Foundations Platform F20: A report to the G20

F20

Aligning G20 Infrastructure Investment with Climate Goals & the 2030 Agenda

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Notification

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Aligning G20 Infrastructure Investment with Climate Goals & the 2030 Agenda

A report by the Foundations Platform

F20

Foreword

In many parts of the world, the issue of climate change and the UN 2030 Agenda with the Sustainable Development Goals (SDGs) are experiencing an unprecedented momentum. Finally! For many years already, robust science is warning of the devastating impacts of greenhouse gas emissions and fatal consequences of global temperature increase beyond the scientifically based target of 1.5 °C. Without an adequate response, the global GHG emissions will remain far off track, threatening to increase the devastating effects of climate change.

Every day huge amounts of additional GHG emitting infrastructure is still being built. Infrastructure construction and development and its operation in the energy, building and transport sector contribute to approximately 70% of the global GHG emissions, while again 70% of the infrastructure required by 2050 is yet to be built. This makes infrastructure a main source of the problem – yet also a substantial opportunity to become a key driver for improving the quality of life by generating development, employment and the unleashing of innovation for a sustainable future. However, fundamental transformations, such as the aligning of infrastructure construction and climate goals, need to take evolving social pressures into account that require an inclusive approach and deliberate policy-making. Ignoring these challenges is not an option – no matter from which perspective.

Contributing to about 80% of the global GHG emissions, the G20 countries should be at the centre of a just transition towards net zero emissions by 2050 and a sustainable future. International agreements, such as the 2030 Agenda or the Paris Agreement can serve as frameworks for a transformation towards a new climate economy that leaves no one behind. At the G20 summit in Buenos Aires, 19 out of 20 parties have reasserted the Paris Agreement as "irreversible" and reiterated the importance of fulfilling the UNFCCC commitment by developed countries in providing the means of its implementation.[3]

The Foundations Platform F20 seeks to outline possibilities and mechanisms shaping the transition lying ahead. Foundations and philanthropic organizations have a crucial role to play as drivers and catalysts for change and F20 builds bridges between civil society, the business and financial sectors, think tanks and politics – within the G20 countries, between them and beyond. F20 wants to encourage strong and decisive actions that can enable countries to capitalize on the potential of a low-carbon economy, such as boosting jobs and productivity growth, while being resilient to economic vulnerability.

As such, F20 seeks to advocate long-term solutions that also support the building of coalitions of ambition in G20 countries to drive forward the implementation of multilateral commitments, such as the 2030 Agenda or the Paris Agreement. With this publication, the F20 platform calls upon the G20 heads of state to

- Align the infrastructure agenda with the 1.5 °C target and the 2030 Agenda with the 17 SDGs
- Promote green investments to unlock funds for investing into renewable energy, energy efficiency and the building of sustainable and resilient infrastructure
- A carbon price across all sectors alongside the phase out of fossil fuel subsidies by 2025, making way for increased investments in the transition towards a low-carbon economy
- Ensure full carbon disclosure by the implementation of the Task Force on Climate-related Financial Disclosure (TCFD) recommendations to reduce the systemic risk that climate change pose to the global financial system and investments, while fostering innovation through the exploration of climate opportunities, e.g. by Green Bonds.

F20 urges to pursue these points as an integral part of a just transition to commit to the principle of "shifting the trillions – leave no one behind". With these recommendations, international foundations reinforce their decision to be of the solution and to constructively support the negotiations towards a sustainable future at the G20 summit 2019 in Osaka, Japan.

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Fundación Avina

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3 G20-leaders-declaration (2017): p.10

Executive Summary

The 2015 international agreements on the 2030 Agenda for Sustainable Development and the Paris Agreement on climate change serve as the new guideposts for the 21st century economy. However, the global community is falling far behind in mobilizing the necessary leadership, ambition and investments to make these goals a reality. There is an urgent need for a renewed, ambitious and coordinated G20 leadership regarding the new global agenda.

The risks and costs of inaction are mounting faster and are greater than previously recognized. The year 2017 was the second hottest year globally since 1880, and 18 of the 19 warmest years on record have occurred since 2000. Data just released indicates that the concentration of carbon dioxide in the atmosphere has reached a record level of 415 ppm (parts per million), a level that has never before been experienced in the history of human civilization. These climatic changes are causing immediate costs in terms of drought, fire, natural disasters, coastal erosion and the subsequent risks to economies and livelihoods. The current growth path is also putting intense pressure on other global commons, including water resources, land and biodiversity, leading to an accelerated loss of natural capital.

The Paris Agreement commits the world's nations to 'holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels,' as well as to build resilience in the face of climate change. The case for limiting the temperature increase to 1.5 °C is even stronger than five years ago given the growing scientific evidence of the costs for a 2 °C scenario. The Sustainable Development Goals (SDGs) now provide a unifying framework with a common mission, ensuring that the transition to a zero-carbon global economy goes hand in hand with economic growth, environmental protection and advancing human progress including by ending poverty, reducing inequality and making marked improvements in global health, education and wellbeing.

Investments in quality and sustainable infrastructure will literally lay the foundation for a new and better growth trajectory and achieving the ambitious development goals. Making a historic series of investments in quality and sustainable infrastructure aligned with 2030 Agenda and the Paris Agreement will benefit multiple generations. Investing in sustainable infrastructure can be a catalyst for inclusive and sustainable growth by creating jobs, spurring industrialization and competitiveness, and connecting people and markets. Sustainable infrastructure can also help reduce poverty by providing basic services and work opportunities. Infrastructure investment reflecting environmental considerations contributes to preserving the natural environment, reducing carbon emissions and pollution, enhancing climate resilience and ensuring efficient use of resources.

The G20 has become a champion for scaling up infrastructure investment and financing, but needs to align its leadership with the Paris Agreement and the SDGs. In 2010, G20 leaders began to emphasise infrastructure as a key pillar of economic growth. The 2014 G20 Brisbane Summit endorsed a *G20 Global Infrastructure Initiative* to support public and private investments in quality infrastructure, which was reaffirmed at the 2016 Hangzhou Summit in China. In 2017, the G20 in Hamburg, Germany, emphasized climate and energy sustainability. Under the Argentinian leadership in 2018, the G20 developed the *Roadmap to Infrastructure as an Asset Class*, and the Japan presidency in 2019 is taking forward this agenda including through G20 principles on quality infrastructure. The G20 must clearly recognize that principles of quality infrastructure, in the 21st century, mean sustainable infrastructure aligned with the Paris Agreement and the SDGs.

Article 2 of the Paris Agreement states that the world aims to 'strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by . . . [m]aking financial flows consistent with a pathway towards low greenhouse gas emissions and climate resilient development.' In many emerging markets and developing countries (EMDCs), new capital investments are needed in sustainable infrastructures, including in renewable energy, zero-carbon transport, resilience and other sectors. In advanced economies and certain segments of EMDCs, in addition to new capital investments, investments are also needed to decommission unsustainable infrastructures, such as coal-fired power plants and inefficient transport networks, and replace them with newer, carbon-neutral infrastructures. To meet the Paris Agreement, all new capital investments should be de-carbonized and made more resilient at an accelerated pace. At its current rate, the global community will not even be able to meet the 2 °C Paris scenario, let alone the 1.5 °C target. In this report we show that:

- **Sustainable infrastructure investments are falling short of investment needs by USD 3.2 trillion per year.** To achieve baseline SDGs and the upper bound of the Paris Agreement targets of 2 °C, the global community will need to invest upwards of 7.6 percent of GDP, —USD 7.6 trillion each year from 2015-2030. Current trends in infrastructure investments are 5.5 percent of global GDP. We thus face a gap of 2.1 percent of global GDP.
- **Multilateral development banks are not mobilizing adequate levels of financing.** Multilateral development banks (MDBs) are currently providing around USD 50 billion per year in financing for sustainable infrastructure, or just 1.5 percent of the prospective needs of EMDCs. Moreover, MDBs are not sufficiently crowding in private participation in infrastructure financing.
- **National development banks and other development finance institutions play a larger role in sustainable infrastructure,** at roughly USD 88 billion per year, but are dominated by major players in Brazil, China, and Germany and only amount to 1.2 percent of the global need.
- **Private capital flows from G20 countries into sustainable infrastructure are also very small, just 0.5 percent of the total global need.**

The G20 plays a central role in pushing for greater ambition and bringing about the decisive shift towards a carbon-neutral, climate-resilient economy. Strong and decisive actions can enable countries to capitalise on opportunities offered by decarbonization, including boosting jobs, enhancing competition and growth and avoiding economic vulnerability.

There is an immediate need to build a powerful coalition of G20 countries that are strongly committed to the scale and urgency of action needed. To this end, the G20 should:

- **Commit to align the infrastructure agenda with the 1.5 °C target and the SDGs.** G20 can exercise leadership by implementing ongoing Nationally Determined Contributions (NDCs) and preparing more ambitious NDCs for the subsequent five years in the run up to COP26. These NDCs should be anchored in growth and development strategies geared to deliver the SDGs and the 1.5 °C goal implying a reduction in emissions by advanced G20 members of 50 percent by 2030 and a pathway to net zero emissions by all G20 members by 2050. The G20 Climate and Energy Action Plan should also be revamped to meet these objectives with well-specified benchmarks and timelines. G20 countries should urge their finance ministers and central banks to join the Coalition of Finance Ministers for Climate Action and the Network of Central Banks and Supervisors for Greening the Financial System (NGFS). Trade ministers should not only introduce reforms to trade and investment treaties, but also incentivize acceleration of trade and investment in renewable energy and carbon-neutral technologies and reduce existing incentives for trade and investment in sectors that need to be phased out.
- **Unlock investments at scale in sustainable infrastructure.** Towards this end, G20 countries should pursue an integrated agenda to deliver on quality infrastructure geared to meet the SDGs and the 1.5 °C goal. The G20 Principles on Quality Infrastructure provide an important opportunity to set out this agenda. Many elements being discussed — such as cost efficiency over the life cycle of the project, resilience, accessibility and debt sustainability — are important for sound investments. But a central focus must be on climate impact and resilience, and the preservation of natural capital, with agreed targets including the 1.5 °C goal. The G20 should make systematic efforts to bolster upstream foundations and set common principles and standards to fully incorporate environmental risks including the climate.
- **Eliminate fossil fuel subsidies and mainstream carbon pricing.** G20 governments play a leading role in establishing credible carbon policies and prices within their own jurisdictions, and acting coherently across jurisdictions. Implementation trajectories will vary accounting to specific national conditions, including distributional and transitional impacts. It is important to phase out fossil fuel subsidies as they are tantamount to negative carbon pricing. Both carbon pricing and eliminating fossil fuel subsidies can generate substantial revenues that can be used to finance an increase of sustainable investments and to help facilitate a just transition.

- **Phase out coal and set timelines for phasing out all fossil fuels** not only in G20 countries but also adjusting polices to overseas trade, investments and financial flows. As policies align, and as prices for coal and other fossil fuels are already higher in certain areas and are projected to be higher than renewable energy over the next decade globally, current investments in coal will prove to be stranded assets involving significant economic and social costs. Estimates suggest that mixed signals could lead to USD 12 trillion of stranded fossil fuel assets by 2035.
- **Mobilising finance at scale with a strong alignment to sustainability and to the 1.5 °C target.** G20 countries should create viable revenue models by tapping into spill-over effects that can boost long-term returns and, together with improved credit enhancement mechanisms, can attract private capital, pension funds and sovereign wealth funds worth trillions of dollars, reduce costs of capital returns and improve debt sustainability. The G20 should commit to mobilising an additional USD 100 billion for climate funds to meet priority needs and anchor the 'billions to trillions' agenda. The G20 should re-engage in the sustainable financing agenda to shift the financial system to align with sustainability. Reporting based on the recommendations of the Task Force on Climate-Related Financial Disclosure should be made mandatory across the G20 and, as proposed by the NGFS, climate risk should be systematically incorporated into the framework of prudential and risk assessment.
- **Establish measurement and monitoring systems** building on the Global Infrastructure Hub that tracks progress toward meeting G20 shared goals in an open and transparent manner. G20 should endorse the development of a methodology to track sustainable infrastructure investment based on a common understanding of what sustainable infrastructure means, and what it means in operational terms for sustainable infrastructure to be aligned with the Paris Agreement and the SDGs. This should explicitly include scenarios and ways to limit the temperature increase to 1.5 °C.

Development Finance Institutions (DFIs) — both MDBs and national level DFIs — are key to delivering these policies. At the *One Planet Summit* in 2017, the International Development Finance Club and many other MDBs signed a joint declaration to align their financial flows with the Paris Agreement and also committed to making the SDGs core to their strategies and objectives.[4] DFIs can guide policy by increasing their commitments to low carbon finance, phasing out fossil fuel finance, enabling country strategies and platforms, and leveraging their balance sheets. What is more, DFIs are equipped to monitor debt sustainability and ensure access and benefit sharing among multiple stakeholders.

- **Development Finance Institutions could potentially mobilise up to USD 2.5 trillion per year** for sustainable infrastructure if they shifted their balance sheets toward sustainable infrastructure, maximized their lending headroom, leveraged private sector finance, and if the MDBs received adequate capital increases.

G20 countries have access to assets worth USD 5 trillion in multilateral and national development banks.[5] The upwards of $250 billion they provide in foreign direct investment outside of the G20 every year could be geared toward sustainable infrastructure. Yet, G20 only invests 3 percent of GDP in infrastructure in their own countries, and DFIs from G20 countries have only mobilised an average of $115 billion annually through financial development institutions — with a very small percentage flowing into low income countries. DFIs should act as coordinating systems, scaling and concentrating financial flows in line with the 2030 Agenda and the Paris Agreement. The DFIs should perform as a broader system to forge common goals, monitoring and accountability systems.

The scale and urgency of the challenge cannot be overstated. Over the next 15 years, the stock of infrastructure is expected to more than double; the world economy is likely to double over the next 20 years, and urban population will nearly double over the next 30 years. With the scale of investment that will have to be made, we cannot afford to lock in carbon intensive technologies and inefficient capital. Decisions made over these next crucial years will shape the trajectory of investments for the coming 10 to 15 years and these, in turn, will determine the future of people and the planet for this century and beyond.

4 IDFC (2018)

5 Kring & Gallagher (2019)

Contents

FIGURES

TABLES

BOXES

Introduction

An ambitious global agenda on climate change and sustainable development has emerged from the landmark international agreements of 2015. Together, the 2030 Agenda for Sustainable Development that established the SDGs, the Paris Agreement, and the Addis Ababa Action Agenda aim to deliver strong, sustainable, balanced and inclusive growth, reduce global poverty, and secure a better and more sustainable future for people and the planet for decades to come.

This global agenda is based on the understanding that eliminating extreme poverty and laying the foundation for a sustainable, future prosperity worldwide go hand in hand with effectively addressing climate change. As the pioneering 2014 New Climate Economy (NCE) report on 'Better Growth and Better Climate' had underscored, there is no trade-off between these objectives: The only long-term growth path that is sustainable is a low-carbon, climate-resilient one (New Climate Economy, 2014). The new global agenda has also highlighted the central role of sustainable infrastructure. Raising quantum and quality of sustainable infrastructure is crucial for sustainable and inclusive growth, poverty reduction, attainment of the sustainable development goals and meeting the ambitions of the Paris Agreement of 'holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels', as well as building resilience in the face of climate change. Two thirds of future infrastructure investment will take place in emerging and developing economies, and all of the infrastructure we build needs to be low-carbon or carbon-neutral and climate-resilient.

The transition to a carbon-neutral climate-resilient economy offers the opportunity to shape a much more attractive growth path. As the 2018 report of the New Climate Economy has argued, the world has an unprecedented opportunity to shift to a better growth trajectory, one driven by innovation, high quality and sustainable investments and the tremendous potential of the private sector (New Climate Economy, 2018). The new growth path offers a boost through technological innovations and cost advances that can help create jobs and drive growth. Well-targeted climate action can also deliver other co-benefits, including reduced air pollution and congestion, while avoiding the costs of high-carbon growth paths such as remedial measures that will become progressively costlier over time. Most analysts agree that this transformation is both technically and economically feasible, and can deliver better, more equitable and sustainable growth (e.g. OECD, 2017a; Energy Transitions Commission, 2017; New Climate Economy, 2018).

While the opportunities for carbon neutral transition are greater than they appeared a few years ago, the risks and costs of inaction are mounting faster and are greater than previously recognized. 2017 was the second hottest year globally since 1880, when modern record-keeping began, and 18 of the 19 warmest years have occurred since 2000.[6] The latest data indicates that concentrations of carbon dioxide in the atmosphere have reached a record level of 415 ppm (parts per million) – levels that have never been experienced by humanity before. Planetary systems are under severe threat, not just by GHG emissions, but by polluted air, endeangered fresh water and oceans, degradation of agricultural land and natural landscapes, loss of biodiversity and ecosystems and the alteration of biogeochemical cycles. World Bank and other analyses show that there will be major impacts that will largely affect poor and vulnerable populations (Hallegatte *et al.*, 2017; Rigaud *et al.*, 2018).

