do.

¹⁴⁸ UNEP Inquiry, 2016. *Fiduciary Duty in the 21st Century*.

¹⁴⁹ See: <https://www.unpri.org/about>.

¹⁵⁰ See: <https://www.unpri.org/about>.

¹⁵¹ PRI, 2015. *Report on Progress 2015*. Available at: https://www.unpri.org/download_report/13718.

¹⁵² UNEP Inquiry, 2016. *Fiduciary Duty in the 21st Century*.

¹⁵³ Source: based on OECD (forthcoming) report for the Working Party on Private Pensions, and part of OECD's contribution to the Green Finance Study Group of the G20.

¹⁵⁴ Baron, R. and Fischer, D., 2015. *Divestment and Stranded Assets in the Low-carbon Transition*. Available at: <https://www.oecd.org/sd-roundtable/papersandpublications/Divestment%20and%20Stranded%20Assets%20in%20the%20Low-carbon%20Economy%2032nd%20OECD%20RTSD.pdf>.

UNEP Inquiry, 2015. *The Financial System We Need: Aligning the Financial System with Sustainable Development*. The UNEP Inquiry Report. Available at: <http://web.unep.org/inquiry/publications>.

OECD and CDSB, 2015. *Climate Change Disclosure in G20 Countries: Stocktaking of Corporate Reporting Schemes*. Organisation for Economic Co-operation and Development and Climate Disclosure Standards Board, Paris. Available at: <http://www.oecd.org/daf/inv/mne/Report-on-Climate-change-disclosure-in-G20-countries.pdf>

FSB TCFD, 2016. *Phase I Report of the Task Force on Climate-Related Financial Disclosures*. Presented to the Financial Stability Board. March 2016. Available at: <http://www.fsb.org/wp-content/uploads/TCFD-Phase-1-report.pdf>.

¹⁵⁵ FSB TCFD, 2016. *Phase I Report of the Task Force on Climate-Related Financial Disclosures*.

See also: Bank of England, 2015. The impact of climate change on the UK insurance sector. A Climate Change Adaptation Report by the Prudential Regulation Authority. Available at: <http://www.bankofengland.co.uk/pru/Documents/supervision/activities/pradefra0915.pdf>.

¹⁵⁶ Sandra Batten, S., Sowerbutts, R., Tanaka, M., 2016. *Let's talk about the weather: the impact of climate change on central banks*. Bank of England Staff Working Paper No. 63. May.

¹⁵⁷ UNEP Inquiry and 2^o Investing Initiative, 2016. *Building a Sustainable Financial System in the European Union*.

¹⁵⁸ OECD and CDSB, 2015. *Climate Change Disclosure in G20 Countries: Stocktaking of Corporate Reporting Schemes*. Organisation for Economic Co-operation and Development and Climate Disclosure Standards Board, Paris. Available at: <http://www.oecd.org/daf/inv/mne/Report-on-Climate-change-disclosure-in-G20-countries.pdf>.

¹⁵⁹ See, for example, Gelles, D., 2016. *S.E.C. Is Criticized for Lax Enforcement of Climate Risk Disclosure*. The New York Times, 23 January. Available at: <http://www.nytimes.com/2016/01/24/business/energy-environment/sec-is-criticized-for-lax-enforcement-of-climate-risk-disclosure.html>.

¹⁶⁰ See: <https://www.cdp.net>.

¹⁶¹ UNEP Inquiry and 2^o Investing Initiative, 2016. *Building a Sustainable Financial System in the European Union*.

¹⁶² Ibid.

¹⁶³ Carbon Pulse, 5 November 2015. China central bank chief economist proposes mandatory CO₂ reporting for listed companies. Available at: <http://carbon-pulse.com/11487/>.

¹⁶⁴ CDP, 2015. *Corporate Ambition & Action on Climate Change*. CDP policy briefing, based on analysis conducted for the New Climate Economy. New York. Available at: <https://www.cdp.net/Documents/policy/Corporate-ambition-action.pdf>.

¹⁶⁵ CDP, 2015. *Putting a Price on Risk: Carbon Pricing in the Corporate World*. Available at: <https://www.cdp.net/cdpresults/carbon-pricing-in-the-corporate-world.pdf>.

¹⁶⁶ We Mean Business, 2014. *The Climate Has Changed: Why Bold, Low Carbon Action Makes Good Business Sense*. Report prepared by CDP. Available at: <https://www.cdp.net/Documents/we-mean-business-the-climate-has-changed.pdf>.

¹⁶⁷ UNEP Inquiry, 2015. *The Financial System We Need: Aligning the Financial System with Sustainable Development*. The UNEP Inquiry Report. Available at: <http://web.unep.org/inquiry/publications>.

¹⁶⁸ Note that these disclosure statistics hide two important subtleties. First, climate change is not material for all companies and all sectors, so some of the “non-disclosures” may indeed be complying with expectations. Second, actual disclosure varies across countries and disclosure rates are much higher in countries with national requirements. Third, the OECD and Climate Disclosure Standards Board review found that largely due to the complexities and uncertainties involved, existing requirements of the mandatory systems in place do not broadly cover other material aspects of climate-related financial risks such as potential losses due to climate-related extreme weather events.

¹⁶⁹ OECD and CDSB, 2015. *Climate Change Disclosure in G20 Countries: Stocktaking of Corporate Reporting Schemes*. Organisation for Economic Co-operation and Development and Climate Disclosure Standards Board, Paris. Available at <https://www.oecd.org/daf/inv/mne/Report-on-Climate-change-disclosure-in-G20-countries.pdf>.

See also: Mercer LLC, 2015. Investing in a Time of Climate Change. Available at <http://www.mercer.com/our-thinking/investing-in-a-time-of-climate-change.html>.

¹⁷⁰ EBRD, 2016. *Government Assets: Risks and Opportunities in a Changing Climate Policy Landscape*. Prepared by the Climate Policy Initiative. European Bank for Reconstruction and Development, London. Available at: <http://www.ebrd.com/publications/government-assets-climate-policy>.

¹⁷¹ EBRD, 2016. *Government Assets: Risks and Opportunities in a Changing Climate Policy Landscape*.

¹⁷² FSB TCFD, 2016. *Phase I Report of the Task Force on Climate-Related Financial Disclosures*.

See also: <http://www.fsb.org/what-we-do/policy-development/additional-policy-areas/developing-climate-related-financial-disclosures/>.

- 173 FSB TCFD, 2016. *Phase I Report of the Task Force on Climate-Related Financial Disclosures*.
- 174 Miyamoto, K. and Biousse, K., 2014. *Official Support for Private Sector Participation in Developing Country Infrastructure*. OECD Development Co-operation Working Papers, No. 19. Organisation for Economic Co-operation and Development, Paris. Available at: http://www.oecd-ilibrary.org/development/official-support-for-private-sector-participation-in-developing-country-infrastructure_5jz14cd40nf0-en.
- 175 ADB, 2015. *ADF-OCR Merger to Boost Support for Region's Poor*. Asian Development Bank news release, 2 May. Available at: <http://www.adb.org/news/adf-ocr-merger-boost-support-region-s-poor>.
- 176 ADB, 2016. *ADB Backs First Climate Bond in Asia in Landmark \$225 million Philippines Deal*. Asian Development Bank news release, 29 February. Available at: <http://www.adb.org/news/adb-backs-first-climate-bond-asia-landmark-225-million-philippines-deal>.
- 177 Bhattacharya et al., 2016. *Delivering on Sustainable Infrastructure for Better Development and Better Climate*.
- 178 Prizzon, A., Greenhill, R. and Mustapha, S., 2016. *An Age of Choice for Development Finance: Evidence from Country Case Studies*. ODI report, April. Available at: <https://www.odi.org/publications/10390-age-choice-development-finance-evidence-country-case-studies>.
- 179 Prizzon, A., Greenhill, R. and Mustapha, S., 2016. *An Age of Choice for Development Finance: Evidence from Country Case Studies*.
- Davies, R. and Pickering, J., 2015. *Making Development Co-operation Fit for the Future A Survey of Partner Countries*. OECD, Paris. Available at: http://www.oecd-ilibrary.org/development/making-development-co-operation-fit-for-the-future_5js6b25hzv7h-en.
- 180 Crishan Morgado, N., 2016 (forthcoming). *Private sector engagement to address climate change and promote green growth*. OECD Policy Brief.
- 181 Ibid.
- 182 Crishna Morgado, N., 2015. *Development Co-operation and the Environment: Engaging the private sector for green growth and climate change*. OECD – DCED Workshop Report (Summary record). Paris: OECD. See: http://www.oecd.org/dac/environment-development/SUMMARYRECORD_PSE%20workshop_1March.pdf.
- 183 See: <http://www.wri.org/our-work/project/initiative-20x20>.
- 184 See: <http://www.eib.org/projects/priorities/climate-action/road-to-paris/fi-climate-mainstreaming.htm>.
- 185 Bhattacharya et al., 2016. *Delivering on Sustainable Infrastructure for Better Development and Better Climate*. Excludes investments in primary energy production (coal, oil) and investments in energy efficiency.
- 186 Shearer, C., Ghio, N., Myllyvirta, L., Yu, A. and Nace, T., 2016. *Boom and Bust 2016 Tracking the Global Coal Plant Pipeline*. Coalswarm, Sierra Club and Greenpeace. Available at: <http://www.greenpeace.org/eastasia/publications/reports/climate-energy/2016/Boom-and-Bust-2016/>.
- 187 Nelson, D., et al., 2014. *Moving to a Low Carbon Economy: The Impact of Different Policy Pathways on Fossil Fuel Asset Values*. Climate Policy Initiative. Available at: <http://climatepolicyinitiative.org/publication/moving-to-a-low-carbon-economy/>.
- 188 GCEC, 2014. *Better Growth, Better Climate*.
- 189 IPCC, 2014. *Climate Change 2014: Synthesis Report and SystemIQ*. This corresponds to 260 billion tonnes (Gt) of CO₂ emissions over their lifetimes, which in turn is over a quarter of the global carbon budget as estimated by IPCC to be consistent with a two-thirds chance of meeting the goal of limiting global mean temperature change to 2°C.
- 190 See: www.iea.org/etp2015
- 191 See Chapter 4 in *Better Growth, Better Climate*. GCEC, 2014. Based on IEA, 2013. *Energy Efficiency Market Report 2013 – Market Trends and Medium Term Prospects*. International Energy Agency, Paris. Available at: https://www.iea.org/publications/freepublications/publication/EEMR2013_free.pdf.
- 192 IEA, 2015. *Special Report on Energy and Climate Change*. Available at: <http://www.iea.org/publications/freepublications/publication/world-energy-outlook-special-report-2015-energy-and-climate-change.html>.

¹⁹³ Bishop, R., 2015. *Raising Energy Efficiency Standards to the Global Best*. Contributing paper for Global Commission on the Economy and Climate Synthesis Report 2015, Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate. Available at: <http://newclimateeconomy.report/misc/working-papers/>.

IEA, 2014. *Capturing the Multiple Benefits of Energy Efficiency*. International Energy Agency, Paris. Available at: http://www.iea.org/bookshop/475-Capturing_the_Multiple_Benefits_of_Energy_Efficiency.

¹⁹⁴ IEA, 2014. *Capturing the Multiple Benefits of Energy Efficiency*.

¹⁹⁵ Kennedy and Corfee-Morlot, 2012 & 2013: Kennedy, C.A., & Corfee-Morlot, J. (2012) *Mobilising Investment in Low-Carbon, Climate-Resilient Infrastructure*. OECD Environment working paper 46; Kennedy, C.A., & Corfee-Morlot, J. (2013) *Past Performance and Future Needs for Low-Carbon, Climate-Resilient Infrastructure – An Investment Perspective*, Energy Policy, 59, 773-783.

¹⁹⁶ Association of American Railroads, 2015. *Railroads and Coal*. Available at: <https://www.aar.org/BackgroundPapers/Railroads%20and%20Coal.pdf>

¹⁹⁷ Zukerman, J. et al., NCE Working paper, 2015. See also:

CERES 2014. *Investing in the Clean Trillion: Closing the Clean Energy Investment Gap*.

CERES – BNEF 2016. *Mapping the Gap – The Road from Paris*. Available at: <http://www.ceres.org/resources/reports>.

