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

The Global Commission on the Economy and Climate

Working Paper

Ensuring new infrastructure is climate-smart

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CONTENTS

Overview

About US$90 trillion in infrastructure investment is needed globally by 2030 to achieve global growth expectations, particularly in developing countries. To achieve this, infrastructure investment needs to be both scaled up, and, due to climate risk, integrate climate objectives.

Infrastructure investment has become a core focus of international economic cooperation through the G20 and also for established and new development finance institutions. Integrating climate objectives into infrastructure decisions will increase resilience to climate change impacts[1], avoid locking in carbon-intensive and polluting investments, and bring multiple additional benefits, such as cleaner air and lower traffic congestion. Shifting to low-carbon infrastructure could add as little as 5% to upfront investment costs in 2015-2030. These costs could be offset by resulting energy and fuel savings.

A number of institutions have already started integrating climate risk into their investment decisions, but this needs to be done in a far more systematic way, making best practices the norm. For example, several international institutions are working to halt unabated coal project financing, but this effort will need to extend to national development banks and newer multilateral development banks (MDBs).

International finance will also have to be significantly scaled up to deliver the US$90 trillion. This includes increasing capitalisation of both national and multilateral development banks.

The Global Commission on the Economy and Climate recommends that G20 and other countries 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. Governments, development banks and the private sector should cooperate to share experience and best practice in mainstreaming climate into infrastructure policies, plans and projects.

About this working paper

This New Climate Economy Working Paper was written as a supporting document for the 2015 report of the Global Commission on the Economy and Climate, Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate. It reflects the research conducted for Section 2.6 of the full report and is part of a series of 10 Working Papers. It reflects the recommendations made by the Global Commission.

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1. Introduction

Infrastructure is a foundation for economic growth. Robust, efficient power grids, water and sewer systems, transportation systems and communications networks are essential to modern economies and societies. They shape our economies in profound ways, determining whether people drive, walk, cycle or ride public transit, whether we remain dependent on fossil-fuelled power or move towards renewables and enhanced energy efficiency, and whether heavy downpours cause devastating floods or landslides, or storm water is efficiently channeled out to sea.[2]

Better Growth, Better Climate estimated that over the next 15 years, about US$90 trillion in infrastructure investments will be needed in cities, energy and land use systems around the world. These investments will largely determine the path of economic growth and the future of the climate system. Getting infrastructure investment right can provide a foundation for sustained growth and prosperity, while also reducing climate risk. Getting it wrong will waste resources on assets that may be damaged by climate change or devalued or stranded if policy changes, and will increase the risk of severe climate impacts that undermine future economic growth and development.

In recent years, infrastructure investment has become a core focus of international economic cooperation, notably through the G20 and the development finance institutions (DFIs).[3] The G20 established a new Global Infrastructure Initiative (GII) in 2014, along with a Global Infrastructure Hub (GIH) to implement it, with the aim of catalysing both public and private investment. New multilateral and national development banks are being established with a specific infrastructure focus, notably the Asian Infrastructure Investment Bank and the New Development Bank.[4] Yet the G20 Global Infrastructure Initiative largely ignores the close links between infrastructure investment and climate change, as do many national and local government planning processes: too often infrastructure and climate policies exist in separate silos.

However, some institutions are now pioneering new methods of "mainstreaming" climate concerns into infrastructure planning and policy. The multilateral development banks (MDBs) and the International Development Finance Club of national development banks (IDFC) have agreed to work together to develop best practices for "greening" finance, including principles for tracking climate change adaptation finance.[5] In the private sector banks and pension funds are collaborating to boost investment in climate-smart infrastructure–Bank of America's Catalytic Finance Initiative, for example, is collaborating with DFIs, insurers and other financial institutions to develop de-risking instruments for clean energy projects. There is now significant scope for stronger international cooperation, including both among governments and with the private sector, to share best practices and methodologies on the integration of climate into infrastructure investment decisions.

This paper explores how this can be done. It starts by looking at the infrastructure "investment gap" and how the aim of closing it has risen to the top of the international economic agenda in recent years. It then discusses the importance of integrating climate change issues in infrastructure decision-making, and examines how governments, businesses and investors can individually or together help to mainstream climate into infrastructure planning and policies, proposing two principles for climate-smart infrastructure. The final section sets out the Global Commission's recommendations.

2. Infrastructure for growth

Infrastructure investment underpins modern economic growth and development.[6] Increasing such investment, particularly during times of slow economic growth, can raise output in the short term by boosting demand, and in the medium to long term by expanding the productive capacity of the economy.[7] It can help to revitalise cities, connect markets and improve human health. As noted above, about US$90 trillion in infrastructure investment in cities, energy and land use systems is needed by 2030 to achieve global growth expectations.[8] That is equivalent to around US$6 trillion per year, but current annual global investment is estimated at less than half this.[9]

Scaling up infrastructure investment is therefore crucial for growth, but is a challenge for developing and advanced economies alike. Most of the US$90 trillion in investment is needed in emerging and developing economies, where lack of infrastructure can be a barrier to development and sustained growth.[10] The demand for infrastructure investment in these economies is high, driven by maintenance backlogs on existing infrastructure, increased demand for new infrastructure as a result of growing populations and wealth, and the need to adapt to and reduce climate and environmental risks and impacts. It is also a challenge for advanced countries, where much infrastructure is outdated and sometimes decaying due to chronic underinvestment.[11]