The scale and urgency of the challenge cannot be overstated. Over the next 15 years, the stock of infrastructure is expected to more than double; the world economy is likely to double over the next 20 years, and urban population will nearly double over the next 30 years (New Climate Economy, 2018). These transformations will primarily happen in emerging markets and developing countries, but in industrialized economies there is also a pressing need to replace aging and polluting infrastructure. With the scale of investments that will have to be made, we cannot afford to lock in carbon-intensive technologies and inefficient capital. The window for making the right choices is uncomfortably narrow, both because of a shrinking carbon budget and because remedial measures will become progressively costlier. Decisions made over the next 1 or 2 years will shape the trajectory of investments for the coming 10 to 15 years and these, in turn, will determine the future of people and the planet for this century and beyond.

6 NASA (2018), NASA Global Climate Change (2019)

Although broad-based efforts are now underway to deliver on the global Paris and SDGs agenda, we are presently falling behind on actions and on the quantum and quality of infrastructure investment to deliver on growth, development and climate goals. Current climate commitments, embodied in the NDCs of countries under the Paris Agreement, fall far short of the reductions needed to meet the target of limiting the global temperature rise to well below 2 °C (UNEP, 2018). Given the growing evidence of the severe costs of even a 2 °C scenario, it is imperative that the world delivers on the higher ambition of a 1.5 °C target.

The G20 has a pivotal role to play in ramping up on the scale and urgency of action to deliver on the SDGs and limiting global warming to 1.5 °C, given the dominant share of the G20 in the global economy and carbon emissions and their importance in the global agenda setting. The G20 has embraced the commitments it made in 2015, particularly the 2030 development agenda and the Paris Agreement (although the US has indicated its intention to withdraw from the Paris Agreement) and it has made 'strong, sustainable, balanced and inclusive growth' as a unifying theme of its agenda since the 2009 Pittsburgh Summit. The G20 has been pursuing this agenda through multiple tracks: the growth agenda, a long-standing focus on infrastructure, energy transition, climate action, the development track and green/sustainable finance.

Under the Japanese G20 presidency, quality infrastructure has been set as a central plank of this year's G20 working programme and deliverables. While the focus on quality infrastructure is timely, there is a need for an integrated and ambitious agenda on quality infrastructure that can deliver on the SDGs and the goal of limiting global warming to 1.5 °C. This paper reviews the agenda to accelerate the delivery of sustainable and quality infrastructure to meet the ambitions on development and climate, the role and contributions of the G20, and how these need to be enhanced and better aligned with climate goals and the 2030 agenda.

I. Centrality of Quality and Sustainable Infrastructure

A. Why Sustainable Infrastructure?

Sustainable infrastructure is recognized as a critical foundation for inclusive growth, attainment of the SDGs, and meeting the targets of the Paris Agreement to limit global warming to well below 2 °C and even further to 1.5 °C. We understand sustainable infrastructure as 'infrastructure projects that are planned, designed, constructed, operated and decommissioned in a manner that ensures economic and financial, social, environmental (including climate resilience) and institutional sustainability over the entire life cycle of the project' (Amin *et al.*, 2019). As a foundation for economic growth, infrastructure underpins all economic activities. In addition, investments in infrastructure can boost jobs, industrial growth and competition of national economy. Good infrastructure is also a key to poverty reduction and social well-being since it enhances quality of life through providing basic services and work opportunities. Infrastructure investment reflecting environmental considerations contributes to preserving the natural environment through avoiding negative impacts on biodiversity and ecosystem, reducing GHG emissions and pollution, enhancing climate resilience and ensuring efficient use of resources (Figure 1).

Figure 1: Sustainable Infrastructure and Sustainable Development Goals

Source: Bhattacharya *et al.*, (2016)

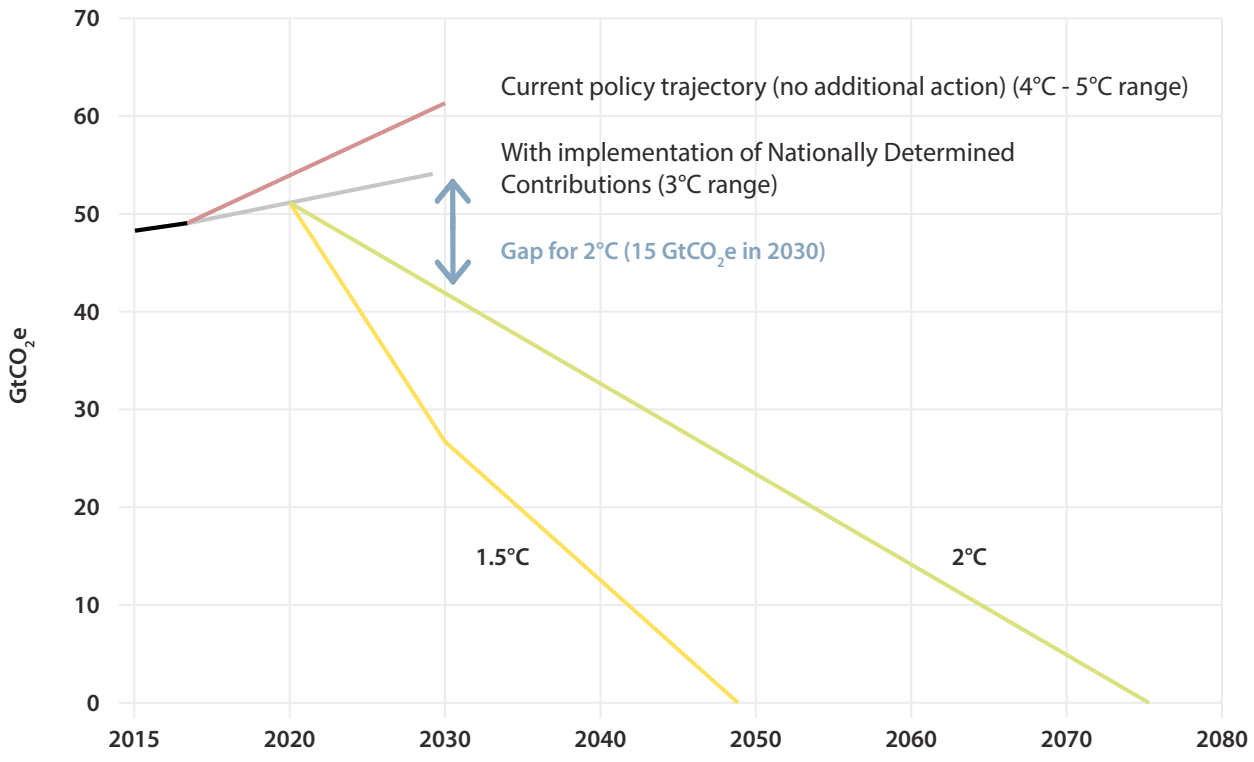
B. Scale and Urgency of the Challenge

The world needs to scale up investments in quality and sustainable infrastructure to respond to the rising infrastructure needs, especially in emerging markets and developing countries and to structural changes such as rapid urbanization. The global stock of infrastructure is expected to more than double by 2030 (New Climate Economy, 2016). Total investment requirements for "core infrastructure" (power generation

and distribution, transport, water and sanitation and telecommunications) between 2016 and 2030 are estimated at USD 75-86 trillion (or around USD 5.4 trillion per year compared to actual spending of around USD 3 trillion at present), much more than the current estimated stock of USD 50 trillion (Bhattacharya *et al.,* 2016). Additional spending on primary energy supply chain and demand is estimated at USD 1.4 trillion a year at present. Reaching the 1.5 °C target and even the 2 °C scenario would imply a major increase in investments to improve energy efficiency and curb emissions on the demand side, offset by reduced supply side investments in primary fossil fuels. The Organisation for Economic Co-operation and Development (OECD) estimates total baseline annual investment requirements (core infrastructure and primary energy supply chain and energy demand) at $6.3 trillion per annum between 2016 and 2030 and $7 trillion per annum to meet the 2 °C scenario (OECD, 2017a). Given this scale of required investments, we cannot afford to lock in carbon-intensive technologies and inefficient capital. At the same time, the replacement of aging and carbon-intensive infrastructure should be accelerated to ensure the quality and sustainability of infrastructure.

The current path is far from sustainable. The present level of NDCs falls far short of the GHG emissions reductions needed to meet the temperature target of the Paris Agreement (see Figure 2). If the current NDC commitments are implemented, the temperature is estimated to increase by 3 °C or more by 2100 (UNEP, 2018). A recent report from the Intergovernmental Panel on Climate Change (IPCC) estimated that the current NDCs would not limit global warming to 1.5 °C, not even by applying extremely challenging increases to the scale of emissions reduction after 2030 (IPCC, 2018). To limit global warming to 1.5 °C, the ambitions of the NDCs need to be sharply raised before the next submissions in 2020: as shown in Figure 2, global GHG emissions have to be reduced by half of the current level by 2030 and to net zero by 2050. What this implies is that even if all the new infrastructure is zero-emissions, we will need to cut emissions from the existing stock by 20 percent in the 2 °C scenario and by 50 percent in the 1.5 °C scenario by 2030. And the greater the emissions from the new investments, the greater the magnitude that emissions will have to be cut back from the existing capital stock.

Figure 2. Emission Pathways and the Climate Goals



Source: Stern (2019); UNEP (2018)

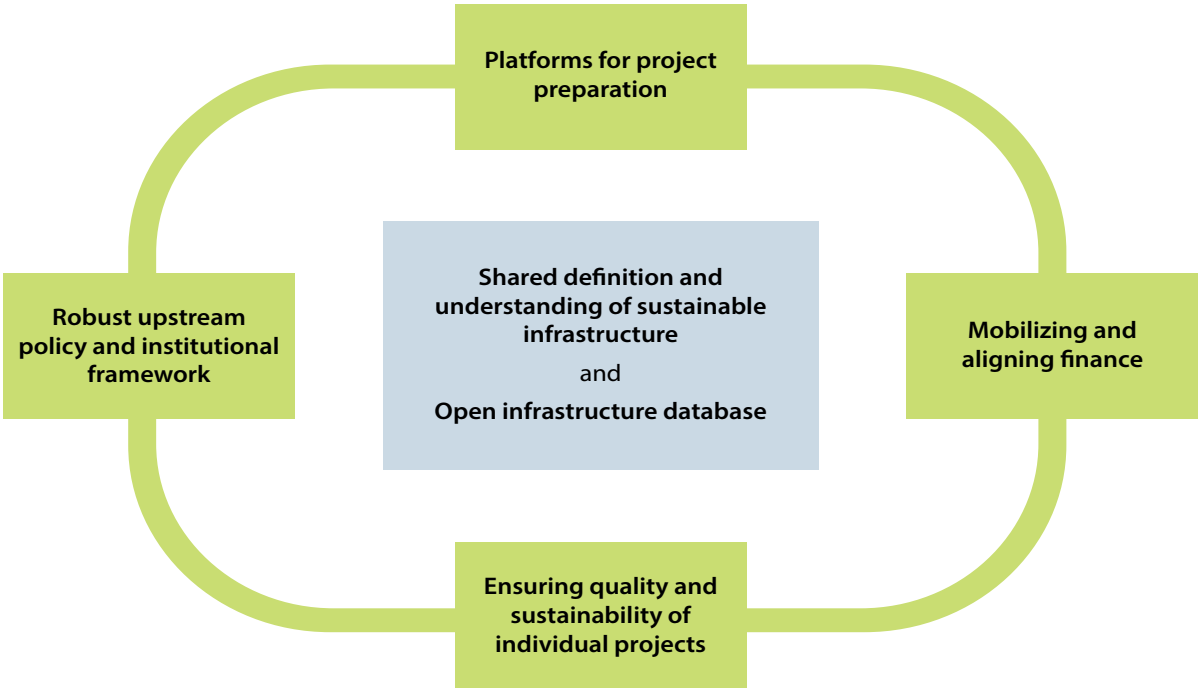
There is growing evidence that a sustainable growth path is feasible. According to the 2018 report of the Global Commission on the Economy and the Climate, the world has an unprecedented opportunity to shift to a better growth trajectory driven by innovation, high quality and sustainable investments, greater resource productivity and the vitality and potential of the private sector. The report found that bold climate action can generate at least USD 26 trillion of economic benefits through to 2030 compared to business-as-usual (New Climate Economy, 2018). Even in the 'harder-to-abate' sectors of heavy industry and heavy-duty transport, reaching net-zero emissions is technically and economically feasible (Energy Transitions Commission, 2018).

Despite this urgency and opportunity, we are falling behind on the quantity of investments needed, and a significant proportion of investments are not as sustainable as they should be (see Section III of this report for further elaboration). The failure to deliver on the scale and sustainability of infrastructure investment reflects two fundamental and persistent gaps. First, most countries are unable to translate the tremendous needs and opportunities for sustainable infrastructure into realized demands and a significant proportion of infrastructure investment is not as sustainable as it should be because existing policy and institutional underpinnings do not favour sustainable infrastructure investment. Second, while there are abundant savings, we are not able to mobilise the scale of finance required for sustainable infrastructure and financing is not aligned with sustainability. To fill these gaps, a broader and more integrated approach to quality and sustainable infrastructure is required.

C. An Integrated Framework for Delivery of Sustainable Infrastructure

Infrastructure investment are challenging because of their complex and political nature. Infrastructure projects are long-term and typically require large upfront investments that generate sustainable cash flows after many years. Many types of infrastructures are public goods with positive spillovers that are difficult to monetize and to capture, for instance, through user charges (CEA, 2016). Some infrastructures generate negative externalities including pollution, carbon emissions and other negative social and environmental impacts. Consequently, markets alone cannot provide effective infrastructure services and private investments cannot often be realized without some form of public support.

Figure 3: Integrated Framework for Delivery of Sustainable Infrastructure



Source: Bhattacharya, Contreras, and Jeong (forthcoming)

The political nature of infrastructure decision-making is another challenge to delivering sustainable infrastructure. Infrastructure investment has a long and complicated decision-making process, which involves many stakeholders, including various government bodies. It is very common that the long-term focus of infrastructure investment conflicts with short-term electoral cycles, which creates significant tensions for sustainable infrastructure planning (Hammerschmid and Wegrich, 2016). The decision-making process becomes more complicated when it cuts across central, regional and local governments, private actors and civil society.

These challenges require concerted efforts on multiple fronts and call for an integrated perspective. In this regard, Bhattacharya and colleagues have been developing an integrated framework for the delivery of sustainable infrastructure which comprises five pillars that should be considered to ensure the delivery of sustainable infrastructure (Figure 3): (1) policy and institutional underpinnings should be robust enough to unlock investments, attract the private sector and ensure sustainability of investments; (2) each individual project needs to be designed, built, operated and decommissioned based on sustainability criteria; (3) platforms for project preparation need to be developed and enhanced; (4) there is a need for better structures required to mobilise financing and to ensure that finance is aligned with sustainability criteria; and (5), all of these should be based on a shared understanding of sustainable infrastructure, as well as robust data and information on infrastructure needs, spending, project pipeline, benchmarks on performance, and financial information in order to support stakeholder decision-making.

The urgent challenge to cut carbon emissions also requires integrated and concerted actions to unlock and enhance the quality and sustainability of investments. To ensure alignment with the Paris Agreement and that the global temperature increase remains under the limit of 1.5 °C, we should not only ensure that new infrastructure is low-carbon and climate-resilient but also accelerate phasing out carbon-intensive infrastructures. This requires transformative changes in key economic systems including cities, energy, food and land use, water and industry. Ongoing work on infrastructure tends to focus on project-levels and new projects and is limited to scaling up the investments on sustainable infrastructure achieving the ambitions of the Paris Agreement. For transformative changes, all the pillars of the framework need to be activated — policy and institutional framework, platforms for project preparation, mobilising and aligning financing, ensuring quality and sustainability of individual projects and sharing understanding and database. As described above, our targets for emissions reduction are well-specified, but they should be translated into consequences and required actions in each pillar of the framework. This section describes the key elements required in each pillar and where we are in terms of these key elements.

i. Shared Definition and Understanding of Sustainable Infrastructure and Open Infrastructure Database

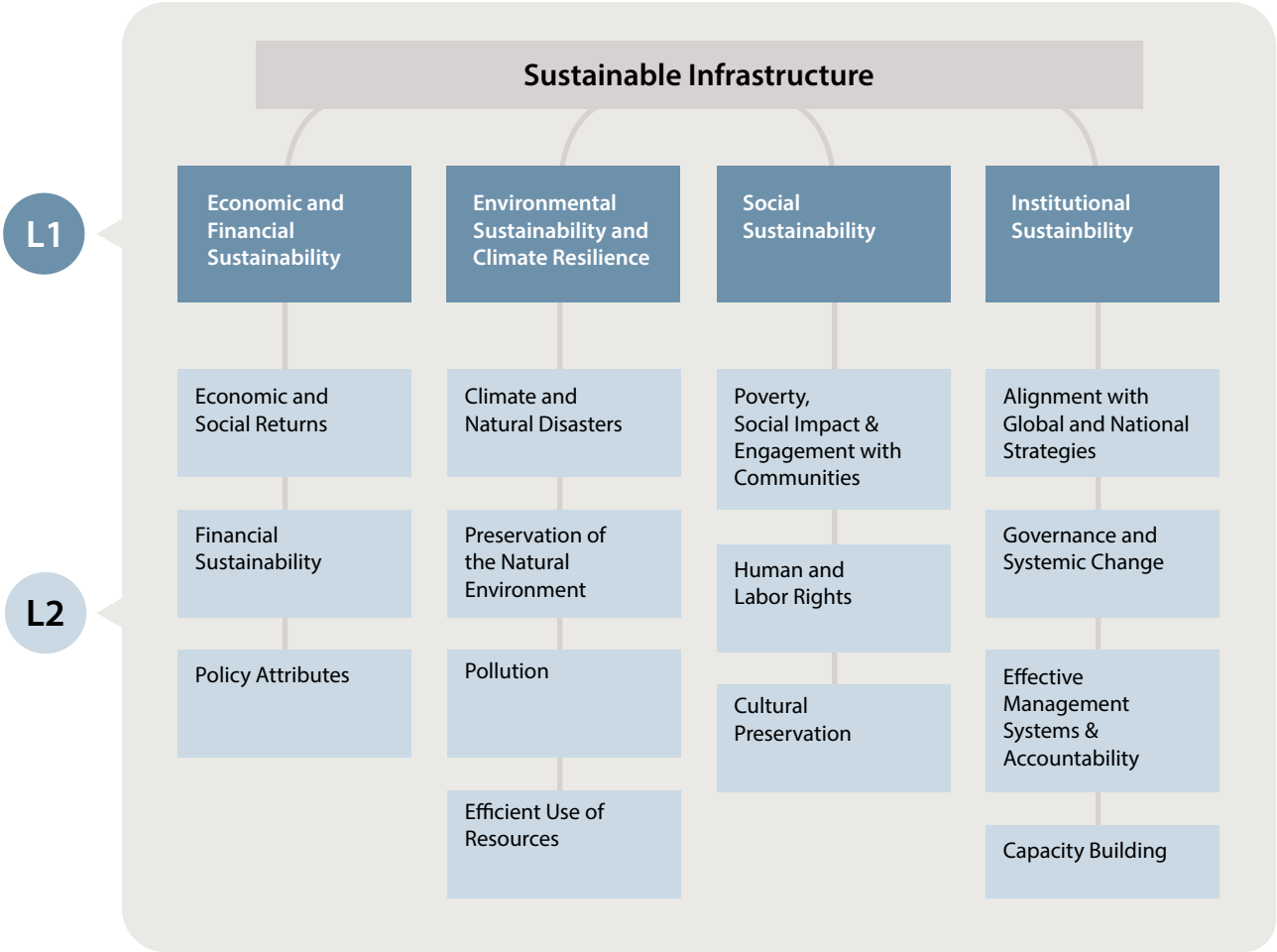
A wide range of initiatives are underway to scale up investments in quality and sustainable infrastructure. A shared understanding of sustainable and quality infrastructure and a robust and open infrastructure database can facilitate the alignment of the initiatives as well as help each initiative work more effectively (Amin *et al.*, 2019).