¹⁹⁸ Sierra Club and Oil Change International, 2016. *Still Failing to Solve Energy Poverty: Internatinoal Public Finance for Distributed Clean Energy Access Gets Another “F”*. Available at: https://www.sierraclub.org/sites/www.sierraclub.org/files/uploads-wysiwig/1281%20Energy%20Scorecard_06_web.pdf.

¹⁹⁹ See: <http://www.se4all.org>.

²⁰⁰ CERES and Bloomberg New Energy Finance, 2016. *Mapping the Gap: The Road from Paris*. Available at: <http://www.ceres.org/resources/reports>.

²⁰¹ See: <http://pacenation.us/what-is-pace/>.

²⁰² See: <http://www.newjerseypace.org/wp-content/uploads/2014/09/NJPACE-Opportunity.pdf>.

²⁰³ See: <http://www.eeslindia.org/writereaddata/EESL%20Annual%20Report%202014-15.pdf>.

²⁰⁴ Co-chaired by France and Mexico, the G20 Energy Efficiency Finance Task Group gathers 14 countries in the aim to enhance capital flows for energy efficiency investments. In 2015, it developed Energy Efficiency Investment Principles, a policy framework to catalyse private investment in energy efficiency which was welcomed by all G20 energy ministers. The Principles focus on increasing the importance of energy efficiency in energy planning, unlocking specific market barriers for the supply and demand on energy efficiency finance, and building capacity of financial institutions. In parallel, the task group coordinates a global mobilization of the financial sector led by UNEP FI and its partners with over 110 banks and investors managing close to US\$4 trillion of assets having committed to further integrate energy efficiency financing in their operations through two Energy Efficiency Statements.

See: <http://www.unepfi.org/fileadmin/energyefficiency/EnergyEfficiencyInvestmentPrinciples.pdf> and <http://www.unepfi.org/fileadmin/documents/EnergyEfficiencyFinanceStatement.pdf>.

²⁰⁵ OECD, 2016. *Population Exposure to Fine Particles: Methodology and Results for OECD and G20 Countries*, by Alexander Mackie, Ivan Haš and Miguel Cárdenas Rodríguez; ENV/EPOC/WPEI(2015)5/FINAL.

OECD, 2014. *The Cost of Air Pollution: Health Impacts of Road Transport*, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264210448-en>.

²⁰⁶ World Health Organization (WHO), 2014. *Burden of Disease from Ambient Air Pollution for 2012*. Geneva. Available at: <http://www.who.int/mediacentre/news/releases/2014/air-pollution/en/>.

²⁰⁷ Ibid.

²⁰⁸ Yuhas, A., 2016. *Scientists: air pollution led to more than 5.5 million premature deaths in 2013*. The Guardian, 12 February. Environment. Available at: <https://www.theguardian.com/environment/2016/feb/12/air-pollution-deaths-india-china>.

²⁰⁹ Chatterjee, P., 2015. *Leave Delhi: That's what doctors are prescribing to patients with serious respiratory ailments*. The Indian Express, 2 April. Available at: <http://indianexpress.com/article/india/india-others/leave-delhi/>.

- ²¹⁰ Health and Environment Alliance, 2013. *The Unpaid Health Bill: How Coal Plants Make Us Sick*. Available at: http://www.env-health.org/IMG/pdf/heal_report_the_unpaid_health_bill_how_coal_power_plants_make_us_sick_final.pdf.
- ²¹¹ Analysis for GCEC, 2014. *Better Growth, Better Climate* showed that non-market costs, based on the value of a statistical life, can be up to 4.4% of GDP in the 15 largest economies.
- See also: OECD, 2016. *The Economic Consequences of Outdoor Air Pollution*, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264257474-en>.
- ²¹² OECD, 2016. *The Economic Consequences of Outdoor Air Pollution*, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264257474-en>.
- ²¹³ These estimates are calculated using estimates of the individual willingness-to pay to reduce the risk of premature death and on results from studies valuing the willingness-to-pay to reduce health risks respectively.
- ²¹⁴ IRENA. 2016. *The True Cost of Fossil Fuels: Saving on the Externalities of Air Pollution and Climate Change*. International Renewable Energy Agency. Available at: http://www.irena.org/DocumentDownloads/Publications/IRENA_REmap_externality_brief_2016.pdf.
- ²¹⁵ International Monetary Fund (IMF), 2015. *IMF Survey : Counting the Cost of Energy Subsidies*. Available at: <https://www.imf.org/external/pubs/ft/survey/so/2015/NEW070215A.htm>.
- ²¹⁶ GCEC, 2014. *Better Growth, Better Climate*, Chapter 6.
- ²¹⁷ There are a number of uncertainties in these numbers, including the relationship between pollution concentrations and health impacts, as well as the appropriate methodology and values used to monetise mortality and damage.
- ²¹⁸ IEA, 2015. *Energy Subsidies*. World Energy Outlook Resources. Available at: <http://www.worldenergyoutlook.org/resources/energysubsidies/>.
- ²¹⁹ OECD, 2015. *Tracking Progress in reforming support for fossil fuels*. OECD Companion to the Inventory of Support Measures for Fossil Fuels 2015. OECD Publishing, Paris. Available at: <http://dx.doi.org/10.1787/9789264239616-6-en>.
- Note: The OECD Inventory covers a broader range of measures than the IEA estimates, including many that do not reduce consumer prices below world levels. The Inventory uses a broad concept of support that encompasses direct budgetary transfers and tax expenditures that provide a benefit or preference for fossil-fuel production or consumption, either in absolute terms or relative to other activities or products. Both sets of estimates provide useful and complementary information.
- ²²⁰ Coady, D., Parry, I., Sears, L. and Shang, B., 2015. *How Large are Global Energy Subsidies?* IMF Working Paper, WP/15/105. International Monetary Fund, Washington, DC. Available at: <http://www.imf.org/external/pubs/ft/wp/2015/wp15105.pdf>.
- ²²¹ See the G7 Ise-Shima Leaders' Declaration after the Ise-Shima Summit on 26–27 May 2016, p.28: "Given the fact that energy production and use account for around two-thirds of global GHG emissions, we recognize the crucial role that the energy sector has to play in combatting climate change. We remain committed to the elimination of inefficient fossil fuel subsidies and encourage all countries to do so by 2025." See: <http://www.mofa.go.jp/files/000160266.pdf>.
- ²²² *OECD Companion to the Inventory of Support Measures for Fossil Fuels*. 2015. Available at: http://www.oecd-ilibrary.org/energy/oecd-companion-to-the-inventory-of-support-measures-for-fossil-fuels-2015_9789264239616-en
- ²²³ See: <https://ec.europa.eu/energy/sites/ener/files/documents/Beijing%20Communique.pdf>.
- ²²⁴ IMF, 2010. *The Unequal Benefits of Fuel Subsidies: A Review of Evidence for Developing Countries*. Arze del Granado, J., Coady, D., and Gillingham, R. Available at: <https://www.imf.org/external/pubs/ft/wp/2010/wp10202.pdf>.
- See also: ODI, 2015. *Time to change the game: Fossil fuel subsidies and climate*. Whitley, S. Available at: <https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/8668.pdf>.
- ²²⁵ IMF, 2015. *The Unequal Benefits of Fuel Subsidies Revisited: Evidence for Developing Countries*. Coady, D., Flamini, V., and Sears, L. Available at: <https://www.imf.org/external/pubs/ft/wp/2015/wp15250.pdf>.
- ²²⁶ OECD, 2015. *Statistical tables on official export credit support for transactions related to electric power generation (2003–2013)*. TAD/ECG(2015)10/FINAL. Organisation for Economic Co-operation and Development, Paris. Available at: <http://www.oecd.org/trade/xcred/electric-power-generation.htm>.

- 227 Rydge, J., 2015. *Implementing Effective Carbon Pricing. Contributing paper for Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate*. New Climate Economy, London and Washington, DC. Available at: <http://newclimateeconomy.report/misc/working-papers/>.
- 228 See: <http://www.oecd.org/tad/xcred/arrangement.htm>
- 229 Van der Burg, L. and S. Whitley, 2016. *How you can stop the UK giving millions to dirty power?* Blog, 17 May. Overseas Development Institute, London. Available at: <https://www.odi.org/comment/10392-how-you-can-stop-uk-giving-millions-dirty-power>.
- 230 Lontoh, L. Beaton, C. and Whitley, S. 2015. *G20 Subsidies to Oil, Gas and Coal Production: Indonesia*. Overseas Development Institute, London. Available at: <https://www.odi.org/publications/10075-g20-subsidies-oil-gas-coal-production-indonesia>
- 231 Touchette, Y. and Whitley, S. 2015. *G20 Subsidies to Oil, Gas and Coal Production: Canada*. Overseas Development Institute, London. Available at: <https://www.odi.org/publications/10091-G20-subsidies-oil-gas-coal-production-Canada>
- 232 Whitley, S. and van der Burg, L. 2015. *Fossil Fuel Subsidy Reform: From Rhetoric to Reality*. New Climate Economy, Washington, DC. Available at: http://2015.newclimateeconomy.report/wp-content/uploads/2015/11/Fossil-fuel-subsidy-reform_from-rhetoric-to-reality.pdf.
- 233 The Times of India. 2016. *Govt Doubles Clean Energy Cess on Coal to Rs 400 per tonne*. Mumbai. Available at: <http://timesofindia.indiatimes.com/budget-2016/industry/Union-Budget-2016-Govt-doubles-Clean-Energy-Cess-on-coal-to-Rs-400-per-tonne/articleshow/51191619.cms>
- 234 van der Burg, L. and Pickard, S., 2015. *G20 Subsidies to Oil, Gas and Coal Production: Germany*. Overseas Development Institute, London. Available at: <https://www.odi.org/publications/10072-g20-subsidies-oil-gas-coal-production-germany>
- 235 Ogarenko, I. Bossong, K. Gerasimchuk, I, Pickard, S. and Whitley, S. 2015. *G20 Subsidies to Oil, Gas and Coal Production: Russia*. Overseas Development Institute, London. Available at: <https://www.odi.org/publications/10078-g20-subsidies-oil-gas-coal-production-russia>
- 236 Kerr, S. 2015. *Saudis Face Fuel Price Jump Under New Austerity Plan*. Financial Times, London. Available at: <http://www.ft.com/cms/s/0/fbbc4b56-af00-11e5-993b-c425a3d2b65a.html?siteedition=intl#axzz4EtN7Tcuo>
- 237 Whitley, S. and van der Burg, L. *Fossil Fuel Subsidy Reform: From Rhetoric to Reality*.
- 238 Lewis, J. 2015. *Brazil Announces Tax Increases for 2015*. The Wall Street Journal, New York City. Available at: <http://www.wsj.com/articles/brazil-announces-tax-increases-for-2015-1421707755>
- 239 Doukas, A. and Whitley, S. 2015. *G20 Subsidies to Oil, Gas and Coal Production: United States*. Overseas Development Institute, London. Available at: <https://www.odi.org/publications/10086-g20-subsidies-oil-gas-coal-production-united-states>.
- 240 Kitson, L. and Whitley, S. 2015. *G20 Subsidies to Oil, Gas and Coal Production: France*. Overseas Development Institute, London. Available at: <https://www.odi.org/publications/10093-G20-subsidies-oil-gas-coal-production-France>
- 241 Rydge, 2015. *Implementing Effective Carbon Pricing*.
- 242 World Bank Group and Ecofys, 2016. *Carbon Pricing Watch 2016. Advance brief from the State and Trends of Carbon Pricing 2016 report*. Washington, DC. Available at: <https://openknowledge.worldbank.org/handle/10986/24288>.
- 243 Felix, B., 2016. *France leads by example with carbon price floor*. Reuters, 17 May. Available at: <http://www.reuters.com/article/france-carbon-idUSL5N18E1Y6>.
- 244 Platts, 2013. *France adopts 2014 budget; carbon tax on fossil fuels*. Available at: <http://www.platts.com/latest-news/electric-power/london/france-adopts-2014-budget-carbon-tax-on-fossil-26563408>. The tax applied only to household heating fuels at first; it was extended to cover transport fuels in 2015, with an exemption for businesses covered by the EU ETS.
- 245 Wingrove, J., 2016. *Canada to introduce national carbon price in 2016, minister says*. Bloomberg News, 15 July. Available at: <http://www.bloomberg.com/news/articles/2016-07-15/canada-to-introduce-national-carbon-price-in-2016-minister-says>.
- 246 See: <https://www.ontario.ca/page/cap-and-trade-program-overview>.
- 247 World Bank Group and Ecofys, 2016. *Carbon Pricing Watch 2016*.