Recent analysis by the International Monetary Fund (IMF) finds that low real interest rates and accommodating monetary policy in advanced countries provides particularly favourable conditions for investing in infrastructure. According to the IMF, if advanced economies invested an extra 1% of GDP in infrastructure, they would on average achieve a 1.5% increase in GDP as little as four years later. Investments based on clearly defined infrastructure priorities and efficient procurement processes, the IMF suggests, could be one of the few remaining policy levers available for developed economies to support growth.[12]

The return on investment in emerging and developing economies, and the benefits for productivity and growth, can be even greater if the investments are accompanied by other reforms that increase institutional capacity. Weak institutions have often led to inadequate project selection processes, appraisal techniques and project execution, leading to poor output gains from infrastructure investment and increases in debt-to-GDP ratios.[13] Raising the productive capacity in many developing countries will require a step-change in institutional capacity to deliver investment in infrastructure that is itself of higher quality.

Closing the global infrastructure gap–the difference between current investment and that needed to meet long-term growth aspirations–will require strong political leadership to make this a policy priority. Targeted public fiscal commitments, both within countries and through international finance for developing countries, are needed to support critical infrastructure investments. The public sector plays a key role in providing infrastructure, as these assets typically deliver public goods that are widely used. Even where assets are privately developed, their "public good" role almost always requires some form of state funding, regulation and control. Public funds typically finance the planning and design stages of infrastructure projects, and are also used to leverage the majority of debt and equity finance from private investors. In developing countries, MDBs often play a key role in leveraging private capital at different stages of the project, thus influencing the nature of infrastructure projects.

As the IMF has noted, better involving the private sector can help, where there are public fiscal constraints, generate efficiency gains and increase investment returns.[14] Economic policy-makers eager to scale up infrastructure investment have looked particularly to institutional investors, such as insurance companies, pension funds, sovereign wealth funds and other forms of "patient" capital, on the basis that the stable and reliable returns available from infrastructure investment align well with their long-term financial outlook. Combined, institutional investors in OECD countries alone have more than US$70 trillion of assets under management.[15]

Yet private deployment of capital for infrastructure has been slow for many asset classes, especially in the developing world. *Better Growth, Better Climate* notes that this is not because of any shortage of global capital, but often due to poor "enabling conditions": the investment climate, policies and regulations that make private-sector infrastructure investment bankable. Thus, the report argues that financial innovation is necessary to align the risk profile of assets with the needs of institutional investors.[16] The key priority in economies with low efficiency of public investment should be to raise the quality of this investment.[17]

The global infrastructure gap has pushed infrastructure investment to the forefront of the international growth agenda. The G20 has identified infrastructure finance as a core priority, and traditional DFIs such as the World Bank are being complemented by a number of new development finance institutions with mandates to invest in infrastructure assets. A significant share of global infrastructure investment will occur in the major economies of the G20, which makes the G20's focus timely and appropriate. The G20 has launched a Global Infrastructure Initiative (GII) to support public and private investment in quality infrastructure.[18] It involves voluntary implementation of the G20/OECD High-Level Principles of Long-Term Investment Financing by Institutional Investors.[19]

In 2014, the G20 Leaders committed to establishing a Global Infrastructure Hub (GIH), based in Sydney, with a four-year mandate to help the GII achieve its objectives. It will help to lower barriers to investment, increase the availability of investment-ready projects, match potential investors with projects, and improve policy delivery. It will also help to develop a knowledge-sharing platform and networks between governments, the private sector, development banks and other international organisations, with the aim of improving the functioning and financing of infrastructure markets.[20] The 2015 Turkish Presidency of the G20 has made a focus on closing the infrastructure investment gap a central pillar for the G20 this year.[21]

DFIs have long been a small but important source of infrastructure financing for development, and several have established vehicles to help deploy such financing more widely.[22] For example, the World Bank now hosts the Global Infrastructure Facility (GIF), a platform to facilitate the development of public–private partnerships (PPPs) to mobilise private-sector and investor

capital for infrastructure projects.[23] The GIF is designed to address key weaknesses in the global infrastructure investment model–in particular, the poor public-sector planning and investment processes that lead to large cost overruns; policy risks where the private sector is involved; weak project development capacity, including an inability to negotiate PPPs; and constraints on accessing long-term private finance. The African Development Bank (AfDB) has likewise established the Africa50 Infrastructure Fund, aiming to accelerate Africa's infrastructure development, especially through a focus on project preparation and development, as well as specialised financial tools.[24] It plans to raise US$3 billion in equity capital to begin operations.

New banks with a focus on infrastructure have also emerged, reflecting new forms of international cooperation. The Asian Infrastructure Investment Bank (AIIB) will be a multilateral development bank with the primary aim of providing infrastructure finance across Asia.[25] The New Development Bank (NDB) will have a similar focus and aims to foster financial and development cooperation between five emerging markets: Brazil, Russia, India, China and South Africa.[26] These new institutions have the opportunity to attract new capital from their own regions as well as internationally. In addition to supplementing the concessional capital provided by existing DFIs, they aim to improve the quality of infrastructure projects and their delivery. They also have great potential to improve long-term development trends by aligning their activities and policies with national development plans.

