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FINANCING LOW CARBON, CLIMATE RESILIENT INFRASTRUCTURE:

THE ROLE OF CLIMATE FINANCE AND GREEN FINANCIAL SYSTEMS

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Global Economy
and Development
at BROOKINGS

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THE ROLE OF CLIMATE FINANCE AND GREEN FINANCIAL SYSTEMS

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EXECUTIVE SUMMARY

The role of climate finance in low-carbon climate resilient infrastructure

Over the next 15 years (2015-2030) the world will need to build on the order of US$75-$86 trillion in infrastructure—approximately double the estimated $50 trillion stock of infrastructure. This increases to $116.55 trillion once investments in energy efficiency and primary energy are included. Around 70 percent of these infrastructure needs will be in emerging markets and developing economies (EMDCs).

Yet, approximately 70 percent of greenhouse gas GHG emissions come from infrastructure such as electricity generation, transportation, industry and buildings. Infrastructure is also central to how societies adapt to climate change. As a result, building the same infrastructure as before—high carbon infrastructure such as coal-fired power stations, low energy efficiency buildings, and more roads to congested cities, will lock the world into a high carbon path that would all but guarantee that the goals agreed at the Paris climate summit of keeping global temperature increases below 2 degrees Celsius and of enabling communities to adapt to climate change will not be met.

Bad infrastructure also kills—it increases air pollution, exacerbates urban congestion, and degrades the environment. This underscores the importance of building low-carbon climate resilient infrastructure (LCR).

Moreover, climate change will have a disproportionate impact on the poorest and most vulnerable communities. This makes building LCR infrastructure also necessary in order to prevent a reversal of the development gains made thus far.

In this paper, LCR infrastructure is a subset of overall infrastructure and comprises “core” infrastructure needs—power, transport, and water/sewage as well as investments in energy efficiency. Between 2015–2030, infrastructure needs in these LCR areas is over US$52 trillion. However, the net (or incremental) cost of

building LCR infrastructure is only $4.1 trillion. This comprises $13.5 trillion in additional infrastructure investments above business-as-usual in energy efficiency and low carbon technologies less savings that arise from less being invested in fossil fuel energy sources and in upstream oil, coal and gas. Moreover, the incremental LCR infrastructure need of $4.1 trillion does not factor in expected reduced operating expenses from low carbon technologies such as renewables, which could reduce operating expenses by a further $5.1 trillion (NCE 2014). As a result, building the needed LCR infrastruc-ture need not be growth constraining.

While the net costs of building LCR infrastructure are low and potentially net positive, there are significant financing challenges as the costs and savings are realized by different actors over time. Instead, the real challenge is to finance the upfront $13.5 trillion in additional LCR infrastructure investment—approximately $900 million per annum.

The size of the LCR infrastructure investment need plus constraints on public sector balance sheets mean that private capital will need to play a key role in financing such investments. In fact, private capital could provide up to half of the finance needed to build the LCR infrastructure.

However, there are challenges to mobilizing the capital needed to meet these LCR infrastructure needs. Infrastructure projects generally face significant financing barriers, due to high upfront capital costs and long-term payoffs that increase the cost of capital and reduce its availability. High transaction costs, lack of viable funding models and exposure to political risk are other barriers that increase the risk of investing in infrastructure.

There are also a range of financing barriers specific to LCR infrastructure projects, particularly in EMDCs. These include uncertainties around the impact of climate change, the higher risk from investing in low carbon technologies and even higher upfront capital costs for LCR projects, such as renewable energy compared with fossil fuel alternatives.

There are also policy barriers to LCR infrastructure. The main ones are continued fossil fuel subsidies as well as the absence of a carbon price.

To address the financial barriers, public concessional climate finance has a particularly key role as a low cost source of finance which, when blended with other sources of public finance, can de-risk LCR infrastructure projects and crowd-in private finance. Concessional climate finance is especially needed at the early project preparation and construction phases of LCR infrastructure projects, where risks are highest and capital most costly and scarce. Once LCR projects commence operation and generate returns, risks are reduced and these projects can be securitized and sold to institutional investors looking for low-risk and stable returns. The higher-risk early-stage concessional climate finance can then be recycled into other LCR infrastructure projects.

Most concessional public climate finance is provided as part of developed countries' climate finance pledge to provide $100 billion per year by 2020. The Paris climate change agreement confirmed this climate finance goal and extended it out to 2025. In 2014, approximately $61 billion of this $100 billion goal was provided, 71 percent of which was from public sources.

Entities such as the Green Climate Fund (GCF) and the Global Environment Facility (GEF) have been important vehicles for delivering concessional climate finance and are the designated multilateral climate funds servicing the parties to the UNFCCC. The Climate Investment Funds (CIFs) have also operated alongside the MDBs to finance LCR infrastructure.

The future of the CIFs remains uncertain, as they were originally to be phased out following establishment of the GCF. Yet, the track record of the CIFs working with the MDBs to co-finance LCR infrastructure has demonstrated their continued usefulness. Also, the CIFs cannot be easily replicated by the other funds, given their different governance structures. Continuation of the CIFs would underpin the MDBs' commitments to expand climate investments. However, to be even more effective, improved coordination amongst these climate funds, including better sharing of lessons learned, is required.

There are a number of ways in which concessional climate finance should be used to develop financing packages that maximize private sector participation. They include:

- Developing enabling environments for LCR infrastructure projects, including appropriate tax regimes and investment protections. More broadly, climate finance can support linking countries infrastructure plans with their efforts to address climate change as reported in their Nationally Determined Commitments (NCDs) under the Paris Agreement.

- Developing co-financing packages, particularly with the MDBs that de-risk LCR infrastructure projects, reducing the cost of finance, and expanding opportunities to leverage private-sector investment.

- Supporting local banks in developing countries in particular, given that LCR projects will predominantly rely on domestic finance.

- Developing financial instruments such as green bonds linked to LCR infrastructure projects that can attract institutional investments.

- Supporting LCR infrastructure for adaptation purposes (in some cases that will include private sector projects such as risk capacity insurance).

Greening the financial system to support private sector investment in LCR infrastructure

The greening of the financial system is needed to create the incentives to support increased private sector investment in LCR infrastructure. The financial system is the main mechanism for allocating private capital into productive investments: therefore, from an allocative efficiency perspective, the system needs to ensure that the allocation of capital better reflects the social costs of GHG emissions. Success here should result in the reallocation of private sector capital away from carbon-intensive investments and towards LCR infrastructure projects.

Greening the financial system requires a number of reforms. Requiring the financial sector to appropriately account for climate risk is the most significant reform needed. This will require action by all relevant actors—banks, securities markets, institutional investors, ratings agencies, regulatory bodies and central banks and the G20.

Incorporate Climate Risk into investment decisions: various voluntary frameworks have already been developed for reporting climate risk. These are important first steps however evidence suggests that this has had little appreciable impact on financing and investment decisions so far. More is needed. The main reforms identified are the following:

- Have mandatory disclosure by companies and investors of their exposure to climate risk including more consistency of reporting, better information of the risks to companies and whether companies have in place appropriate contingency plans.

- Ensure that accounting for climate risk is readily understandable and useful for investors. Companies should be required to identify strategies for responding to climate risk.

- Stress test financial assets and business plans against different climate outcomes and their impact on government policy.

- Incorporate climate risk into sell-side research.

Action by Financial Regulators: Mark Carney Governor of the Reserve Bank of England has argued that financial prudence requires greater regulation given the potential risks of climate change for company balance sheets and financial stability more broadly. Central banks also have a role to play. In countries such as China, Bangladesh and India, central banks are greening their financial systems by requiring banks to integrate environmental considerations into the lending decisions. Additional reforms could include:

- Have financial regulators address the potentially systemic financial risks posed by climate change, building on the work of the G20 Financial Stability Board.

- Require banks to incorporate climate risk into their credit risk management processes.

- Central banks should also consider supporting the green bond market by including green bonds in their reserve requirements for the financial sector.

Another set of financial reforms could include establishing green banks. For example, the UK Green Investment Bank has shown how small amounts of public finance can be used to leverage private capital into climate change investments while delivering a return on capital.

Develop innovative financial instruments: the development and scaling of green financial instruments such as green bonds and YieldCos are needed to provide avenues for private sector investment into LCR infrastructure projects. Green bonds have grown from less than $1 billion in 2007 to over $41 billion in 2015. Further reform is needed to develop and scale these financial instruments:

- Formulate and agree common global green bond standards for assessing what constitutes green projects and how to measure outcomes.

- Develop green stock market indices for LCR infrastructure projects.

1. INTRODUCTION

As the most recent IPCC report concludes, "warming of the climate system is unequivocal." The IPCC also finds that "human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history" (IPCC 2014). The IPCC concludes that it was "extremely likely" that more than half of the observed increase in global warming from 1951-2010 was caused by anthropogenic increases in GHG emissions (ibid).

A central finding of scholars from Brookings, New Climate Economy and the Grantham Institute for Climate Change has been that the agendas of sustainable development and ending poverty, as well as that of tackling climate change are so deeply intertwined that they will succeed or fail together (Bhattacharya, Oppenheim and Stern 2016). Linking these agendas is sustainable infrastructure, given its impact on economic growth, poverty and social development. This paper focuses on low carbon climate resilient (LCR) infrastructure; a subset of sustainable infrastructure that reduces greenhouse gas emissions and is climate resilient. For example, LCR infrastructure such as better roads or access to water will affect how societies adapt to climate change. In addition, as approximately 70 percent of greenhouse gas emissions are related to traditional infrastructure, failure to build LCR infrastructure will lock the world into a high carbon path. Such a trajectory would be incompatible with achieving the Paris Agreement's goal of keeping global average temperature increases well below 2 degrees Celsius.

Building LCR infrastructure is also needed from a development perspective. For instance, building climate resilient infrastructure helps societies adapt to climate change, particularly in EMDCs where the LCR infrastructure needs are highest and the impacts from climate change will be most keenly felt. Infrastructure that reduces greenhouse gas emissions helps avoid the negative developmental outcomes of climate change. In addition, infrastructure such as renewable energy will reduce pollution and its negative impacts on health.

To meet global infrastructure needs between 2015 and 2030, spending on infrastructure will need to increase from current levels of around $3 trillion a year to over $6 trillion in 2030. This increases to $8 trillion a year once investments in energy efficiency and primary energy are included.

Addressing this infrastructure gap will require increased finance, particularly from the private sector given the size of the funding shortfall and rising constraints on public sector balance sheets.

There are various barriers to financing LCR infrastructure. On the policy side, these include the absence of a carbon price as well as pervasive subsidies for fossil fuels. Financial barriers, which are the focus of this paper, are considerable and need to be addressed if the global LCR infrastructure needs are to be met.

Financing barriers are pronounced for most infrastructure projects which require significant upfront capital costs and have long repayment periods. The upfront capital costs needed for LCR infrastructure are often higher and there are additional risks of investing in LCR infrastructure projects arising from factors such as technology-related risks, all of which raises the cost of financing. As a result, public finance is often needed to de-risk, reduce the cost of finance and crowd-in private sector finance.

Part two outlines LCR infrastructure needs from 2015 to 2030. Part three analyzes the implications of the 2015 Paris climate change outcomes for climate finance. Part four provides an overview of available climate finance, where this finance is coming from, and how it is

being used. Part five discusses how climate finance can be most effectively used to finance LCR infrastructure projects, with a focus on the role of multilateral climate funds. Part six explores efforts to increase private sector investment in LCR infrastructure projects by greening financial systems to ensuring that financial systems accurately account for climate risk and allocate capital consistent with broader climate change goals.

2. INFRASTRUCTURE, CLIMATE CHANGE AND DEVELOPMENT OUTCOMES

2.1 The Impact of Low Carbon, Climate Resilient Infrastructure on Climate Mitigation

Infrastructure investment and use have a significant impact on global greenhouse emissions. Approximately 70 percent of greenhouse gas emissions are from infrastructure such as power plants, buildings and transport. Moreover, nearly two-thirds of all carbon emissions can be attributed to the energy sector (IEA 2012). These emissions are largely from consumption of fossil fuels in power, transportation and industrial sectors (IEA 2012). Meeting the below 2°C goal will require a reallocation of investments away from carbon-intensive power generation and toward renewable energy and end-use efficiencies (GCEC 2014, IEA 2014).