- ²⁴⁸ The sample consisted of 146 IETA member representatives. See: IETA, 2016. IETA GHG Market Sentiment Survey 2016. 11th Edition. International Emissions Trading Association. Available at: http://www.ieta.org/resources/Resources/GHG_Market_Sentiment_Survey/IETA%20GHG%20Sentiment%20Survey%202016.pdf.
- ²⁴⁹ See: <http://www.carbonpricingleadership.org>.
- ²⁵⁰ Members of the Carbon Pricing Panel include German Chancellor Angela Merkel, Chilean President Michelle Bachelet, French President François Hollande, Ethiopian Prime Minister Hailemariam Desalegn, Philippines President Benigno Aquino III, Mexican President Enrique Peña Nieto, Canadian Prime Minister Justin Trudeau, Governor Jerry Brown of California, and Mayor Eduardo Paes of Rio de Janeiro.
- ²⁵¹ Parry, I.W.H., Heine, D., Lis, E. and Li, S., 2014. *Getting Energy Prices Right: From Principle to Practice*. International Monetary Fund, Washington DC. Available at: <http://www.imf.org/external/pubs/cat/longres.aspx?sk=41345.0>.
- ²⁵² Rodi, M., Schlegelmilch, K. and Mehling, M., 2012. *Designing environmental taxes in countries in transition: a case study of Vietnam*. In: *Handbook of Research on Environmental Taxation*, J.E. Milne and M.S. Anderson (eds.). Edward Elgar Publishing Limited, Cheltenham, UK. Chapter 7, 122–138.
- ²⁵³ OECD, 2013. *Taxing Energy Use: A Graphical Analysis*. Available at: http://www.oecd-ilibrary.org/taxation/taxing-energy-use_9789264183933-en. (Note: an updated was released on 25 June 2015.)
- ²⁵⁴ OECD, 2013. *Effective Carbon Prices*. Available at: <http://www.oecd-ilibrary.org/>
- ²⁵⁵ OECD, 2015. *Policy Framework for Investment*. Updated edition. Organisation for Economic Co-operation and Development, Paris. Available at: <http://dx.doi.org/10.1787/9789264208667-en>.
- ²⁵⁶ OECD. 2015. *Policy Guidance for Investment in Clean Energy Infrastructure: Expanding Access to Clean Energy for Green Growth and Development*. Organisation for Economic Co-operation and Development, Paris. Available at: <http://dx.doi.org/10.1787/9789264212664-en>.
- ²⁵⁷ OECD 2012. *OECD Investment Policy Reviews: Colombia 2012*. Organisation for Economic Co-operation and Development, Paris. Available at: <http://dx.doi.org/10.1787/9789264167742-en>.
- ²⁵⁸ Ang et al. 2016 (forthcoming). *Jordan Clean Energy Investment Policy Review*. OECD Publishing, Paris.
- ²⁵⁹ The Arab Future Energy Index (AFEX) is a policy assessment and benchmark tool developed by Regional Center for Renewable Energy and Energy Efficiency (RCREEE) that provides a detailed comparison of renewable energy and energy efficiency development in 17 countries of the Arab region on more than 30 different indicators. See: <http://www.rcreee.org/projects/arab-future-energy-index%E2%84%A2-afex>.
- ²⁶⁰ Nassiry, D., Barnard, S. and Nakhoda, S., 2016. *Finding the pipeline: Project preparation and low-carbon investment*.
- ²⁶¹ Sinha, A., 2016. Union Budget 2016-17: Coal cess doubled to fund ministries, green drives. The Indian Express, 2 March. Available at: <http://indianexpress.com/article/india/india-news-india/union-budget-2016-17-coal-cess-doubled-to-fund-ministries-green-drives/>.
- ²⁶² Whitley S. and van der Burg, L., 2015. *Fossil Fuel Subsidy Reform in Sub-Saharan Africa: From Rhetoric to Reality*. New Climate Economy, London and Washington, DC. Available at: <http://newclimateeconomy.report/misc/working-papers>.
- ²⁶³ OECD, 2014. *Going Green: Best Practices for Green Procurement – Italy Integrated Energy Management Services*. Organisation for Economic Co-operation and Development, Paris. Available at: <http://www.oecd.org/gov/ethics/gpp-procurement-Italy-IEMS.pdf>.
- ²⁶⁴ Eberhard, A., Kolker, J. and Leigland, J., 2014. *South Africa's Renewable Energy IPP Procurement Program: Success Factors and Lessons*. Public-Private Infrastructure Advisory Facility, The World Bank, Washington, DC. Available at: <https://ppp.worldbank.org/public-private-partnership/library/south-africas-renewable-energy-ipp-procurement-program-success-factors-and-lessons..>
- ²⁶⁵ See: <http://www.oecd.org/dac/environment-development/afd-idb-oecdworkshoplocalfinancialinstitutionslfsandgreenfinance3november2015.htm>.
- ²⁶⁶ IEA, 2014. *Energy Efficiency Market Report 2014 – Market Trends and Medium-Term Prospects*. International Energy Agency, Paris. Available at: <http://www.iea.org/publications/freepublications/publication/energy-efficiency-market-report-2014.html>.

- 267 European Energy Efficiency Fund, 2015. *Advancing Sustainable Energy for Europe*. Annual Report 2015. Available at: http://www.eeef.lu/tl_files/downloads/Annual_Reports/EEEEF_Annual_Report_2015.pdf
- 268 OECD, 2015. *Green Investment Banks. Leveraging innovative public finance to scale up low-carbon investment*. OECD Policy Perspectives. December 2015. Available at: <https://www.oecd.org/environment/cc/Green-Investment-Banks-POLICY-PERSPECTIVES-web.pdf>
- 269 Smallridge, S., et al., 2013. *The Role of National Development Banks in Catalyzing International Climate Finance*. Inter-American Development Bank. Available at: <https://publications.iadb.org/handle/11319/3478?locale-attribute=en>.
- 270 Bhattacharya et al., 2016. *Delivering on Sustainable Infrastructure for Better Development and Better Climate*. Meltzer, J. 2016. *Financing Low Carbon, Climate Resilient Infrastructure: The Role of Climate Finance and Green Finance*. Brookings.
- 271 Energy efficiency sustainability premium is based on the percentage of construction costs that is required to attain a LEED platinum certification: 4.5–8.5%, according to a study by KEMA. Available at: <http://www.calrecycle.ca.gov/greenbuilding/design/ManagingCost.pdf>.
- 272 Bhattacharya et al., 2016. *Delivering on Sustainable Infrastructure for Better Development and Better Climate*.
- 273 Wang, X., Stern, R., Limaye, D., Mostert, W. and Zhang, Y., 2013. Case study: Commercializing Energy Efficiency Finance (CEEF). In *Unlocking Commercial Financing for Clean Energy in East Asia*. The World Bank. 243–250. Available at: http://elibrary.worldbank.org/doi/abs/10.1596/9781464800207_Ch18.
- 274 IFC [n.d.]. China Utility-Based Energy Efficiency Finance Program (CHUEE). Available at: http://www.ifc.org/wps/wcm/connect/regprojects_ext_content/ifc_external_corporate_site/home_chuee/home.
- 275 EBRD Sustainable Energy Initiative. Available at: <http://www.ebrd.com/what-we-do/sectors-and-topics/sustainable-resources/seffs.html>.
- 276 <http://www.greenclimate.fund/-/green-climate-fund-approves-first-8-investmen-1>
- 277 GCF, 2015. *Consideration of funding proposals – Addendum Funding Proposal Summary for FP005*. Available at: https://www.greenclimate.fund/documents/20182/87610/GCF_B.11_04_ADD.05_REV.01_-_Funding_proposal_package_for_FP005.pdf/42195872-c071-4e14-9772-f10da01133bf?version=1.1
- 278 This box is based on information provided by EBRD.
- 279 See the DAC Prize 2015 booklet, <http://www.oecd.org/dac/DAC%20prize%20booklet.pdf>, and the Fenix International website: <http://www.fenixintl.com/products/> and <http://www.fenixintl.com/uganda/>.
- 280 See: <http://www.vulcan.com/areas-of-practice/philanthropy/key-initiatives/impact-investing>.
- 281 Africa Progress Panel, 2015. *Power, People, Planet: Seizing Africa's Energy and Climate Opportunities*. Available at: http://www.africaprogresspanel.org/wp-content/uploads/2015/06/APP_REPORT_2015_FINAL_low1.pdf.
- See also: <http://solar.m-kopa.com/about/company-overview/>
- 282 See: <http://www.plugintheworld.com/mobisol/>
- 283 The Climate Group, 2015. *The Business Case for off-Grid Energy in India*. Published in partnership with Goldman Sachs. Available at: http://www.theclimategroup.org/_assets/files/The-business-case-for-offgrid-energy-in-India.pdf.
- 284 Banque Du Liban, BDL Environmental Loans. Financing Unit. Available at: www.ali.org.lb.
- 285 See: <http://www.financeforresilience.com/priority/the-clean-energy-investment-accelerator/>.
- 286 Bielenberg, A., Kerlin, M., Oppenheim, J., and Roberts, M., 2016. *Financing change: How to mobilize private sector financing for sustainable infrastructure*. McKinsey Center for Business and Environment. Available at: <http://www.globalinfrastructureinitiative.com/article/financing-change-how-mobilize-private-sector-financing-sustainable-infrastructure>.
- 287 Waissbein, O., Glemarec, Y., Bayraktar, H., & Schmidt, T.S., (2013). *Derisking Renewable Energy Investment. A Framework to Support Policymakers in Selecting Public Instruments to Promote Renewable Energy Investment in Developing Countries*. New York, NY: United Nations Development Programme http://www.undp.org/content/undp/en/home/librarypage/environment-energy/low_emission_climateresilientdevelopment/derisking-renewable-energy-investment.html