While sustainability has long been discussed and some proposed definitions of sustainable infrastructure have been put forward, there is not yet a well-specified definition of sustainable infrastructure that includes its attributes (Amin *et al.,* 2019). Sustainable development has been a widely accepted concept since the 1987 publication of *Our Common Future* by the UN World Commissions on Environment and Development (WCED), also known as the Brundtland Commission (WCED, 1987). Reflecting the elements of sustainable development, sustainable infrastructure has been defined by many international institutions and tool providers in recent years (e.g. UN ESCAP, 2006; UNEP and GIB, 2016; ISCA, 2017). These efforts incorporate the traditional dimensions of sustainable development – economic, social and environmental, and more recently, additional elements such as governance, resilience and financial sustainability have received much attention.

Building on these previous efforts to define sustainable and quality infrastructure, the Inter-American Development Bank and the Brookings Institution are developing a *Sustainable Infrastructure Framework* which consists of key dimensions and attributes of sustainable infrastructure (Amin *et al.,* 2019). Adding to

the traditional three dimensions of sustainable development, the framework comprises the dimension of institutional sustainability and stresses resilience. The framework includes an overarching definition of sustainable infrastructure, four sustainability dimensions, fourteen sub-dimensions, sixty-six attributes and descriptions of each attribute (Figure 4).

Figure 4: Dimensions and Sub-dimensions of the Sustainable Infrastructure Framework



Source: Amin *et al.*, (2019)

In this framework, sustainable infrastructure refers to infrastructure projects that are planned, designed, constructed, operated and decommissioned in a manner that ensures economic and financial, social, environmental (including climate resilience) and institutional sustainability during the entire life-cycle of the project. The framework incorporates the element of climate change by including a sub-dimension, 'climate and natural disasters', with three attributes – reduction of GHG emissions, climate risks and resilience and disaster risk management. In addition, the attribute of 'national and international commitment' states that infrastructure projects should be aligned with national and international commitments including SDGs and the Paris Agreement. This framework aims to provide the basis for a discussion among stakeholders to reach a shared understanding of attributes and drivers for sustainable infrastructure.

While the IDB-Brookings framework sets out the project level attributes of sustainable infrastructure, and an integrated framework for its delivery, the G20 is preparing a set of principles for quality infrastructure building on the *G7 Ise-Shima Principles for Promoting Quality Infrastructure Investment*. The G7 principles include (i) ensuring effective governance, economic efficiency in view of life-cycle cost as well as safety and resilience against natural disaster, terrorism, and cyber-attack risks; (ii) ensuring job

creation, capacity building and transfer of expertise and know-how for local communities; (iii) addressing social and environmental impacts; (iv) ensuring alignment with economic and development strategies including aspect of climate change and environment at the national and regional levels; and (v) enhancing effective resource mobilization including through public-private partnerships (PPP) (G7, 2016). Building on these principles and previous G20 work, the G20 is proposing to enunciate a broader set of principles for quality infrastructure investment under the Japan presidency. The proposed principles would seek to maximize the positive impact of infrastructure to achieve sustainable growth and development; raise economic efficiency with the focus on life-cycle cost; build resilience given increased vulnerability to natural disasters and other risks; integrate environmental considerations over the entire life-cycle; emphasize social considerations and ensure open access; and strengthen governance including financial sustainability, enhanced transparency and strong integrity.

Quality infrastructure and sustainable infrastructure are mutually reinforcing concepts rather than conflicting with each other. Sustainable infrastructure has been developed based on the long-standing discourse of sustainability and anchored in the 2030 Agenda for Sustainable Development and the Paris Agreement. The push for quality infrastructure has been driven by the recognition of the importance of high quality investments at the outset, the importance of economic efficiency over the life-cycle, concerns about debt sustainability and governance, and adherence to strong environmental and social standards. Both concepts incorporate the traditional criteria of sustainable development — economic, environmental, and social — and current discussions on the considerations for infrastructure projects such as a focus on life-cycle cost, resilience, and governance. However, the importance of climate mitigation and adaptation, and the imperative to deliver on the 1.5 °C target is not given adequate recognition and importance in the proposed G20 principles. The T20, which has recently submitted its recommendations on quality infrastructure and climate action, has placed sustainable development and climate outcomes at the center with three broad sets of recommendations: (a) maximizing the economic and development impact of quality infrastructure investments; (b) boost quality infrastructure development by integrating impactful environmental solutions; and (c) develop strategies for enhancing resilient infrastructure development (T20, 2019).

In addition to a shared understanding that is being developed on the attributes of sustainable infrastructure and the principles for quality infrastructure, improving the availability and quality of data on infrastructure investment is fundamental to strengthen all the other pillars of the integrated framework for delivery of sustainable infrastructure. Governments can better plan infrastructure investments with the assessments of the impact generated by infrastructure projects. Better data also enables the support of more diversified financing of sustainable infrastructure by attracting investments from a larger base of investors.

Responding to the paucity of information and benchmarks on infrastructure investments, several data initiatives are now underway. Many existing databases are providing infrastructure data (e.g. Private Participation in Infrastructure Projects Database, Infralatam, Infrascope, InfraCompass, GRESB Infrastructure Assessment and EDHEC Infra Database). Fay and colleagues released the first consistently evaluated data set on infrastructure spending and financing in 120 countries (Fay *et al.,* 2019). A recent study by Rozenberg and Fay attempted to fill the gap of inconsistent infrastructure spending data through focusing on goals and efficiency rather than simply on spending (Rozenberg and Fay, 2019). The need for a more comprehensive project/company database level led to the launch of the 'Infrastructure Data Initiative', instigated by the G20, MDBs, Long Term Investors Club, Global Infrastructure Hub (GIHub), Long Term Infrastructure Investors Association, (LTIIA) and the OECD. The initiative aims to create a global, open infrastructure database, which integrates existing data initiatives, including all types of data such as financial performance benchmarks, economic and impact analysis, and environmental and social governance (ESG) performance such as sustainability and inclusive growth impacts and environmental and climate related risks in both industrialized and developing economies (G20, 2018a).

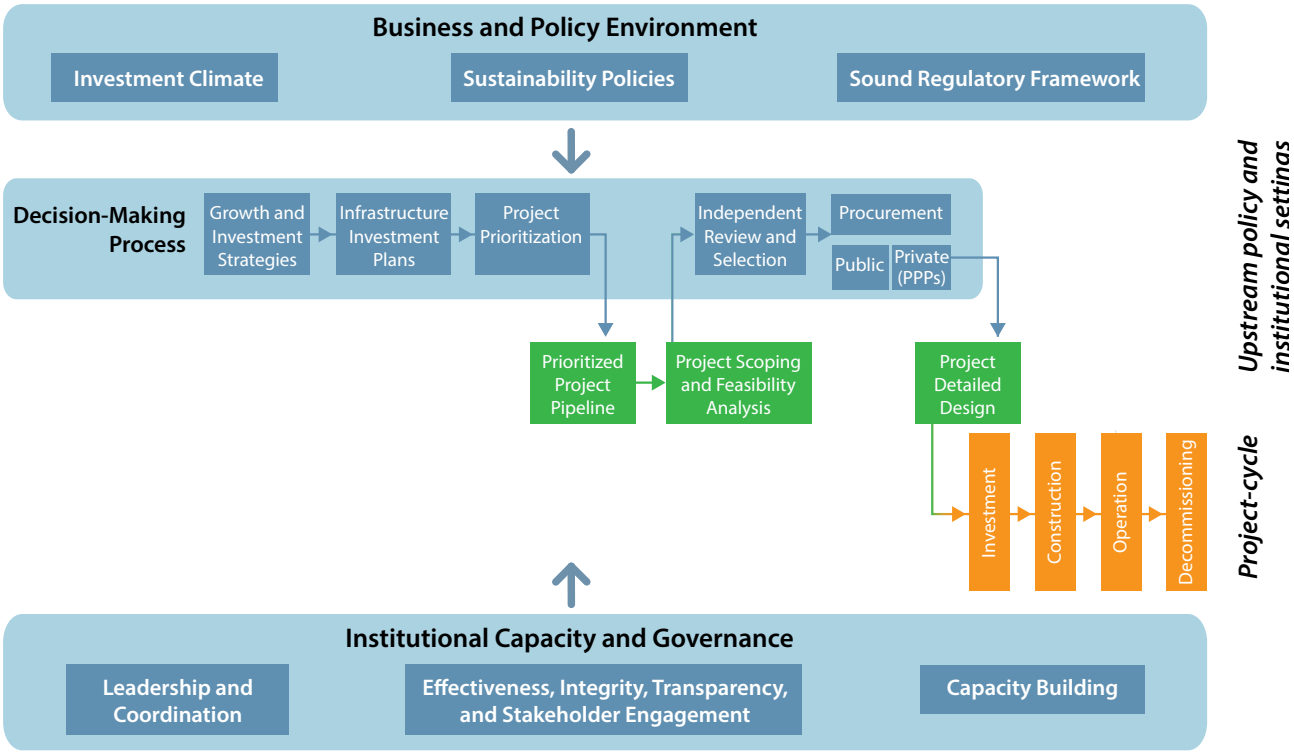
In many data initiatives, environmental dimensions are not approached with the same importance as financial dimensions. Progress has been made quantifying environmental performance, but its link to financial performance needs more assessment. Most benchmarks focus on processes and performance regarding ESG factors rather than the overall impact of sustainable outcomes of infrastructure projects

(OECD, 2018a). More information on the positive impact of ESG factors can help attract investors, especially from the private sector.

ii. Upstream Policy and Institutional Framework for Delivering Sustainable Infrastructure

Recognizing the crucial role of policy and institutional foundations for infrastructure investment, a growing number of studies have been conducted in recent years focusing on upstream policy and the institutional contexts for infrastructure investment (e.g. OECD, 2018b; OECD *et al.*, 2018; Serebrisky *et al.*, 2018). In addition, a large body of work on policies and institutions for public and private investment provides insights on possible policies and institutional framework for sustainable infrastructure. Through a thorough review of the existing work, Bhattacharya and colleagues propose a policy and institutional framework to capture the key elements of upstream settings that determine the selection and quality of infrastructure investment (Bhattacharya *et al.*, forthcoming). As well as building a well-articulated decision-making process for selecting infrastructure projects, sound institutional capacity and governance and well-aligned business and policy environments are key to building a robust upstream policy and institutional framework for sustainable infrastructure (Figure 5).

Figure 5: Upstream Policy and Institutional Framework for Sustainable Infrastructure



Source: Bhattacharya, Contreras, and Jeong (forthcoming)

The first pillar of the policy and institutional framework for sustainable infrastructure is the business and policy environment, which determines the whole decision-making process of infrastructure investment, investment climate and incentives for investors and project developers. The business and policy environment consist of three interacting dimensions — investment climate, sustainability policies and a sound regulatory framework. Given the long duration and importance of government-induced policy risk for infrastructure investment, creating a favorable investment climate and a sound regulatory framework are of paramount importance. In addition, sustainability policies play a central role in ensuring that private investors are taking into account potential negative externalities including impact and resilience to climate. Carbon pricing and avoidance of distortionary pricing and subsidies are of central importance

in this regard, and discussed in more detail below.

The second pillar is the decision-making process of infrastructure investment from planning to project prioritization to procurement. Growth and investment strategies that integrate growth, development and climate goals through a long-term vision, including a pathway to a low-carbon economy, are a critical first step towards sound and sustainable infrastructure development. Based on the growth and investment strategies, comprehensive infrastructure investment plans need to be developed for major sub-sectors. NDCs must be closely linked to and anchored in these growth strategies and infrastructure investment plans. A sound project prioritisation and selection framework are necessary to ensure the efficiency, sustainability, and feasibility of projects. Procurement needs to be developed, implemented, and managed to ensure both efficiency and sustainability of infrastructure projects. At present procurement systems and PPP frameworks in most countries do not give adequate emphasis to sustainability and climate impact (Aizawa, 2018).

The last pillar of the framework is institutional capacity and governance, which is the foundation that ensures the whole decision-making process for infrastructure investment is working efficiently, applying elevated standards of sound governance. To achieve strong institutional capacities and sound governance, three dimensions need to be considered. Infrastructure and sustainability objectives need to be addressed at the highest levels of government, and relevant policies should be coordinated between the different bodies of governments and ministries. Each component of the decision-making process should be effective and transparent and ensure adequate stakeholder consultations. Strong institutional capacities are needed to developed efficient decision-making processes and coordination between stakeholders.

The three pillars described above should be well-articulated and liaise with the other pillars to certify quality and sustainable infrastructure. For example: Even though the decision-making process of infrastructure investment has been well-established, it will not work as long as the institutional capacities applying it are insufficient. Since growth and investment strategies are not necessarily aligned to sustainability strategies, an appropriate mechanism for coordination may be needed according to country contexts. Indonesia, for instance, launched the Low Carbon Development Initiative at the Ministry of National Development Planning in order to integrate carbon emissions targets into national growth strategy and policy planning thus enabling internalization of low carbon policies into, including the upcoming national medium-term development plan. There is a lot of work to help governments strengthen specific elements of the proposed policy and institutional framework for sustainable infrastructure, but little work has been done so far on how to align and coordinate the elements of the framework.[7]

iii. Carbon Pricing and Fossil Fuel Subsidies[8]

Among sustainability policies, carbon pricing is a central instrument for climate mitigation. Carbon pricing sends a clear signal to the market. A recent analysis of the IMF showed that comprehensive carbon pricing is more effective in reducing emissions than other mitigation instruments (IMF, 2019a). In addition, carbon pricing is able to generate considerable revenues that can be used to support sustainable and resilient growth and a just transition. According to the IMF study, a carbon tax of USD 70 per ton of carbon dioxide-equivalent (tCO_2e) is expected to raise revenues of around 1-3 percent of GDP in most countries that were analysed.

Despite these benefits, carbon pricing alone cannot drive the transition to a sustainable and resilient economy. It needs to be complemented by removing legislative barriers for e.g. renewable energy, and by other policies addressing market and government failures. These policies should include sector-specific policies for electricity, public transportation and urban planning, research and development of clean technologies, efficiency standards, renewable energy and financial instruments. They help lower the carbon price needed for the required emission reductions. Moreover, given the potentially significant impact of carbon pricing to the economy and society, a well-articulated mix of policies from a comprehensive perspective is important to ensure a just transition (Jakob *et al.*, 2018).