2.2 Low Carbon, Climate Resilient (LCR) Infrastructure and Climate Adaptation

Investments in LCR infrastructure are vital to successful adaptation to the inevitable impacts of climate change. At the same time, adapting to climate change remains inextricably linked to sustainable development (IPCC 2014). Adaptation through sustainable infrastructure helps build resilience of vulnerable communities and provides protection against exposure to extreme climate events. Given the disproportionately greater exposure of the poorest communities to climate change impacts (IPCC 2014, Granoff et al. 2015, Burke et al. 2015, Nakhooda and Watson 2015), building LCR infrastructure is also crucial for preventing a reversal of the development gains made thus far.

This link between adapting to climate change and other development goals is reflected in the Sustainable Development Goals (SDGs). The SDGs recognize that climate change will exacerbate poverty and that ex-

Box 1 Greenhouse Gas Emissions from Energy

Power: Electricity generation, including transmission and distribution, make up nearly a third of total greenhouse gas emissions (IEA 2012). Investments in power generation efficiency, fuel switching, nuclear power development, renewables and Carbon Capture and Storage (CCS) can help reduce total emissions in the sector by range 40-50 percent (IEA 2012).

Buildings: Emissions from buildings (commercial and residential) make up a fifth of the total global energy-related emissions (IEA 2012). Investments in more energy efficient building envelopes, heating ventilation and cooling (HVAC) systems, lighting and appliances can help halve total emissions by 2050 (IEA 2012).

Transportation: Fossil fuel consumption in transportation is a major contributor to carbon emissions, accounting for nearly one fifth of global emissions (IEA 2012). It is estimated that investing in better end-use fuel and electricity efficiency in transport use can help cut emissions in the sector by nearly 30 percent by 2050 (IEA 2012).

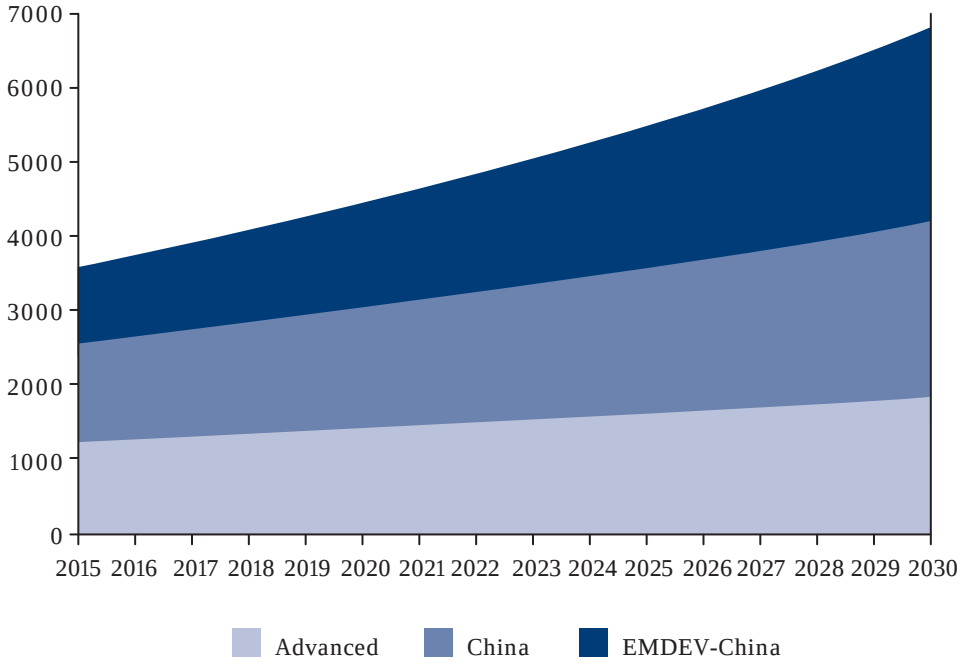
treme climate disruptions have the potential to undermine many of the other SDGs (UNGA 2015). According to estimates based on current emissions, the impacts from climate change may push up to 720 million people into extreme poverty between 2030 and 2050 (Granoff et al. 2015). The World Health Organization estimates that, already, approximately 150,000 deaths per year are attributable to anthropogenic climate change, a number projected to rise to 250,000 deaths per year by 2030 (WHO 2016). The vast majority of such climate change-induced deaths are expected to be in developing countries.

2.3 Infrastructure Needs

The US Council of Economic Advisors defines infrastructure as "fixed capital assets that are consumed jointly in various production processes that facilitate and support economic activity, with 'core' infrastructure referring to roads and other transportation facilities, power generation facilities and distribution networks, and water and sewer systems" (COEA 2016). The New Climate Economy includes all of these sectors as well as telecommunications, but also includes primary energy generation and investments in energy use. Given the importance of investments in energy efficiency for climate outcomes, this paper's calculation of LCR infrastructure needs includes low-carbon "core infrastructure" plus investments in energy efficiency.

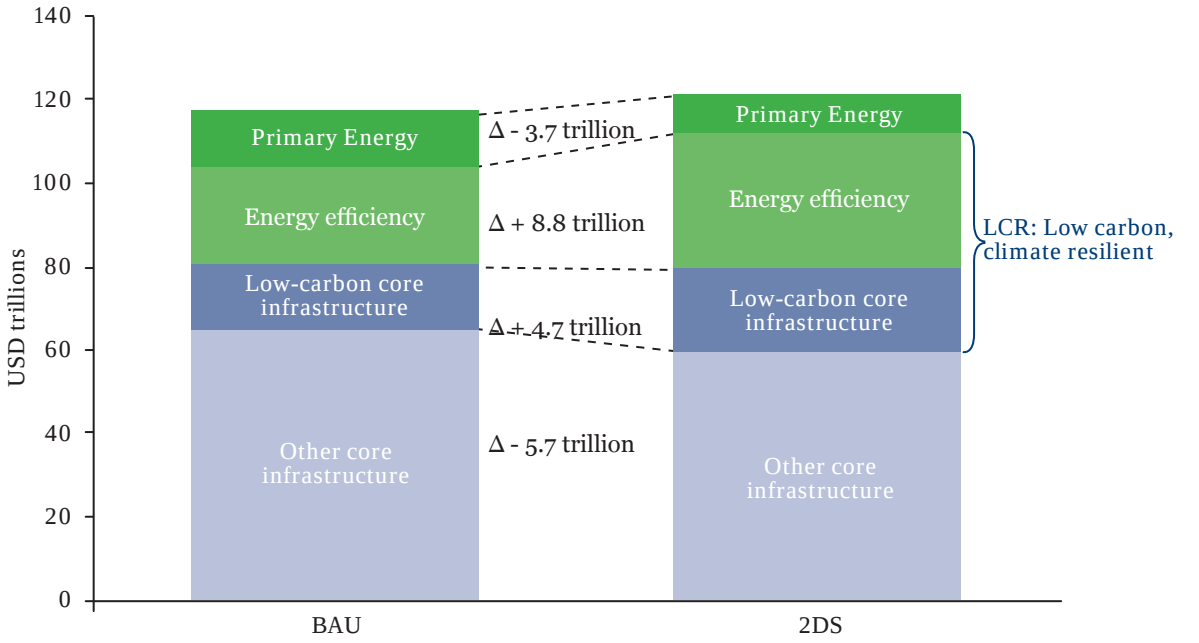
There is limited data on infrastructure investment needs across countries. Data on infrastructure needs in this paper are based on a report, *Delivering on Sustainable Infrastructure for Better Development and Better Climate*, by Bhattacharya, Oppenheim, Qureshi, Stern, and myself, which uses a 2015 baseline of investment spending for major countries. We then project investment requirements using assumed growth and investment rates based on assessments of investment plans and identified infrastructure gaps.

Figure 1. Projected Annual Infrastructure Investment Trends (2014 USD billions)



Source: *Bhattacharya et al (2016)*

Figure 2. Cumulative infrastructure investment needs, 2015-2030 (2014 USD trillions)



- Primary Energy: Extraction of oil, gas and coal
- Energy efficiency: Buildings, energy and transportation
- Low carbon, core infrastructure: Renewable energy, nuclear, CCS, low-carbon transport (e.g. light rail and Bus Rapid Transit systems), climate-proofed water and sanitation, including some adaptation infrastructure (e.g. sea walls and flood protection)
- Other core infrastructure: Standard water and sanitation, high-carbon transport (e.g. roads), energy production, and telecommunications

Note: Computed estimates and projections based on information in GCEC 2014, IEA 2012, OECD/IEA 2013, UNEP 2016, WRI 2015 and CPI 2015a.

Based on this methodology, total 'core' infrastructure requirements over the next 15 years are estimated to be on the order of $75–$86 trillion ($80.5 trillion midpoint), much more than the current estimated stock of $50 trillion. The equivalent figure for core infrastructure in NCE 2014 is $56 trillion (GCEC 2014). This increases to $116.55 trillion once investments in energy efficiency and primary energy are included.

As shown in Figure 1, around 70 percent of the projected investment needs ($3.5–$4 trillion p.a.) will be required in EMDCs, with countries other than China accounting for most of the increase. With rapidly growing populations and urbanization, investment requirements in Africa will grow most rapidly. Power and transport account for 60 percent of the investments needed and are the most important for accelerating the low-carbon transition. Significant investments are also needed in water and sanitation to improve access and adapt to the impacts of climate change.

2.4 Low Carbon, Climate Resilient Infrastructure Needs

There is increasing evidence that building LCR infrastructure is not growth-constraining (DDPP 2015, GCEC 2014, Granoff et al. 2015, World Bank 2016, Dechezleprêtre et al. 2016). While upfront costs to ensure LCR infrastructure investments consistent with a below two degree world are considerable, there are important offsetting savings from investments in LCR infrastructure.

Figure 2 shows the allocation of infrastructure investments under business as usual (BAU) and what is needed to achieve the below two degree climate goal. As can be seen, total incremental investment needed for LCR infrastructure over 2015–2030 is a relatively modest $4.1 trillion. This comprises $13.5 trillion in additional infrastructure investment in low carbon energy generation and use, which includes $8.8 trillion in making buildings, transport, and energy use more energy efficient, along with $4.7 trillion for low carbon technologies such as CCS and nuclear.

Figure 2 also shows that, under a below 2 degree world the needed reallocation of capital away from carbon-intensive infrastructure, with $5.7 trillion less invested in fossil fuel energy generation, transmission and distribution, and $3.7 trillion less invested in the upstream oil, coal and gas markets. Building more compact cities will also lead to less being invested in infrastructure such as roads.

In addition, the incremental LCR infrastructure needs of $4.1 trillion does not factor in expected reduced operating expenses from low carbon technologies such as renewables, which could reduce operating expenses by a further $5.1 trillion (NCE 2014).

3. CLIMATE FINANCE AND INFRASTRUCTURE INVESTMENTS

As discussed, while the incremental cost of building LCR infrastructure over 15 years is small relative to overall investment needs, the full financing implications are more significant, since costs and savings will be realized by different actors and across various time periods. Factoring this in, the challenge is the upfront financing of an additional $13.5 trillion or over $900 billion per year in LCR infrastructure. And this will be in the context of the need to finance an additional $75 trillion in other core infrastructure investments.

While infrastructure needs have grown, infrastructure investment as a share of GDP declined in much of the developing world following the debt crisis of the early 1980s. Starting with the early 2000s, there has been significant recovery in public infrastructure investment in EMDCs, with real investment rising from 7.5 percent of GDP in 2004 to 9.5 percent of GDP by 2011. China has accounted for the largest share of this increase, but spending also rose substantially in India, Russia and the oil-rich countries of the Middle East. Infrastructure spending has also risen significantly in sub-Saharan Africa, but with wide variations. However, spending increased only modestly in Latin America and Southeast Asia. Amongst advanced economies, Australia, New Zealand and Canada infrastructure spending has grown considerably; the United States and Japan had modest growth. By contrast, infrastructure investment rates in the European Union have declined during and since the prolonged economic slowdown that began in 2009.

Overall infrastructure investment has increased by around $1 trillion over the past decade to an estimated $3.4 trillion in 2015. Of this, $2.2 trillion is accounted for by EMDCs. China alone accounts for $1.3 trillion.