3. Infrastructure and climate change

Deploying the world's next round of infrastructure investment will require more than just scaled-up investment. The kinds of infrastructure assets which get built and–just as important–the ways in which existing infrastructure is upgraded, will critically affect the global response to climate change, in four key ways.[27]

First, the vulnerability of infrastructure to present and future climate change impacts poses severe economic risks.[28] Extreme weather events can lead to the breakdown of infrastructure networks and critical services such as electricity, water supply, and health and emergency services.[29] The infrastructure itself can be damaged, or external impacts can disrupt operations–for example, a power failure or severed IT connections, or transport system disruptions that prevent key staff from getting to work. Insurance now provides crucial protection from the costs and economic losses that can result, but it could become prohibitively costly or be withdrawn if measures to reduce future risk are not taken. Flooding in the UK in 2000 and 2007, for example, led insurers to threaten to withdraw coverage from high-risk areas unless the government increased funding for flood defences and other measures.[30] Some disasters will cause damages that are beyond governments' capacity to prevent and will take years to achieve even an initial recovery–as when Cyclone Pam tore through Vanuatu in March of this year, or when Typhoon Haiyan (Yolanda) struck the Philippines.[31] Even when the damages are manageable, the failure of infrastructure can seriously disrupt economic activity; this is how damages from Hurricane Sandy in the US in 2012 rose to an estimated US$50 billion, as power outages, subway tunnel flooding and other problems persisted well after the storm.[32] State and local officials–most notably the City of New York–have made it a priority to make infrastructure more resilient to future weather events.[33] In the face of rising risks, governments need to ensure that all forms of infrastructure, existing and new, will be resilient to the projected impacts of climate change during their lifetimes.

Second, infrastructure is a key determinant of greenhouse gas (GHG) emissions. Because most infrastructure assets last for 30–50 years or longer, the choices made about infrastructure investment may "lock in" emissions levels for decades. As *Better Growth, Better Climate* notes, choices made over the next 15 years–essentially, whether countries build mostly high- or low-carbon infrastructure—will determine the course of climate change for the next century. This is particularly the case for energy systems, e.g. whether investments are made in coal-fired power or renewables, and for transport and urban design, e.g. whether cities are built in compact and connected forms with good public transport, or exacerbate sprawl and car dependence.

Third, how existing infrastructure is upgraded will also determine the extent of "lock in" to future emissions. Upgrading can involve retrofitting to integrate climate risk and reduce emissions. In buildings, for example, which are the largest consumers of energy worldwide, this can be achieved through better building energy codes that improve energy efficiency, promote energy security and require the use of renewable energy.[34]

Fourth, high-carbon assets are at risk of "stranding"—a decline in asset value due to reduced demand and/or prices for future production. Because infrastructure assets are durable, assets built now will be subject to future climate impacts, resource insecurity, more stringent climate change policies and regulations, and changing social norms and public opinion about high-

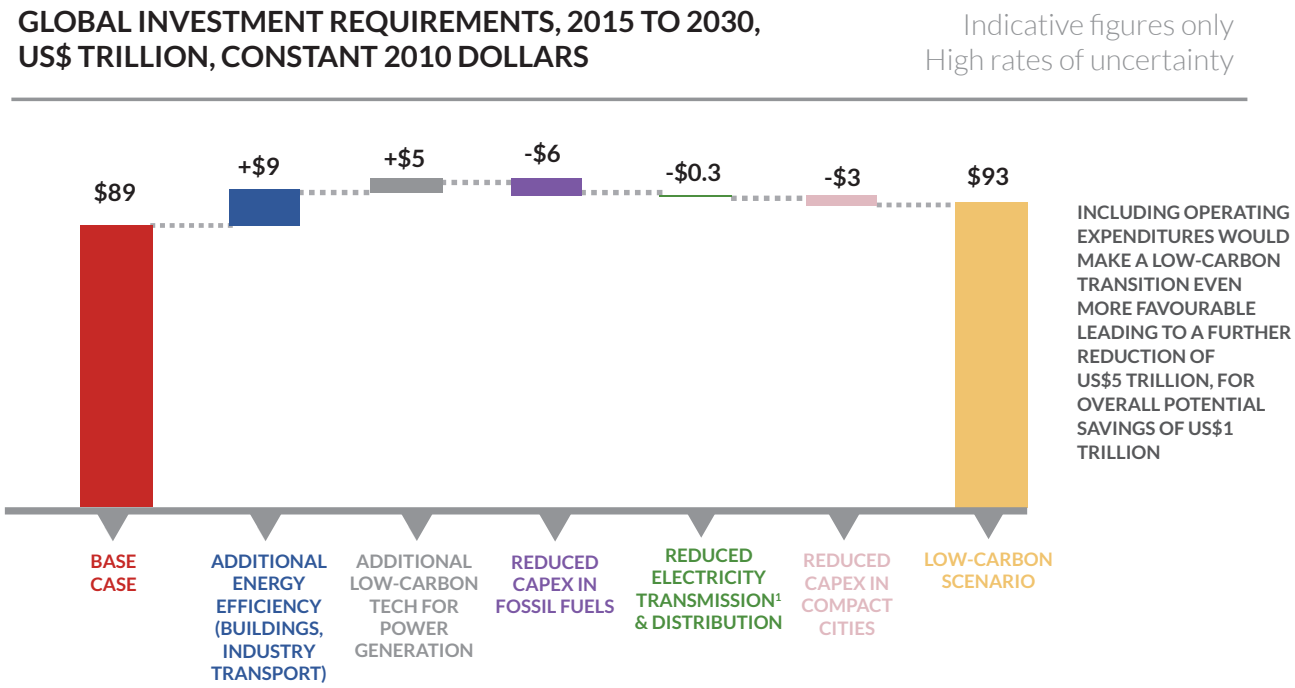
carbon investment.[35] As a result, high-carbon infrastructure could experience unanticipated or premature write-offs, downward revaluations or even conversion to liabilities. Research suggests that these risks are poorly understood and are regularly mispriced.[36] *Better Growth, Better Climate*, for example, estimates that around US$1.1 trillion of energy-sector assets are at risk of stranding if financial markets fail to anticipate the transition to low-carbon energy.[37] Coal mining investments face the majority of lost value. Stranding risks could be significantly reduced by early action to shift to low-carbon development paths, enabling financial markets to reflect future reductions in fossil-fuel use in their investment valuations.