- 288 UNDP, 2015. *Derisking Renewable Energy Investment*. Available at:
http://www.undp.org/content/undp/en/home/librarypage/environment-energy/low_emission_climateresilientdevelopment/derisking-renewable-energy-investment.html
- 289 See: <https://www.wundercapital.com>
- Business Wire, 2015. *Wunder Capital Launches Wunder Bridge Fund to Help Investors Tap Into Booming Solar Market*. Available at: <http://www.businesswire.com/news/home/20151116006021/en/Wunder-Capital-Launches-Wunder-Bridge-Fund-Investors>.
- 290 Climate Bonds Initiative, 2016. *Bonds and Climate Change: The State of the Market 2016*. Commissioned by HSBC. London. Available at: <https://www.climatebonds.net/resources/publications/bonds-climate-change-2016>.
- 291 Ibid.
- 292 See also: OECD, 2015. *Green Bonds: Mobilising the Debt Capital Markets for a Low-Carbon Transition*. Policy Perspectives, published with Bloomberg Philanthropies. Organisation for Economic Co-operation and Development, Paris. Available at: [https://www.oecd.org/environment/cc/Green%20bonds%20PP%20\[f3\]%20\[Ir\].pdf](https://www.oecd.org/environment/cc/Green%20bonds%20PP%20[f3]%20[Ir].pdf).
- 293 Climate Bonds Initiative, 2015. *Bonds and Climate Change: The State of the Market in 2015*. Commissioned by HSBC. London. Available at: <http://www.climatebonds.net/resources/publications/bonds-climate-change-2015>.
- 294 Wu, Y., 2016. BRICS New Development Bank to issue first yuan-denominated bonds. *China Daily*, 1 June. Available at: http://www.chinadaily.com.cn/business/2016-06/01/content_25564215.htm.
- 295 The Climate Bonds Initiative lists a 10-point green bond agenda for the public sector. See: Climate Bonds Initiative, 2015. *Bonds and Climate Change*.
- 296 Climate Bonds Initiative, 2015. *2015 Green Bond Market Update*. Briefing for COP21. London. Available at: <http://www.climatebonds.net/resources/publications/2015-green-bonds-market-update>.
- 297 Some examples of Yieldcos include NextEra Energy Partners, NRG Yield, Brookfield Renewable Energy Partners, TransAlta Renewables, Pattern Energy Group, Abengoa Yield PLC, Hannon Armstrong Sustainable Infrastructure, TerraForm Power, and TerraForm Global.
- 298 Zuckerman, J., et al. *Investing at Least a Trillion Dollars a Year in Clean Energy*. A Contributing Paper for *Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate*. Available at: <http://2015.newclimateeconomy.report/wpcontent/uploads/2015/12/NCE-restoring-protecting-ag-forest-landscapes-increase-ag.pdf>.
- 299 Eis, J., Bishop, R. and Gradwell, P. *Galvanising Low-Carbon Innovation*. A Contributing Paper for *Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate*. Available at: <http://newclimateeconomy.report/2015/workingpaper/galvanising-low-carbon-innovation>.
- 300 IEA, 2015. *Key Trends in IEA Public Energy Technology Research, Development and Demonstration (RD&D) Budgets*. Fact sheet. International Energy Agency, Paris. Available at: http://wds.iea.org/wds/pdf/IEA_RDD_Factsheet_2015.pdf.
- 301 GCEC, 2014. *Better Growth, Better Climate*.
- 302 Andonova, L. B., 2010. Public-private partnerships for the Earth: politics and patterns of hybrid authority in the multilateral system. *Global Environmental Politics*, 10(2). 25–53. DOI:10.1162/glep.2010.10.2.25.
- 303 IEA. 2016. *Technology Collaboration Programmes: Highlights and Outcomes*, Paris. <https://www.iea.org/publications/freepublications/publication/TechnologyCollaborationProgrammes.pdf>
- 304 Figueroa, A. 2010. *Governance of International Co-Operation of Science, Technology and Innovation for Global Challenges*. OECD Report DSTI/STP(2010)30.
- 305 Haš, I., Johnstone, N., and Kahrobaie, N., 2012. *International Technology Agreements for Climate Change: Analysis Based on Co-Invention Data*. OECD Environment Working Papers, No. 42. Organisation for Economic Co-operation and Development, Paris. Available at: <http://dx.doi.org/10.1787/5k9fgpw5tt9s-en>.
- 306 <http://mission-innovation.net/joint-statement/>
- 307 <http://energy.gov/eere/about-us/asia-pacific-partnerships-and-projects>

- 308 See White House factsheet: <https://www.whitehouse.gov/the-press-office/2016/06/07/fact-sheet-united-states-and-india-%E2%80%93-moving-forward-together-climate>.
- 309 See discussion Section 4.2 for more information on M-KOPA and Mobisol. For more information on Solar Now and Greenlight Plant, see: www.solarnow.eu/ and www.greenlightplanet.com/
- 310 Global Commission on the Economy and Climate, 2015. *Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate*. The 2015 New Climate Economy Report. Washington, DC, and London. Available at: <http://newclimateeconomy.report>.
- 311 Ibid.
- 312 See: <http://www.ge.com/about-us/ecomagination> and:
- Haldemann, A., 2015. *GE's Ecomagination turns 10: How a brand can be a driver for change*. The Huffington Post, 16 September. Available at: http://www.huffingtonpost.com/dr-alexander-haldemann/startup-slideshow-test_b_7181672.html.
- 313 Cities Climate Finance Leadership Alliance, 2015. *The State of City Climate Finance 2015*. Available at: <https://sustainabledevelopment.un.org/content/documents/2201CCFLA-State-of-City-Climate-Finance-2015.pdf>
- UN Department of Economic and Social Affairs, Population Division, 2014. *World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352)*. Available at: <https://esa.un.org/unpd/wup/Publications/Files/WUP2014-Highlights.pdf>.
- 314 Erickson, P. and Tempest, K., 2015. *Keeping Cities Green: Avoiding Carbon Lock-in due to Urban Development*. SEI Working Paper No. 2015-11. Stockholm Environment Institute, Seattle, WA, US. Available at: <http://www.sei-international.org/publications?pid=2829>. A paper prepared for the C40 Cities Climate Leadership Group.
- 315 GCEC, 2014. *Better Growth, Better Climate*.
- 316 GCEC, 2015. *Seizing the Global Opportunity*.
- 317 Litman, T., 2015. *Analysis of Public Policies That Unintentionally Encourage and Subsidize Urban Sprawl*. Working Paper for Global Commission on the Economy and Climate, 2014. *Better Growth, Better Climate*.
- 318 Revi, A., et al., 2014. *Urban areas*. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects*. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 535-612.
- 319 Delta Cities, 2016. *Climate Change Adaptation in Delta Cities*. Available at: http://www.deltacities.com/documents/5_C40_GPG_CDC.original.pdf.
- 320 CCFLA, 2015. *State of City Climate Finance 2015*. Cities Climate Finance Leadership Alliance. New York.
- Maier, T. and Jordan-Tank, M., 2014. *Accelerating Infrastructure Delivery New Evidence from International Financial Institutions*. World Economic Forum (WEF). Available at: http://www3.weforum.org/docs/WEF_AcceleratingInfrastructureDelivery_2014.pdf.
- Bhattacharya et al., 2016. *Delivering on Sustainable Infrastructure for Better Development and Better Climate*.
- 321 United Nations Environment Programme (UNEP). *Cities and Coastal Areas*. Available at: http://www.unep.org/urban_environment/issues/coastal_zones.asp. (Accessed on 14th April.)
- 322 Hughs, G., Chinowsky, P. and Strzepek, K., 2010. *Development and climate change: The costs of adapting to climate change for infrastructure*. The World Bank. Available at: http://siteresources.worldbank.org/EXTCC/Resources/407863-1229101582229/DCCDP_2Infrastructure.pdf.
- 323 CCFLA, 2015. *State of City Climate Finance 2015*.
- 324 Harding, M. 2014. *Personal Tax Treatment of Company Cars and Commuting Expenses: Estimating the Fiscal and Environmental Costs*. OECD Taxation Working Papers, No. 20, OECD Publishing. Available at: <http://dx.doi.org/10.1787/5jz14cg1s7vl-en>.
- 325 Zhao, X., et al., 2015. *Unlocking the power of urban transit systems for better growth and a better climate*. Technical note. New Climate Economy, London and Washington, DC. Available at: <http://newclimateeconomy.report/misc/working-papers/>.
- Whitley, S. and van der Burg, L., 2015. *Fossil Fuel Subsidy Reform: From Rhetoric to Reality*.

- 326 Molloy, R. and Shan, H., 2012. The effect of gasoline prices on household location. *Review of Economics and Statistics*, 95(4). 1212–1221. DOI:10.1162/REST_a_00331.
- 327 People's Daily, 2016. *Beijing Daily: motor vehicle pollution in the local maximum contribution to PM_{2.5}* (in Chinese). 9 January. Available at: <http://politics.people.com.cn/n1/2016/0109/c1001-28032372.html>.
- 328 Wang, W., Primbs, T., Shu, T., Staci, L. and Simonich, M., 2009. *Atmospheric particulate matter pollution during the 2008 Beijing Olympics*. *Environmental Science and Technology*, 43(14). 5314–5320.
- 329 Harding, M., 2014, *The Diesel Differential: Differences in the Tax Treatment of Gasoline and Diesel for Road Use*. OECD Taxation Working Papers, No. 21, Organisation for Economic Co-operation and Development, Paris. Available at: <http://dx.doi.org/10.1787/5jz14cd7hk6b-en>
- 330 For an examination of the health and economic consequences of air pollution and pathways from the transport sector see recent OECD work:
- OCED, 2014. *The Cost of Air Pollution: Health Impacts of Road Transport*, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264210448-en>
- OECD, 2016. *Population Exposure to Fine Particles: Methodology and Results for OECD and G20 Countries*, by Alexander Mackie, Ivan Haš and Miguel Cárdenas Rodríguez
- OECD, 2016. *The Economic Consequences of Outdoor Air Pollution*, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264257474-en>
- 331 OECD, 2014. *The Cost of Air Pollution: Health Impacts of Road Transport*, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264210448-en>
- 332 Soffiatti, R.V.F., 2012. A contribuição de melhoria como instrumento de recuperação da Mais-Valia Fundiária Urbana: Estudo de caso Eixo Urbano “Linha Verde”. Pontifícia Universidade Católica Do Paraná, Curitiba, Brazil.
- 333 Van Amelsfort, D. and Swedish, V., 2015. *Introduction to Congestion Charging: A Guide for Practitioners in Developing Cities*. Asian Development Bank and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Manila and Eschborn. Available at: <http://www.adb.org/sites/default/files/publication/159940/introduction-congestion-charging.pdf>.
- 334 United Nations Human Settlements Programme (UN-Habitat), 2011. *Innovative Land and Property Taxation*. Chapter 08: Innovations in Property Taxation Systems in India. Available at: https://www.ucl.ac.uk/qaser/pdf/publications/UN_HABITAT.
- 335 Merk, O., et al, 2012. *Financing Green Urban Infrastructure*. OECD Regional Development Working Papers 2012/10. Organisation for Economic Co-operation and Development, Paris. Available at: http://www.oecd.org/gov/regional-policy/WP_Financing_Green_Urban_Infrastructure.pdf.
- 336 Hiroaki, S., Murakami, J., Hong, Y. H., and Tamayose, B., 2015. *Financing Transit-Oriented Development with Land Values: Adapting Land Value Capture in Developing Countries*. Urban Development Series. Washington, DC: World Bank. doi:10.1596/978-1-4648-0149-5. License: Creative Commons Attribution CC BY 3.0 IGO.
- 337 The World Bank, 2013. *Planning, Connecting, and Financing Cities – Now. Priorities for City Leaders*. 74920. Washington, DC. Available at: <http://dx.doi.org/10.1596/978-0-8213-9839-5>.
- 338 Ibid.
- 339 OECD, 2015. *Aligning Policies for the Transition to a Low-Carbon Economy. Meeting of the OECD Council at Ministerial Level*. Available at: <http://www.oecd.org/env/Aligning-policies-for-the-transition-to-a-low-carbon-economy-CMIN2015-11.pdf>.
- 340 Asian Development Bank, 2015. *Establishing the Future Cities Program in the Asia and Pacific Region*. Available at: <http://www.adb.org/sites/default/files/project-document/178245/49053-001-tar.pdf>
- 341 See: http://www.bmz.de/en/what_we_do/issues/klimaschutz/cities-and-climate/germanys-commitment/index.html
- 342 OECD, 2015. *Aligning Policies for the Transition to a Low-Carbon Economy*.
- 343 Singapore's electronic road pricing system, designed to reduce congestion, automatically charges tolls as vehicles pass through gantries. See: <https://www.lta.gov.sg/content/ltaweb/en/roads-and-motoring/managing-traffic-and-congestion/electronic-road-pricing-erp.html>.