Despite this growth in infrastructure spending, there remains a shortfall of approximately $2.5 trillion per year (when investments in primary energy are added, the shortfall increases to $3 trillion a year).

Given the enormity of these funding requirements and public budget constraints, private finance will need to play a key role in meeting these additional needs. McKinsey estimates that the private sector could close up to half of the LCR infrastructure spending gap (Bielenberg et al. 2016).

However, and as will be discussed in part 5, barriers to financing LCR infrastructure projects (particularly in EMDCs) can make private sector finance costly and often unavailable. Public sector climate finance—and in particular concessional international climate finance—can play a key role as part of a package of finance in reducing risk and lowering overall financing costs, thereby helping leverage private sector capital into LCR infrastructure projects. Climate finance can also be used to support pre-investment steps such as strengthening enabling environments and developing carbon taxes and other climate-friendly policies.

What constitutes climate finance depends on whether it is climate finance as defined in the UNFCCC context or more broadly as all finance used to support climate change mitigation and adaptation. Post-Paris, it is important to break down the different estimates of climate finance and understand how climate finance can be most effectively used to finance the LCR infrastructure needs.

3.1 The UNFCCC and the Paris Agreement

What counts as climate finance and its role in supporting climate action by developing countries has been central to the UN climate negotiations. The 2015 UN

Box 2 Intended Nationally Determined Commitments to Nationally Determined Commitments

For those countries that submitted Intended Nationally Determined Commitments (INDCs) in the lead-up to the Paris Climate meeting, these are deemed to be NDCs under the Paris Agreement; countries that did not submit INDCs are encouraged to submit them by the time the Paris Agreement comes into force.

According to the UNFCCC, 189 parties have submitted INDCs representing 99.1% of total emissions. Implementation of these INDCs is estimated to result in aggregate global emission levels of 55.2 Gt CO2 eq. in 2025 and 56.7 Gt CO2 eq. in 2030. However, the world will need to reduce emissions to around 40 Gt eq. to have a 50 percent chance of reaching the 2 degree temperature goal (UNFCCC 2015).

Paris Climate conference provides a basis for new, international, cooperative and long-term action on climate change that will influence financing for LCR infrastructure.

The outcomes from the Paris Climate meeting are reflected in two documents: the Paris Climate Agreement which is a legally binding treaty and the decisions of the Conference of the Parties (COP), which except in a few cases creates no legal obligations on the Parties (Bodansky 2016).

The role of climate finance in supporting climate outcomes needs to be understood within the broader set of goals and compliance mechanisms established at Paris. In terms of climate goals, the Paris Agreement reflects a collective ambition to keep global average temperature increases "well below" 2 degrees Celsius and to pursue efforts to limit temperature increases to 1.5 degrees (UNFCCC 2016). All Parties also agreed on the need to achieve global peaking of GHGs as soon as possible and acknowledged the need for rapid reductions thereafter (UNFCCC 2016). These goals are to be achieved by each Party in large part through NDCs. Developed countries' NDCs are required to include economy wide reduction targets; developing country NDCs are expected to reflect their existing mitigation efforts and move over time to economy-wide targets.

The Paris outcome also includes a range of mechanisms aimed at ensuring compliance by countries with their NDCs and for ratcheting up over time efforts to reduce greenhouse gas emissions that could bring NDCs in line with the broader climate change goal of keeping global temperature increases below 2 degrees.

For instance, all Parties have agreed to communicate their NDCs in a way that facilitates "clarity, transparency and understanding" of the NDC (UNFCCC 2016).[1] The Paris Agreement also provides for a "transparency framework" for action and support under which each Party is to provide the "information necessary to track progress made in implementing and achieving its NDCs" (ibid).[2] Such information will also undergo a "technical expert review" (ibid).[3]

Another important development that should spur countries to increase their mitigation efforts is the agreement that new NDCs are to be submitted by 2020 and every five years thereafter and these are to "represent a progression" on previous NDCs (UNFCCC 2016).[4] This will provide opportunity to periodically assess progress against the climate goals and to push for more ambition.

The Paris agreement is also embedded within the broader goal of sustainable development. For instance,

a sustainable development mechanism is established under the Agreement to "promote mitigation of greenhouse gas emissions while fostering sustainable development." This is a voluntary mechanism that builds on the previous Clean Development Mechanism (CDM) framework. The mechanism encourages mitigation by public and private entities in one country that can also affect mitigation outcomes applicable by a third country to fulfil its NDC. In addition, in a number of other provisions the Paris Agreement recognize the links between climate mitigation, adaptation and sustainable development (UNFCCC 2016).[5]

3.2 Climate Finance in the Paris Outcome

Climate finance has been a core element of the climate negotiations. In many respects the outcomes from Paris were possible due to progress on climate finance achieved during previous climate change meetings. In particular, the 2009 Copenhagen climate change conference where developed countries pledged to mobilize $30 billion for the period 2010–2012 and $100 billion a year from public and private sources by 2020 were crucial in demonstrating developed countries' ambition and commitment to support the capacity of developing countries to respond to climate change.[6] Moreover, the willingness of developed countries to achieve the initial $30 billion climate finance goal helped build trust among developing countries that the larger $100 billion climate finance commitments will be met (Nakhooda et al. 2013).

The decisions agreed by the COP at Paris are where the specific climate finance goals are enshrined (instead of in the legally binding Paris Agreement). Specifically, the Parties agreed that:

- Developed countries will meet the $100 billion per annum target by 2020 and extend it until 2025.
- Prior to 2025, the COP will set a new "collective quantified goal from a floor of $100 billion per year, taking into account the needs and priorities of developing countries."

This latter commitment is significant, both in terms of beginning to meet the financing needs for LCR infrastructure outlined above, and in better reflecting the global economic changes underway that are leading to large developing countries becoming increasingly important sources of climate finance. This COP decision effectively recognizes the need to raise ambition for finance —trillions not billions—particularly when read in the context of the Paris Agreement's climate goals and the encouragement to all Parties to develop long-term strategies for lowering GHGs (UNFCCC 2016).[7] Moreover, the reference to setting a new "collective goal" for climate finance opens the door to a new goal that might include contributions from developed and developing countries alike.

There is no explicit link in the Paris Agreement between providing finance and mitigation action, but throughout the agreement there is much that effectively links support (including finance) with developing country ambition. For instance, the Agreement includes an obligation to provide financial resources to assist developing countries with their mitigation and adaptation obligations. Also, the Agreement recognizes that "enhanced support for developing country Parties will allow for higher ambition in their actions" (UNFCCC 2016).[8] Developing countries are also "encouraged" to provide or continue to provide financial support (ibid).[9] The Paris Agreement also envisions financial support to developing countries to facilitate access to technology and R&D (ibid).[10]

Another issue in the negotiations ever since the developed country pledge to provide $100 billion p.a. by 2020 has been what counts as climate finance—how

much should come from public and private sources and if so, what sources of public and private finance should count (Westphal et al. 2015). A lot of this debate has revolved around the language included in previous COP decisions that climate finance will be "new and additional" (Venugopal and Patel 2013).

One reason developing countries have insisted that climate finance be "new and additional" has been to avoid the $100 billion pledge being met by developed countries merely designating existing Official Development Assistance as climate finance, detracting from other (often seen as more pressing) development needs (Nakhooda et al. 2013). Another reason for such insistence on the part of developing countries relates to their demands for burden sharing: Since developed countries have contributed disproportionately to climate change so far, the argument is that they should shoulder a proportionate share of the responsibility for addressing it (UNFCCC 2016).[11]

Despite much debate on what constitutes "new and additional" finance, there is no agreement on what this might mean (UNFCCC 2014). The Paris agreement does not re-state the need for climate finance to be additional, which may represent a move away from additionality as the yardstick for determining what counts.

The Paris Agreement does, however, reiterate that climate finance will come from a "wide variety of sources, instruments and channels, noting the significant role of public funds" (UNFCCC 2016).[12] As for sources of private finance, the agreement emphasizes finance "mobilized through public interventions."

These outcomes on finance are also embedded within the Agreement's framework for transparency and reporting on implementation of commitments. For instance, there is a commitment to report biennially on such support (UNFCCC 2016).[13] As part of the Agreement's transparency framework, developed countries are to provide information on the financial, technology transfer and capacity-building support provided to developing countries and such information on finance is to undergo a technical expert review (UNFCCC 2016).[14]

4 COUNTING CLIMATE FINANCE

4.1 Defining Climate Finance

There is no accepted definition on what counts as climate finance. As a general matter, climate finance is finance that is focused on addressing the impacts arising from climate change mitigation and adaptation. For instance, the UNFCCC Standing Committee on Finance (SCF) working definition is: "climate finance aims at reducing emissions, enhancing sinks of greenhouse gases and aims at reducing vulnerability of, and maintaining and increasing the resilience of, human and ecological systems to negate climate change impacts" (UNFCCC 2014).

Table 1 provides a schematic of what counts as climate finance. In the UNFCCC context, climate finance is limited to international climate finance that flows from developed to developing countries as well as private sector capital mobilized by such public finance. Total climate finance includes all sources of climate finance—international climate finance from developed and developing countries, domestic sources of climate finance as well as all private sector finance.

4.2 Counting Climate Finance in the UNFCCC

There have been various efforts to count climate finance (UNFCCC 2014). In terms of the amount of climate finance going towards the UNFCCC $100 billion pledge, an OECD/Climate Policy Initiative (CPI) study estimates that almost $61 billion of this $100 billion was provided in 2014, comprising $43.5 billion in bilateral and multilateral public finance, $1.6 billion in export credits and $16.7 billion of private finance that was mobilized by public finance (OECD and CPI 2015).

Access to the OECD/CPI database allowed us to determine that, with regard to the UNFCCC $100 billion pledge, approximately $18 billion, or 40 percent of the public climate finance provided towards the $100 billion goal was for LCR infrastructure. Adding all private sector climate finance in renewable energy infrastructure gives $36.3 billion or 60 percent of the climate finance going towards the UNFCCC $100 billion per annum goal.

Table 1. Components of Climate Finance

Definition	Source	Public Finance (Bilateral, Public Financial Institutions, climate funds)	Private Finance Leveraged by Public Finance	Other Private Finance
UNFCCC Climate Finance $100 billion p.a. by 2020	International climate finance from developed countries to developing countries	X	X	
Total Climate Finance	International + domestic climate finance from developed & developing countries	X	X	X

4.3 Counting Total Climate Finance

One of the most comprehensive accounting of total climate finance was undertaken by CPI and is the baseline against which the UNFCCC makes its climate finance calculations (UNFCCC 2014). As reflected below in Table 2, in 2014 total climate finance was estimated at $391 billion, up from $331 billion in 2013. Of this amount, public finance accounted for approximately $148 billion, or 38 percent of total climate finance.

On the private sector side, the CPI figures only captures investments in renewable energy, valued in 2014 at $243 billion, up 26 percent from $193 billion in 2013. However, the amount of private climate finance going to LCR infrastructure is likely much higher. Table 2 includes in italics estimates of other sources of private climate finance in energy efficiency, land-use, and adaptation. Including these estimates increases private sector climate finance in 2014 to $765 billion. This figure doesn't include government's domestic budgets for climate—which CPI estimates could be $60 billion per annum—and would raise total 2014 climate finance to $825 billion (CPI 2015). Data limitations mean that it is not possible to determine how much of the $825 billion per annum is spent on infrastructure. Applying the 40 percent share to the larger public finance amount of $148 billion gives approximately $60 billion on low carbon infrastructure.

Table 2. Climate Finance by Sector, 2014 (USD billions)

	Renewable Energy	Energy Efficiency	Transport	Land Use	Adaptation	Other	Total
Public	49	26	21	7	25	20	148
Private	243	*90-365*		*4.2*	*5.25*		243/ *342-617*
Total	292	*116-391*	21	*11.2*	*30.25*	20	391/ *490-765*

Source: Climate Policy Initiative; UNFCCC Standing Committee on Finance
Note: Figures in Italics are estimates of private sector climate finance.