Infrastructure assets that increase dependency on fossil fuels pose particular risks. Not only do they face a high potential for being stranded under future climate policies, but they also create a risk of locking in to increasingly volatile global fossil fuel prices. That volatility itself can hurt growth. Analysis for the Commission examining the recent fall in oil prices finds a substantial "fossil fuel price volatility penalty" on growth.[38] Simply replacing and expanding infrastructure along historical patterns is thus increasingly a risky rather than a safe choice.

3.1 LOW-CARBON INFRASTRUCTURE MAKES ECONOMIC SENSE

Better Growth, Better Climate demonstrates how investing in low-carbon infrastructure can provide attractive benefits for both economic growth and climate change mitigation. Figure 1 illustrates global investment requirements for 2015–2030 in a high-carbon scenario (the "base case" in red on the left of the figure) and a low-carbon scenario (in gold on the right). This shows that the difference in infrastructure investment needs is likely to be relatively modest. A shift to low-carbon infrastructure investments would add about US$4 trillion, or around US$270 billion per year, to the projected global aggregate infrastructure investment requirements to 2030, representing an increase of less than 5%. The reason for the small increase is that the higher capital investment in energy efficiency and low-carbon energy would be largely offset by capital savings from less fossil fuel investment, reduced electricity transmission and distribution, and a shift to better-planned and more compact cities.

Figure 1
Global investment requirements 2015–2030, US$ trillion, constant 2010 dollars



Source: Better Growth, Better Climate.[39]

The additional upfront investment costs will need to be financed. These should not be considered as one-off additional costs but as part of a broader calculation of the net economic cost of the infrastructure investment over its lifetime. Calculating the net economic cost requires consideration of the full range of costs and benefits, including the returns on up-front investments. For example, savings in operating costs once these investments are in place, such as from lower fossil fuel import expenditure and exposure to fossil fuel price volatility, could lead to a further reduction of US$5 trillion, potentially offsetting any additional upfront capital investments. At the same time, much low-carbon infrastructure is associated with wider short- and medium-term benefits, such as better health, resource savings, less traffic congestion, greater security and innovation. These benefits can be substantial. The case for ensuring that new infrastructure and upgrades alike are "climate-smart"—both climate-resilient and low-carbon—is thus very strong.

The challenge of ensuring infrastructure is climate smart is often not economic costs per se, but rather the distribution of costs and benefits among various stakeholders and over time. The transition to low-carbon infrastructure may change who bears the construction and other capital costs, who makes the operating budget decisions, and who realises the benefits of those investment choices. Low-carbon infrastructure also delivers increased benefits and reduced risks for the future. It is important to define how these future net benefits are valued; often high discount rates are used, which result in very low values. There is therefore a strong case here for more innovative valuation methods, including non-linear discounting, where future costs and benefits are weighted more accurately.[40]

4. International cooperation on infrastructure: making it climate-smart

Concern about climate change and stranding risks associated with infrastructure are on the rise. International cooperation provides a crucial vehicle for addressing those concerns, but even as cooperation around infrastructure investment has grown, those efforts have paid little attention to climate issues.

The G20 Global Infrastructure Initiative, discussed in Section 2, is a case in point. It focuses on improving infrastructure quality and delivery, but its mandate makes no mention of climate-related risk.[41] This sends mixed signals to developers and financial institutions. The international community has acknowledged the rising risks of climate change, which has led them to seek a new international climate agreement this year in Paris. Almost all G20 member countries are setting climate targets and developing climate policies ahead of Paris, with the likelihood of stronger policies in the future. Yet at the same time the G20 is pursuing an infrastructure initiative which ignores both the risks of damage to infrastructure assets from worsening climate change, and the potential contradiction between stronger climate policies and a "business as usual" approach to high-carbon investment. This disconnect mirrors the way in which infrastructure policy and planning is separated from climate policy in many countries. They are often treated as different areas of policy, handled by different ministries with different goals, and often with little interaction. This is clearly not sustainable.