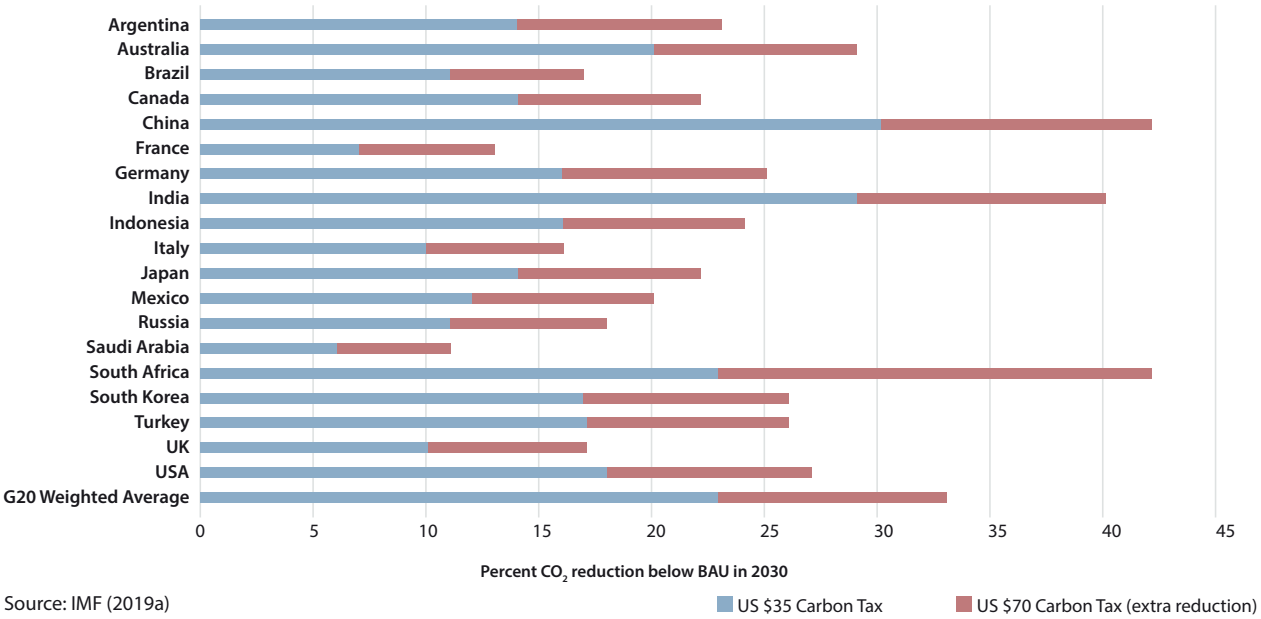
7 For the existing work on specific elements of the framework, see Bhattacharya, Contreras, and Jeong (forthcoming).

8 Carbon pricing and the elimination of fossil fuel subsidies are part of sustainability policies, which is a sub-pillar of the upstream policy and institutional framework described in the previous section. Given its importance for the climate agenda, carbon pricing and fossil fuel subsidies are analyzed in a separate section.

A growing number of countries and cities have adopted carbon pricing, but the current coverage and level of carbon pricing do not reach the standards set by the Paris Agreement. Since 2018, 51 carbon initiatives covering 15 percent of the global CO_2 emissions have been implemented or are being planned (UNEP, 2018). In 42 OECD and G20 countries, the price of about 90 percent of the CO_2 emissions are below USD 40, which is the minimum carbon price set for 2020 to meet the goal of the Paris Agreement, identified by the Carbon Pricing Leadership Coalition (OECD, 2018c; Carbon Pricing Leadership Coalition, 2017). The participation of businesses is also growing: Since 2017, almost 1,400 companies have disclosed that they are implementing or planning to implement an internal carbon price within a period of two years (CDP, 2019).

However, to meet the goals of the Paris Agreement the level of carbon pricing should be much more ambitious than it currently is. The IMF analysis shows that by 2030, G20 countries can reduce 33 percent of emissions below business as usual (BAU) by adopting the USD 70 carbon tax (Figure 6). This is in line with the 2 °C goal, but does not suffice to achieve the 1.5 °C goal, which requires almost 50 percent reduction by 2030 compared to the current level of emissions. This result highlights the huge gap between the current status of carbon pricing and the required level for the 1.5 °C goal.[9] The design elements of carbon pricing are also key to ensure the effectiveness of reducing GHG emissions and avoiding carbon spillover (Kulovesi *et al.,* 2011) and other unintended consequences (Boyer King 2018).

Figure 6: CO_2 Reduction from Comprehensive Carbon Pricing in G20 Countries



Source: IMF (2019a)

Carbon pricing needs to be accompanied by the elimination of fossil fuel subsidies, which is tantamount to negative carbon pricing. According to another recently published IMF paper, aggregate subsidies for fossil fuel worldwide reached USD 4.7 trillion in 2015, which is 6.3 percent of the global GDP, and USD 5.2 trillion in 2017 (Coady *et al.,* 2019). This paper estimated that efficient fossil fuel pricing would have reduced global emissions by 28 percent and increased government revenues by 3.8 percent of GDP. To avoid social impacts, it is important that fossil fuel subsidy removal be accompanied by adequate support for transition adjustments in the most affected segments of society.

In recent years, reforming fossil fuel subsidies has progressed in many countries and the international community. More than 40 countries started reforming fossil fuel subsidies between 2015 and 2017 (Zinecker, 2018). Indonesia, for example, saved USD 16 billion by reforming subsidies for gasoline and diesel in 2015 (Gerasimchuk, 2018). The EU committed to phase out subsidies harmful to the environment by 2020. In 2016,

9 The price of carbon emissions presented in the IPCC's report also infers how much ambitions are required to achieve the 1.5°C goal compared to 2°C goal. The price of carbon ranges from 15 to 220 USD2010 per tCO_2 under the 2°C pathway in 2030, but it ranges from 135 to 6050 USD2010 per tCO_2 under the 1.5°C pathway. The price of carbon varies considerably across models and scenarios.

the G7 leaders pledged to remove 'inefficient fossil fuel subsidies' by 2025. Since 2009, G20 countries have reconfirmed their promise to phase out fossil fuel subsides at every summit, but progress has been slow. In 2016, G20 countries provided USD 147 billion to subsidise coal, oil and gas (Climate Transparency, 2018).

iv. Platforms for Project Preparation

The fragmentation of decision making and the bespoke nature of infrastructure investments often pose an impediment to the scaling up and quality of infrastructure projects. Project preparation is also typically complex and requires significant upstream financing. There has been systematic efforts to establish and make more effective project preparation facilities and develop platforms for project preparation.

PPFs were created to help develop and proficiently prepare projects. Many PPFs provide diverse support covering all the stages of project preparation, from defining the need for a project all the way to the contract award (Kortekaas, 2015). In the past 10 years, at least 64 PPFs were operated to unlock private sector investments (Moser & Nealer, 2016). Their involvement can extend to establishing an enabling environment or offering support for project implementation. Multilateral development banks (MDBs) have played a key role in arranging PPFs; all major MDBs have at least one PPF. The PPFs fund different stages of project preparation including pre-feasibility studies, feasibility studies and project design. They also provide technical assistance and upstream policy advice.

SOURCE is a global platform for project development, which was launched by MDBs in 2016. It provides comprehensive support covering governance, technical, economic, legal, financial, environmental and social issues. SOURCE supports ranges from early project definition phases through to project implementation. It enables engaging all stakeholders including government agencies, private sector contractors, bidders, financiers and civil society. In May 2019, SOURCE was supporting more than 250 projects in 49 countries. [10]

These platforms can better contribute to scaling up sustainable projects and investment-ready projects if they incorporate sustainable criteria in a more balanced way. Currently, many PPFs are focussing on economic and financial viability and addressing environmental and social considerations from a 'no-harm' approach, which ensures that a project complies with environmental and social safeguards. In discussions about the preparation of infrastructure projects, environmental and social dimensions have received less attention compared to economic and financial dimensions. For example, the G20 Principles for the Infrastructure Project Preparation Phase did not include specific considerations regarding climate mitigation. Environmental impacts tend to be seen as costs that should be monetized whenever possible. Nevertheless, the environmental and social dimensions also mean externalities and financial risks related to the physical impacts of climate change and policy advances.

v. Ensuring Quality and Sustainability of Individual Projects

Increasing numbers of principles, guidelines, tools and protocols have been developed to ensure the quality and sustainability of infrastructure projects in recent years. These include high-level definitions and principles, reporting guidelines, safeguard standards and best practices, sustainability rating systems, databases and benchmarks. Several infrastructure sustainability rating systems were especially designed to provide a detailed project-level assessment of the sustainability performance. Some of them are SuRe, Envision, CEEQUAL and the IS-Scheme. These rating systems provide a comprehensive approach to sustainable infrastructure through a well-defined structure and a set of indicators that can be quantified and monitored. The American Society of Civil Engineers (ASCE) is also developing standards for sustainable infrastructure.

Developing a single assessment scheme that incorporates all ongoing discussions would be very challenging because infrastructure projects have different contexts in terms of geography, sector and regulations. Thus, this proliferation of standards and tools is likely to be continued (Bennon & Sharma, 2018). A method that finds commonalities and gaps between existing tools is necessary to help tool providers learn from one another and to provide a more consistent signal to investors.

10 Available at: https://public.sif-source.org/source/

To find commonalities and gaps of current infrastructure sustainability rating systems, a recent Brookings-IDB paper assesses four main rating systems, and found significant gaps and variance in addressing sustainability dimensions and attributes (Bhattacharya *et al.,* forthcoming). The rating systems barely focus on financial rates of return over the project lifecycle and its determinants. Compared to economic and financial sustainability, environmental sustainability is well covered by the rating systems. Each rating system includes detailed identification of impacts on the environment and climate as well as mitigation measures. Their approach includes both outcome-based indicators such as GHG emissions and process-based indicators such as assessment and management of disaster risks. Some elements of social sustainability such as minimization of displaced communities are not fully covered. Regarding institutional sustainability there is room for improvement in some elements such as the integration of anti-corruption requirements. Other than this research, MDBs, standard setters and civil society are exploring further opportunities of aligning standards and tools.

Efforts to align diverse tools, should be combined in their application given the insufficient use of standards and tools, especially in developing economies. Since designing a single system for all infrastructure projects is very challenging, promoting the use of fit-for-project standards or tools is a more feasible goal. Finding the gaps in standards and tools and enhancing them is still necessary, as they serve to better reflect sustainability criteria.

vi. Mobilising and Aligning Finance

The urgency of the scale and shift in investment that is needed to deliver on the SDGs and the 1.5 °C target poses a commensurate challenge to mobilize finance at the right scale and affordable cost and ensuring that finance is well aligned with sustainability. Given the infrastructure gap,[11] we need to mobilize finance from all sources available — domestic, international, public and private — and to utilize these pools most effectively. The complex nature of infrastructure investment emphasises the need to create viable revenue models for infrastructure projects to attract all sources of finance, especially private capital. The DFIs' role is crucial to mobilise finance for sustainable investments. At the same time, finance should be strongly aligned with sustainability criteria.

Creating viable revenue models is key to mobilise finance for infrastructure investment because of the complex characteristics of infrastructure projects. As already noted, infrastructure investment requires large upfront costs, but cash flows are generated after many years. User charges are not sufficient to cover the full cost of many projects because current users pay only a portion, and most of what remains is paid by the users in the future. Infrastructure generates positive spillovers that increase economic activities and property valuation, but they are difficult to capture through user charges. The spillovers from infrastructure projects can be used to create a viable revenue model. For example, Yoshino and colleagues have suggested models to use the spillovers from infrastructure development to boost returns and share the benefits with infrastructure stakeholders including investors and landowners (Yoshino & Abidhadjaev, 2016; Yoshino *et al.,* 2019).

Robust public finance is an essential foundation for investments in sustainable infrastructure. To meet the growing needs of infrastructure investment, public resource mobilisation needs to be strengthened through tax and expenditure policies not only at the national level but also at the sub-national and local levels (Qureshi, 2016). As well as expanding public finance, the national public finance system with the ability to unlock the potential of financing instruments for sustainable investment should be well-established (Ahmad *et al.,* 2019).

The biggest opportunity to mobilize finance exists in the large pools of private capital held by institutional investors. To scale up private finance, improved mechanisms for tackling risks in early stages of infrastructure investment and crowd-in long-term finance are required. A lot of effort has been devoted to developing and refining the mechanisms to scale up private financing. Blended finance, which refers to the use of concessional capital to crowd-in private finance, can be a measure to attract private financing through mitigating the private sector's risks. The MDBs, governments, the OECD, and the private sector have worked on the agenda of blended finance given its crucial role to crowd-in private finance (Blended Finance Taskforce, 2018; OECD, 2018b; Tri Hita Karana Roadmap for Blended Finance, 2018). The G20 and the OECD have worked to foster the development of infrastructure as an asset class for attracting institutional investors' participation in infrastructure financing.

11 For a discussion and quantification of the gap see section III of this paper and Figure 7

MDBs and other DFIs have a central role to play in providing support for policy and institutional strengthening, enhancing the quality of projects, reducing risk and crowding in private finance. They can bring down the cost of capital: crucial for volume and sustainability (quantity and quality). They are trusted conveners that can help coordination and help establish replicable and scalable models. They play a crucial role in getting projects through difficult early stages. After that institutional investors can be attracted by stable long-term returns; with great potential for mobilizing finance at scale.

DFIs also need to increase their base and callable capital and the lending headroom to expand their balance sheets to meet climate goals. Since the global financial crisis, some DFIs have made significant increases to the amount of DFI capital in the world economy, but a stepwise increase from these levels is still needed. Chiefly these contributions have come from China. Since the crisis, China has increased the assets of the China Development Bank by USD 1.5 trillion, with roughly one fifth of its balance sheet now in overseas financing tied to sovereign governments outside China. China was also instrumental in setting the Asian Infrastructure Investment Bank and is one of the founding members of the New Development Bank. Many national and sub-regional development banks in emerging markets and developing countries also replenished or created new DFIs and accumulated reserves during the commodity boom in the aftermath of the crisis. Recently, shareholders endorsed a USD 7.5 billion paid-in capital increase (with a USD 52.6 billion callable capital increase) for the International Bank for Reconstruction and Development (IBRD) and USD 5.5 billion paid-in capital for the International Finance Corporation (IFC) (World Bank, 2018d).

In addition to further capital increases, some DFIs have significant 'lending headroom' to provide more financing while maintaining strong credit ratings. A number of recent studies, including a study by Standard and Poor's rating agency, estimate that MDBs could increase their lending headroom by USD 598 billion to USD 1.9 trillion in various scenarios (Munir & Gallagher, 2018). If MDBs optimized their balance sheets at an AAA rating without a capital increase, the increase would be between USD 598 billion to USD 1 trillion. With a capital increase of 25 percent by major MDBs, lending could expand from USD 1.2 to USD 1.7 trillion. If some MDBs were to optimize at an AA+ rating, expansion could reach close to USD 2 trillion dollars. In the latter case, however, optimizing at AA+ would have a negative impact on profitability, though according to supporting research, the net economic benefits are still likely to be positive. In addition to expanding lending headroom (Munir & Gallagher, 2018).

Another important pillar to mobilize financing is boosting and optimizing the use of concessional capital. Multilateral climate funds — Climate Investment Funds (CIF), the Global Environment Facility (GEF) and the Green Climate Fund (GCF) — have provided small amounts of highly concessional finance supporting transformative projects (Itad, 2019). Since the size of funds is limited, their use should be optimized through blending resources with private finance and MDB finance (Meltzer, 2018). There is need for a clear commitment from developed countries to deliver on the $100 billion of climate finance per annum made initially at Copenhagen (2009) and reaffirmed in the Paris Agreement, and especially to deliver on the critical shortfalls in grant finance including successful replenishment of the Green Climate Fund, the Climate Investment Funds (CIFs) and for adaptation finance. Adequate grant finance can anchor the "billions to trillions" agenda to mobilise the scale of finance needed to deliver on the 2030 Sustainable Development Agenda and the Paris Agreement.

Aligning finance with sustainability criteria is as important as mobilising it to achieve climate and sustainability goals. All finance should be aligned to support low-carbon, climate-resilient and sustainable infrastructure projects. A rapidly growing number of initiatives and actions to align finance with sustainability are underway in recent years. Since the release of the recommendations of the Task Force on Climate-Related Financial Disclosures (TCFD) in 2017, many companies and investors have decided to voluntarily implement the TCFD's recommendations. The EU High Level Expert Group on Sustainable Finance recommended that the European Commission endorse and implement the TCFD's recommendations at EU level. In its first comprehensive report, published in April 2019, the Network for Greening the Financial System (NGFS), a group of central banks and supervisors, called for actions to manage environmental and climate-related risks. Their six recommendations include: (1) integrating climate-related risks into financial stability monitoring and micro-supervision; (2) integrating sustainability factors into own portfolio management; (3) bridging the data gaps; (4) building awareness and intellectual capacity, and encouraging technical assistance and knowledge sharing; (5) achieving robust and internationally consistent climate and environment-related disclosure; and

(6) supporting the development of a taxonomy of economic activities (Network for Greening the Financial System, 2019). With the NGFS, the Coalition of Finance Ministers for Climate Action is expected to play a crucial role in accelerating the shift of finance to sustainable and climate resilient investments. The coalition was launched with the participation of finance ministers from more than 20 countries in April 2019. The coalition endorsed the 'Helsinki Principles' to promote climate actions through macroeconomic and fiscal policy, public financial management and financial regulations.[12] Green bond markets have dramatically increased the flow of private capital into sustainable infrastructure investment. The size of the green bond market reached to USD 167.3 billion in 2018, which is more than 15 times the size the market was in 2013 (Climate Bonds Initiative, 2019). Sustainability issuances, SDGs and social bonds are also rapidly increasing.