Table 3. Climate Finance Landscape 2014 (USD billions)

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="2">Sources/Managers of Capital</th><th>Financial Instruments</th><th>Location of Projects</th><th>Projects</th></tr>
<tr><td colspan="2">Governments and Agencies
15</td><td>Grants
14</td><td>Developed Countries
179</td><td>Renewable Energy
49</td></tr>
<tr><td rowspan="6">Public Finance</td><td rowspan="3">International Financial Institutions</td><td>National Development Banks
66</td><td>Low Cost Debt
69</td><td rowspan="5">Developing Countries
210</td><td>Energy Efficiency
26</td></tr>
<tr><td>Bilateral Development Banks
17</td><td rowspan="2">Risk Management
1</td><td>Transport
21</td></tr>
<tr><td>MDBs
47</td><td>Land Use
7</td></tr>
<tr><td colspan="2">Climate Funds
2</td><td>Market Rate Debt
102</td><td>Adaptation
25</td></tr>
<tr><td colspan="2"></td><td></td><td>Other
20</td></tr>
<tr><td rowspan="6">Private Finance</td><td colspan="2">Commercial Financial Institutions
46</td><td>Project Equity
24</td><td rowspan="6"></td><td rowspan="6">Renewable Energy
243</td></tr>
<tr><td colspan="2">Equity, Venture Capital, Infra Funds etc
1.7</td><td rowspan="5">Balance Sheet Finance
175</td></tr>
<tr><td colspan="2">Institutional Investors
0.9</td></tr>
<tr><td colspan="2">Project Developers
92</td></tr>
<tr><td colspan="2">Corporate Actors
58</td></tr>
<tr><td colspan="2">Households
43</td></tr>
<tr><td colspan="5">Total</td><td>391</td></tr>
</table>

Source: Climate Policy Initiative Global Climate Landscape 2015

To understand in more detail how climate finance is being provided, Table 3 below shows the various sources and intermediaries of climate finance.

As can be seen, public provision of climate finance has been dominated by the International Financial Institutions (IFIs) and National Development Banks (NDBs). These institutions provide climate finance mainly as concessional and market rate debt. On the private sector side, the main source of finance is balance sheet finance by corporations and project developers, representing over 60 percent of private sector climate finance. Households are also significant sources of climate finance. In contrast, financial intermediaries such as banks make up only around 19 percent of total private climate finance.

Table 2 also highlights the very limited involvement of institutional investors in LCR infrastructure, a notable absence given that such investors are globally the largest source of private capital with approximately $120 trillion in assets under management (Bielenberg et al 2016).

5 WHY CLIMATE FINANCE MATTERS

5.1 Barriers to Financing LCR Infrastructure

Infrastructure investments present a range of financing challenges. Some barriers are generally applicable to infrastructure and include the need for large upfront commitments of capital investments while such projects only generate cash flows after many years. Moreover, the risks of investing in infrastructure are highest at the early stages of projects—during the project preparation and construction phase which are most susceptible to delays. The long-term nature of infrastructure projects also makes them illiquid and therefore sensitive to changes in government policy. Other risks are more project specific, arising from technology choice or country specific governance and investment environment challenges.

A McKinsey Institute report identifies five main barriers to financing infrastructure (Bielenberg et al. 2016).

1. Lack of transparent and bankable pipelines of infrastructure projects: this arises from absence of long term development plans and failure by governments to communicate infrastructure needs to investors.

2. High development and transaction costs due to inefficient bidding and procurement processes that require investors to tailor each infrastructure project to different standards.

3. Lack of viable funding models: investors may demand returns higher than what infrastructure can deliver; also, in developing countries users may be unwilling or unable to pay high enough charges.

4. Inadequate risk-adjusted returns: particularly in developing countries, infrastructure projects often don't deliver a return to compensate investors for the additional risk.

5. Unfavorable regulations and policies: this includes foreign investment restrictions and financial regulations such as capital adequacy requirements or Basel III, which discourages banks from mismatching maturity of assets and liabilities, a disincentive to holding long-term debt.

While approximately 70 percent of infrastructure needs over the next 15 years will be in EMDC, the above barriers are often higher in these countries, contributing to sovereign risk and higher financing costs. For instance, real interest rates in Brazil are over 20 percent, in Colombia around 10 percent and India around 7 percent compared with around 2 percent in the US, 1 percent in Canada and negative real interest rates in the UK and Japan.

In addition, most infrastructure projects in EMDC will be greenfield projects, which have higher upfront capital costs, higher risk during project planning and construction phase, and a longer payback over the operating phase (*Delivering on Sustainable Infrastructure* 2016).

Many of these barriers are also more significant for LCR infrastructure (Bielenberg et al. 2016). For instance, developing a pipeline of LCR infrastructure requires planning for climate mitigation and adaptation, where specific impacts of climate change persist and their costs remain uncertain. Transaction costs for LCR infrastructure projects are also higher than for traditional projects, as there is less data on what works and therefore fewer opportunities to learn from past experiences. LCR infrastructure projects such as renewable energy usually require higher upfront capital

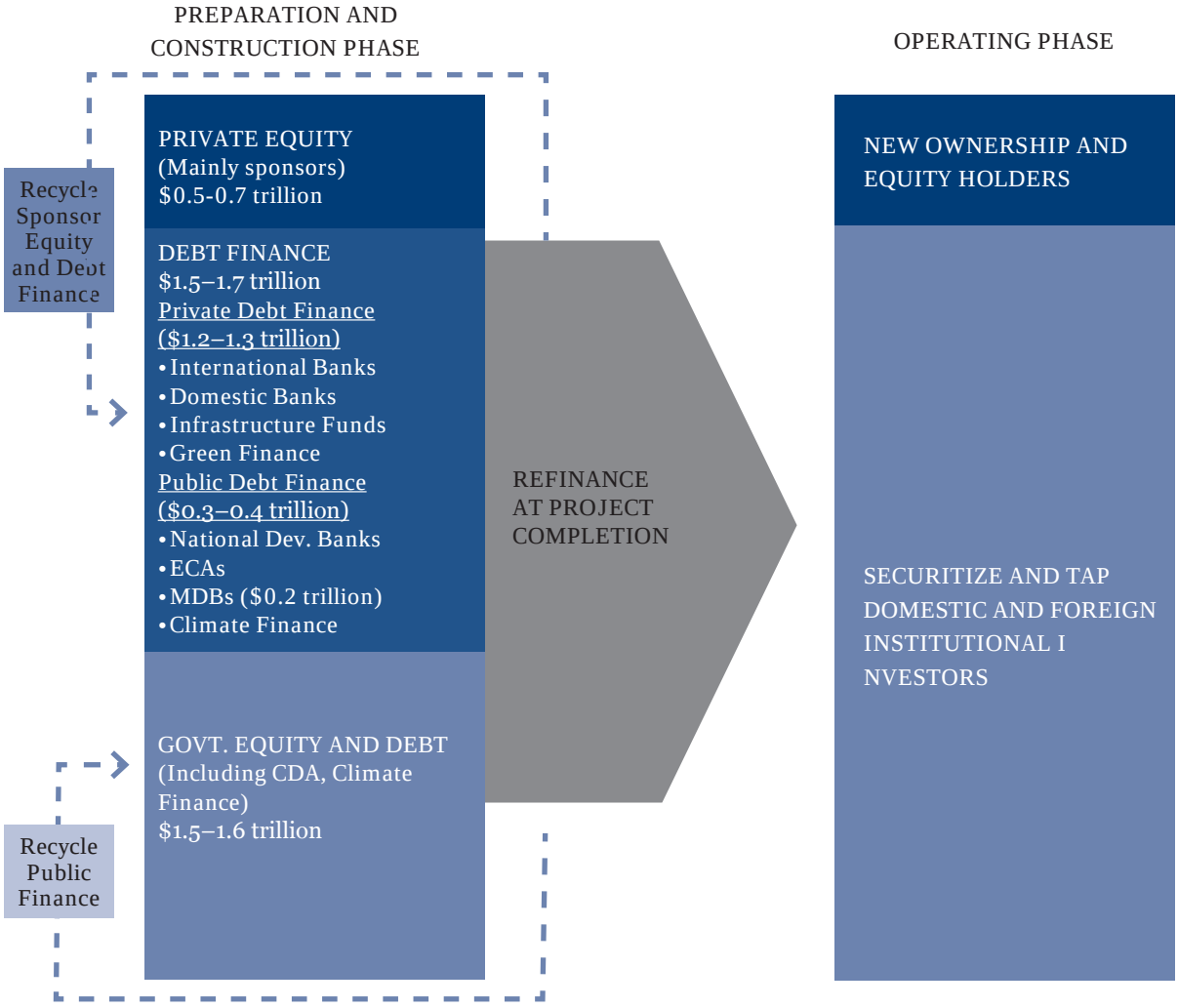
than gas or coal plants, increasing the difficulty of accessing affordable finance. The absence of carbon taxes and subsidies for fossil fuels compound this challenge. Finally, uncertainty around climate policy increases regulatory risk from regulations and policies.

5.2 A Financing Framework for LCR Infrastructure

Overcoming the barriers to financing LCR infrastructure projects(particularly in EMDC) will require matching the risk profiles of various sources of capital—private sector, MDBs and climate finance—with the different risks during the lifecycle of an infrastructure projects (*Delivering on Sustainable Infrastructure* 2016). Figure 3 outlines a framework for addressing this.

At the project preparation and construction phase, concessional climate finance blended with MDB finance private finance is needed to de-risk and reduce the cost of capital, thereby leveraging private sector finance (mainly sponsor equity).

Figure 3. Infrastructure Financing Requirements for Emerging Markets and Developing Countries



Source: *Delivering on Sustainable Infrastructure (2016)*

As projects progress to the construction phase, there is scope for more private sector debt and equity finance. Banks have tended to be the most significant providers of debt at this stage, but their capacity is often constrained by the long tenors needed for LCR infrastructure and delayed payback (Bielenberg et al. 2016).

At the operational stage where returns are proven and risk is much reduced, there are significant opportunities to refinance the project and bring in institutional investors with long-term debt finance. With an estimated $120 trillion in assets held by institutional and private investors, this highlights the magnitude of private capital that could potentially be harnessed to finance LCR infrastructure projects. Investors such as pension funds, insurance companies and sovereign wealth funds often have long-term time horizons and look to invest in low risk assets with stable yields (Bielenberg et al 2016). LCR infrastructure could fulfil these investment criteria. However, currently only a small fraction of such private capital is being channeled into LCR projects (World Bank 2015a).

Success in refinancing LCR infrastructure projects will also allow for the recycling of higher-risk concessional capital from MDBs, banks and climate finance funds back into new LCR infrastructure projects.

Making LCR infrastructure projects attractive to institutional investors and scaling that finance will require developing new forms of financial instruments that institutional investors are willing to hold. This could include investing directly in LCR infrastructure, increasingly as partners in infrastructure funds (Bielenberg et al. 2016). Another promising way of scaling institutional investment is to expand investment opportunities in financial instruments such as green bonds and Yield Co (discussed in more detail in part 6.5).

Developing green bonds tied to LCR infrastructure is a particularly important opportunity given the potential of bonds to offer institutional investors low risk investments at scale (Ehlers 2014). Securitizing an asset pool of LCR infrastructure and issuing green bonds can transform LCR infrastructure projects into low risk, liquid assets that can be attractive to institutional investors. Green bonds backed by the AAA credit rating of issuing institutions such as the World Bank further reduces the risk of such bonds (Farid, M. et al. 2016). Moreover, this then allows riskier capital from MDBs, climate funds, governments, project developers and banks that is invested at the earlier, riskier stage of infrastructure projects to be recycled into new projects (UNEP and BNEF 2015).

Achieving this will require developing LCR infrastructure as an asset class (*Delivering on Sustainable Infrastructure* 2016). Here, relevant reforms would include standardizing project templates, improving the flow of information to investors on LCR infrastructure projects and regulatory reforms that reduce policy risk.

5.3 Using Climate Finance for LCR Infrastructure

As noted, McKinsey estimates that the private sector could close up to one half of the LCR infrastructure spending gap (Bielenberg et al. 2016). To meet LCR infrastructure needs, concessional climate finance invested as part of a broader package of finance can reduce risk and lower overall financing costs, thereby leverage private sector capital. In particular, financial support for the riskier stages of LCR infrastructure projects will require low cost public climate finance in the form of grants and concessional finance.