Interestingly, the G20 has begun to examine stranding risks in a separate forum. Backed by all its member countries, it has asked the Financial Stability Board (FSB)[42] to conduct a public inquiry into the financial risks from high-carbon investments in a world of more stringent climate policy. This initiative follows concerns expressed by the Bank of England about financial stability risk from "unburnable" carbon.[43] The resulting analysis is to be published later in 2015. There is an obvious inconsistency between the G20's request to the FSB and its lack of consideration of climate risk in its infrastructure programme.

By contrast, MDBs and the broader group of DFIs have begun to examine and tackle the climate implications of their infrastructure investments.[44] But application of best practices remains patchy. While many DFIs have developed climate change policies and practices, and expanded their financing of low-carbon infrastructure, in most cases this has not become central to their core portfolio decisions. Transforming the infrastructure agenda of DFIs, rather than simply adding climate to it, is difficult: it goes to the heart of their fundamental strategies and will involve a much stronger dialogue with the governments with which they work.

DFI commitment to climate-smart infrastructure is particularly ripe for international cooperation. Ultimately, DFIs are tasked with deploying public financial capital to foster development, primarily in the form of concessional and other debt financing of public and private borrowers. Many, particularly the MDBs, have recognised the importance of climate change to their work. Many MDBs fear, however, that a more aggressive low-carbon portfolio would face inadequate demand from borrower countries.

Cooperation can lead to a "race to the top". Many DFIs already have policies and methodologies that seek to mainstream climate change considerations. Several, such as the World Bank, the European Investment Bank (EIB) and the European Bank for Reconstruction and Development (EBRD), are now committing to halting unabated coal project financing, for example. But no one institution reflects all best practices. MDBs have worked together in this field for some years, but their efforts will need to extend to national development banks and new entrants such as the AIIB and NDB. Making best practices the norm, across all DFIs old and new, national and multilateral, will help to ensure that all capital is deployed towards low-carbon investments. Progress is already being made: for example, as noted above, the MDBs and the IDFC, a network of national and sub-regional development banks, have agreed to work together to track and develop best practices for greening finance.[45]

DFIs and governments could also work more closely with the private sector. Parts of the private financial sector are seriously evaluating the risk of stranded assets from investment in the production of "unburnable" fossil fuels.[46] Private investors are also calling for greater policy clarity, which must ultimately come from the governments such as those represented in the G20, and concessional financiers such as the MDBs.

Collaboration with the insurance industry, which has much at stake from climate risk, could be particularly beneficial for governments. In 2014, Chief Executives from 60 leading insurers committed to a set of principles guiding their contributions to global efforts to tackle climate risks.[47] The insurance sector is already a leader in analytical techniques, data requirements and platforms to assess risk, and is now funding research to assess and manage climate risk.[48] Insurers are using variable premiums in some regions to motivate investment in risk reduction.[49] These tools and techniques could be adapted to infrastructure valuation and debt pricing in the context of financing. There is considerable opportunity for governments and DFIs to collaborate to learn about and apply this work.[50]

4.1 TWO HIGH-LEVEL PRINCIPLES FOR CLIMATE-SMART INFRASTRUCTURE

Ensuring that infrastructure investments around the world take climate change considerations into account will require rethinking how infrastructure policy and plans are made, and how individual projects are designed and assessed. This will be done differently in different countries and different financial institutions. But it could be assisted by the widespread adoption of two clear and simple high-level principles which would serve to make the connections between infrastructure and climate change explicit:

1. All infrastructure policies, plans and projects should build in resilience to the risks of climate changes projected during their lifetimes.

2. All infrastructure policies, plans and projects should be consistent with countries' adopted climate targets and policies and long-term ambitions, and able to be justified in the context of the global long-term goal of holding average global warming to under 2°C.

These principles should not in themselves be controversial, since they reflect the scientific consensus and commitments that almost all governments and public authorities have accepted. If adopted and followed, these guidelines would help to ensure that climate risk and climate policy were more properly integrated into future infrastructure decisions. They can be made operational by explicitly assessing infrastructure policies, plans and projects for consistency with adopted climate policies, against likely future policy needed to meet long-term targets, against lifetime emissions and the risks of "carbon lock-in", and against projected climate change risks.[51] We discuss some ways in which this can be done below.

These principles are particularly relevant for governments, DFIs and other public institutions and financial vehicles deploying public capital, where there are clear public service and development mandates; there are clear benefits for social well-being and development from adopting these principles. For example, low emission transportation models can have positive effects on air quality and the health of urban populations. Similarly, resilient infrastructure (such as hospitals and schools) that can withstand climate disasters can reduce fatalities and injury from increasing climate hazards. Public-sector capital deployment should be carefully allocated to provide these long-lasting public economic benefits, and to send clear and credible signals to the private capital it aims to leverage. In particular, it would be sensible for the principles to be adopted by the G20 as part of its Global Infrastructure Initiative and its other related programmes, such as the voluntary G20/OECD High-level Principles of Long-Term Investment Financing by Institutional Investors, and the G20 Climate Finance Study Group.[52] They would also be appropriate for adoption by multilateral development banks (including new entrants such as the AIIB and NDB, national development banks and sovereign wealth funds).