- ³⁴⁴ <http://hosted.verticalresponse.com/1527053/0d19dd9402/547703185/02395aa16c/>
<http://www.forbes.com/sites#/sites/briansolomon/2016/05/18/uber-teams-up-with-real-estate-developer-to-replace-car-ownership/#123d599623bd>
- ³⁴⁵ The World Bank, 2013. *Planning and financing low-carbon, livable cities*. News feature, 26 September. Available at: <http://www.worldbank.org/en/news/feature/2013/09/25/planning-financing-low-carbon-cities>.
- ³⁴⁶ Dimitriou, H.T., and Gakenheimer, R., 2011. *Land use and transport in rapidly motorizing cities: Contexts of controversy*. In: *Urban Transport in the Developing World: a Handbook of Policy and Practice*. H.T. Dimitriou and R. Gakenheimer (eds.). Edward Elgar. Available at: <https://www.e-elgar.com/shop/urban-transport-in-the-developing-world>.
- ³⁴⁷ See: <http://www.etu.org.za/toolbox/docs/localgov/webidp.html>.
- ³⁴⁸ Qureshi, Z., 2016. Meeting the Challenge of Sustainable Infrastructure: The Role of Public Policy. *Global Economy and Development*, Brookings. June 2016.
- ³⁴⁹ OECD, ed., 2010. *Cities and Climate Change*. Organisation for Economic Co-operation and Development, Paris. Available at: <http://www.oecd.org/gov/citiesandclimatechange.htm>.
- Merk, O., et al, 2012. *Financing Green Urban Infrastructure*.
- ³⁵⁰ Cabannes, Y., 2004. *Participatory budgeting: a significant contribution to participatory democracy*. *Environment and Urbanization*, 16(1), 27–46. DOI:10.1177/095624780401600104.
- Campbell, T., 2003. *The Quiet Revolution: Decentralization and the Rise of Political Participation in Latin American Cities*. University of Pittsburgh Press, Pittsburgh, PA, US. Available at: <https://www.upress.pitt.edu/BookDetails.aspx?bookId=35450>.
- ³⁵¹ UCLG, 2011. *Local Government Finance: The Challenges of the 21st Century. Second Global Report of United Cities and Local Governments*. Edward Elgar, Cheltenham. Executive summary available at: http://www.cities-localgovernments.org/gold/gold_report_2.asp.
- ³⁵² UCLG, 2010. *Local Governments in the World: Basic Facts on 96 Selected Countries*. United Cities and Local Governments, Barcelona. Available at: <http://www.cib-uclg.org/cib-library/content/local-governments-world-basic-facts-96-selected-countries>.
- ³⁵³ Bosworth, B. and Milusheva, S., 2011. *Innovations in U.S. Infrastructure Financing: An Evaluation*. The Brookings Institution. Available at: <https://www.brookings.edu/research/innovations-in-u-s-infrastructure-financing-an-evaluation/>.
- Merk, O., et al, 2012. *Financing Green Urban Infrastructure*.
- ³⁵⁴ The World Bank, 2013. *Financing Sustainable Cities: How We're Helping Africa's Cities Raise Their Credit Ratings*. Available at: <http://www.worldbank.org/en/news/feature/2013/10/24/financing-sustainable-cities-africa-creditworthy>.
- ³⁵⁵ The World Bank, 2013. *Planning and Financing Low-Carbon, Livable Cities*.
- ³⁵⁶ PPIAF, 2014. *PPIAF Helps Kampala Capital City Authority Improve its Creditworthiness*. Public-Private Infrastructure Advisory Facility. Available at: <http://www.ppiaf.org/sites/ppiaf.org/files/publication/Uganda-Kampla-SNTA-Credit-Rating.pdf>.
- ³⁵⁷ PPIAF, 2011. *PPIAF Helps Peruvian Sub-Nationals Tap Financial Markets*. Public-Private Infrastructure Advisory Facility. Available at: http://www.ppiaf.org/sites/ppiaf.org/files/publication/PPIAF-Impact-Stories-Peru-SNTA_0.pdf.
- ³⁵⁸ PPIAF, 2011. *SNTA Program: Summary of Results to Date*. Presentation at Steering Group Meeting, Paris, 21 January. Available at: <http://www.ppiaf.org/sites/ppiaf.org/files/documents/Presentation-SNTA-Results.pdf>.
- ³⁵⁹ Climate Bond Initiative, 2016. *2015 Green Bond Market Roundup*.
- ³⁶⁰ Bond banks are state-level entities that provide that state's smaller public entities with debt financing at a lower cost than they could obtain on their own. Bond banks are able to provide lower-cost financing, as long as they have higher credit ratings than the entities they serve.
- ³⁶¹ Floater, G., et al., 2014. *Steering Urban Growth: Governance, Policy and Finance*. New Climate Economy Cities Paper 02. LSE Cities. London School of Economics and Political Science. Available at: <https://files.lsecities.net/files/2014/12/Steering-Urban-Growth-02.pdf>.

362 Climate Bonds Initiative, 2016. *2015 Green Bond Market Roundup*.

Kidney, S., 2016. 2015 Year End Review - From tall trees to many green shoots: the evolution of the green bond market continues with 2015 seeing \$41.8bn green bonds issued – that’s the biggest ever! Climate Bonds Initiative. Available at: <https://www.climatebonds.net/2016/01/2015-year-end-review-tall-trees-many-green-shoots-evolution-green-bond-market-continues-2015>.

363 Floater, G., et al., 2014. *Steering Urban Growth: Governance, Policy and Finance*.

364 Maier, T and Jordan-Tank, M., 2014. *Accelerating Infrastructure Delivery New Evidence from International Financial Institutions*. World Economic Forum. Available at: http://www3.weforum.org/docs/WEF_AcceleratingInfrastructureDelivery_2014.pdf.

365 The World Bank, 2013. *Planning, Connecting, and Financing Cities - Now*.

366 Ibid.

367 Ibid.

368 Floater, G., et al., 2014. *Steering Urban Growth: Governance, Policy and Finance*.

369 See: <https://www.london.gov.uk/about-us/mayor-london/london-green-fund>.

370 The PPP Knowledge Lab, a collaborative project of top MDBs, defines a public-private partnership (PPP) as “a long-term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility, and remuneration is linked to performance”.

To learn more, see: <https://pppknowledgelab.org/ppp-cycle/what-ppp>.

371 Marin, P., 2009. *Public-Private Partnerships for Urban Water Utilities. A Review of Experiences in Developing Countries*. Public-Private Infrastructure Advisory Facility (PPIAF), The World Bank. Available at: <http://www.ppiaf.org/sites/ppiaf.org/files/FINAL-PPPsforUrbanWaterUtilities-PhMarin.pdf>.

372 Merk, O., et al, 2012. *Financing Green Urban Infrastructure*.

373 The World Bank, 2013. *Planning, Connecting, and Financing Cities - Now*.

374 Ibid.

375 United Nations News Centre, 2012. *Rio+20: Development banks to invest \$175 billion in sustainable transport*. Available at: <http://www.un.org/apps/news/story.asp?NewsID=42287#.V4YetpMrLVo>.

376 Barnard, S., 2015. *Climate Finance for Cities – How can international climate funds best support low-carbon and climate resilient urban development?* Overseas Development Institute, London. Available at: <https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9660.pdf>.

377 Ibid.

378 The World Bank, 2013. *Planning, Connecting, and Financing Cities*.

379 Barnard, 2015. *Climate Finance for Cities*.

See also: <https://www.cif.climateinvestmentfunds.org/projects/ecocasa-program-energy-efficiency-program-part-ii>.

380 See: <http://www.ecocasa.gob.mx> (in Spanish).

381 See: <https://www.usaid.gov/documents/1861/urban-climate-change-resilience-trust-fund>.

382 See: <http://www.adb.org/projects/48102-002/main>.

383 Rode, P., et al., 2014. *Accessibility in Cities: Transport and Urban Form*. NCE Cities Paper 03. LSE Cities. London School of Economics and Political Science.

384 See: http://18microcreditsummit.org/wp-content/uploads/2015/12/REMMP_Briefing_Note_PayGo.pdf.

385 Gauntlett, D., 2014. *Distributed solar PV poised to reach its potential in Africa*. Navigant Research blog. Available at: <https://www.navigantresearch.com/blog/distributed-solar-pv-poised-to-reach-its-potential-in-africa>.

- 386 See the Energy and Environment Partnership Southern and East Africa website: <http://eepafrica.org/about-us/success-stories/energcare/> and the UNFCCC Momentum for Change website: https://unfccc.int/secretariat/momentum_for_change/items/8325txt.php.
- 387 Feldman, D., Brockway, A. M., Ulrich, E. and Margolis, R. 2015. *Shared Solar: Current Landscape, Market Potential, and the Impact of Federal Securities Regulation*. National Renewable Energy Laboratory and U.S. Department of Energy. Available at: <http://www.nrel.gov/docs/fy15osti/63892.pdf>.
- 388 For an example on cost savings, see: <http://www.greentechmedia.com/articles/read/Californians-Just-Saved-192-Million-Thanks-to-Efficiency-and-Rooftop-Solar>.
- 389 California's distributed solar programme covers rooftop solar for electricity generation and thermal solar for water heating; for more information see: <http://www.gosolarcalifornia.ca.gov/about/index.php> and <https://www.californiasolarstatistics.ca.gov/>
- 390 See: <https://www.ruimtevoorderivier.nl/english/>.
- See also: <http://www.pri.org/stories/2016-06-22/holland-relocating-homes-make-more-room-high-water>.
- 391 See: <http://urbanland.uli.org/sustainability/before-it-runs-off/>.
- 392 FAO, 2015. *How to Feed the World in 2050*. Food and Agriculture Organization of the United Nations, Rome. Available at: http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf.
- 393 International Sustainability Unit, The Prince's Charities, 2015. *Tropical Forests: A review*. London. Available at: <http://www.pcfisu.org/wp-content/uploads/2015/04/Princes-Charities-International-Sustainability-Unit-Tropical-Forests-A-Review.pdf>. The underlying studies are: World Wildlife Fund, 2012. Chapter 4: Forests and Wood Products, In WWF Living Forest Report. Washington, DC. Available at: http://wwf.panda.org/what_we_do/how_we_work/conservation/forests/publications/living_forests_report/; and Elias, P. and Boucher, D., 2014. Planting for the Future: How demand for wood products could be friendly to tropical forests. Union of Concerned Scientists, Cambridge, MA. October. Available at: <http://newgenerationplantations.org/multimedia/file/9f447ff6-5935-11e4-a16a-005056986313>.
- 394 FAO, 2016. *Global Forest Resources Assessment 2015: How Are the World's Forests Changing?* 2nd ed. Food and Agriculture Organization of the United Nations, Rome. Available at: <http://www.fao.org/forest-resources-assessment/en/>.
- 395 Food and Agriculture Organization of the United Nations (FAO), 2010. *Global Forest Resources Assessment 2010*. Rome. Available at: <http://www.fao.org/forestry/fra2010/>.
- 396 Schirmer, J., R. Pirard, and P. Kanowski. 2016. "Promises and perils of plantation forestry", Chapter 9 in R. Panwar, R. Kozak and E. Hansen, eds. *Forests, Business and Sustainability*. (London: Earthscan and Routledge) 153-178.
- 397 R. Petersen, et al. 2016 "Mapping Tree Plantations with Multispectral Imagery: Preliminary results for seven tropical countries". World Resources Institute Technical Note, January 18 pp.
- 398 Calculations by Rachel Petersen, WRI, from the dataset developed in the previous reference.
- 399 FAO, 2011. *Scarcity and degradation of land and water: growing threat to food security*. Food and Agriculture Organization of the United Nations, Rome. Available at: <http://www.fao.org/news/story/en/item/95153/icode/>.
- 400 UNCCD, 2015. *Desertification, Land Degradation and Draught – Fact Sheet*. Available at: <http://www.unccd.int/Lists/SiteDocumentLibrary/WDCD/DLDD%20Facts.pdf>. As cited in: UN, n.d., *Desertification*. Available at: <http://www.un.org/en/events/desertificationday/background.shtml>. [Accessed 13 June 2016]
- 401 This is the estimated annual average for 2010–2015. Reforestation and afforestation averaging 4.3 million ha per year reduce the net loss to 3.3 million ha per year, but old-growth and new forests are not ecologically equivalent.
- See: FAO, 2016. *Global Forest Resources Assessment 2015: How Are the World's Forests Changing?* 2nd ed. Food and Agriculture Organization of the United Nations, Rome. Available at: <http://www.fao.org/forest-resources-assessment/en/>.
- 402 See FAO's Aquastat: <http://www.fao.org/nr/water/aquastat/didyouknow/index2.stm> and OECD statistics: <http://www.oecd.org/agriculture/wateruseinagriculture.htm>. [Accessed 12 June 2016]
- 403 See: IPCC, 2014. *Climate Change 2014: Synthesis Report*. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Core Writing Team, R. K. Pachauri, and L. A. Meyer (eds.). Intergovernmental Panel on Climate Change, Geneva. Available at: <http://www.ipcc.ch/report/ar5/syr/>.

For a more detailed discussion of the contributions of agriculture, forestry and other land use to global greenhouse gas emissions, see Chapter 3 (Land Use) in:

GCEC, 2014. *Better Growth, Better Climate*.

404 GCEC, 2014. *Better Growth, Better Climate*, Chapter 3.

405 Ibid.

406 See: <http://4p1000.org/understand>.

407 Chomitz et al., 2007. *At Loggerheads? Agricultural expansion, poverty reduction, and environment in the tropical forests*. World Bank Policy Research Report. Washington, D.C.