For example, non-IDA concessional climate finance is already blended with MDB finance, leveraging private sector capital for LCR infrastructure projects. For instance, $8.3 billion of CIF finance (see Box 3) is on track to support a further $58 billion of MDB and private sector sources of finance (World Bank 2016).

Table 3 shows that in 2014, climate finance provided as grants amounted to $14 billion and constituted more than half of the capital from governments and the climate funds. Concessional loans were an even more significant share of public climate finance—$69 billion or 37 percent—almost all of it coming from international financial institutions.

Much of this public climate finance is being provided by developed countries in fulfillment of their $100 billion per annum climate pledge in the UNFCCC. For instance, approximately $22 billion, or almost 80 percent of the climate finance from governments in fulfillment of their pledge to provide $30 billion during 2010-2012 was in grants and concessional finance (Nakhooda et al. 2013). The Paris Agreement reinforces the importance of public finance, including the role of grant-based funding for adaptation purposes (UNFCCC 2016).[16] Combined with concessional loans, guarantees and equity, these sources of finance can leverage private sector capital into private sector LCR infrastructure projects for climate purposes.

Provision of concessional climate finance as fulfilment of the UNFCCC $100 billion pledge will also be important for LCR infrastructure projects in EMDCs. For instance, in low-income countries, around 92 percent of private and PPP financing comes from international finance from high and middle income countries (Bielenberg et al. 2016).

Increasing access to grant and concessional climate finance and deploying it in ways that achieve a private sector leverage ratio similar to that attained by the Climate Investment Funds in support of private sector projects means that $100 billion per annum of such climate finance could potentially leverage $800–$900 billion per annum in private sector capital. This would close much of the incremental cost needed to fund enough LCR infrastructure required to achieve a below two degree world. While the $100 billion in climate finance will come from public as well as private sources, this example underscores the potential importance of the UNFCCC process on climate finance in mobilizing the finance needed for LCR infrastructure projects.

5.4 Delivering Climate Finance

Public climate finance is delivered either via public financial institutions such as MDBs and NDBs, bilaterally as part of aid programs or through multilateral and bilateral climate funds. In terms of UNFCCC climate finance, governments have expressed a preference for a significant portion of it to be delivered through multilateral climate funds (UNFCCC 2011).

In Paris, it was decided that the UNFCCC/COP will be served by the Green Climate Fund, the Global Environment Facility (GEF), the Least Developed Country Fund and the Special Climate Change Fund administered by the GEF (UNFCCC 2016).

However, countries are not limited by the UNFCCC in terms of which climate funds they can use to deliver their UNFCCC financing commitments. In addition to the climate funds formally serving the UNFCCC, there is the Climate Investment Funds as well as a number of bilateral funds such the UK's International Climate Fund, Germany's International Climate Initiative and Norway's International Climate and Forest Initiative, through which public climate finance will continue to be channeled. Ultimately, how countries channel climate finance will reflect a range of considerations, such as perceptions of the legitimacy of the various climate funds, their governance and responsiveness to recipient countries (Nakhooda et al. 2013).

The following analyzes how the multilateral climate funds could be used to support LCR infrastructure projects in EMDC.

Box 3 The Multilateral Climate Funds

The Green Climate Fund: the Green Climate Fund (GCF) was established at the 2010 COP 16 as a formal fund of the UNFCCC. The GCF receives guidance from and is accountable to the COP. The GCF has commenced operating and currently has paid in capital of $10.2 billion.

The Global Environment Facility: GEF funds include the Least Developing Countries Funds, the Special Climate Change Fund and the GEF Trust Fund. The GEF invests directly as well as through accredited institutions. Such institutions include the World Bank as well as other regional partners. As an entity of the UNFCCC, the GEF receives guidance from and is accountable to the COP.

The Climate Investment Funds: created in 2008, the CIFs are made up of the Clean Technology Fund (CTF) and the Strategic Climate Fund (SCF); the SCF encompasses the Pilot Project for Climate Resilience (PPCR), the Forest Investment Program (FIP) and the Scaling Up Renewable Energy Program (SREP) The MDBs are the key implementing agencies of CIF funding. Funds pledged to the CIFs total $8.3 billion.

5.5 The Role of the Climate Funds

The following table lists the multilateral climate funds. Over $26 billion has been pledged to these funds and over $10 billion of finance has been approved, with $2 billion in disbursements in 2014. These figures will increase substantially as progress is made towards the $100 per annum billion pledge, as a significant share of this climate finance is expected to be channeled through multilateral climate funds. For instance, for the Green Climate Fund (GCF) alone, $10.2 billion has been pledged and the Fund aims to disburse approximately $2.25 billion in 2016.

The following analyzes how concessional climate finance can be used to support LCR infrastructure projects.

5.5.1 Develop an Enabling Environment

The enabling environment refers to the range of policy and regulations that supports investment in infrastructure projects. This includes general legal and regulatory issues such as rule-of-law, investment protection, political stability and corruption issues. Lack of a robust enabling environment increases sovereign risk and the cost of financing infrastructure (de Nevers 2013). The lack of a strong enabling environment is particularly acute in developing countries with less developed political and legal institutions.

Having in place the right enabling environment is important for infrastructure projects, which due to their large upfront capital costs, long-term and illiquid nature expose investors to political and policy risks. In addition, LCR infrastructure often relies on some form of policy support such as feed-in-tariffs or tax breaks, making such projects particularly sensitive to the risk of regulatory changes.

Public sector climate finance can support improvements in a country's enabling environment, something that is less feasible for the private sector, due to the

Table 4. Multilateral Climate Funds

Fund	Administrator	Funds Pledged	Funds Deposit	Funds Approved
		USD millions		
Adaptation Funds				
MDG Achievement Fund	UN	90	90	90
Adaptation Fund (AF)	AFB	487	483	325
Adaptation for Smallholder Agriculture Programme (ASAP)	IFAD	366	326	239
Pilot Program for Climate Resilience (PPCR)	CIF	1125	1125	857
Least Developed Countries Fund (LDCF)	GEF	964	962	795
Special Climate Change Fund (SCCF)	GEF	350	344	278
Adaptation Total		*3382*	*3329*	*2583*
Mitigation Funds				
Global Environment Facility (GEF4)	GEF	1083	1083	953
Global Energy Efficiency and Renewable Energy Fund (GEEREF)	EIB	170	164	89
Clean Technology Fund (CTF)	CIF	5299	5128	4101
Global Environment Facility (GEF5)	GEF	1350	777	865
Global Environment Facility (GEF6)	GEF	1101	1078	197
Partnership for Market Readiness (PMR)	WB	127	107	52
Scaling-Up Renewable Energy Program for Low Income Countries (SREP)	CIF	528	528	168
Mitigation Total		*9657*	*8864*	*6425*
REDD+ Funds				
Amazon Fund	Brazil	1034	917	553
Biocarbon Fund	WB	361	361	
Congo Basin Forest Fund (CBFF)	AfDB	186	165	82
Forest Investment Program (FIP)	CIF	583	528	333
Forest Carbon Partnership Facility	WB	826	688	211
REDD+ Total		*2990*	*2659*	*1179*
Multiple Foci Funds				
Global Climate Change Alliance (GCCA)	EU	326	326	347
Green Climate Fund (GCF)	GCF	10204	974	172
Indonesia Climate Change Trust Fund (ICCTF)	ICCTF	21	11	10
Multiple Foci Total		*10551*	*1311*	*529*
All Total		***26580***	***16163***	***10717***

Source: UNFCCC (2014)

high costs and uncertain payback (Kato et al. 2014). Specifically, climate finance should be used in the following ways:

To develop strong institutions including key climate policies such as setting a carbon price and phasing out fossil fuel subsidies. For example, CIF finance for the development of large-scale concentrated solar power in Morocco supported the gradual removal of fossil fuel subsidies (de Nevers 2013). Including explicit contractual requirements that require such policy outcomes as a condition of climate finance will make this increasingly effective.

To mainstream climate goals into national development plans and NDCs. Linking infrastructure projects to NDCs would help align infrastructure investment with national climate goals and help mainstream climate infrastructure needs into broader development plans (Ellis et al. 2013). Such an approach would also signal long-term government commitment to a course of action, helping to reduce the risk of policy change. For instance, Zambia mainstreamed its climate goals into the country's Sixth National Development Plan, which led to increased political buy-in for climate resiliency programs and greater allocation of domestic resources for climate resilience projects (CIF 2015).

Countries' Paris commitment to prepare NDCs and the promise of support for developing such NDCs provides an opportunity for governments to take a broader view of the regulatory and policy changes needed to support low carbon development (including LCR infrastructure) and for climate finance to support such efforts.

To make sector-specific market-based interventions such as reform of government monopolies in the energy sector that discourage competition and deter feed-in tariffs for renewable energy. For example, CIF financing of geothermal development in Tanzania included support to revise the country's geothermal laws to improve the regulatory framework governing private power generation (CIF 2015).

To help develop a pipeline of bankable sustainable infrastructure projects. This requires building government capacity to undertake project preparation and planning, including the negotiation of complex PPPs as well as the standardization of contracts and project evaluation procedures (Kaminker et al. 2013). This is important, as project preparation can add 5–10 percent to total infrastructure costs (World Bank 2013). Climate finance could be used to develop these skills and capacities. For example, the World Bank/IFC Scaling Solar program helps countries develop a rapid pipeline of solar energy projects by providing support with tendering as part of the due diligence needed to develop bankable project documents.

Providing such technical support is not new and has been a target of climate finance by the CIFs and the GEF. The GCF has also identified the need for "readiness and preparatory support" as an area for support (GCF 2015a).[17] The challenge will be using climate finance to build domestic capacity that can be scaled and replicated along a pipeline of projects. This could involve building better domestic institutions, Improving coordination amongst relevant government ministries and more involvement of the private sector as development plans evolve and become linked to LCR infrastructure needs is also important for country buy-in.

5.5.2 Develop co-financing packages

Climate finance can also be used to reduce the cost of financing LCR infrastructure investments. Blending climate finance alongside other sources of MDB and private sector finance can bring down overall project risks (Kaminker et al. 2013).

For example, blended GEF and Africa Renewable Energy Fund (managed by the AfDB) finance was used to finance a renewable energy project in Africa. The GEF, by accepting a capped return on its equity, enabled increased returns to be offered to private sector partners, thereby crowding in further private sector capital. In a land restoration project in Latin America, the GEF provided guarantees and subordinated loans that reduced risk, while funding from IADB crowded-in private sector finance.

Blending CIF funds with MDB finance has also enabled the MDBs to structure higher risk transactions than would have been possible using only MDB balance sheets (CIF 2015). The CIF has also blended its finance with other public and private capital to reduce risk. For example, the development of the geothermal market globally received significant CIF support at the earliest and riskiest exploration and test-drilling stages (CIF 2015), supported by other MDB finance.

5.5.3 Support Local Banks

Climate finance can also be used in a wholesale manner to support the involvement of local institutions. Domestic banks play an important intermediation role at the project preparation and construction phase, particularly in middle income countries where over half of the private and PPP sources of infrastructure funds are local. Local banks can also provide funding in the local currency, thereby reducing currency risk.

Local banks are also well positioned to address barriers to investing in LCR infrastructure. For instance, domestic banks often have a more detailed understanding of local conditions, which allows them to more accurately assess the creditworthiness of project developers and thereby better understand and manage risk. Building up this local experience can further develop banks' ability to assess risk, reducing transaction costs and lowering overall costs of financing LCR infrastructure (IFC 2013).

Climate finance can play a role here by directly funding local financial institutions, reducing the cost of finance for LCR infrastructure projects. A challenge here is identifying the relevant institutions with climate-related infrastructure expertise. This includes those with expertise in accounting, financial reporting and monitoring, since the absence of such capacity can require duplicative systems and raise transaction costs (Ellis et al. 2013).

The GCF is positioning itself to invest directly in local financial institutions by allowing intermediaries in recipient countries to become accredited to receive climate finance. This process should be used to encourage accreditation by private financial institutions in each country and be used as a form of due diligence to assess capacity to further leverage additional capital into LCR infrastructure.

5.5.4 Support the Development of Financial Instruments

As discussed, developing LCR infrastructure as an asset class is needed to scale the green bond market for such projects. This can be achieved by securitizing projects at the operating stage and then issuing green bonds.