These principles could also usefully steer the decisions of private investors, particularly those considering medium- and long-term structural risk to project assets and portfolios, and those seeking ways to enhance long-term value creation.[53] While much private capital looks for returns on a time horizon misaligned with longer-term climate risks, private investors with longer time horizons might use these principles to ensure that owned assets and portfolios appropriately manage climate risks. Other private capital with shorter time horizons, such as equity and bond portfolios, might also find these principles useful to guide their investment decisions as markets shift.

4.2 PUTTING CLIMATE-SMART PRINCIPLES INTO PRACTICE

Ensuring that infrastructure decisions are made with a proper consideration of climate risks will require governments, DFIs and the private sector to review their current approaches to infrastructure planning and project assessment. Fortunately, a body of good practice in this field has begun to emerge in recent years as various institutions around the world have begun the process of mainstreaming climate issues, taking them out of specialised policy-making silos and integrating them into core decision-making processes. However, no single institution would claim yet to have addressed all the issues or "solved the problem" of integrating climate and other objectives. There is therefore a huge opportunity for enhanced international cooperation to disseminate existing models and develop a body of best practice, which in time might become a set of widely accepted norms and rules. This would now be an appropriate focus for the G20 Infrastructure Initiative and its Hub secretariat, building off the cooperation already established between MDBs and the IDFC.

Integration of climate-smart principles into infrastructure decision-making needs to happen at three levels: in the design and alignment of overall strategy and policy; in the composition and balance of infrastructure plans and portfolios considered as a whole; and in relation to individual projects. Each is discussed, in turn, below.

The design of policy frameworks that influence and incentivise construction and investment decisions are particularly crucial for the kinds of infrastructure that gets built. Governments can create a supportive enabling environment for climate-smart infrastructure through strong policies and regulations. Organisations such as the United Nations Development Programme (UNDP) are actively working with governments to strengthen policies and legislation, for example on building codes for energy efficiency and disaster risk resilience.[54]

As *Better Growth, Better Climate* argued, inconsistency and poor alignment between government policies is a major source of uncertainty among investors, inhibiting investment and raising the cost of capital. The report calls for a number of core policies which would help set the framework for lower-carbon and climate-resilient infrastructure decisions, including the introduction of strong and predictable carbon prices.

The OECD and its partner organisations have now developed this theme, publishing a major study on how policy in many countries sends inconsistent signals in relation to climate outcomes. These include conflicting incentives in financial regulation, competition, trade, tax and innovation policies, as well as insufficient coordination between different levels of government. The study argues that greater alignment and integration of government policies can greatly enhance the achievement both of climate and wider economic and social policy objectives.[55]

There is a particular need to ensure that the national and international regulation of the financial system does not inhibit low-carbon and climate-resilient investment by the private sector. It would now be sensible for climate-smart infrastructure to be defined as an asset class in financial and prudential regulations such as Basel 3 and Solvency 2 regulations. At the same time better data are needed on infrastructure risks, costs and performance.[56]

The finance sector also needs to reassess how it accounts for natural disaster risk in asset valuations, loan books and in real estate. With the accelerating risk of natural disasters, insufficiently taking climate change into account will lead to rising financial system risk. Financial regulators could for example require public companies to publish their maximum probable annual losses to natural disasters against their current assets and operations using a "1 in 100" test. Investors could then be encouraged to better evaluate risk and encourage companies to make their assets climate-smart.

Specialist infrastructure planning and financing institutions with a specific climate-smart remit can help to integrate climate into infrastructure investment decisions.[57] Two examples are the Green Investment Bank in the UK, and the Clean Energy Finance Corporation (CEFC) in Australia. It is notable that the CEFC's current portfolio is expected to earn a return of about 7%, around double the Australian Government's five-year bond rate. The investments, once constructed and operational, are expected to

cut emissions by more than 4.2 million tonnes of carbon dioxide equivalent (Mt CO2e) per year, at a net gain of AUD$2.40 per tonne.[58] These and other specialist institutions offer valuable lessons for DFIs and governments elsewhere.

Another key task at national level is the development and publication of infrastructure pipelines–forward projections of infrastructure needs and project options and proposals. This is done, for example, by the UK Government.[59] These can help to establish a clear framework of expectation and future opportunity for investors. They can also allow public assessment of projects for resilience to climate risk and compatibility with climate policies, and against the risk of carbon lock-in and asset stranding.[60] In many developing countries, there remains a crucial role for technical assistance from DFIs and other partners to help develop pipelines of future infrastructure projects.

It is important in these national policy processes that the definition of "infrastructure investment" is broad enough to allow consideration of the full range of policy options. For example, energy efficiency measures are often the most cost-effective way of meeting rising energy demand,[61] so they need to be considered along with supply infrastructure investments. By reducing the need for new supply, energy efficiency measures can free up valuable capital for more productive uses, including operation and maintenance of existing assets. Many US states permit utilities to recoup the value of energy efficiency investments, so-called "negawatts", as the equivalent of increased supply, and the UK has piloted a similar approach.[62] Plans and policies that reduce demand for infrastructure services in these ways–other examples arise with water supply and transport–should therefore be valued and accounted for against infrastructure investment benchmarks and targets.[63]