408 De Luca, G. D., 2007. *Roads, Development, and Deforestation: a review*. World Bank Development Research Group, Washington DC. Available at: http://siteresources.worldbank.org/INTKNOWLEDGEFORCHANGE/Resources/491519-1199818447826/roads_development_and_desorestation_a_review.pdf

See also: <https://www.sei-international.org/publications?pid=2584>.

409 Dulac, J, 2013. *Global Land transport Infrastructure Requirements: Estimating Road and Railway Infrastructure Capacity and Costs to 2050*. Report. International Energy Agency. Cited in Lawrence, W. et al., 2014. *A global strategy for road building*. *Nature* (513): 11 September. 229-234

410 Lawrence, W. et al., 2014. *A global strategy for road building*. *Nature* (513): 11 September 2014.

411 Assunção et al. 2013. *Production and Protection: A First Look at Challenges in Brazil*. Climate Policy Initiative, Rio de Janeiro. Available at: <http://climatepolicyinitiative.org/publication/production-protection-a-first-look-at-key-challenges-in-brazil/>

412 Assunção, J., Gandour, C., and Rocha, R., 2013. *Does Credit Affect Deforestation? Evidence from a Rural Credit Policy in the Brazilian Amazon*. Climate Policy Initiative and Nucleo de Avaliaco de Politicas Climaticas, PUC Rio. Rio de Janeiro. Available at: <http://climatepolicyinitiative.org/publication/does-credit-affect-deforestation-evidence-from-a-rural-credit-policy-in-the-brazilian-amazon/>.

413 See Ozment, et al. 2015. *Natural Infrastructure in the Nexus*. International Union for Conservation of Nature, Gland. Available at: <https://portals.iucn.org/library/node/45374>.

Garcia-Escribano, M., Goes, C., and Karpowicz, I., 2015. *Filling the Gap: Infrastructure Investment in Brazil*. International Monetary Fund, Washington, DC. Available at: <http://www.imf.org/external/pubs/cat/longres.aspx?sk=43139.0>

414 Hanson et al., 2010. *Southern Forests for the Future*. World Resources Institute. Available at: http://www.wri.org/sites/default/files/pdf/southern_forests_for_the_future_lowres.pdf.

415 Ibid.

416 United Nations Environment Programme (UNEP), 2008. *Opportunities in Environmental Management for Disaster Risk Reduction: Recent Progress*. Geneva. Available at: http://postconflict.unep.ch/download/DRR_platform/opp_DRR.pdf.

417 Hanson et al., 2010. *Southern Forests for the Future*.

418 Fu, B., Wang, Y. K., Xu, P., and Yan, K., 2013. *Mapping the flood mitigation services of ecosystems – A case study in the Upper Yangtze River Basin*. *Ecological Engineering*, 52. 238–246. DOI:10.1016/j.ecoleng.2012.11.008.

419 UNEP, 2011. *Forests in a Green Economy: A Synthesis*. United Nations Environment Programme, Nairobi. Available at: http://www.unep.org/pdf/PressReleases/UNEP-ForestsGreenEco-basse_def_version_normale.pdf.

420 Hanson et al., 2010. *Southern Forests for the Future*.

421 Howells et al., 2013. *The impact of transforming two sugar-processing plants to produce second-generation ethanol in Mauritius (projections for 2030)*. *Nature Climate Change*, 3. 621-626. Available at: http://www.nature.com/nclimate/journal/v3/n7/fig_tab/nclimate1789_F2.html.

422 See: Delgado et al., 2015. *Restoring and protecting agricultural and forest landscapes and increasing agricultural productivity*. A Contributing Paper for *Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate*. Available at: <http://2015.newclimateeconomy.report/wp-content/uploads/2015/12/NCE-restoring-protecting-ag-forest-landscapes-increase-ag.pdf>.

This estimate covers only the value of the net annual economic loss from new degradation, not the much larger value of annual production or the cumulative loss over years. It is the sum of a cost estimate for soil degradation from the Food and Agriculture Organization of the United Nations (US\$40 billion per year), and applying an estimated value of US\$3,100 to US\$6,120/ha to an FAO estimate of 13 million ha gross deforestation annually, yielding US\$40 to US\$80 billion for forest degradation.

See: FAO, n.d. *Land Degradation Assessment*. Available at: <http://www.fao.org/nr/land/degradation/en/>.

FAO, 2010. *Global Forest Resources Assessment 2010*. FAO Forestry Paper 163. Rome. Available at: <http://www.fao.org/forestry/fra/fra2010/en/>.

The per hectare estimates are from: TEEB, 2010. *The Economics of Ecosystems and Biodiversity Ecological and Economic Foundations*. Edited by Kumar, R. Earthscan, London and Washington. Available at: <http://www.teebweb.org/publication/the-economics-of-ecosystems-and-biodiversity-teeb-ecological-and-economic-foundations>.

Costanza, R., de Groot, R., Sutton, P., van der Ploeg, S., Anderson, S.J., Kubiszewski, I., Farber, S. and Turner, R.K., 2014. *Changes in the Global Value of Ecosystem Services*. *Global Environmental Change*, 26. 152–158. DOI:10.1016/j.gloenvcha.2014.04.002.

The International Resource Panel Report (in conjunction with UN REDD+) at: <http://www.un-redd.org/IRPReport/tabid/132330/Default.aspx>.

TEEB, 2009.

423 GCEC, 2014. *Better Growth, Better Climate*, Chapter 3.

424 Delgado et al., 2015. *Restoring and Protecting Agricultural and Forest Landscapes and Increasing Agricultural Productivity*.

425 FAO, 2011. *The State of the World's Land and Water Resources for Food and Agriculture – Managing Systems at Risk*. Rome. Available at: <http://www.fao.org/nr/solaw/>. Note that on the forest side a net 260 million ha of forest were eliminated in Africa, Asia, Central and South America combined between 1990 and 2012; a net 10 million ha of forest were added in Europe and North America combined. Available at: <http://faostat3.fao.org/download/G2/GF/E>.

Developing countries are also where the vast majority of agricultural emissions from ruminants, rice, and over-application of nitrogenous fertilizers occur (the latter primarily in India and China). See C. Delgado, M. Wolosin and N. Purvis. 2015. *Restoring and Protecting Agricultural and Forest Landscapes and Increasing Agricultural Productivity*. New Climate Economy, Washington DC. Available at: <http://newclimateeconomy.report/misc/working-papers/>

426 Global Canopy Programme, 2015. *The Little Book on Sustainable Landscapes*. Available at: <http://globalcanopy.org/sustainablelandscapes>.

427 Lars et al, 2014. A Guide to the Restoration Opportunities Assessment Methodology (ROAM): Assessing forest landscape restoration opportunities at the national or sub-national level. International Union for Conservation of Nature, Gland, Switzerland. Available at: <https://portals.iucn.org/library/node/44852>

428 Credit Suisse, World Wildlife Fund, and McKinsey & Co., 2014. *Conservation Finance: Moving beyond donor funding toward an investor-driven approach*. Available at: <https://www.credit-suisse.com/media/assets/corporate/docs/about-us/responsibility/environment/conservation-finance-en.pdf>

429 Parker, Cranford, Oakes, & Leggett, 2010. *Little Biodiversity Finance Book*. The Global Canopy Program, Oxford. Available at: http://theredddesk.org/sites/default/files/resources/pdf/2010/LBFB_EN.pdf

430 The high-income countries accounted for less than ¼ of global cropped area in 2010, so it is no surprise that the brunt of degraded agricultural land is presently in developing countries, although the developed countries of today had massive landscape degradation in the past. For details on location, see FAO, 2011. *The State of the World's Land and Water Resources for Food and Agriculture*. On the forest side, 260 million ha of forest were eliminated net in Africa, Asia, Central and South America combined between 1990 and 2012; 10 million ha of forest were added net in Europe and North America combined. See: <http://www.fao.org/docrep/017/i1688e/i1688e.pdf>. Massive forest fires in the far northern regions of the world have been a major factor in the case of forest degradation in very recent years, but these are not included here as anthropogenic.

431 UNFCCC, n.d. Fact sheet: *Financing climate change action. Investment and financial flows for a strengthened response to climate change*. Available at: http://unfccc.int/press/fact_sheets/items/4982.php.

432 Ecosystem Marketplace. 2014. *Gaining Depth: State of Watershed Investment 2014 - Executive Summary*. Washington DC. Available at: www.ecosystemmarketplace.com/reports/sowi2014

- 433 Mafira, T., Sutiyono, G. and Falconer, A., 2015. *Improving Land Productivity through Fiscal Policy*. Climate Policy Initiative. Available at: <http://climatepolicyinitiative.org/publication/improving-land-productivity-through-fiscal-policy/>.
- 434 Morrison-Métois, S., and Lundgren, H., 2016. *Forests and Sustainable Forest Management*. OECD, Paris. Available at: <http://www.oecd.org/dac/evaluation/Evaluation-Insights-Forests-Final.pdf>
- Frechette A, de Bresser, M and Hofstede, R, 2014. External Evaluation of the United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (the UN-REDD Programme). UNEP, Nairobi. Available at [http://www.unep.org/eou/Portals/52/Reports/UN-REDD%20Evaluation%20Final%20Report%20July%202014%20\(ENG\).pdf](http://www.unep.org/eou/Portals/52/Reports/UN-REDD%20Evaluation%20Final%20Report%20July%202014%20(ENG).pdf)
- Tipper et al, 2011. *Real-Time Evaluation of Norway's International Climate and Forest Initiative*. OECD, Paris. Available at: <https://www.oecd.org/derec/norway/48086385.pdf>
- 435 Falconer A et al., 2016. *Three Tools to Unlock Finance for Land Use Adaptation and Mitigation*. CPI, London. Available at: <http://climatepolicyinitiative.org/publication/three-tools-to-unlock-finance-for-land-use-mitigation-and-adaptation/>
- 436 Dobbs, R., Oppenheim, J., Thompson, F., Brinkman, M., and Zornes, M., 2011. *Resource Revolution: Meeting the world's energy, materials, food and water needs*. McKinsey Global Institute, Washington, DC. Available at: <http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/resource-revolution>.
- 437 OECD, 2016. *Agricultural Policy Monitoring and Evaluation*. OECD, Paris. DOI: 10.1787/22217371
- 438 OECD, 2012. *OECD review of agricultural policies: Indonesia 2012*. Paris. Available at: http://www.oecd-ilibrary.org/agriculture-and-food/oecd-review-of-agricultural-policies-indonesia-2012_9789264179011-en
- Osario et al, 2005. *Who is Benefitting from Fertilizer Subsidies in Indonesia?* The World Bank, Washington DC. Available at: <https://openknowledge.worldbank.org/bitstream/handle/10986/3519/5758.pdf>
- OECD, 2015. *Indonesia Policy Brief: Agriculture – Achieving Greater Food Security*. Paris. Available at: <https://www.oecd.org/policy-briefs/indonesia-agriculture-improving-food-security.pdf>.
- Hedley, D., and Tabor, S.R., 1989. *Fertilizer in Indonesian Agriculture: the Subsidy Issue*. Agricultural Economics. DOI: 10.1016/0169-5150(89)90038-8. Available at: <http://www.sciencedirect.com/science/article/pii/0169515089900388>
- 439 OECD, 2013. *Agricultural Policy Monitoring and Evaluation 2014*. Paris. DOI: http://dx.doi.org/10.1787/agr_pol-2014-en
- 440 OECD, 2015. *Aligning Policies for Low-Carbon Economy*. Paris. Available at: <http://www.oecd.org/env/Aligning-policies-for-the-transition-to-a-low-carbon-economy-CMIN2015-11.pdf>.
- 441 Gale, F., 2013. *Growth and Evolution in China's Agricultural Support Policies*. Economic Research Service Report No. 153. US Department of Agriculture, Washington DC. Available at: <http://www.ers.usda.gov/publications/err-economic-research-report/err153.aspx>.
- 442 Grossman, N., and Carlson, D., 2011. *Agriculture Policy in India: The Role of Input Subsidies*. USITC, Washington DC. Available at: https://www.usitc.gov/publications/332/EBOT_IndiaAgSubsidies.pdf
- 443 India's FY 2016-17 budget (effective in April) includes 70,000 crore rupees for fertilizer subsidies. That amounts to about US\$10.4 billion by today's exchange rate. See: PTI, 2016. Budget 2016: Subsidy bill cut by over 4% to Rs 2.31 lakh cr for 2016-17. *The Economic Times*, 29 February. Available at: <http://economictimes.indiatimes.com/news/economy/policy/budget-2016-subsidy-bill-cut-by-over-4-to-rs-2-31-lakh-cr-for-2016-17/articleshow/51192299.cms>.
- 444 For a discussion of when and how fertiliser subsidies make sense in Africa, see: The World Bank, 2007, *World Development Report 2008*, 150-153, Washington DC. Available at: <http://siteresources.worldbank.org/INTWDRS/Resources/477365-1327599046334/8394679-1327614067045/WDRover2008-ENG.pdf>
- 445 Zhang W. et al., 2013. New technologies reduce greenhouse gas emissions from nitrogenous fertilizer in China.
- 446 United Nations World Water Assessment Programme, 2014. *World Water Development Report 2014 - Water and Energy*. UNESCO, Paris. Available at: <http://www.unwater.org/publications/world-water-development-report/en/>.
- 447 Reducing emissions from deforestation and forest degradation and foster conservation, sustainable management of forests, and enhancement of forest carbon stocks. McFarland, M., Whitley, S., and Kissinger, G. 2014. *Subsidies to key commodities driving forest loss*. Implications for private climate finance. ODI, London. Available at: <https://www.odi.org/publications/9286-subsidies-commodities-deforestation-brazil-indonesia-redd>.