Given that the hard rules for global trade and investment flows reside in the trade and investment treaty system, it is paramount that alignment occurs in that same regime. What has received relatively little attention is the extent to which the world trade and investment rules are (not) aligned with climate goals and SDGs. The Working Group on Trade, Investment, and Climate Policy (2016) conducted a 'compatibility review' of the trade and investment regime with the Paris Agreement. The group found that the trade and investment regime accentuates and incentivises the current carbon-intensive trade and growth structures in the world economy, reducing the policy space for aggressive climate change policy and possibly enshrining governance structures that could inconvenience climate policy. For example, a recent study found that a 1% tariff cut by G20 countries for mining gas, manufactured machinery, metal, and other mining imports would result in respective embodied CO_2 emissions of 2,779, 1,747, 1,453, and 1,018 tons (Islam *et al.*, 2019). In order to bring alignment between the climate and trade regimes, the World Trade Organisation (WTO) and any subsequent trade and investment treaties will need guiding principles that prioritise the acceleration of trade, investment and technology relevant to goods and services that prevent, mitigate and help adapt to climate change. Just as importantly, it will be necessary to use the regime as a tool that significantly curbs trade, investment and technology flows of goods and services that exacerbate climate change.

II. The Role of G20 Supporting the Global Agenda on Climate and Infrastructure

The G20 has embraced the 2030 Agenda including the SDGs, the Addis Ababa Action Agenda and the Paris Agreement. The G20 also embarked on the process of broadening its perspective on growth since it launched 'A Framework for Strong, Sustainable, and Balanced Growth' in 2009. There has been a long-standing focus on infrastructure since the 2010 Korea presidency, and the agenda has evolved focusing on scaling up investment and attracting private capital. The G20 did not engage meaningfully in the climate agenda until the 2012 Mexican Presidency. After the Paris Agreement, the G20 began to focus more systematically on the climate agenda starting with the 2016 China presidency and the 2017 German presidency. Although all other G20 countries remained committed, the U.S. announced their withdrawal from the Paris Agreement discouraging the acceleration of climate actions thereafter. To advance climate actions and achieve the goals of the Paris Agreement, G20 countries need to move forward by building effective coalitions.

A. G20 Agenda on Infrastructure

The G20 has focussed on infrastructure ever since the 2010 Korea presidency. Infrastructure was incorporated as one of the nine pillars of the Multi-Year Action Plan on Development, which includes concrete actions on the development agenda over the medium term given its importance for growth in developing countries. Through this action plan, the G20 committed to tackle the obstacles to infrastructure investment, designing project pipelines, furthering capacities and mobilising finance for infrastructure investment in developing countries (G20, 2010). The infrastructure agenda focussed on tackling the gap in infrastructure in order to remove the barriers that decelerate development, especially in low-income countries.

The focus on scaling up investment to tackle the infrastructure gap continued in the 2011 Cannes Summit. The G20 supported the recommendations of the High-Level Panel on Infrastructure, created at the 2010 Seoul summit, to scale up and diversity financing for infrastructure needs. In its recommendations

12 The Helsinki Principles are available at: http://pubdocs.worldbank.org/en/600041555089009395/FM-Coalition-Principles-final-v3.pdf

to the G20, the panel suggested building capacities to prepare bankable projects, creating an enabling environment for private sector participation, making funding available under appropriate terms and collaborating with MDBs to identify exemplary projects (High Level Panel on Infrastructure, 2011). The panel stressed the role of MDBs in scaling up and catalysing private capital and suggested that MDBs expand their work, such as exploring innovative financing approaches, to leverage capital. The MDBs also submitted the Infrastructure Action Plan to the G20, which includes their plans to unlock infrastructure project pipelines and to improve infrastructure spending efficiency (MDB Working Group on Infrastructure, 2011). The 2012 Los Cabos Summit encouraged MDBs to continue progress according to plan.

During the Russian presidency in 2013, the focus was on financing for the infrastructure investment and, in particular, on long-term financing. Recognizing the key role of long-term investment, the 2013 Saint Petersburg summit endorsed the working plan prepared by the G20 Study Group on Financing for Investment, and the G20/OECD High-Level Principles of Long-Term Investment Financing by Institutional Investors. The principles aimed to facilitate and promote long-term investment by institutional investors willing to consider investment over a long period (OECD, 2013). The summit agreed to start implementing a set of collective and country-specific actions to improve investment environments favouring long-term investments financing infrastructure and small and medium enterprises (G20, 2013).

The Australian presidency of 2014 pushed forward the infrastructure agenda as one of the central priorities. The G20 leaders endorsed the G20 Global Infrastructure Initiative, a multi-year programme to support public and private investment in quality infrastructure. The initiative includes the G20's will and plans to create a climate that facilitates higher investment in quality infrastructure through collaborative efforts including facilitating long-term financing from institutional investors, improving transparency and performance of securitization markets and lowering the barriers to investment (G20, 2014). During the initiative, the G20 agreed on the Leading Practices on Promoting and Prioritising Quality Investment, a guideline for governments on ways to identify, prioritise, plan, and deliver infrastructure projects. This initiative also led to the establishment of the Global Infrastructure Hub (GIHub), which aims to help implement the G20's multi-year infrastructure agenda. The importance of mobilising private sector financing was one of the central priorities. The private sector was recognized as one of the main stakeholders to collaborate with governments, international organisations, and development banks.

The G20 continued to focus on the role of private finance in infrastructure investment. The 2015 Antalya Summit developed country-specific investment strategies with policies and actions to improve the investment ecosystem, foster infrastructure investment and support long-term financing in order to boost investment, especially through private sector participation (G20, 2015). In addition, the G20 developed guidelines for public-private partnership (PPP) models and worked on developing toolkits to help countries prepare, prioritise and finance infrastructure projects.

Since 2016, the G20 has focused on 'quality infrastructure investment.' The leaders' communiqué at the 2016 Hangzhou Summit emphasised the importance of 'quality infrastructure investment, which aims to ensure economic efficiency in view of life-cycle cost, safety, resilience against natural disaster, job creation, capacity building, and transfer of expertise and know-how on mutually agreed terms and conditions, while addressing social and environmental impacts and aligning with economic and development strategies' (G20, 2016a). The summit also emphasised the role of MDBs within the infrastructure agenda. The G20 encouraged the progress made optimising MDBs' balance sheets and their support for countries to mobilise public and private finance and showed its support to the Joint Declaration of Aspiration on Actions to Support Infrastructure Investment. The declaration includes MDBs' determination to scale up infrastructure investment, attract private finance and strengthen project pipelines through enhancing the quality of project preparation (MDBs Joint Declaration, 2016). The declaration also listed their considerations to maximise the quality of their infrastructure investment. These considerations included: (1) economic efficiency throughout project life-cycles, as well as safety, climate change mitigation and adaptation, and resilience against natural disasters; (2) sustainable job creation; (3) capacity building and transfer of expertise and know-how to local communities; (4) social and environmental impacts; (5) alignment of economic and development strategies at the national and regional levels; and (6) effective resource mobilisation including through the use of PPPs.

During the Argentinian leadership in 2018, the G20 developed a roadmap for quality infrastructure with a focus on private financing and promoting infrastructure as an asset class. Recognizing infrastructure as a key driver of economic prosperity, sustainable development and inclusive growth, the G20 reaffirmed their commitment to mobilise more private capital for infrastructure investment to fill the infrastructure financing gap (G20, 2018b). In line with this, the G20 endorsed the Roadmap to Infrastructure as an Asset Class and the G20 Principles for the Infrastructure Project Preparation. The roadmap aims to identify elements that foster the development of infrastructure as an asset class to crowd-in private capital. It was organised into three pillars including (1) improving project development, (2) improving the investment environment for infrastructure and (3) promoting greater standardization (Roadmap to Infrastructure, 2018).

As described earlier, the Japan presidency in 2019 is building on the roadmap of quality infrastructure and the G7 Ise-Shima Principles of Quality Infrastructure to set out a new set of G20 principles of quality infrastructure that will be adopted at the upcoming Summit.

B. G20 Agenda on Climate

The G20 recognized the integrated aspects of climate, growth and sustainability agenda in the 2012 Mexican presidency. While the previous leaders' declarations tended to limited showing their commitment to fight against climate change, the 2012 declaration emphasised 'the need to structurally transform economies towards a climate-friendly path over the medium term' (G20, 2012). 'Inclusive green growth' was recognized to help achieve growth and development goals, protect the environment, and improve social well-being. The G20 created a study group on climate finance, supported the operationalization of the Green Climate Fund and encouraged national and international efforts to implement inclusive green growth strategies and policies.

The 2015 Turkish Presidency reaffirmed the 'below 2 °C goal as stated in the Lima Call for Action' (G20, 2015). The G20 welcomed that more than 160 countries submitted Intended Nationally Determined Contributions (INDCs)[13] to the UN Framework Convention on Climate Change (UNFCCC) and stated their willingness to implement the INDCs. The 2015 summit stressed the role of energy through holding the Energy Ministers' first meeting. The G20 endorsed the G20 Toolkit of Voluntary Options for Renewable Energy Deployment and the G20 Energy Access Action Plan.

The 2016 Chinese presidency pushed the climate agenda forward with a focus on green finance and energy. The leaders' communiqué stated that the G20 will promote the timely entry into force and implementation of the Paris Agreement and encourage financial flows in line with a pathway towards low greenhouse gas emissions and climate-resilient development. The G20 established the Green Finance Study Group (GFSG) and called on MDBs and DFIs to mainstream climate actions across their development strategies. The importance of energy collaboration towards a 'cleaner energy future' was reaffirmed and phasing out of fossil fuel subsides and the needs to promote natural gas, a less emission-intensive fossil fuel, were emphasised.

Despite the US withdrawal announcement from the Paris Agreement in June 2017, the leaders of the other G20 members reaffirmed their strong commitment to the agreement and approved the G20 Hamburg Climate and Energy Action Plan for Growth at the 2017 Hamburg Summit (G20, 2017a). The plan includes detailed action plans of the G20 in a broad climate and energy agenda, including the implementation of the NDCs, developing long-term low GHG emission development strategies, transforming energy systems into affordable, reliable, sustainable and low-carbon systems, enhancing climate resilience and mobilising finance for low carbon and climate resilient investments (G20, 2017b). In particular, the plan stressed the importance of investment in sustainable and clean energy technologies, energy efficiency, energy infrastructure and aligning finance flows, role of MDBs and phase out of inefficient fossil fuel subsidies.

The 2018 Argentinian presidency reconfirmed that the G20 countries, except the U.S., are committed to the implementation of the Paris Agreement. The summit, however, stated climate actions in a modest way. The leaders' declaration affirmed that they 'note the latest IPCC Special Report on the Impacts of Global Warming of 1.5 °C' and 'discussed long-term low GHG emission development strategies and alignment of

13 INDCs were the precursors of NDCs before the Paris Agreement was agreed and entered into force.

international finance flows' (G20, 2018b). For adaptation, the G20 showed their support for the actions and cooperation on adaptation in developing countries.

G20's climate actions have included a focus on financing, especially on mobilising private capital. To identify barriers for green finance and enhance the financial system to mobilise private capital for green investment, the GFSG was launched in 2016. The 2016 leaders' communiqué welcomed the report of the GFSG and the suggested voluntary options for G20 countries including the following:

- Providing strategic policy signals and framework;
- Promoting voluntary principles for green finance;
- Expanding learning networks for building capacity;
- Supporting the development of local green bond markets;
- Promoting international collaboration to facilitate cross-border investment in green bonds;
- Encouraging and facilitating knowledge distribution regarding environmental and financial risk; and
- Improving the measure of green finance activities and their impacts

In 2017, the GFSG tracked the progress of these seven options and studied specific topics of environmental risk analysis and the use of publicly available environmental data. Under the Argentinian presidency, the GFSG was renamed to the Sustainable Finance Study Group (SFSG) to incorporate a broader concept of sustainable finance. The SFSG developed voluntary options for deploying sustainable finance in three areas — creating sustainable assets for capital markets, developing sustainable private equity and venture capital and exploring the potential applications of digital technologies for sustainable finance.

Another notable initiative is the launch of the previously mentioned TCFD under the Financial Stability Board (FSB), in which the G20 Finance Ministers and Central Bank Governors requested the FSB to review how the financial sector can take account of climate-related issues. In 2017, the Task Force released its recommendations on climate-related financial disclosures around four majors subjects — governance, strategy, risk management and metrics and targets — exposing comprehensive guidance to carbon disclosure in the finance sector. As of September 2018, 513 organisations supported the recommendations of TCFD. G20 support for the green and sustainable finance agenda has flagged in the wake of US objections to a strong and proactive role.

C. G20 Agenda on Sustainable Development and the Role of MDBs

After the global financial crisis, the G20's efforts to boost the global economy led to the launch of 'A Framework for Strong, Sustainable, and Balanced Growth' at the 2009 Pittsburgh Summit. The G20 aimed to return the world to 'high, sustainable and balanced growth, while maintaining our commitment to fiscal responsibility and sustainability, with reforms to increase our growth potential and capacity to generate jobs and policies designed to avoid both the re-creation of asset bubbles and the re-emergence of unsustainable global financial flows' (G20, 2009). The pursuance of sustainability focused on economic and fiscal sustainability to restore growth.

2015 was a crucial year for sustainable development. The 2015 Antalya Summit strongly committed to implementing the 2030 Agenda, including the SDGs and the Addis Ababa Action Agenda. The G20 reconfirmed its commitment to the 2030 Agenda and endorsed the G20 Action Plan for the 2030 Agenda for Sustainable Development at the 2016 Hangzhou Summit. The plan stated the importance of sustainable development in 'all its dimensions (economic, environmental and social) in a balanced and integrated manner' and to integrate sustainable development into both domestic policies and international development efforts (G20, 2016b). The plan recognized that all G20 work streams can contribute to realising the 2030 Agenda and described ongoing activities and plans.

The G20 has recognized the key role of MDBs in scaling up investments and catalysing finance to accelerate the development agenda. As described above, the G20 has supported MDBs' efforts for scaling up infrastructure investment, including the 2011 MDBs Infrastructure Action Plan and the Joint Declaration of Aspiration on Actions to Support Infrastructure Investment, in order to scale up infrastructure investment,

especially through private finance. For the Global Infrastructure Connectivity Alliance, launched in 2016, the G20 has asked the World Bank Group to serve as the Secretariat of the Alliance. The 2017 Hamburg Summit endorsed the MDB's Joint Principles and Ambitions on Crowding in Private Finance and welcomed MDBs' work on optimising balance sheets and mobilising investment in infrastructure and connectivity (G20, 2017a). Through the statement of ambitions, MDBs jointly committed to:

- Work with client countries to help them strengthen their governance of sustainable infrastructure;
- Review the range of credit enhancement products and expand where feasible;
- Review and strengthen internal incentives for mobilising private sector finance;
- Identify additional opportunities to work together and provide complementary advisory and financing products; and
- Pursue opportunities for standardisation, harmonisation and setting standards.

In April 2017, the G20 Finance Ministers and Central Bank Governors established the Eminent Persons Group on Global Financial Governance that was asked to recommend reforms for the system of international financial institutions (IFIs) to promote economic stability and sustainable growth. The report the group, published in 2018, highlighted the urgent need to organise multilateral development capabilities and resources in a new way to tackle global challenges. The report recommended the ways to achieve a better development impact through system-side shifts of IFIs and the role of the G20 regarding this change (G20 Eminent Persons Group, 2018).

As the EPG report pointed out, the G20 has to work with the IFIs and other international organisations to push forward the global agenda, because the G20 does not have universal membership and is not legally constitute to deliver on decisions. MDBs have played a key role to accelerate the G20's initiatives on the development agenda. For IFIs, MDBs included, it will become more important to push forward the G20's development and climate agenda, given the urgency of challenge and the slow progress of climate agenda in G20 after the U.S. announced their withdrawal from the Paris Agreement.

III. G20 Contributions to Infrastructure and Sustainable Development

The scale of investment and financing for infrastructure is well below the ambition necessary to close infrastructure gaps, and it is not aligned with the SDGs and the Paris Agreement. What is more, G20 tracking systems for sustainable infrastructure investment are not adequate to monitor progress on achieving sustainable development and climate goals. This section of the paper analyses current infrastructure spending trends versus projected needs for sustainable infrastructure. The section is structured in two parts. Part A provides a global analysis of gaps and investments in sustainable infrastructure. Part B comprises an analysis of G20 foreign direct investment (FDI) and public financing flows into sustainable infrastructure in EMDCs and other non-G20 members.

There is no singly agreed measurement of sustainable infrastructure in the same sense as discussed in section II. In this section, our measurements of sustainable infrastructure draw from OECD (2018), Bhattachara *et al.,* (2016), NCE (2014), and the IDFC (2014, 2018). For quantifying purposes, we adopt a more limited approach, drawing from the Bhattacharya and OECD notion that sustainable infrastructure investments are those needed for power and electricity transmission and distribution, the primary energy supply chain, transport, water and sanitation, natural capital, telecommunications and investments in energy efficiency for buildings, transport and industries — in order to achieve a 2 degree scenario (see Figure 1). We later estimate the levels of foreign direct investment and development finance in G20 countries and by G20 countries into EMDCs. We rely on the International Development Finance Club's (IDFC, 2014, 2018) 'green finance' classification system that categorizes different investments in energy, water, transport as so forth according to their impacts on climate and other environmental issues. The IDFC committed to align their financial flows with the Paris Agreement in 'redirecting financial flows in support of transitions towards low-carbon and climate-resilient sustainable development (IDFC, 2018, 2015 – see Appendix I for a full discussion of our methodology).