There has been some use of climate finance to develop the green bond market, such as the IDB Green Bond Securitization Project supported by CTF and GCF financing, where the finance raised is earmarked for a range of eligible green assets. Green bonds are needed that are explicitly earmarked for LCR infrastructure. In addition, to ensure that sustainability of these instruments, globally accepted green bond standards are needed to ensure that bonds are clearly linked to climate change outcomes (UNEP 2015a).

Financial instruments to hedge against foreign exchange risk can also de-risk LCR infrastructure projects, particularly in EMDCs where financing is in local currencies (*Delivering on Sustainable Infrastructure* 2016).

5.5.5 Develop Low-Carbon Technology

Another role for climate finance is to invest in the deployment of low-carbon technologies. The IEA estimates that existing technologies can reduce global GHG emission by around 60 percent of what is needed to achieve the 2 degree goal (IEA 2015). This highlights the importance of intensified research and development for new low carbon technologies such as clean fuels for transport and CCS. Climate finance can be used to cover the technology risk from deployment of new technologies, where there are particularly challenges in assessing risk and building financing plans at an acceptable cost (IFC 2013). Here, the role for climate finance is to mitigate these risks to support the demonstration and scaling up of new technologies.

Small amounts of targeted climate finance in the form of grants can help bring down the costs of such investments in climate technologies, enabling public funds from MDBs and private capital to come on board. For example, CTF finance along with IFC finance supported the development in South Africa of the first concentrated solar power plant with storage in the developing world.

Channeling climate finance through local financial institutions is another complementary approach to addressing technology risk. Local institutions are often better able to assess the application of new technologies to local conditions, such as the willingness of regulators to pass on the costs of clean energy technologies through increased rates, public acceptance of new technologies such as CCS and the political durability of subsidies.

5.5.6 Strengthen Monitoring of Outcomes

Monitoring investments and learning from experience is another important role for climate finance. Improving data and information on LCR infrastructure investments is needed to allow investors to properly assess risk, determine what works and can be scaled (Kaminker et al. 2013). It is also important to have mechanisms in place to monitor and evaluate the effectiveness of climate finance to assess the costs and benefits of more ambitious action and to establish an evidence base of necessary policies and interventions (Ellis et al. 2013).

The programmatic approach of the CIFs has supported monitoring and reporting of outcomes across sectors. To ensure accountability, learning, and progress toward investment goals, the CIF requires all countries to report annually on results achieved. Monitoring and reporting systems are country-led and build on the CIFs' programmatic approach, engaging stakeholder groups across sectors, including government institutions at national, sub-national and local levels, as well as civil society, local communities and the private sector, to jointly analyze and discuss results achieved and lessons learned in the implementation of investment plans.

The GCF is working to develop ways for countries to share experience and learning, but so far this appears limited to sharing experiences of gaining accreditation under the GCF (GCF 2015b). This could be broadened to address lessons regarding what financing models and policies have successfully produced sustainable infrastructure. Tying climate finance to improved measuring, reporting and verification under a UN climate change agreement would facilitate this information gathering.

5.5.7 Improve Coordination amongst Climate Funds

Improved coordination amongst the multilateral climate funds is also needed to prevent overlap and duplicative processes for accessing funds. Consistent criteria across the funds for demonstrating impact should also help ensure that LCR projects are mutually reinforcing.

Improving coherence and cooperation across the climate finance funds within and outside the UNFCCC would also improve the sharing of lessons, increasing the scope for climate finance to be targeted, effective and catalytic.

5.5.8 Finance Infrastructure for Adaptation

The Paris Climate Agreement emphasizes the importance of adaptation and developing an agenda that should increase action and support for adaptation. The Agreement establishes a global adaptation goal—"strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the temperature goal referred to in Article 2" (UNFCCC 2016).[18] To make progress on this goal, each Party is encouraged to engage in adaptation planning, which includes formulating national adaptation plans and prioritizing actions in light of each country's assessment of their vulnerability to climate change.

Under the Paris Agreement there is also recognition of the need for support for international cooperation on adaptation efforts, including strengthening institutional arrangements, and assisting developing countries identify adaptation needs and to improve adaption effectiveness (UNFCCC 2016).[19]

The Paris Agreement underlies that there is an important role for climate finance in helping developing countries adapt to climate change, particularly in the poorest countries where there will be limited scope for private sector funding (GCF 2015c). The Paris Agreement also stresses the importance of balancing climate finance between mitigation and adaptation. The GCF already aims to achieve such a balance. In addition, there are three other UNFCCC climate funds focused on adaptation—the $964 million Least Developed Countries Fund, the $350 million Special Climate Change Fund and the $487 million Adaptation Fund which is financed through sales proceeds from certified emissions reductions under the Kyoto Protocol. The CIF Pilot Program on Climate Resilience is also adaptation-focused.

For many adaptation projects, the scope for generating returns, which in turn constrains the prospect for private sector financing, is limited. In these cases public finance will need to play the dominant role.

There is, however, growing recognition that climate adaptation involves risk that the private sector should be responding to. For instance, ratings agency Standard & Poor's has identified climate change as a threat to private sector infrastructure, asserting that making such infrastructure resilient to climate change requires private sector support. Such risks need to be better taken into account by companies and by investors (see section 6.1 for more on climate risk).

When scope exists for private investment in strengthening climate resilience, targeted climate finance can help overcome barriers and reduce risks. For instance, some success in leveraging private sector investment in adaptation in the provision of climate-related weather insurance has been reported. Insurance can spread the risk-related costs of climate-related events, offer new and innovative risk management solutions, and

directly invest in LCR infrastructure (IFC 2013). For example, Rockefeller Foundation support for early development of risk capacity insurance to African states led to further buy-in from private capital and finance from German and UK development agencies (KfW and DFID). The Caribbean Catastrophic Risk Insurance Facility is a public-private partnership, multi-country risk pool aimed at mitigating the effects of hurricanes and earthquakes (G20 2014).

5.6 The Climate Funds Going Forward

The multilateral climate funds—the CIF and the GEF in particular—have demonstrated how concessional climate finance can be deployed alongside other public and private finance to build LCR infrastructure projects. The GCF will play an increasingly important role in this space.

Clearly, many climate funds are needed. A single fund could not fulfil all the different needs of the Parties, given divergent country interests, uneven mitigation capacities and adaptation needs (Nakhooda).

Going forward, it will be important to maximize synergies across the climate funds, minimize duplication and reduce transaction costs. The COP decisions at Paris reflect these goals, encouraging coordination of support amongst bilateral and multilateral financial sources and greater "coordination and delivery of resources to support country-driven strategies through simplified and efficient applications and approval procedures" (UNFCCC 2016).

An immediate issue will be the future of the CIFs, given that they were originally conceived of as a transitional arrangement until more permanent financing arrangements were established under the UNFCCC.

One of the key benefits of the CIFs has been their integration with the MDBs, which has enabled greater MDB financing of climate change projects, including LCR infrastructure projects (ICF 2014). A key way that the CIF structure has achieved this has been through blending CIF finance with MDB finance to reduce the risk and cost of finance for LCR infrastructure projects. The CIF has also bought climate finance expertise to the table, which has also been important in de-risking LCR infrastructure projects.

In fact, the potential centrality of the MDBs in financing LCR infrastructure needs globally underscores the importance of the CIFs (*Delivering on Sustainable Infrastructure* 2016). Following the Paris outcome, World Bank President Jim Yong Kim welcomed the deal and committed the Bank to do its utmost to help achieve the Paris agreement's goals (World Bank 2015b). The Bank has also pledged to increase funding for climate adaptation by up to $29 billion. All other CIF-partnered MDBs have committed to similar goals. Yet achieving these goals will require continued access to non-International Development Association (IDA) concessional climate finance, such as the type of support that has been provided by the CIFs (World Bank 2016).

Given these World Bank goals, the case for the CIF's continued role in financing LCR infrastructure is strong. While the GCF will also provide concessional climate finance, it is too early to tell how well it will work with the MDBs and whether the synergies and learning from embedding the CIFs within the MDBs can be replicated.

While there is a role for the CIF going forward, it is also the case that reform of the CIFs could produce even better outcomes in terms of LCR projects. Given the scarcity of concessional finance and its importance in leveraging private sector capital for LCR infrastructure,

the CIFs need to continue to ensure concessional climate finance is deployed as effectively as possible. This is a complex challenge that gets at how to determine when public finance catalyzes private investment.

The CIFs also need to increasingly support the piloting of high risk climate technologies that can potentially be scaled up, particularly given the importance of new technologies for achieving the below 2 degree goals and limits on private sector support. Progress here will require the CIF to expand its willingness to take on risk and to expand its use of financial instruments. This in turn will require donor support.

To more effectively leverage private sector finance, the CIFs also need to reduce project preparation time, since slowness at that stage can be a disincentive to private sector participation (ICF International 2014). Finally, to further mainstream climate objectives into a whole-of-government approach, CIF should engage with key government officials and stakeholders, including finance ministers where possible.

6 GREENING THE FINANCIAL SYSTEM

As outlined, the scale of LCR financing needs will require approximately a doubling of current financing for infrastructure, with approximately half the finance coming from the private sector. In addition to using public climate finance to de-risk and crowd-in private sector capital, it is also necessary to green the financial system to better align private sector capital allocation with climate and broader sustainability goals. In fact, the Paris Agreement's goal of making "finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development" reflects that global recognition that trillions in funding is needed and fundamental institutional changes are required to finance LCR infrastructure needs (UNFCCC 2016).[20]

Already, UNEP and the Canfin-Grandjean Commission are exploring reforms to align financial system's incentives and investments with achieving climate and broader sustainability goals (UNEP 2015a; Canfin and Grandjean 2015).

Greening the financial system is aimed at achieving the following goals:

- Facilitating the low carbon transition, such as by incorporating climate risk into financing decisions.
- Ensuring financial stability, given the risk that climate change could present. Responding to this is within the mandate of financial regulators and central banks. Effective prudential responses should also lead to greater allocation of capital for LCR infrastructure (and away from carbon intensive investments).
- Supporting the development of innovative green institutions and instruments, such as green investment banks and green bonds.

6.1 Responding to Climate Risk

The most significant reform that will more closely align financing decisions with climate change needs is to require the financial sector to better account for climate risk. An appropriate accounting of climate risk should increase the attractiveness of LCR infrastructure and reduce that of fossil fuel investments.

The main near-term climate risk is from so-called transition risk—the physical risk arises in the short to medium term with liability risk to follow (PRA 2015,

Box 4 What is Climate Risk?

There are three broad channels through which climate change can affect financial stability:

Physical Risks: damage from climate and weather related events that could damage property or disrupt trade.

Liability Risks: impact that could arise if parties who have suffered loss and damage from the effects of climate change seek compensation from those they hold responsible.

Transition Risks: financial risks from the structural economic adjustment to a low-carbon economy could result in re-pricing of a range of assets and commodities.

Covington and Thamotheram 2014). A potentially significant financial cost arising from transition risk and the de-carbonization of economies is the potential for stranded assets—assets that lose value or cannot be used due to their climate impact. These include investments in fossil fuel resources such as coal, oil and gas extraction or in entities or subsectors that use fossil fuels (i.e. utilities, chemicals, metals). In fact, the carbon budget implied by a two degree climate goal could mean that 30 percent of global oil reserves, 50 percent of gas reserves and around 80 percent of coal reserves will be unusable (Ekins and McGlade 2014). On the investment front, this means that approximately 80 percent of declared reserves owned by the world's largest listed coal, oil and gas companies are potentially subject to being stranded if a 2 degree world prevails (CTI 2012).

The extent and speed of the transition risk will shape how the financial system responds to the losses from holding stranded assets. The value of potentially stranded assets is estimated at approximately one-third of global equity and fixed-income assets (PRA 2015). To better understand what such an outcome might mean for the financial sector, financial assets should be 'stress tested' against different transitions scenarios (Farid et al. 2016). Accounting for such risk now should alter capital allocations away from economic sectors where transition risk is highest and into LCR infrastructure investments.