Integrating climate-smart principles at the level of infrastructure plans and portfolios requires the use of strategic assessment frameworks and processes. A number of DFIs and some government departments around the world have developed processes and methodologies for "mainstreaming" climate into their strategies, including the World Bank, the EBRD, the EIB, the Inter-American Development Bank (IDB), the African Development Bank (AfDB), the South African Development Bank and the German development bank KfW.[64] Most of these are relatively new, and there is currently little consistency between them, but together they are building a body of knowledge and experience. It is important to assess these approaches, and identify and disseminate best practices.[65]

One specific approach to encourage a shift to a pipeline of projects that support the low-carbon transition is the EBRD's Sustainable Energy Initiative. This provides financing and local capacity-building to develop and lend to a high-quality pipeline of energy efficiency and renewable energy projects. In this way, project evaluation is situated within a larger context of economic transition, rather than evaluated on its own.[66] The EIB has published an Environmental and Social Statement and Handbook to operationalise its commitment to only finance projects that are consistent with its climate compatibility requirements. KfW requires monthly reporting to the Board on progress against climate targets.[67] The AfDB has a high-level commitment to support the transition to green growth as one of its two 10-year strategic objectives: the effects of this are still working their way through the bank's operations.

In general, where climate has been reflected in the agreed strategic direction of DFIs, the outcome has been the setting of aspirational commitments to devote a growing share of their portfolios to "climate investment".[68] The MDBs and national development banks are now collaborating on how to measure and track climate-related investments to ensure that these goals can be monitored.[69] As the focus increasingly moves away from specific climate projects towards ensuring that the entire infrastructure portfolio of DFIs is climate-smart, this will become particularly important.

Nevertheless, most of these institutions would acknowledge that strategic, portfolio-level evaluation is challenging. Many current practices look only at project-level interventions, which then become difficult to evaluate against overall strategies and objectives. Many DFIs, for example, use climate mainstreaming as part of a framework for project safeguards, focused on minimising the harms of an existing pipeline, and avoiding specific types of projects, such as coal-fired power stations. This is important, but it does not actually ensure that an alternative low-carbon pipeline of projects is developed and financed. (Emissions Performance Standards, which are one level above project safeguards, can be effective here in avoiding specific, high-risk projects.) The full implications of investment choices only become clear when they are examined within the larger context of alternative development pathways. This requires portfolio-level analysis and strategy.[70]

For DFIs, operating within the constraints of government policy, more systematic, strategic shifts will require a challenging dialogue with national governments whose current development plans follow high-carbon development models. Several cooperative initiatives are designing methodologies to more systematically assess how overall infrastructure plans and

portfolios measure up against long-term goals. The NewClimate Institute is leading a consortium composed of Germanwatch, the 2°C Investing Initiative and McKinsey & Company to develop criteria and a toolkit for public and private investors to align their day-to-day investment decisions with a 2°C pathway.[71] Another consortium, including the OECD, IEA, Climate Bonds Initiative, the 2°C Investing Initiative, WWF/Credit Suisse, Mercer, Ceres and the Smith School of Enterprise and the Environment, is developing an assessment framework for financial institutions to measure their performance and set progress targets against energy transition roadmaps such as those developed by the IEA.[72] All these tools are likely to use long-term decarbonisation pathways and various indicators to help determine whether individual plans or ongoing projects are consistent with long-term collective goals.[73]

Once a high-level strategic direction is set, a range of methods and instruments are available to mainstream climate at the project level. These techniques are reviewed in several studies[74] and can be broadly grouped into three categories: technical assessment, where technological and process options and alternatives are considered that will achieve the project aim; economic assessment, which involves measuring the net impacts of the project on welfare; and financial assessment of the costs and revenues of the project.[75] Box 2 offers some examples.

Box 1
Examples of best practice in project-level assessment

At the *technical assessment* stage, the EIB established a quantitative Emissions Performance Standard (EPS) that only permits the financing of power projects that emit less than 550g CO_2/kWh. The IDB has "no-go" criteria for certain projects, including coal-fired power plants. Assessments of climate risk and resilience are also done at this stage. The Asian Development Bank (ADB) has guidelines for climate-proofing across a range of sectors, including agriculture, energy and transport. The EIB and the EBRD have guidelines and toolkits to ensure climate resilience.[76] Guidance documents and processes for more tailored evaluations can be important, particularly because they signal an in-house capacity to evaluate the climate implications of projects, but they are more malleable and risk failing to induce shifts in capital allocation.

Economic assessment involves an assessment of a project's impact on welfare, primarily through cost–benefit analysis. Incorporating climate into assessment methodologies involves introducing a social cost of carbon; calculating estimates of GHG emissions; considering resource use, including energy; and any other relevant metrics.[77] The US government's latest estimate of the social cost of carbon is US$36 in 2015, rising to US$50 in 2030. US government agencies are advised to use this price in cost–benefit analysis of regulatory actions that affect emissions.[78] This requires a reliable estimate of a project's lifetime GHG emissions impact. Similarly, the EIB has developed an approach to estimating a project's carbon footprint, and integrates the results in the economic evaluation of the project[79] Several other institutions have developed GHG measurement methodologies as well, including the ADB, KfW, IDB, the World Bank and the EBRD. A framework for harmonising emissions reporting and accounting is being developed.[80] Methodologies and findings need to be publicly available and transparent, to ensure consistency, accuracy and comparability.