A. Global Investment and Needs for Sustainable Infrastructure

Global infrastructure investment lacks the scale and composition that is needed to make the necessary transition to a carbon-neutral and more inclusive global economy. The G20-sponsored GIHub[14] is poised to be a key tool to measure progress in sustainable infrastructure financing, but has yet to develop adequate measurements, estimates and methodologies on how to do so.

To achieve the SDGs and the upper bound of the Paris Agreement targets of 2 °C,[15] the global community will need to invest between USD 6.9 trillion and USD 7.9 trillion per annum between 2015-2030 (OECD, 2017a). Current spending on core infrastructure globally is around 3.5 percent of GDP and on infrastructure including primary energy supply and energy demand around 5.5 percent of GDP.

The investment needs necessary for infrastructure compatible with the Paris Agreement fall in two broad categories. In many EMDCs new capital investments are needed in sustainable infrastructure, including in renewable energy, zero-carbon transport, resilience, and other sectors. In advanced economies and certain segments of EMDCs, in addition to new capital investments, investments are also needed to decommission unsustainable infrastructure, such as coal fired power plants, and replace it with newer, carbon-neutral infrastructure (OECD, 2017b). To meet the Paris Agreement, all new capital investments should be Paris-aligned. The magnitude and speed of decommissioning and replacing existing unsustainable infrastructure increase the closer we get to the 1.5 °C goal.

Worldwide estimates of the global infrastructure financing needs range from USD 3.3 trillion to USD 7.9 trillion per year between 2016 and 2030 (GIHub, 2016, Mckinsey, 2016, OECD, 2017, Bhattacharya *et al.,* 2016). Proportional to the GDP in 2015, this annual infrastructure investment needs are 3.3 to 7.9 percent of global GDP during the 2015-2030 period. This compares with current spending that is assessed by different sources to be in the range from of 3-5.5 percent of the global GDP during the 2015–2030 period.

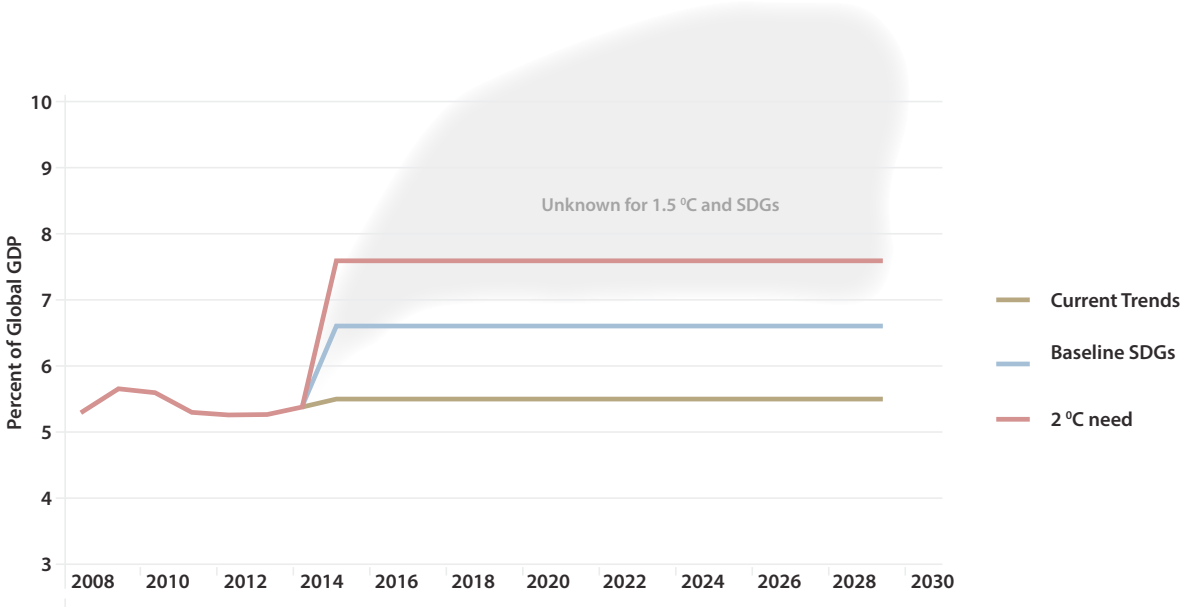
14 At the Brisbane Summit in 2014, the G20 launched the Global Infrastructure Hub (GIHub) which has pursued a broad based work program including developing better data on infrastructure spending and needs. The GIHub database tracks total infrastructure spending and project needs for energy, telecommunications, transport and water (for a detailed discussion of how they arrive at estimates, see Oxford Economics, 2018).

15 It must be noted that reaching global temperature increases of 2 °C is not compatible with the Paris Climate Agreement goal of 'well below 2 °C'

On a comparable basis, the gap between current spending and what is needed to meet the SDGs and the 2 °C climate goal is around 2.1 percent of GDP.

The wide range in estimates and gaps in needs reflects differences in coverage (core vs. more encompassing definitions of infrastructure) and lack of robust methodologies to assess the requirements for different climate scenarios. The lower bound estimates are the size of the infrastructure gap for 'core infrastructure' pathways that will maintain economic growth and partly achieve SDGs related to access to electricity (SDG 7.1.1), water (SDG 6.1), and sanitation (SDG 6.2), but do not consider infrastructure needs to achieve climate targets (Oxford Economics, 2019), while the higher estimates are the gaps needed to achieve a 2 °C climate scenario. Importantly, there are no systematic estimates for investment needs to reach a 1.5 °C target.

Figure 7: Investing in Sustainable Infrastructure: Current Trends vs. 2 °C Needs



Note: Shaded area represents unknown infrastructure investment needs for reaching 1.5 °C and full SDGs.

Source: Authors calculations based on Oxford Economics, 2019; OECD, 2017; McKinsey, 2016; Bhattacharya *et al.*, 2016; and NCE 2014.

The gaps in the scale of infrastructure investment needs relative to current trends are depicted in Figure 7. Current spending on infrastructure is roughly 5.5 percent of global GDP (brown line — 3.8 percent of global GDP on core infrastructure and the remainder on primary energy supply and demand side investments). To meet growth and baseline SDG development targets, core infrastructure investment spending needs are projected at 5.2 percent of global GDP annually between 2016-2030 (average of OECD and Bhattacharya *et al.*,) and another USD 1.4 trillion is needed for baseline primary energy needs, raising the need to 6.6 percent of global GDP annually on average — indicated by the blue line. To meet the 2 °C target, additional spending of around 1 percent of global GDP will be needed based on the analysis of OECD and NCE (indicated by the red line). Annual infrastructure spending therefore needs to increase by USD 3.2 trillion from present levels. As a share of global GDP, spending needs to increase by 2.1 percent as shown in Figure 7.

The New Climate Economy and Bhattacharya *et al.*, (2016) and the OECD (2017), have each provided estimates of the investments needed to reach low-carbon, 2 °C scenarios. For Bhattacharya, the 2 °C scenario are the investments needed to make an energy transition and an emissions trajectory consistent with a 50% chance of limiting average global temperature increases to 2°C by the end of the century. The OECD (2017) estimate is based on a 66% chance of keeping the temperature rise below 2°C. Bhattacharya *et al.*, estimates that USD 7.6 trillion is needed on an annual basis to reach a 2 °C target, the OECD estimates that USD 6.9 trillion is needed — with about 75 percent of the need residing within G20 countries themselves, approximately USD 5.25 trillion per year for the G20 and USD 1.75 trillion for the rest of the world. Table 1 displays the OECD and Bhattacharya estimates by sector. In each case, energy and transportation are over 70 percent of the total investment needs.

Table 1: Sectoral Needs for 2 °C Infrastructure Scenarios

	OECD	Bhattacharya (2015 USD trillion)
Energy	2.7	3.9
Transport	2.7	2
Water and Sanitation	0.9	0.9
Telecoms	0.6	1
Totals	**6.9**	**7.9**

Source: Authors calculations based on OECD 2017a.

While the scientific targets can be relatively well-specified, quantitative implications for policy, investment and finance are more tenuous. We know that the current global capital stock is not 'fit-for-purpose'. Not only does it generate a level of emissions that is not sustainable, but it is not as economically efficient as it could be, and it has many negative externalities — from congestion to pollution to destruction of natural and social capital. We also know that we have to roughly double the current capital stock in the next 20 years in order to meet projected growth and the SDGs. What does this imply for the 1.5 °C target? Since total emissions must be cut by 50 percent by 2030, we must not only build new infrastructure to a standard as close to zero emissions as possible, but we must also rapidly cut emissions of the existing capital stock. This means swiftly phasing-out aging and carbon-intensive capital, mainly in advanced economies but also in all major emerging markets, and ensuring that all new infrastructure is low-carbon and climate resilient. Together these two imperatives imply the extraordinary scale of investment the world needs to undertake over the next two decades — both to meet new needs and to shift the capital stock.

While the estimates provided by the GIHub, OECD and NCE give useful overviews of the overall scale and common direction of infrastructure needs in general and for a 2 °C scenario,[16] there lacks a more granulated, open and accessible portal with data for monitoring such. As mentioned earlier, in terms of the 'need' for further infrastructure, the GIHub currently lacks data and classifications calibrated to Paris (both 1.5 and 2 °C scenarios) and the SDGs, both in terms of the investments needed to convert existing capital stocks into sustainable infrastructure and meeting future needs in other regions. In addition, the portal does not display the information needed to decipher investments on a country and technology level over time as well. When using the GIHub data portal, for instance, only the total G20 investment that has gone into 'energy' can be seen, but the distribution of the investments regarding solar, wind, coal and other technologies remains unclear. Thus, the GIHub estimates do not allow to determine investment in zero-carbon energy generation and other relevant sectors, an essential step to understanding the progress in meeting global climate change targets.

B. B. G20 Overseas Investment and Development Finance into Infrastructure for Sustainable Development

G20 countries lead the world in the amount of overseas investment and finance to each other and to EMDCs, but they fall far short of calibrating that investment and finance toward sustainable infrastructure. The ability and effort to track and monitor the extent to which capital flows to EMDCs are compatible with sustainable infrastructure is very much in its infancy. Similar to the effort the GIHub made, the World Bank has created an interactive data portal that reflects a bigger picture of SDG-related infrastructure needs in EMDCs. However, it does not track the progress toward achieving those spending needs (World Bank, 2019). We attempt to partly fill that gap by providing a first order estimate of sustainable infrastructure FDI flows from G20 members to EMDCs and other non-G20 members from 2011 to 2017, as well as finance from MDBs to non-G20 countries and international flows into sustainable infrastructure from G20 country NDBs outside

16 As noted earlier, there are no infrastructure needs estimates for 1.5 °C, and 2 °C does not meet the Paris Agreement goal of 'well below 2 °C'

17 For a discussion on the operational definition of sustainable infrastructure and sectors used for this analysis, as well as data limitations and DFIs included, please refer to the methodology Annex and see Table 9.

their home country. Table 2 below summarizes the authors' estimates of sustainable infrastructure financing from MBDs and G20 NDBs, and G20 FDI in sustainable infrastructure.[17] These estimates are further elaborated upon throughout this section. The methodology for deriving them is located in the appendix.

Table 2: G20 Outflows to EMDCs for Sustainable Infrastructure 2011-2017 (USD billion)

	Total (USD billion)	Annual (USD billion)	Share of EMDC need	Share of global need
MDBs	180	25.7	1.2%	0.3%
NDBs	621	88.8	4.2%	1.2%
FDI	282	40.3	1.9%	0.5%
Total	**1,083**	**154.8**	**7.4%**	**2.0%**

Source: Authors calculations based on IDFC 2014, 2018; World Bank, 2018a; FDI Intelligence, 2019

We estimate that G20 FDI flows and development finance institutional flows (both from MDBS and NDBs) to EMDCs from 2011 to 2017 for sustainable infrastructure were just over USD 1 trillion — or USD 154.8 billion per year. Relative to EMDC-specific estimates by the World Bank on infrastructure financing needs for the SDGs and aligning with the Paris Agreement, G20 countries have not played a major role filling sustainable infrastructure gaps in EMDCs and beyond. The World Bank estimates that EMDCs need to invest (or receive investments) of roughly USD 1.5 trillion to 2.7 trillion per year for infrastructure on an annual basis from 2015 to 2030 in order to achieve SDGs and meet a 2 °C climate change target (World Bank, 2019). As a share of that estimate, our calculation of USD 154.8 billion annually is just 7.4 percent of the midpoint of those World Bank range estimates, and just 2 percent of the total need estimated by the OECD and NCE discussed earlier.[18] NDBs' finance for sustainable infrastructure outside their countries is upwards of USD 48 billion — roughly USD4.8 billion per year.

i. G20 Foreign Direct Investment

According to our analysis,[19] all FDI from G20 members during the 2011-2017 period was USD 4 trillion. About USD 448 billion from that amount were invested in sustainable infrastructure, that is roughly 11%. When looking at FDI from G20 members in EMDCs,[20] our analysis finds that FDI amounts to slightly over USD 2.6 trillion, approximately 64.7% of the overall G20 FDI. Sustainable infrastructure FDI from G20 to EMDCs is USD 282 billion, which amounts to USD 40 billion/year. Significantly, only USD 4 billion of sustainable infrastructure FDI from G20 flowed into low-income countries, representing less than 1% of total G20 sustainable infrastructure FDI. If we only consider FDI from G20 to non-G20 members, our analysis finds sustainable infrastructure investment of USD 139 billion for the 2011-2017 period.

Table 3 shows the distribution by origin of G20 FDI in sustainable infrastructure in EMDCs. With USD 62.5 billion, the 'rest of the EU'[21] invested most of the amount into sustainable infrastructure in EMDCs, led by Spain's massive foreign investments in solar and wind power. The United States is not far behind with USD 50.1 billion, followed by China with USD 35.4 billion and Italy and France, both above USD 20 billion.

G20 FDI for sustainable infrastructure in EMDCs is not evenly distributed, with nine countries (India, Chile, Mexico, Turkey, Brazil and South Africa, Romania, Pakistan and China) receiving 60% of the total, while 78 countries received less than 1% each, and many none at all.

18 The World Bank (2018a) publishes an annual 'joint report' on climate finance tracking and the Climate Policy Initiative attempts to track all climate finance on an annual basis from 2011 to 2017. The figures in the MDB row in Table 2 reflect the sum of each year's action total, but the composition or sectoral distribution of sustainable infrastructure is based on the 2017 structure. The row for national development banks is from IDFC 2014; 2018, with the share from 2011 to 2014 based on 2014 share, and the 2015-2017 based on the 2017 share. For a smaller set of analogous estimates that arrive at similar orders of magnitude see (Climate Policy Initiative, Table A.5, 2018).

19 Based on FDI intelligence, see methodology Annex for details including what was considered sustainable infrastructure.

20 EMDCs where defined according to latest World Economic Outlook classification, see IMF (2019b)

21 For this analysis, FDI from G20 members was quantified. In the case of the EU, since France, Germany, Italy and UK are G20 members in their own right, all other countries were aggregated as 'rest of EU'. To calculate EU totals, one can add 'rest of EU' with Germany, France, Italy and, depending on status of 'Brexit,' the UK.

Table 3: G20 FDI for Sustainable Infrastructure in EMDCs by origin 2011-2017 (USD million)

	Energy	Water	Transport	Waste	Total (USD million)
rest of EU	59,026	2,396	902	222	62,546
United States	48,052	814	1,097	187	50,151
China	33,727	250	715	800	35,492
Italy	25,448	24		45	25,517
France	18,705	2,455	575	260	21,995
Germany	16,377	181	1,771	100	18,428
United Kingdom	15,106	17		144	15,268
Canada	14,011	139	924	59	15,134
South Korea	10,909	413	40	25	11,387
Japan	7,649	1,828	122	208	9,808
Australia	1,412	2,060		125	3,597
India	2,829	573		170	3,572
Saudi Arabia	3,189	123			3,312
Brazil	2,220				2,220
Russian Federation	1,339		216		1,555
Turkey	1,475			24	1,499
Argentina	433				433
Mexico	272	2			274
South Africa			15	34	49
Total (USD million)	**262,178**	**11,276**	**6,377**	**2,405**	**282,236**

Source: Authors calculations based on FDI Intelligence, 2019

It is noteworthy that over 92% of FDI in Table 3 goes to the energy sector. Energy investments have been by far the most attractive to the private sector, especially in solar and wind — receiving USD 262 billion out of the USD 282 billion in sustainable infrastructure FDI from G20. Below, Table 4 shows that sustainable energy infrastructure FDI is led by solar, with USD 131.3 billion, followed by wind with USD 73.1 billion. Nearly 40% of all G20 sustainable energy infrastructure FDI flowed into India, Chile, Mexico and Turkey. Along with Brazil, Romania, South Africa and Pakistan, these countries each attracted over USD 10 billion in FDI for renewable energy in the 8-year period 2011-2017. Examples of such investments include Spain's Acciona USD 343 million investment in solar in Vallenar, Chile; China's China Three Gorges Corporation company investment of USD 224 million in wind power in Jhimpir, Pakistan; and Japan's Hitachi USD 125 million investment in biomass power generation in Ho Chi Minh, Vietnam.