- 448 Assunção, J. e Gandour, C.C. & Rocha, R., 2012. *Deforestation slowdown in the legal Amazon: prices or policies*. Climate Policy Initiative, Rio de Janeiro. Available at: <http://climatepolicyinitiative.org/wp-content/uploads/2012/03/Deforestation-Prices-or-Policies-Working-Paper.pdf>.
- 449 Morrison-Métois, S., and Lundgren, H., 2016. *Forests and Sustainable Forest Management*.
- 450 Wise, T., 2012. *The costs to Mexico of US corn ethanol expansion*. Tufts Global Development and Environment Institute, Boston. Available at: <http://www.ase.tufts.edu/gdae/Pubs/wp/12-01WiseBiofuels.pdf>
- 451 King, M., 2013. *Green Growth and Poverty Reduction: Policy Coherence for Pro-poor Growth*, OECD Development Co-operation Working Papers, No. 14, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/5k3ttg45wb31-en>.
- 452 To put the full environmental value of tropical forest in context, a well-accepted figure is US\$6,120/ha/yr. This includes both market-mediated and non-compensated ecosystem services, such as food, water, raw materials such as timber, genetic resources, medicinal resources, improved air quality, climate regulation, regulation of water flows, waste treatment, water purification, erosion prevention, recreation, and tourism. See: TEEB, 2009. *The Economics of Ecosystems and Biodiversity (TEEB) Climate Issues Update*. Available at: <http://www.teebweb.org/publication/climate-issues-update/>. By contrast, in the present section, we are only including tangible benefits such as foods produced, services sold, or the impacts on the market-valued production and services of others.
- 453 GCEC, 2014. *Better Growth, Better Climate*. Chapter 3, Land Use.
- 454 Porras, I., et al., 2013. *Learning from 20 years of Payments for Ecosystem Services in Costa Rica*. International Institute for Environment and Development, London. Available at : <http://pubs.iied.org/pdfs/16514IIED.pdf>.
- 455 FAO, 2013. *Case studies on Remuneration of Positive Externalities (RPE)/ Payments for Environmental Services (PES)*. Rome. Available at: http://www.fao.org/fileadmin/user_upload/pes-project/docs/FAO_RPE-PES_PSAH-Mexico.pdf.
- 456 OECD, 2015. *Strengthening Incentives for Sustainable Land Use. In Aligning Policies for a Low-carbon Economy*, OECD Publishing, Paris. Available at: http://www.oecd-ilibrary.org/environment/aligning-policies-for-a-low-carbon-economy/strengthening-incentives-for-sustainable-land-use_9789264233294-13-en.
- 457 For a recent evaluation of REDD+ and other development cooperation programmes designed to reduce CO₂ from forests and deforestation, see OECD 2016, Morrison-Métois and Lundgren, op cit. Examples in this section also drawn from: OECD, 2015. *Strengthening Incentives for Sustainable Land Use*.
- 458 UNEP, 2014. *External Evaluation of the United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (the UN-REDD Programme)*.
- 459 Ecosystem Marketplace, 2014. *Gaining Depth: State of Watershed Investment 2014 - Executive Summary*.
- 460 Norad, 2014. *Real-Time Evaluation of Norway's International Climate and Forest Initiative Synthesizing Report 2007-2013*. Available at: <http://www.oecd.org/derec/norway/Real-Time-Evaluation-of-Norway-International-Climate-and-Forest-Initiative-Synthesizing-Report-2007-2013.pdf>
- 461 Barrett, K. and Goldstein A, 2015. *Norway, Germany, UK Pledge \$5 Billion to Combat Tropical Deforestation*. Ecosystem Marketplace, Paris. Available at: <http://www.ecosystemmarketplace.com/articles/norway-germany-uk-pledge-5-billion-to-combat-tropical-deforestation/>
- 462 Bartlett, S. and David, S., 2016. *Cities on a Finite Planet: Towards transformative responses to climate change*. Routledge, Abingdon.
- 463 OECD, 2013. *Agricultural Policy Monitoring and Evaluation 2013: OECD Countries and Emerging Economies*. Paris. Available at: http://dx.doi.org/10.1787/agr_pol-2013-en
- OECD, 2013. *Putting Green Growth at the Heart of Development*. Paris. Available at: <http://dx.doi.org/10.1787/9789264181144-en>.
- 464 Parker, C., M. Cranford, N. Oakes, and M. Leggett, ed. 2012. *The Little Biodiversity Finance Book*. This citation gives estimates of “biodiversity finance”, but this is taken as a good indicator of both conservation and landscape restoration finance.
- 465 Falconer, A., Parker, C., Kennlyside, P., Dontenville, A. and Wilkinson, J., 2015. *Three Tools to Unlock Finance for Land-Use Mitigation and Adaptation*. This draws on OECD DAC CRS <http://stats.oecd.org/Index.aspx?QueryId=58192>
- 466 Ibid.

- 467 Morrison-Métois, S., and Lundgren, H., 2016. *Forests and Sustainable Forest Management*.
- German Federal Ministry of Economic Cooperation and Development (BMZ), 2015. *REDD+: Protecting forests and climate for sustainable development*. Berlin. Available at: https://www.bmz.de/en/publications/topics/countries_regions/Materialie250_redd.pdf.
- 468 UK Department for International Development, n.d. *Investments in Forests and Sustainable Land Use*. London. Available at: <https://devtracker.dfid.gov.uk/projects/GB-1-202745/documents>.
- 469 UNCCD, 2016. *The Great Green Wall. Research and compilation of news, success stories, references to projects, opinions, etc.* Bonn. Available at: http://www.unccd.int/Lists/SiteDocumentLibrary/Publications/Be_among/Biblio_Great_Green_Wall_research_Success_stories_news_science_media_projects.pdf.
- 470 DiFrancesco, K and Gartner T, based on the Nexus Dialogue Synthesis Paper (Ozment, et al. 2015), as adapted in Bhattacharya et al., 2016. *Delivering on Sustainable Infrastructure for Better Development and Better Climate*.
- 471 Hanson, C., Talberth, J., and Yonavjak, L., 2011. *Forests for water: exploring payments for watershed services in the U.S. South*. World Resources Institute, Washington, DC. Available at: http://www.wri.org/sites/default/files/pdf/forests_for_water.pdf.
- 472 TNC, 2012. *Water Funds Business Case : Conservation as a Source of Competitive Advantage*. The Nature Conservancy, Arlington. Available at: http://www.watershedconnect.com/documents/files/water_funds_business_case.pdf
- 473 TNC, 2012. *Water funds - conserving green infrastructure*. The Nature Conservancy, Arlington. Available at: <http://www.nature.org/media/freshwater/latin-america-water-funds.pdf>
- 474 Rönnbäck, P., 1999. The ecological basis for economic value of seafood production supported by mangrove ecosystems. *Ecological Economics*, 29(2), 235–252.
- 475 Rutberg, L., 2013. *In the Northwest, Innovative Projects Use Trees to Cool Streams*. High Country News, Paonia. Available at: <http://www.hcn.org/issues/45.2/in-the-northwest-innovative-projects-use-trees-to-cool-streams>.
- 476 Sommer, et al., 2001. California's Yolo Bypass: Evidence that flood control can be compatible with fisheries, wetlands, wildlife, and agriculture. *Fisheries*, 26(8), 6–16.
- 477 TNC, CTG, Goldman Sachs Group, et al 2011. *Yangtze River Sustainable Hydropower*. The Nature Conservancy, Arlington. Available at: <http://www.greatriverspartnership.org/SiteCollectionDocuments/HydropowerProposal-Yangtze.pdf>.
- 478 Development Initiatives, 2016. *Improving ODA allocation for a post-2015 world*. Bristol. Available at: http://www.un.org/en/ecosoc/newfunct/pdf15/un_improving_oda_allocation_for_post-2015_world.pdf
- 479 Loeffler K, 2015. *Experiences with risk transfer, sharing and financing*. Allianz Climate Solutions, Munich. Available at: <http://www.slideshare.net/OECDdev/6c-kloffler-allianz>.
- 480 See: ARC Ltd. Website, n.d., Available at: <http://ltd.arc.int>. (Accessed 16 June 2016).
- Artemis, 2015. *African Risk Capacity in first payout of \$25m to three countries*. East Sussex. Available at: <http://www.artemis.bm/blog/2015/01/07/african-risk-capacity-in-first-payout-of-25m-to-three-countries/>.
- Artemis, 2014. *First African parametric catastrophe insurance pool*. East Sussex. Available at: <http://www.artemis.bm/blog/2014/05/14/first-african-parametric-catastrophe-insurance-pool-launches/>.
- 481 NatureVest and EKO Asset Management Partners, 2014. *Investing in Conservation: A landscape assessment of an emerging market*. The Nature Conservancy, Arlington. Available at: <http://www.naturevesttnc.org/Reports/info.html>.
- 482 Climate Bonds Initiative, 2016. *2015 Green Bond Market Roundup*.
- 483 Climate Bonds Initiative, 2016. *Bonds and Climate Change: The State of the Market 2016*.
- 484 Ibid.
- 485 Recognising the importance of land use in addressing climate change, the Climate Bonds Initiative convened a Land Use Technical Working Group in 2014 to develop criteria for bonds in this sector. A first set of criteria is nearing approval; a second phase will focus on adaptation and resilience. See: Climate Bonds Initiative, 2016. *Bonds and Climate Change*.
- 486 At its simplest, an IRR measures with one number the percentage returns to capital at a given time of an income stream when all inputs and outputs are valued at market prices (more technically, the discount rate that is needed to make the net present value of an income stream equal to zero). From a finance standpoint, an IRR that exceeds the “opportunity cost of

capital” (or what it costs in the relevant marketplace to borrow to invest) is profitable. Public impact investors such as the World Bank currently tend to prefer “Economic Rates of Return” (ERR), which are similar to IRRs, except that all inputs and outputs are valued at their undistorted (and often somewhat theoretical) real economic values that include allowances for non-market costs and benefits (i.e. impacts).

487 NatureVest and EKO Asset Management Partners, 2014. Investing in Conservation: A landscape assessment of an emerging market.

488 See: <http://www.wri.org/our-work/project/initiative-20x20>.

489 GCEC, 2015. *Seizing the Global Opportunity*.

490 See: <https://www.tiaa.org/public/assetmanagement/strategies/alternatives/agriculture>.

491 The first fund closed to new investors in 2012 having reached its subscription objectives, and the larger second partnership (\$3 billion) closed to new investment in 2015. After closure the investments are implemented until the partnership is liquidated. See: <https://www.tiaa.org/public/about-tiaa/news-press/press-releases/pressrelease602.html>

492 GCEC, 2014. *Better Growth, Better Climate*.

GCEC, 2015. *Seizing the Global Opportunity*.