Best practice at the *financial assessment* stage involves considering climate in the analysis of the project owner's costs and revenue streams. There is a strong case for all DFIs to conduct a full financial analysis, particularly when public funds or a state guarantees are involved. The analysis may consider the potential impact of future policies, such as carbon pricing and fossil fuel subsidy reform, stranded asset risks, and risks from future climate change (e.g. if a coastal road would be flooded by rising seas). Where assets have a carbon impact, a carbon price should be applied (the market price or a shadow price).[81] The EIB, for example, uses a shadow carbon price of €30 per tonne of CO_2, rising to €50 in 2030. However, in cases where there are split incentives (such as buildings that will not be occupied by the developers) or where the GHG impact is indirect (such as with grid infrastructure), then it is not clear that a carbon price sends a sufficient signal.[82] This highlights the importance of ensuring that countries have low-carbon development strategies in place that send more complete signals to guide system-wide infrastructure choices.

Progress has also been made towards ensuring that infrastructure plans and projects are resilient to the risks of projected climate changes during their lifetimes. An Economics of Climate Adaptation (ECA) methodology has been developed by Swiss Re and others to help decision-makers understand the climate risk in their region and design adaptation strategies.[83] The framework consists of an adaptation cost curve, based on a cost–benefit analysis showing the investments and measures most feasible and cost-effective for adapting to expected climate risks. It is claimed that the cost-effective measures identified could avoid more than 65% of future climate losses, with (re-)insurance mechanisms able to cover much of the remaining risk.[84] Around 20 ECA case studies focusing on infrastructure have been completed since 2009.[85] The methodology has been applied to help in building a climate-resilient US Gulf Coast energy system.[86]

5. Conclusion and recommendations

Infrastructure is critical both to future economic growth, and to the trajectory of emissions and climate change. Yet public- and private-sector actors continue to make infrastructure investment choices without adequately considering climate issues. This neglect creates significant economic risks, including the potential for stranded assets, lock-in to fossil fuels with volatile prices, and exposure to future climate change impacts that may damage or disable infrastructure. Many institutions are starting to examine and correct this disconnect between climate and infrastructure policies and decision-making, but there is a need for greatly enhanced international cooperation to establish and apply best practice consistently. There are major advantages in getting governments, development finance institutions and the private sector to think about this together rather than individually.

The Global Commission on the Economy and Climate therefore recommends that the G20 and other governments and development finance institutions should adopt, and encourage the private sector to adopt, two key high-level principles for ensuring that climate change is mainstreamed into infrastructure investment decisions:

1. **All infrastructure policies, plans and projects should build in resilience to the risks of climate changes projected during their lifetimes.**
2. **All infrastructure policies, plans and projects should be consistent with countries' adopted climate targets and policies and long-term ambitions, and able to be justified in the context of the international long-term goal of holding average global warming to under 2°C.**

The Commission recommends in particular that these principles are adopted by the G20 in the mandates of the G20 Global Infrastructure Initiative and Global Infrastructure Hub, and in its associated programmes such as the voluntary G20/OECD High-level Principles of Long-Term Investment Financing by Institutional Investors, and the G20 Climate Finance Study Group. The Global Infrastructure Hub should be given the responsibility to identify, evaluate and disseminate within the G20 and more widely good practice in the integration of these principles into infrastructure decision-making.

The Commission further recommends that:

- All DFIs, both multilateral and national, seek to undertake a board-level evaluation of existing climate mainstreaming and integration practices against these principles. This evaluation could involve adoption of Recommendation 5 of the 2015 Canfin-Grandjean report, which suggests that DFIs "develop a '2°C investment roadmap' compatible with the 2°C limit". Such a roadmap would specify how the development banks intend to contribute to the fulfilment of the 2°C limit agreed to by the international community.[87]
- Together the DFIs expand on their current forms of cooperation on climate finance to develop and share best practice around methods, policies and approaches for mainstreaming climate into infrastructure investment decisions. In doing this, they should seek to collaborate with the new development banks (notably the AIIB and NDB) and with other international organisations and groups such as the OECD, the IDFC,[88] the United Nations Environment Programme Finance Initiative (UNEP FI), and private-sector associations.
- Private sector actors involved in infrastructure development examine their operating policies and practices in the light of these principles, through associations of investors such as Ceres, the Institutional Investors Group on Climate Change and the International Project Finance Association (IPFA).
- National and international financial regulators review their financial and prudential regulations to ensure compatibility with the goals of financing climate-smart infrastructure. This would help to address key barriers to greater institutional investment in infrastructure.

Endnotes

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12 IMF, 2014. Is it time for an infrastructure push?

13 IMF, 2014. Is it time for an infrastructure push?

14 IMF, 2014. Is it time for an infrastructure push? The IMF also warns, however, that "public-private partnerships can also be used to bypass spending controls, and governments can end up bearing most of the risk involved and facing potentially large fiscal costs over the medium to long term" (p.77). High fiscal transparency is thus critical, the IMF finds.

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ABOUT 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.

In September 2014, the Commission published *Better Growth, Better Climate:* The New Climate Economy Report. Since then, the project has released a series of country reports on the United States, China, India and Ethiopia, and sector reports on cities, land use, energy and finance. In July 2015, the Commission published *Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate.* It has disseminated its messages by engaging with heads of governments, finance ministers, business leaders and other key economic decision-makers in over 30 countries around the world.

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