To be effective, accounting for climate risks needs to be done by all relevant actors, including financial intermediaries such as banks, securities markets and institutional investors, as well as by those actors and institutions regulating financial markets. This includes rating agencies, regulatory and supervisory bodies and central banks. The MDBs should also incorporate climate risk as a matter of course into all of their investment decisions.

6.2 Disclosing Climate Risk

One way of incorporating climate risk into financing decisions is to require disclosure by investors and companies of their exposure to such risk. Bank of England Governor Mark Carney has emphasized that such transparency will be essential if the financial market is to react efficiently to climate change risks (Carney 2015). Investment giant BlackRock has noted that that "greater transparency of climate risks and exposures will likely lead to a gradual discounting of companies' assets exposed to climate risk—and increase the value of those most resilient to these risks" (BlackRock 2015).

Climate risk disclosure can also reinforce the impact of climate policies and the transition towards a low carbon economy (Boissinot et al. 2015). Such disclosure could create a useful feedback mechanism between policy and markets, giving policy makers greater information on business exposure to risks and how they are managed, allowing for more informed and targeted decisions (Carney 2015).

There are already various voluntary principles developed by the private sector that recognize the importance of disclosing exposure to climate risk (and the impact on sustainability more generally). The Principles for Responsible Investing (PRI) established in 2006 comprise six voluntary principles developed by institutional investors and supported by the U.N. The PRI propose incorporating environmental, sustainability and governance (ESG) issues into investment decisions. A key element of PRI is ESG disclosure by institutional investors and the entities in which they invest. The PRI oversaw the 2014 Montreal Carbon Pledge by over 120 big institutional with the aim of publicly disclosing the carbon footprint of their investments on an annual basis.

Box 5 Voluntary Green Disclosure Standards

The Global Reporting Initiative: has developed a sustainability reporting framework for companies to use to report the impact of their business on sustainability issues.

The Carbon Disclosure Project (CDP): collects data on how companies identify and manage climate risks. This information is then made available to institutional investors for assessing the climate risk and corporate governance of the companies in which they invest.

The Equator Principles are a complimentary set of principles guiding investments in large infrastructure projects. The Equator Principles require the incorporation of sustainability into financial risk management and include as one approach looking at ways to reduce an infrastructure project's GHG emissions. However, the principles are limited to reducing GHG emissions in ways that are technically and financially feasible, underlining the need to reduce the cost of financing climate-related infrastructure.

These principles are supported by various voluntary standards that companies can use to disclose their exposure to climate risk and their impact on broader sustainability issues.

There is evidence that such voluntary disclosure has had a positive impact, including on the effectiveness of boards in addressing climate risk (Ben-Amar and McIlkenny 2015). There are, however, limits to such voluntary approaches. For one, the UNEP inquiry, drawing on Bloomberg data, reported that 75% of 25,000 listed companies assessed did not disclose a single sustainability data point. Secondly, the proliferation of schemes with different disclosure requirements can hamper effectiveness and lead to a lack of comparability (Farid et al.). This has led to calls to make such disclosure mandatory. Since 2009 the US Securities Exchange Commission has made it mandatory to disclose climate risk on businesses, including transition risk as well as physical risk (SEC 2010). In France, Article 173 of the Energy Transition Law came into force on 1 January 2016. Article 173 requires mandatory reporting by companies of the risks of climate change and requires companies to report on how they take climate change into account and implement low-carbon strategies. In addition, institutional investors in France have to disclose their portfolio carbon footprint and report on their climate risk exposure. In December 2015, the Financial Stability Board Task Force on Climate-related Financial Disclosures was established to develop recommendations for consistent, reliable and comparable climate-related disclosures by companies.

6.2.1 Financial Impacts so Far?

Despite the growing recognition of climate risk within the finance industry, increasing disclosure of exposure to climate risk and the potential of stranded assets has had little appreciable impact on financing and investment decisions. BlackRock for example has not found any climate change risk premium for equities (BlackRock 2015). Climate Tracker has concluded that the failure of the market to account for the potential for stranded assets under a scenario where the world achieves its two degree limit suggests the existence of a carbon bubble in fossil fuel intensive assets (CTI 2012).

6.3 What more is needed?

6.3.1 Voluntary Action

This lack of results does not mean efforts at encouraging disclosure of climate risks are not worthwhile. Instead, it underlines that incorporating climate risk into financial decisions is still at an early stage, that steps to require disclosure to climate risk need to be expanded, that shortcomings must be addressed and that additional action is required.

For instance, beyond merely identifying climate risks, investors and companies need to more fully reflect risk in their investment decisions. Investors are taking some steps here. For example, the Global Investor Statement on Climate Change signed by 409 investors includes: an agreement to support funding for the transition to a low carbon economy; a commitment to better evaluate low carbon investment options and to work with the companies they are invested in to minimize climate risk; and a pledge to maximize the opportunities presented by climate change and climate policy (AIGCC et al. 2015).

The first step toward getting institutional investors and asset managers more engaged is to educate them about the carbon footprint of their portfolios. In fact, given the potential economic and financial extent of climate risks, understanding what this could mean for a portfolio is likely part of existing fiduciary obligations. Raising awareness in this way will likely require pushing for greater analysis and assessment of the impact of climate change in the entities in which they are invested (Guyatt et al. 2012). For instance, BlackRock is using its investment stakes to incentivize corporate managers to improve their disclosure of climate risk (BlackRock 2015). CalPERS (the California Public Employees Retirement System) used its investment in BHP Billiton to push for the appointment of an outside director who could advocate for climate change action.

Another point of leverage for institutional investors is portfolio decarbonization—reducing investments in companies most exposed to climate risk and increasing the weighting of those less exposed who are contributing to reducing GHG emissions. There is already evidence that decarbonizing portfolios is likely to enhance long-term investment performance (UNEP 2015b). However, for some long-term investors, proactive engagement and efforts to change the behavior of management can be a more effective strategy (BlackRock 2015).

Other complimentary action includes more consistent and better incorporation of climate risk into sell-side research and consideration of climate risk by ratings agencies such as Standard & Poor's into their corporate bond ratings.

6.3.2 Regulatory Action

In addition to voluntary and private sector actions, government regulations to deal with the systemic risks climate change can pose to the financial system are both financially prudent and essential, given the potential negative impact of climate change on macro-level financial stability (Carney 2015).

Given the potential risk climate change poses for financial stability, the G20 asked the Financial Stability Board (FSB) to consider ways that the financial sector can take account of climate change. In December 2015, the FSB established the Task Force on Climate-related Financial Disclosures to undertake a coordinated assessment of how financial reporting can incorporate climate-related issues that are responsive to the needs of diverse stakeholders including lenders, insurers,

investors, and others who rely on financial disclosure to assess risks. The aim of the exercise is to encourage effective climate disclosures that can reduce uncertainties in decision making and thus lower the potential of destabilization in financial markets due to unforeseen corrections in asset values as a result of climate change.

In developing these recommendations, Stern and Zenghelis (2016) argue for: 1) clearer articulation and unbundling of material risks, 2) marginalization of non-physical risk and, 3) business vulnerability forecasts. Under 1), they argue that principles and practices for voluntary disclosures should first and foremost help clarify the existence of effective risk management processes that include some assessment of material risks. Achieving this requires relevant, coherent and verifiable metrics that provide clear upfront definitions of risk.

Central banks also have a role to play. For example, in 2011 Banco Central do Brasil was the world's first bank regulator to request banks to monitor environmental risks as part of the implementation of Basil III's Internal Review for Capital Adequacy; China has developed Green Credit Guidelines; Bangladesh has a Green Banking Framework; and Indonesia has a Roadmap for Sustainable Finance. The Swedish Financial Services Authority reported to the Swedish Government about sustainability aspects of the bank's lending in 2015 and in 2016 published an assessment of the risk climate change poses to financial stability.

Regulatory action may also be needed to ensure a more fulsome accounting by businesses of their exposure to climate risk. For instance, the extent of a company's exposure arising from transition risk, including changes in the legal and regulatory environment, market economic responses and reputational impact need to be considered alongside certain climate risks, which, when combined, could lead to tipping points and trigger a cascade of damaging climate-related effects.

Such disclosure should also be done in a way that is readily understandable and useful to investors. Companies should also be required to identify strategies for responding to the range of climate risks (Stern and Zenghelis 2016), including undertaking explicit sensitivity analysis and stress-tests of the viability of business models with varying carbon prices and regulations. Such forward-look assessments can tease out the underlying assumptions firms make and help investors make informed decisions and assess market capitalization (Stern and Zenghelis 2016).

6.4 Greening the Banks

As discussed, banks will need to play a greater role financing sustainable infrastructure. In terms of voluntary action that banks could take, drawing on the Equator Principles or Principles for Responsible Investment, banks could commit to the type of reporting and disclosure of their exposure in their balance sheets to climate risk. A complimentary approach would be for banks to also include climate risk in their credit risk management processes. In fact, there is evidence that integrating sustainability criteria in credit risk management improves its predictive validity by approximately 5 percent (Weber 2015). Banks could also stress test current portfolios against various climate risk scenarios.

Box 6 Green Investment Banks

A green investment bank is a public entity that uses limited public capital to mobilize private investment into domestic low carbon and climate resilient infrastructure. This includes mobilizing private investment to meet domestic target for renewable energy deployment, energy efficiency and GHG emission reductions.

6.4.1 Green Investment Banks

In addition to greening the banking system, some countries such as the U.K., Australia and Japan and in the U.S, states such as California, Connecticut and New York have established green investment banks (GIBs). These GIBs have also tended to be established in countries that do not have a national development bank.

GIBs aim to leverage private capital for investment in climate change mitigation and adaptation. Some GIBs such as the UK GIB are required to deliver a return on capital and in this respect are not mere grant making entities. In fact, the UK GIB turned a profit in the second half of 2014-15 and is projected to generate an overall return of 9% when its projects are fully operational. In 2014, the Australian Clean Energy Finance Corporation achieved a 4.15% return (net of operating costs) and their current portfolio of investments in 2015 is projected to generate an annual return of 6.1% once fully deployed.

GIBs bring a range of benefits to financing LCR infrastructure. The UK GIB was able to bring sectoral and technical expertise that the GIB can bring to the deals it was involved in, allowing for greater de-risking. For instance, institutional investors have been prepared to invest in a GIB-developed platform that holds equity positions in renewable energy infrastructure projects. Investors' willingness was due in part to the technical experience of the UK GIB, which offered them reassurance (UNEP and BNEF 2016).

The GIB also uses loan loss reserves, guarantees and debt subordination to apportion risk based on risk appetites of different sources of private sector capital.

GIBs tend to focus on domestic investments in climate mitigation and adaptation, since most climate-related infrastructure investments are local. As a result, GIBs in developing countries can be used to channel UNFCCC climate finance. GIBs can then either reinvest such finance either in green investment vehicles such as wind or solar funds, or directly in project development, working with local banks and other investors to support new climate-related infrastructure projects.

6.5 Develop Green Financial Instruments

Attracting and scaling green finance requires developing green financial instruments that expose investors to sustainable infrastructure assets. To attract long term financing, these instruments need to be structured in ways that respond to the particular risk/return profiles that these investors require. Green bonds hold the most promise this regard. Listed vehicles such as Yield co are also providing new opportunities to invest in sustainable infrastructure assets that are attracting institutional investor capital.