The second largest sector is water, where EMDC sustainable infrastructure investment recipients are led by Chile (USD 2.3 billion) and Kuwait (USD 2.1 billion), followed by Oman (USD 1.8 billion) and Saudi Arabia (USD 0.94 billion). Examples of such investments in Oman include USD 300m for a new sewer system in Barka by Japan's Itochu company, and USD 123 million for sewer expansion in Muscat by Germany's Bauer company. FDI in the transport and waste sectors is comparatively smaller and includes, for example, France's Séché Environnement USD 125.3 million investment in recycling in Casablanca, Morocco.

Table 4: Top EMDC recipients of G20 FDI on Sustainable Energy Infrastructure 2011-2017 (USD million)

EMDCs	Solar	Wind	Hydro*	Biomass	Geo-thermal	Ocean	Non-Specified	Total (USD million)	% of Total
India	24,269	5,971	505	2	0	330	4,422	35,500	14%
Chile	14,624	8,048	91	1,912	0	0	2,175	26,849	10%
Mexico	10,051	8,842	227	271	0	0	434	19,824	8%
Turkey	4,274	13,146	0	281	868	0	0	18,569	7%
Brazil	4,677	5,014	3,619	1,442	0	0	428	15,180	6%
Romania	5,018	7,547	320	678	0	0	156	13,718	5%
South Africa	9,122	3,668	497	0	7	20	186	13,501	5%
Pakistan	5,055	4,844	0	2,830	0	0	0	12,728	5%
China	4,760	378	1,944	40	0	0	172	7,293	3%
Nigeria	6,144	0	0	0	0	0	507	6,651	3%
Vietnam	5,821	235	335	0	0	0	0	6,392	2%
Bulgaria	2,917	454	796	724	151	0	156	5,197	2%
Malaysia	3,222	42	1,869	0	0	0	43	5,175	2%
Serbia	443	1,748	379	2,236	89	0	3	4,899	2%
Morocco	2,659	1,772	0	0	0	0	156	4,587	2%
Egypt	2,462	1,403	0	0	0	0	162	4,027	2%
Russian Federation	543	1,350	305	1,564	163	0	51	3,977	2%
Ukraine	2,385	643	310	0	0	0	22	3,361	1%
Panama	1,653	440	0	533	0	0	378	3,004	1%
Rest of 71 countries	21,244	7,631	9,523	7,442	1,238	50	4,617	51,745	20%
Total (USD million)	131,345	73,176	20,720	19,953	2,517	401	14,067	262,178	

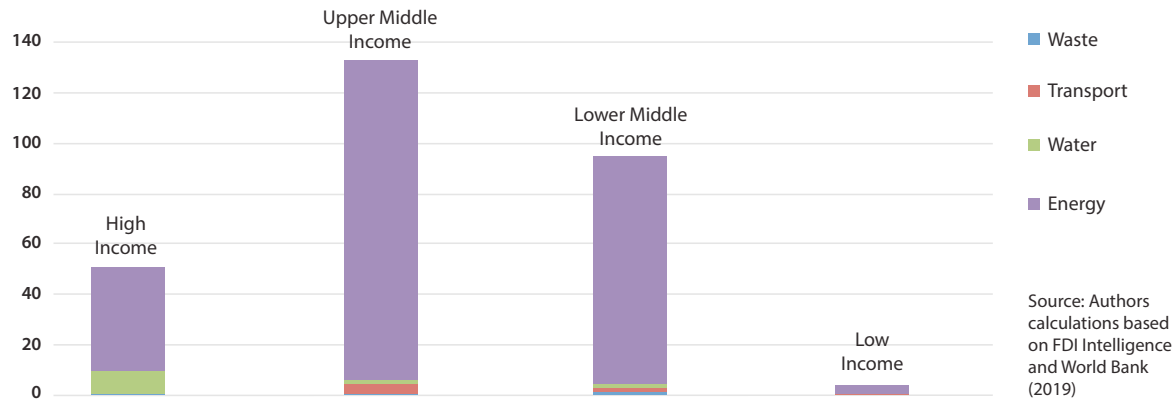
Source: Authors calculations based on FDI Intelligence, 2019

* For this analysis, hydropower is included as sustainable. However, please refer to discussion after Table 10 on the social and environmental impacts of hydropower, as well as its net GHG mitigation effects.

Distribution by Income Level

Nearly 18% — or USD 50.4 billion — of sustainable infrastructure FDI from G20 to EMDCs went to countries with high income levels. This strongly contrasts with the less than one percent — or USD 4 billion — that went to low income countries.[22] This is clearly illustrated in Figure 8, which depicts the distribution of G20 FDI to EMDCs as calculated by the authors for each sector according to income levels following the World Bank classification (World Bank 2019). While all income levels are dominated by energy, it is interesting that water investments are proportionately higher in high-income countries while transport

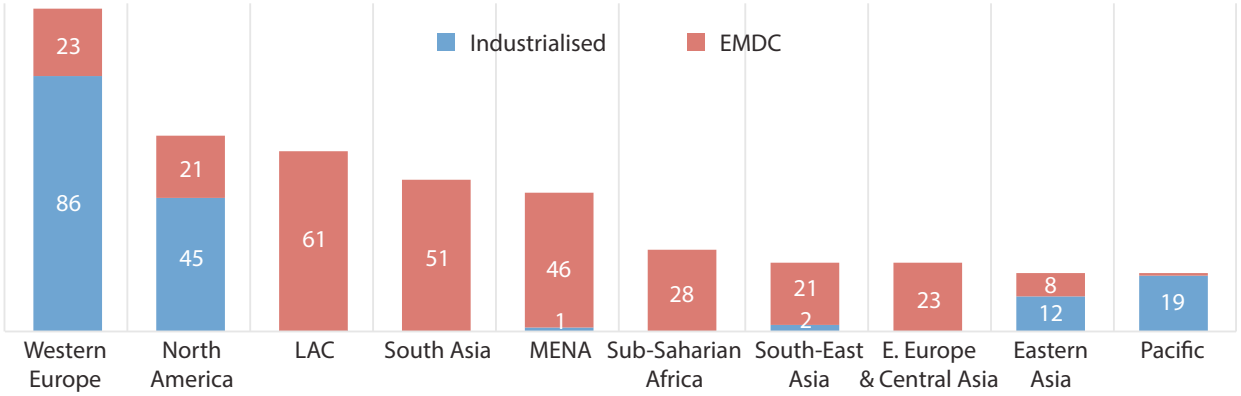
Figure 8: Distribution of Sustainable Infrastructure FDI from G20 to EMDCs by Income Level 2011-2017 (USD billion)



22 Income levels according to World Bank classification World Bank (2019)

is proportionately higher in middle-income countries. Further research would be needed to determine whether there is an underlying trend. Energy FDI depicted in Figure 8 is dominated by Chile in the case of high-income countries, and India and Pakistan for lower-middle income countries. However, in the case of upper-middle income countries, five countries (Mexico, Turkey, Brazil, South Africa and Romania) have between 10-15% of the investment each, and a further 10 have between 1-7% of the investment each.

Figure 9: Regional Distribution of Sustainable Infrastructure FDI from G20 (USD billion, 2011-2017)[23]



Source: Authors calculations based on FDI Intelligence, 2019

Box 1: China's Belt and Road Initiative

China's Belt and Road Initiative (BRI) is an ambitious global infrastructure and integration effort that promises to contribute trillions of dollars to meet global infrastructure needs. In terms of magnitude, China has scaled, both at home and abroad, to the ambition needed to fill the infrastructure gaps discussed earlier in this report. In the first years after the BRI was launched, however, infrastructure investment has largely not been calibrated toward the Paris Agreement or achieving the SDGs.

In mainland China, China now produces 60 per cent of the world's solar panels. EY recently put China's PV industry and offshore wind industries at the top of their rankings, with offshore wind at number two. Shenzhen-based CATL is the biggest producer of electric vehicle power packs in the world, raising more than USD 800M from its IPO in June of this year. At the same time, China has put in place a policy to cap domestic coal production by 2020 (Baruniuk, 2018).

Research by the World Resources Institute and Boston University's Global Development Policy Center found that Chinese entities provided upwards of USD 240 billion in energy financing to BRI countries since the BRI conception, and the vast majority of such investments were in fossil fuels — 91 per cent of all syndicated loans, 61 per cent of policy bank loans by the China Development Bank and Export Import Bank of China, 93 per cent of the Silk Road Fund's equity investments, and 95 per cent of state-owned enterprise investment. According to the report, the one bright spot was in private overseas investment, where cleaner energy was 64 per cent, though the total was only USD 12.2 billion (Zhou et al., 2018).

There are signs that China seeks to better align the BRI with the SDGs and the Paris Agreement. At the second Belt and Road Forum in 2019, China reportedly acknowledged some of the environmental shortcomings of the BRI (Goh & Cadell, 2019). A series of green initiatives were further pushed through. Major financial institutions of China, the UK, France, Singapore, Pakistan, the UAE, Hong Kong SAR and other countries and regions signed up to the Green Investment Principles for Belt and Road Development. A BRI International Green Development Coalition was jointly launched by the Ministry of Ecology and Environment of China, the environmental departments of 25 countries, international organisations, research institutions and businesses. BRI-related green bonds, green investment funds, environmental research and training programmes were also in the 'list of outcomes' of this forum.[24] At the summit, the Chinese Ministry of Ecology and Environment, along with the United Nations Environment Program, established a forum with civil society organisations aimed at greening the BRI, the Beijing Initiative for a Clean Silk Road. The ministry also formed a Belt and Road Environmental Technology Exchange and Transfer Center (MOFA, 2019). If implemented, these are positive steps toward aligning the BRI with the SDGs and Paris goals.

Regional Distribution

Above, Figure 9 shows the regional distribution of G20 sustainable infrastructure FDI during the 2011-2017 period, including both industrialized countries and EMDCs. For EMDCs, Latin America and the Caribbean (LAC) was the main recipient region, with USD 61 billion. South Asia followed (USD 51 billion), with Middle East and

23 In this classification Western Europe includes the UN sub-regions of Western, Southern and Northern Europe, as well as all EU members.

24 E.g. Green Silk Road Envoys Program, which trains environmental officials from the participating countries of the BRI; the National Development and Reform Commission of China launched the Belt and Road Green Lighting Initiative and Green Cooling Initiative with UN Agencies and Energy Foundation; the Belt and Road Bankers Roundtable Mechanism (BRBR) green bond and the Belt and Road Green Finance Index issuedissue by The Industrial and Commercial Bank of China and its international partners; the Silk Road Environment ProgrammeProgram by the Chinese Academy of Sciences to study the pathways and scientific solutions of green Silk Road development; and BRI Green Investment Fund launched by The China Everbright Group and financial institutions of relevant countries.

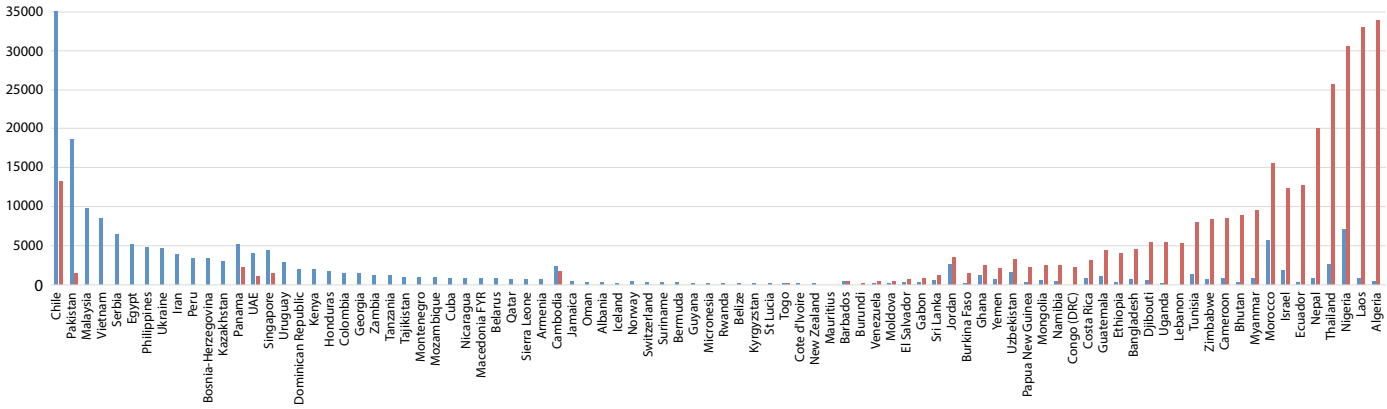
North Africa and (MENA) close behind at USD 46 billion. G20 sustainable infrastructure FDI to EMDCs was between USD 20-30 billion for all other regions except Eastern Asia and the Pacific, where it was below USD 10 billion and negligible respectively.

Nationally Determined Contributions

Past research by some of the authors determined that the annual investments necessary to achieve all quantifiable renewable energy contributions in developing country NDCs until 2030 is USD 68.8 billion/year (Muñoz Cabré *et al.*, 2018). If we look at past FDI for a comparable time, we find that the average G20 FDI in sustainable energy infrastructure outside the G20 was USD 17.3 billion/year for the period 2008-2018. While the figures are not directly comparable, and only apply to non-G20 countries, they illustrate how renewable energy FDI needs to be scaled significantly in order to meet the NDCs.

Notwithstanding the overall need to increase FDI in order to meet renewable energy targets in NDCs, the picture is not the same for all countries. In fact, past G20 FDI in renewable energy exceeds the quantified NDC targets for renewable energy in many non-G20 countries (as estimated in Muñoz Cabré *et al.*, 2018, Zhou *et al.*, 2018, IRENA, 2018). For example, FDI investment in renewables in Pakistan exceeds 13-fold its NDC quantifiable renewable energy contribution. In Rwanda, UAE and Singapore, renewables FDI is more than triple the NDC demand, and in Chile, Panama and Togo it is more than double. At least 40 countries that did not make explicit renewable energy contributions in their NDCs have received renewable energy FDI from G20 members (Figure 10). With some exceptions, the most likely explanation for this mismatch is the lack of ambition of the first NDCs. As an example of the lack of ambition of NDCs, it has been estimated that reaching a 2°C scenario would require investments in renewable energy in the order of USD 1 trillion per year, with 70 percent in developing countries (NCE 2016).

Figure 10: Overseas G20 FDI in Renewable Energy (2008-2018) vs NDC Renewable Energy Investment Needs (USD million)



Source: Authors calculations based on FDI Intelligence and Munoz Cabré *et al.*, 2018

FDI RE - USD million

NDC RE needs - USD million

ii. G20 Development Finance Institutions

G20 members also dominate the world of DFIs in terms of their own NDBs that invest abroad and their majority stakes in many MDBs (see Table 5). While many of these institutions have put in a considerable effort to shift their balance sheets towards sustainable infrastructure and to track and monitor such investments, the scale of trackable commitments from G20 DFIs is still far from what is needed to play a key role in filling sustainable infrastructure gaps.

G20 members have access to roughly USD 5 trillion in DFI assets — roughly 3/5 in national development banks (NDBs) and the rest in MDBs — and lend roughly USD 1 trillion per year (Kring & Gallagher, 2019). Table 5 shows the 25 largest DFIs which G20 countries are members of, as well as the aggregate voting share of G20 members. It is worth noting that G20 members have a full or a majority vote for the largest 14 DFIs, totalling USD 4.7 trillion in assets.

With the proper policies in place these resources, aligned with the SDGs and Paris, could be mobilised for a generational investment in sustainable infrastructure.

Table 5: Twenty-Five Largest DFIs with G20 Members (USD billion)

DFI		Assets (USD billion)	Loans (USD billion)	Voting share by G20 members*
CDB	China Development Bank	1,957	1,428	100%
EIB	European Investment Bank	623	500	100%
KFW	KfW Development Bank	537	477	100%
IBRD	International Bank for Reconstruction and Development (World Bank Group)	349	163	74.6%
BNDES	Brazilian Development Bank	251	175	100%
KBD	Korea Development Bank	235	125	100%
JBIC	Japan Bank for International Cooperation	162	124	100%
DBJ	Development Bank of Japan	141	119	100%
ADB	Asian Development Bank	118	62	71.2%
IDB	Inter-American Development Bank	111	79	77.6%
EBRD	European Bank of Reconstruction and Development	60	23	92.6%
IDBI	Industrial Development Bank of India	56	32	100%
VEB	Bank for Development and Foreign Economic Affairs (Russia)	53	28	100%
AFD	French Development Agency	46	38	100%
AfDB	African Development Bank	35	18	42.9%
Banobras	Banobras (Mexico)	34	18	100%
CAF	Development Bank of Latin America	32	21	21.3%
NAFIN	NAFIN (Mexico)	25	11	100%
IdDB	Islamic Development Bank	23	3	32.3%
AIIB	Asian Infrastructure and Investment Bank	18	10	77.6%
BDC	Business Development Bank of Canada	17	15	100%
NDB	New Development Bank	10	n/a	100%
CABEI	Central American Bank for Economic Integration	9	6	15.7%
IDC	Industrial Development Corporation (South Africa)	8	2	100%
FMO	Netherlands Development Finance Company	8	3	100%
Total (USD billion)		4,919	3,478	

***This includes shares by members of the EU. For details on how voting shares for a particular MDB are determined, see Ray, 2019. For NDBs, 100% voting share by home country is assumed.**

Source: Authors calculations based on Kring & Gallagher, 2019, & Ray, 2019

Policies on Sustainable Infrastructure and Climate Finance

DFIs have increased their support for sustainable infrastructure in recent years through support for policy and institutional strengthening, platforms for project preparation, risk mitigation, and measuring and monitoring impact. They are also essential in helping to ensure that host countries have the absorptive capacity to manage such a major structural transformation in a manner that is sustainable from both development and financial perspectives. The IDFC and the MDBs have taken significant steps committing to address the climate challenge. In 2015, they updated a set of Common Principles for Climate Mitigation Finance Tracking, jointly created a tracking methodology[25] for climate finance and are now regularly releasing annual reports (World Bank, 2018; IDFC, 2014; 2018). More importantly, these institutions have committed to converting a certain percentage of their balance sheets into climate friendly finance in the

25 A criticism to the principles, which were developed in 2012 and updated in summer 2015, is that they are not explicitly aligned to the Paris Agreement (reached in December 2015) and that it is unclear how they do or do not overlap with the OECD Rio markers used by some MDBs such as EIB, EBRD and EU institutions (Germanwatch, 2018)

near future. Perhaps most significantly, in 2018, both the IDFC and the MDBs jointly committed to aligning their financial flows to the Paris Agreement and are currently working together to create a dedicated approach (World Bank, 2018).