493 Consumer Goods Forum, 2010. *Board Resolution on Deforestation*. Paris. Available at: <http://www.theconsumergoodsforum.com/sustainability-strategic-focus/climate-change/deforestation>.

494 See: www.tfa2020.org.

495 Greenpeace, 2015. *Palm oil giant Wilmar caves to public pressure, commits to end forest destruction*. Amsterdam. Available at: <http://www.greenpeace.org/international/en/press/releases/2013/Palm-oil-giant-Wilmar-caves-to-public-pressure-commits-to-end-forests-destruction/>.

496 Consumer Goods Forum, n.d. *Palm Oil: Deforestation*. Paris. Available at: <http://www.theconsumergoodsforum.com/component/tags/tag/205-palm-oil>.

497 GCEC. 2015. *Seizing the Global Opportunity: Partnerships for better growth and a better climate* p. 7.

498 Beintema, N., Stads, G.-J., Fuglie, K., and Heisey, P., 2012. *ASTI Global Assessment of Agricultural R&D Spending*. International Food Policy Research Institute, Washington, DC, and Global Forum on Agricultural Research, Rome. Available at: <http://www.ifpri.org/publication/asti-global-assessment-agricultural-rd-spending>.

499 OECD data, *Government appropriations of budget outlays for R&D*, 2013 or latest year available, downloaded on 22 May 2014. See: https://stats.oecd.org/Index.aspx?DataSetCode=GBAORD_NABS2007. The largest share of OECD government allocations for R&D go to general outlays (e.g. universities) followed by health.

500 Marker-assisted selection (MAS) is a biotechnology used in plant or animal breeding whereby a marker (morphological, biochemical or one based on DNA/RNA variation) is used for indirect selection of a trait of interest (e.g. productivity, disease resistance, abiotic stress tolerance, or quality).

501 News Agency of Nigeria, 2016. *EU, FAI, ACP inaugurate 41m euros Action Against Desertification in Africa*. Abuja. Available at: <http://nannewsigeria.com/eu-fao-acp-inaugurate-41m-euros-action-against-desertification-africa>.

502 See: <http://africacsa.org/>.

503 Schirmer, J., R. Pirard, and P. Kanowski. 2016. “Promises and perils of plantation forestry”, Chapter 9 in R. Panwar, R. Kozak and E. Hansen, eds. *Forests, Business and Sustainability*. (London: Earthscan and Routledge) 153-178. Also see: Carle, J. and P. Holmgren. 2008. “Wood from planted forests: a global outlook 2005-2030, *Forest Products Journal*, 58 (12) 6-18 and Warman, R. 2014. “Global wood production from natural forests has peaked”, *Biodiversity and Conservation*, 23, 1063-1078.

504 The literature on this is vast and there is not much disagreement on the points concerning lower biodiversity and loss of vital ecosystem services compared to intact natural forest. See for example Schirmer, J., R. Pirard, and P. Kanowski. 2016. “Promises and perils of plantation forestry”, Chapter 9 in R. Panwar, R. Kozak and E. Hansen, eds. *Forests, Business and Sustainability*. (London: Earthscan and Routledge) 153-178. Also see: Jenkins, M. and E. Smith. 1999. *The Business of Sustainable Forestry: Strategies for an industry in transition*. Washington, D.C.: Island Press.

⁵⁰⁵ See for example: Higman, S., J. Mayers, S. Bass, N. Judd, and R. Nussbaum. 2005. *The Sustainable Forestry Handbook, 2nd edition*. London: Earthscan

⁵⁰⁶ This was a major thrust of the GCEC, 2014. *Better Growth, Better Climate*, Chapter 3, which reviews evidence here.

⁵⁰⁷ See: <http://www.worldbank.org/en/news/press-release/2015/03/27/supporting-sustainable-forest-plantations-in-vietnam>

⁵⁰⁸ FAO, n.d. Climate-Smart Agriculture. Rome. Available at: <http://www.fao.org/climate-smart-agriculture/en/>.

Higman, S., J. Mayers, S. Bass, N. Judd, and R. Nussbaum. 2005. *The Sustainable Forestry Handbook, 2nd edition*. London: Earthscan

Jenkins, M. and E. Smith. 1999. *The Business of Sustainable Forestry: Strategies for an industry in transition*. Washington, D.C.: Island Press.

⁵⁰⁹ ASTI. 2012. *Global Assessment of Agricultural R&D Spending*. See: <https://www.asti.cgiar.org/globaloverview>
This assessment is based on data to 2008 and includes a wide survey of data for diverse sources. Agroforestry and related fields are included but pure forest research is not.

⁵¹⁰ This proportion has not been estimated on a global basis, is if anything likely a large overestimate of the share of agricultural and forest research that is climate-smart; it is roughly the share of the World Bank's agricultural portfolio that was coded as being "climate smart" in 2015, even as the Bank works to achieve 100% climate smartness over time.

Acknowledgements

The Commission is grateful to the many organisations and individuals that have made comments or substantial contributions to this report, as listed below. They are, however, not responsible for the accuracy, content, findings or recommendations. The findings do not necessarily reflect their views, or those of the organisations they represent.

Asian Development Bank (ADB)

Asian Infrastructure Investment Bank (AIIB)

Bank of England

BlackRock

Bloomberg Philanthropies

Broadscale Group

Brookings Institution

C40 Cities Climate Leadership Group

Ceres

Climate Bonds Initiative (CBI)

Climate Policy Initiative (CPI)

Confederation of Norwegian Enterprise (NHO)

Deutsche Bank

Energy Transition Commission (ETC)

Ethiopian Development Research Institute (EDRI)

European Bank for Reconstruction and Development (EBRD)

European Climate Foundation (ECF)

Fundación Desarrollo Humano Sustentable A.C. (FDHS)

GE Corporate

Global Green Growth Institute (GGGI)

Global Infrastructure Hub

HSBC Holdings plc

Indian Council for Research on International Economic Relations (ICRIER)

Inter-American Development Bank (IDB)

International Finance Corporation (IFC)

International Monetary Fund (IMF)

International Partnership for Energy Efficiency Cooperation (IPEEC)

International Trade Union Confederation (ITUC)

London School of Economics and Political Science (LSE)

McKinsey & Company

Mercer

New Development Bank (NDB)
Office of the President of the United Nations General Assembly
Organisation for Economic Co-operation and Development (OECD)
Overseas Development Institute (ODI)
PricewaterhouseCoopers (PwC)
Schneider Electric
Statkraft
Stockholm Environment Institute (SEI)
Sustainable Energy for All (SE4All)
SystemiQ
Tsinghua University
Unilever
United Nations Development Programme (UNDP)
United Nations Economic Commission for Africa (UNECA)
United Nations Environment Programme (UNEP)
United Nations Environment Programme Inquiry into the Design of a Sustainable Financial System (UNEP Inquiry)
United Nations Executive Office of the Secretary-General
United Nations Framework Convention on Climate Change (UNFCCC)
World Bank
World Resources Institute (WRI)

This report has been prepared by:

Jan Corfee-Morlot, Ipek Gençsü, James Rydge, Helen Mountford, Ferzina Banaji and Joel Jaeger

Substantial input to the report or supporting background papers has been provided by:

Amar Bhattacharya (Brookings), Barbara Buchner (CPI), James Cameron (SystemIQ/ODI), Ian de Cruz (NCE), Marion Davis (SEI), Chris Delgado (WRI), Helen Ding (WRI), Kate Eklin (OECD), Sean Gilbert (WRI), Nick Godfrey (NCE), Michael Jacobs (NCE), Christopher Kaminker (OECD), Emmy Labovitch (OECD), Austin Morton (NCE), Smita Nakhoda (ODI), Darius Nassiry (ODI), Jeremy Oppenheim (SystemIQ/NCE), Josué Tanaka (EBRD), Jane Wilkinson (CPI), Robert Youngman (OECD) and Xiao Zhao (NCE)

Thanks also for comments, guidance and support to:

Gebrehiwot Ageba (EDRI), James Alexander (C40), Poppy Allonby (BlackRock), Amal-Lee Amin (IDB), Manish Bapna (WRI), Sam Barnard (ODI), Beth Benyishay (NCE), Preeti Bhandari (ADB), Murray Birt (Deutsche Bank), Russell Bishop (NCE), Simon Buckle (OECD), Jazmin Burgess (UNDP), Juan Casado-Asensio (OECD), Anna Cavazzini (UN PGA), Sarah Challe (UNEP), Ayman Cherkaoui (Morocco), Tomas Anker Christensen (UN PGA), Anthony Cox (OECD), Julia Dills (NCE), Sandrine Dixson-Declève (SE4All), Dan Dowling (PwC), Bill Dugan (WRI), V.K. Duggal (ADB), Jane Ebinger (SE4All), Sam Fell (United Kingdom), Andrea Fernández (C40), Christiana Figueres (UNFCCC), Chris Fox (Ceres), Diletta Giuliani (CBI), Kookie Habtegabber (WWF), Alison Harwood (World Bank), Vidar Helgesen (Norway), Tom Heller (CPI), Celine Herweijer (PwC), Rajat Kathuria (ICRIER), Jan Kellet (UNDP), David Kennedy (United Kingdom), Tom Kerr (IFC), Maia Kutner (CDP), Seijoong Kwon (Korea), Emmanuel Lagarrigue (Schneider Electric), Spencer Lake (HSBC), Edmund Lakin (HSBC), Gaia Larsen (WRI), Benoit Lebot (IPEEC), Annie Lefebure (NCE), Li Shan (Chinastone Capital Management), Thomas Lingard (Unilever), Néstor Osorio Londoño (Colombia), Luca de Lorenzo (SEI), Kjetil Lund (Statkraft), Aditi Maheshwari (World Bank), Johannes Maier (ECF), Astrid Manroth (Deutsche Bank), Alejandra Mazariegos (NCE), Will McFarland (ODI), Tim McMinn (PwC), Joshua Meltzer (Brookings), Anna Müller-Debus (ECF), David Nelson (CPI), Måns Nilsson (SEI), Michel Noel (World Bank), Kjell Øren (NHO), Jerónimo Pastor (FDHS), Shilpa Patel (WRI), Sim Paton (United Kingdom), Per Pharo (Norway), Annalisa Prizzon (ODI), Cory Rand (NCE), Melissa Roberts (McKinsey), Nick Robins (UNEP Inquiry), Filippo Rodriguez (NCE), John Roome (World Bank), Jo Scheuer (UNDP), Matthew Scott (Bank of England), Jeff Seabright (Unilever), Nemat (Minouche) Shafik (Bank of England), Michael Sheren (Bank of England), Anushree Shetty (NCE), Zhu Shouqing (WRI), Andrew Steer (WRI), Fiona Stewart (World Bank), Bambang Susantono (ADB), Philippine de T'Serclaes (Schneider Electric), Teng Fei (Tsinghua University), Laura Tuck (World Bank), Anders Turesson (Sweden), Simon Upton (OECD), Pablo Abba Vieira Samper (Colombia), Daniele Viappiani (United Kingdom), Rachel Waddell (NCE), Kevin Watkins (ODI), Ed Wells (HSBC), Michael Westphal (WRI), Shelagh Whitley (ODI), Vikram Widge (IFC) and Simon Zadek (UNEP Inquiry)

Editor: Marion Davis

Designer: Jenna Park

NCE's work on finance is made possible with support from, among others, the government of Norway, the government of Sweden, UK Aid from the UK government, Bloomberg Philanthropies, Children's Investment Fund Foundation, and the ClimateWorks Foundation. The views expressed here do not necessarily reflect the opinions or official policies of these institutions.



THE **NEW** CLIMATE **ECONOMY**

The Global Commission on the Economy and Climate

New Climate Economy

c/o World Resources Institute

10 G St NE

Suite 800

Washington, DC 20002, USA

+1 (202) 729-7600

www.newclimateeconomy.net

www.newclimateeconomy.report

New Climate Economy

c/o Overseas Development Institute

203 Blackfriars Road

London, SE1 8NJ

+44 (0) 20 7922 0300

978-0-9906845-9-6



This work is licensed under the Creative Commons Attribution-NonCommercial-NoDerivative Works 3.0 License. To view a copy of the license, visit <http://creativecommons.org/licenses/by-nc-nd/3.0/>