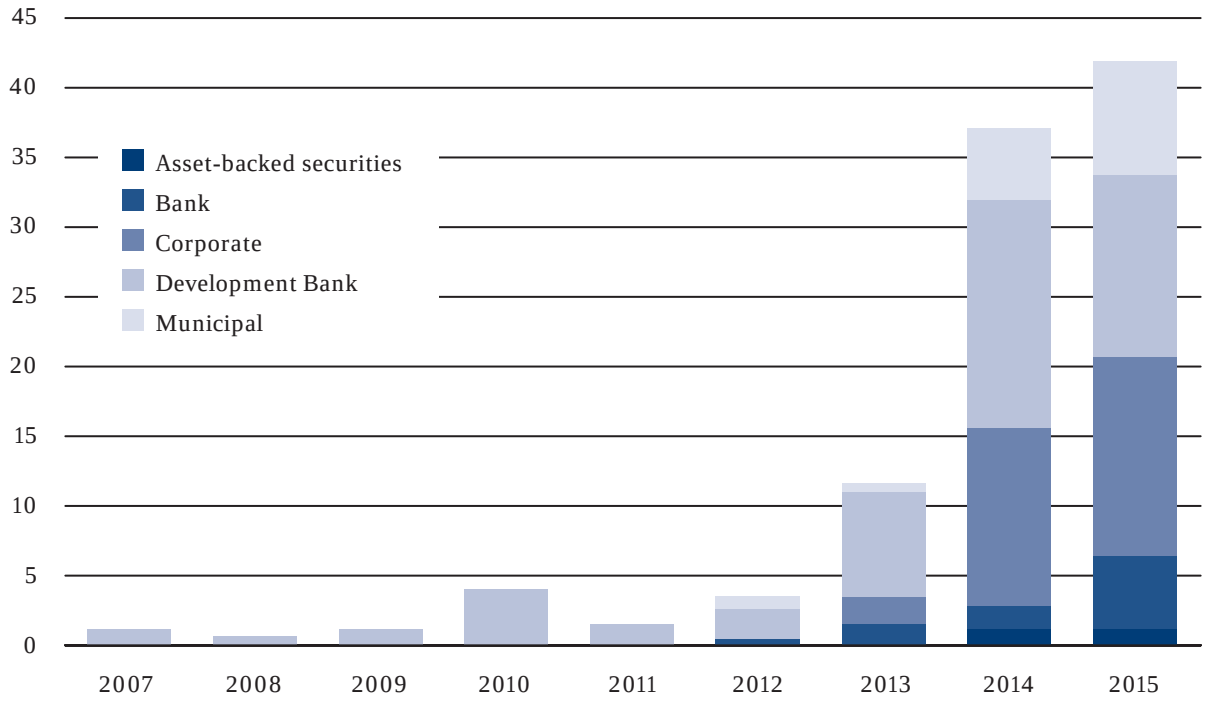
6.5.1 Green Bonds

There is no specific agreed upon definition of what a green bond is. The World Bank defines green bonds as fixed income, liquid financial instruments that are used to raise funds dedicated to climate-mitigation, adaptation, and other environment-friendly projects.

As Figure 4 shows, the green bond market has grown from less than $1billion in 2007 to over $41 billion in 2015 (CBI 2015a). Over 80 percent of green bonds issued went to climate-related infrastructure and energy efficiency projects. Yet, the market pales in comparison to the global bond market which is worth around $93 trillion, underscoring the potential for growth (World Bank 2010).

Green bonds, like all bonds, are issued by a public or private entity. Credit ratings are assigned to the bond

Figure 4. Global labelled green bond issuance (USD billion/year)



depending on factors such as the rating of the issuing entity and the underlying assets. Developments banks such as the World Bank have traditionally been the main issuers of green bonds which have allowed the World Banks AAA credit rating to apply to these bonds. In 2015, however, approximately half of the climate bonds were issued by the private sector (CBI 2015a).

Green bonds will be important for financing LCR infrastructure, particularly in terms of attracting investment from institutional investors. From an investment perspective, green bonds resemble standard bonds, aside from the fact that they give the investor an opportunity to invest in projects that have a positive effect on climate. Institutional investors that need to hold certain amount of low risk securities typically require that green bonds be rated by a credit rating. Green bonds (like all bonds) are liquid and can be traded, which can be important for investors such as pension funds who have ongoing payment obligations.

While green bonds present a range of financing opportunities for LCR infrastructure, some challenges need to be overcome if green bonds are going to scale. One of the main challenges is the absence of common mandatory standards around which to assess what constitutes a LCR project along with agreed metrics for assessing whether the project produces LCR outcomes (Farid et al. 2016).

There are various voluntary industry-led initiatives to develop standards that address how proceeds from green bonds are used, how to evaluate and select sustainable projects, and reporting protocols to be used by the issuing organization detailing the use of proceeds. For example, the Green Bond Principles developed by investors and civil society and in consultation with the World Bank provides a framework that covers the use of proceeds from green bonds; project evaluation and selection; management of proceeds; and reporting on use of proceeds (ICMA 2015; CBI 2015b). These

principles remain voluntary and in some respects are too broad to fully address many of the challenges. For instance, the Principles merely identify broad sectors that constitute green projects, but don't address how to account for projects with objectives that are not 100 percent green, or when climate adaptation is merely a byproduct of the project's larger impact. Other challenges not addressed in the principles include who should verify compliance and what actions should be triggered when an issuer fails to reduce GHG emissions and (BlackRock 2015).

Green bond indices have also been created to help determine what qualifies as "green." For example, the Barclays-MSCI Geen Bond Index launched in November 2014 goes beyond the voluntary standards such as the Green Bond Principles and includes specifics about the use of proceeded. The Oslo Securities Exchange crated the first separate green bond listing in 2015.

Another way to reassure investors over the use of the proceeds have been through incorporation into the issuance of an independent second opinion of the 'greenness" of the bond—approximately 60% of issuers to data have done this. While this may help boost investor confidence it has added to verification costs, which could prevent rapid scaling of issuance.

Progress on green bonds standards will likely require more government involvement in developing green bond standards. This could involve for instance collective action at the G20 level amongst finance ministers or having the FSB develop common principles that governments could endorse.

Central banks could also act to support growth in the green bond market. This could include central bank purchases of green bonds and including green bonds in the reserve requirements for the financial sector (UNEP 2015a).

6.5.2 Green Equities

Providing opportunities for equity investments in LCR infrastructure projects is also needed. As outlined above, equity investments remain important at the earlier stage of infrastructure projects and could be another investment option for institutional investors once projects are operational.

One financial innovation that holds promise is Yield co in the U.S. and quoted project funds in the UK - listed vehicles that invest in renewable energy assets at the operating phase and hold them through to the end of their lives. Investing in such vehicles gives investors exposure to LCR infrastructure (UNEP 2015a). Over 2013–2015, Yield co and quoted project funds sold more than $14 billion in equity (UNEP and BNEF 2016). Moreover, institutional investors are increasingly looking to invest in such equities (ibid).

Developing green indexes such as the MSCI Low Carbon Leaders Index and demonstrating superior investment returns is another way investors can get exposure

Box 7 China's Green Bond Market

China's People's Bank established a green bond market in December 2015 to complement the green bank lending. China's green bond market is expected to grow to $230 billion within the next 5 years.

China has also published guidelines on the issuance of green bonds, the first country to do so. The Shanghai Stock Exchange in 2016 announced a pilot program for trades of corporate green bonds that will encourage firms to seek independent assessments of green qualifications.

to sustainable infrastructure assets. For example, Morgan Stanley has developed an index of stocks that provide GHG services and are reducing their GHG footprint, which has demonstrated higher long-term price earnings expectations, lower risk and volatility and higher return on equity (MSR 2015). BlackRock also believes that investors can generate superior returns by investing in companies showing the biggest progress reducing GHG emissions (BlackRock 2015).

Similar to green bonds, these equity vehicles are in the early stage of development and more of them will be needed to provide investors with the scale of investment opportunities to start meeting the infrastructure investment needs.

7. CONCLUSION

Global infrastructure needs are large. Approximately $75–$86 billion will need to be invested in core infrastructure over 2015-2030, and up to $116.55 trillion when taking into account investments needed in energy efficiency and primary energy. Furthermore, 70 percent of these investments needs will be in EMDC. Of these infrastructure investment needs, approximately 60 percent will be in power and transport, with significant amounts also in water and sanitation.

Ensuring that the infrastructure that is built is LCR infrastructure will determine whether the world achieves the SDGs and the Paris Climate Change goal of keeping global temperatures below 2 degree Celsius. As 70 percent of greenhouse gas emission are from infrastructure. Building the same infrastructure as in the past will lock the world into high carbon development pathway inconsistent with the below 2 degree goal. Moreover, building the same infrastructure will lead to more pollution, congestion and poorer health outcomes that will reverse the development gains made so far and undermine achievement of the SDGs.

Building the needed LCR infrastructure will require a combination of less investment in fossil fuel intensive infrastructure such as coal fired power stations and more invested in areas such as energy efficiency, renewable energy and low carbon technologies such as CCS. As discussed, LCR infrastructure needs above BAU are estimated at $13.5 trillion between 2015 and 2030. However taking into account the savings from building less carbon-intensive infrastructure and the like means that the global net cost of building the needed LCR infrastructure is $4.1 trillion over 2015–2030.

While this is a relatively low net need, the costs and savings from LCR infrastructure will be realized by different actors over time. As a result, the financing needs are in fact more difficult—the real challenge is to finance the upfront $13.5 trillion additional investment needed—approximately $900 million p.a.

Taking into account overall global infrastructure needs, the financing gap is in the order of $3 trillion per annum. It is estimated that up to 50 percent of these LCR infrastructure needs could be met by private capital. The rest will need to come from public sources of finance such as governments, national and multilateral development banks and climate finance. To attract more private sector capital into LCR infrastructure will require reforms that alter the policy and financing landscape.

The key policy reforms are pricing carbon and removing fossil fuel subsidies. However, policy reforms alone are not enough as there are other significant barriers to financing LCR infrastructure that also need to be addressed. Some of these barriers exist for infrastructure projects generally such as the lack of transparent and bankable pipelines of projects and the higher risks of infrastructure projects at the early project planning and construction phase where delays and cost overruns are more likely and the project has yet to generate any cash flow. Moreover, in EMDCs in particular, higher levels of sovereign risk raise the cost of finance, which makes infrastructure projects even more difficult to finance.

There are also financing barriers specific to LCR infrastructure. These include often higher upfront capital costs for LCR infrastructure over more traditional infrastructure and increased risk arising from the greater uncertainty from low carbon technologies.

Climate finance has a key role to play in addressing these financial barriers. In particular, concessional climate finance that governments provide as part of their

$100 billion UNFCCC climate finance pledge can play a catalytic role in financing LCR infrastructure. Concessional public climate finance in the form of grants and loans are most useful in reducing risk, crowding in private sector finance and bringing down the overall cost of finance for LCR infrastructure projects. Such public climate finance is also most needed for LCR infrastructure projects in EMDC where the majority of infrastructure needs arise but where the risks and costs of capital are highest.

To underpin growing investment by the private sector in LCR infrastructure will also require broader reform of the financial system to more closely align the financial incentives for companies and investors with climate change goals. A core element of this is to ensure that climate risk is fully reflected in companies and investor decisions on capital allocation. There are already various voluntary efforts on disclosing their climate risk but as discussed, a more comprehensive approach backed with sanctions seems needed.

Development of green banks is another area where countries are demonstrating how building the financing skills for investing in LCR infrastructure can itself have a de-risking impact on such projects.

Complementing this is financial innovation in the debt and equity markets that are providing investors with new ways of investing in LCR infrastructure. Green bonds are the most significant development here, but more is needed to ensure consistency in standards and to guarantee that the funds raised are reducing greenhouse gas emissions below business-as-usual. These are also areas where climate finance can be used to support such outcomes.

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NOTES

1. COP 21 Decisions, para 27
2. Paris Agreement, Article 13.7(b).
3. Paris Agreement, Article 13.11
4. Paris Agreement, Article 4.3 & COP Decisions para 23
5. Paris Agreement, Article 6(1); Article 4(19); Article 7(1)
6. At COP 16 in Cancun this $100 billion goal was endorsed and COP 17 in Durban established a work program to analyze options. The 2011 COP 18 in Doha called on developed Parties to identify pathways to mobilize the scaling up of climate finance
7. Paris Agreement, Article 4.19
8. Paris Agreement, Article 4.5
9. Paris Agreement, Article 9
10. Paris Agreement, Article 10.5
11. Paris Agreement, Article 2
12. Paris Agreement, Article 9.3
13. Paris Agreement, Article 7
14. Paris Agreement, Article 13
15. Paris Agreement, Article 9(3) & 9(4).
16. COP 21 Decisions, para 58; The Adaptation Fund may also serve the Agreement, subject to a further COP decision.
17. These are: helping countries identify an institution that will be the focal point for interaction with the GCF; developing a strategic framework for interaction with the fund; selecting local intermediaries through which funding can be channeled; and support to identify programs and projects for financing.
18. Paris Agreement, Article 7.1
19. Paris Agreement, Article 7.13
20. Paris Agreement, Article 2(c).

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