In late 2018, a group of MDBs, including the African Development Bank Group (AfDB), the Asian Development Bank (ADB), the Asian Infrastructure Investment Bank (AIIB), the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB), the Inter-American Development Bank Group (IDB), the Islamic Development Bank (IsDB), the New Development Bank and the World Bank Group, announced a joint framework to be presented at COP25, aligning their activities with the goals of the Paris Agreement, reinforcing their commitment to combat climate change, aiming to limit the increase in global temperatures to well below 2° C and pursuing efforts for 1.5° C. This strengthens the MDBs' endeavours throughout the decade to implement various policies, systems and tools to understand and limit the negative effect of their investments on climate change mitigation efforts (Larsen *et al*., 2018), including setting quantitative goals for climate finance, expanding their exclusion lists to fossil fuels and logging projects, setting emission performance standards, and adding internal shadow carbon prices.

Table 6 shows whether and how these tools are being deployed by the different banks. The table has been created by compiling information contained in the WRI report *'Toward Paris Alignment: How the Multilateral Development Banks Can Better Support the Paris Agreement'* (Larsen *et al*., 2018) as well as the E3G report *'Banking on Reform Aligning Development Banks with the Paris Agreement'* (Wright *et al*., 2018). This has been complemented with updated information and additional references wherever available such as EBRD's new Energy Sector Strategy, and information for the New Development Bank.

As seen in Table 6, some DFIs are leading on climate change commitments by pledging to provide disincentives for economic activity that accentuate climate change, while simultaneously encouraging climate friendly activity. Many of the MDBs have strong limits for financing coal-fired power plants, and the World Bank has pledged to end financing for upstream oil and gas extraction by 2019 (Piccio 2016), as well as coal projects except in 'rare and exceptional circumstances.' The EBRD excludes financing oil exploration and coal power generation. The AfDB and ADB have also restricted exploration of new gas fields (Larsen *et al.,* 2018). The IDB has pledged to screen all projects for relevant climate risks starting in 2018, and the Caribbean Development Bank has explored adopting 'climate-stress testing' to their entire balance sheet to protect it from climate-related stranded assets (IDB 2017, Monasterolo & Battiston 2016). Sustainability requirements for infrastructure projects can usually be found in the banks' environmental and social standards. Many banks have also started sustainable infrastructure initiatives, with the IDB pioneering a framework to guide sustainability across the project cycle, (IDB 2018). The AIIB and IsDB have not published quantified goals for climate change, but they have signed joint MOUs for sustainable infrastructure partnerships. Nevertheless, many of these goals in the MDB need to be updated and further operationalized.

Table 6: MDB Policies on Sustainable Infrastructure and Climate Finance

	Climate Finance Commitments[a]	Climate Related Exclusion List	Emission Performance Standards	Shadow Carbon Pricing [b]
AfDB	40% climate finance by 2020 Committed climate finance of at least USD 25 billion for 2020-2025 [c]	Exploration of new oil & gas fields Purchase of logging equipment for use in unmanaged primary tropical rainforests [d]	N/A	N/A
ADB	75% number of committed operations support climate finance by 2030. USD 80 billion climate finance (own resources) 2019-2030 period.	Exploration of new oil and gas fields Extraction of oil Commercial logging in primary tropical or old-growth forests	N/A	USD 36.3/tCO_2 in 2018 2% yearly increase in real terms [e]
EBRD	40% Green Economy Transition financing by 2020 (estimated to exceed €4 billion/year by 2020) [f]	Thermal coal mining or coal-fired electricity generation capacity [g] Upstream oil exploration Upstream oil development projects except in rare and exceptional circumstances [g,h] Gas supported during the period "where it is" consistent with a low-carbon transition" [g]	N/A	USD 40-80 in 2020 [i] USD 50-100 by 2030 [i] USD 78-156 by 2050 [i]
EIB	35% climate lending in developing countries by 2020.[j]	Converting natural forests to plantations Commercial logging in primary tropical or subtropical forest Coal is excluded de facto by Emmisison Performance Standard [p]	550g CO_{2e}/kWh[u]	Price range. Central value ~USD 50/ton CO_2 by 2020 [k]
IDB	30% finance for climate related projects by 2020 [L] Climate change-related operations to reach approx. USD 4 billion/yr [m]	Commercial logging operations in primary tropical forests	Industry benchmarks for high-emitting sectors, such as chemical and cement plants.	N/A
World Bank Group	28% climate portfolio by 2020[n] $200 billion for Climate Action over 2021-2025[w]	Coal except in "rare and exceptional circumstances"[p] All upstream oil and gas activities after 2019	N/A	USD 40-80 in 2020 [q] USD 50-100 by 2030 [q] USD 78-156 by 2050 [q]
AIIB	N/A	Commercial logging operations or the purchase of logging equipment for use in primary tropical moist forests or old-growth forests [r] Unsustainable fishing practices [r]	N/A	N/A
NDB	Pledged 60% lending for renewable energy [t]	Commercial logging operations or the purchase of logging equipment for use in primary tropical moist forests or old-growth forests [s] Unsustainable fishing practices [s]	N/A	N/A

NOTES: Unless otherwise noted, information originally from Larsen *et al.,* (2018); [a] For a detailed description of climate strategy or action plans for the AfDB, ADB, EBRD, EIB, IBD and World Bank see Wright *et al.,* (2018); [b] For details on GHG accounting thresholds and scope of pricing, see Germanwatch (2018). For a visual representation of carbon pricing for the different MDBs from 2020 to 2050 refer to Figure 18 in Wright *et al.,* (2018); [c] AfDB (2019); [d] AfDB (2013); [e] ADB (2018): [f] CPI 2008b; [g] EBRD (2018); [h] where the projects reduce GHG emissions or flaring;[j] EBRD (2019);[j] EIB (2016a); [k] TBC EIB (2018); [L] IDB 2016b; [m] IDB (2016); [n] World Bank (2016); [p] for details see discussion in Wright *et al.,* 2018 page 59-60; [q] For a yearly range of carbon prices see Figure 1 in World Bank (2017); [r] AIIB (2016); [s] NDB (2016); [t] Political pledge, not formal bank policy, NDB (2016); [u] EIB (2013) [w] World Bank (2018b). This amount includes USD 100bn direct finance (IBRD/IDA) and USD 100bn in finance from IFC, MIGA and private capital mobilized by World Bank

Sources: Adapted from Larsen *et al.,* (2018) with data from Wright *et al.,* (2018), Germanwatch (2018), ADB (2019, 2018a, b), AfDB (2019a, b, 2016), AIIB (2016), EIB (2018, 2016), EBRD (2019a, b, 2018, 2015), IDB (2018, 2016), IsDB (2019, 2018), NDB (2019, 216a, b), and World Bank (2018, 2017).

Box 2: New Development Bank (NDB) – the Sustainable Infrastructure Bank?

Using the IDFC-derived methodology outlined in the Appendix, the BRICS-led New Development Bank (NDB), also known as the BRICS Bank, has the largest share of its balance sheet targeted toward sustainable infrastructure, at 68 percent (see Table 7). This compares to the 20% identified earlier for other MDBs. According to the NDB web page, this should be no surprise, as they say their strategy is 'to support infrastructure and sustainable development projects in BRICS and other emerging economies' (see also Table 6). Indeed, the NDB's president earmarked as much as 60 percent of its lending for renewable energy. Thus far, the NDB has financed wind power, water sanitation, solar and beyond. It should be noted, however, that the NDB has been criticized for investing USD 480 million in one of the largest coal fired power plants in the world, South Africa's controversial Medupi Power plant operated by Eskom public utility (Bloom, 2019). The investment is labelled by NDB as 'environmental protection' because it includes retrofitting the plant with flue gas desulphurization units (NDB 2019).

Table 7: New Development Bank Sustainable Infrastructure[26] portfolio as a percentage of total

	Energy		Water		Transport		Other		All Portfolio		
Country	SI (USD million)	% energy portfolio	SI (USD million)	% water portfolio	SI (USD million)	% transport portfolio	SI (USD million)	% other portfolio	SI (USD million)	All (USD million)	% SI
Brazil	500	100%					50	100%	550	621	89%
China	664	62%	723	100%	300	33%	500	100%	2,187	3,194	68%
India	250	100%	815	100%	260	18%			1,325	2,550	52%
Russia	400	100%	320	100%					720	1,009	71%
South Africa	1,041	100%	225	100%					1,265	1,465	86%
Total sustainable infrastructure (USD million)	**2,855**	**88%**	**2,083**	**100%**	**560**	**20%**	**550**	**71%**	**6,048**		**68%**
Total portfolio projects (USD million)	**3,255**		**2,083**		**2,732**		**770**			**8,839**	

Source: Authors calculations from NDB online project information

SI = sustainable infrastructure

Potential to Shift and Scale DFI Financing for SDGs and Paris

DFIs can play a larger role scaling up the necessary financing for the SDGs and Paris, though they should not be expected to bear the full burden. As shown in Table 2, DFIs have financed roughly USD 800 billion toward sustainable infrastructure since 2011. MDBs have covered USD 180 billion and NDBs USD 621 billion adding up to collective $114.5 billion per year – roughly 11 percent of their combined annual lending and only 1.6 percent of the total investment needed in the 2 °C scenario. In any case, sustainable energy financing is just over half of all development finance for sustainable infrastructure (authors' calculations based on IDFC 2014; 2018 and World Bank 2018a).

If DFIs shifted their balance sheet from 11 to 35 percent of their portfolios to Paris and the SDGs (as the EIB has committed to do, see Table 6), they could finance USD 240 billion more per year. If they shifted their sustainable infrastructure balance share to 66%, the effective level of the New Development Bank (see Table 7), they could finance USD 550 billion more toward sustainable infrastructure per year. By 2030, those increases could amount to between USD 2.6 trillion and USD 6.1 trillion (see 'current trends' in column 1 in Table 8 under 'no leverage' 'ambition 35 percent portfolio' and 'no leverage' ambition 66 percent portfolio.).

26 Using methodology as described in the Annex

Table 8: Illustrative Scenario for Potential DFI Financing toward Sustainable Infrastructure

		Total Mobilized capital (USD trillion)		
		no leverage	leverage ratio 2.7	leverage ratio 4
		Ambition 35 % portfolio		
Current trend	total	2.6	7.1	10.6
	annual	0.240	0.648	0.960
Maximise headroom	total	3.2	8.7	13.0
	annual	0.294	0.795	1.2
25 % capital increase	total	3.4	9.2	13.7
	annual	0.311	0.841	1.2
		Ambition 66 % portfolio		
Current trend	total	6.1	16.3	24.2
	annual	0.550	1.5	2.2
Maximise headroom	total	6.6	17.9	26.6
	annual	0.604	1.6	2.4
25 % capital increase	total	6.8	18.5	27.3
	annual	0.621	1.7	2.5

Source: authors calculations based on Munir & Gallagher, 2018

As mentioned in section I.C.vi in this report, many DFIs can expand their lending headroom to achieve Paris and the SDGs. New research suggests that the MDBs alone could increase their portfolio by USD 598 billion while maintaining their AAA bond status (Munir & Gallagher, 2018). If MDBs maximized their headroom, that would increase available financing to 2030 from USD 3.2 trillion for DFIs that shifted to 'ambition 35 percent portfolio', to USD 6.6 trillion for DFIs that shifted to 'ambition 66 percent portfolio.' In annual terms, this amounts to between USD 294 to USD 604 billion per year, depending upon whether those increases were part of a 35 percent or a 66 percent of DFI balance sheets.

Capital increases would provide further space. With a 25 percent capital increase for the SDGs and Paris, MDBs could finance up to USD 789 billion in their portfolios without jeopardizing their AAA rating (Munir & Gallagher, 2018). If MDBs maximized their headroom with a 25 percent capital increase and shifted to 'ambition 35 percent portfolio,' they would have USD 3.4 trillion to 2030 or USD 311 billion per year. If they did so with the 'ambition 66 percent portfolio' levels, they would have USD 6.8 trillion, at USD 621 billion per year until 2030.

Convergence, a blended finance firm, conducted a study that calculated the average leverage ratio for blended finance across 72 climate change funds, and found a median leverage ratio of 2.7 and an average ratio of 4.0 (Bery, 2018). If DFIs could mobilise the resources in the first column and could leverage what Convergence found in a similar fashion by applying those ratios to the expanded headroom analysis discussed above, there is a potential to mobilise a total of between USD 7.1 trillion to USD 27.3 trillion, depending on the level of ambition and leverage or, in annual terms, between USD 648 billion and USD 2.5 trillion per year (Table 8) (see Nevers, 2017 for good overview of leveraging for climate change).

G20 DFI Financing Outside of G20: Need for Data Transparency and Accessibility

DFIs accessible to G20 members are falling short of financing the SDGs and Paris and also suffer from a lack of data transparency and/or accessibility to allow third parties to verify and monitor progress. Many DFIs have engaged in internal tracking of climate finance, but there lacks transparent and accessible tracking of sustainable infrastructure financing. We did an assessment of the major MDBs and NDBs to examine the extent to which it is possible to track and evaluate how far these institutions are calibrating their sustainable infrastructure finance toward the SDGs.

It is important to distinguish between data transparency and accessibility. ISDB, for example, with 8348 financed projects, does provide project information in its website or even just basic search functions by country and sector. However, information is given on a project-by-project basis, with individualized pages for each project though they can't be downloaded. A search of the entire portfolio provides individual project links spread over 169 search webpages. The EIB, with 12284 financed projects in 162 countries, also provides individualised project information and search tools. Additionally, it provides downloadable data for its portfolio. Unfortunately, the data does not include project descriptions or sub-sector categorization, so it cannot be used to systematically identify a wind farm from a coal power plant, for example. The EBRD, with over 5200 projects, has similar features to EIB. EBRD, EIB and ISDB all provide information in multiple languages, which is a welcome feature for international researchers. Therefore, EIB, EBRD and ISDB can be categorized as transparent, with specific individual project information that is easy to find. However, their data is not accessible for portfolio research and analysis. Many of the G20 NBDs also share similar characteristics regarding portfolio data.

Other institutions can still improve both transparency and data accessibility. For example, the Saudi Fund for Development (SFD) with 687 projects over 82 countries, does not provide individual project information in its website. A list of all projects including title, country and amounts (without details) can be found in an Annex to its annual report. Likewise, Korea's Economic Development Cooperation Fund, with 395 projects in 54 countries, provides information only on project name, country, year and amount, but no more detail at the project level. Table 9 below describes data transparency and accessibility levels for FDIs as assessed by the authors.

Table 9: Data Transparency and Accessibility

		Basic Project Information	Detailed Project Information	Portfolio Data for Download	Data organised by Sub-Sectors, Project Descriptions
MDBs		Transparency		Data Accessibility	
ADB	Asian Development Bank	X	X	X	X
AfDB	African Development Bank	X	X	X	X
AIIB	Asian Infrastructure Investment Bank	X	X	X	X
CAF	Latin America Development Bank				
EIB	European Investment bank	X	X	X	
EBRD	European Bank for Reconstruction and Development	X	X	X	
IDB	Inter-American Development Bank	X	X	X	X
IFC	International Finance Corporation	X	X	X	X
IsDB	Islamic Development Bank	X	X		
WB	World Bank	X	X	X	X
NDB	New Development Bank	X	X		
NDBs		Transparency		Data Accessibility	
AFD	Agence Française de Développement	X	X	X	X
BNDES	Brazilian Development Bank	X		X	X
CDP	Cassa Depositi E Prestiti (Italy)	X	X		
CDB	China Development Bank				
CDC	UK's development finance institution	X	X	X	*
CHEXIM	Export-Import bank of China				
DBSA	Development Bank of Southern Africa				
EDCF	Economic Development Cooperation Fund (Korea)	X			
IIB	International Investment Bank				
JBIC	Japan Bank for International Cooperation				
KfW	KfW Development Bank (Germany)	X	X	X	X
SFD	Saudi Fund for Development	X			

*Full data available for only a subset, Source: Own elaboration

The MDB reports are indeed comprehensive but often lack disaggregated and detailed project information and/or do not provide downloadable data for tracking and verifying. The IDFC reports cover a complimentary set of DFIs, but the reports also suffer from aggregation and lack of accessibility. In 2018, the IDFC reports that their membership mobilised over USD 200 billion in green finance for NDBs, but they do not indicate the extent to which financing was in the NDB's home country or abroad.

Table 10 exhibits 13 of the most open and accessible DFIs with G20 participation. The trackable sustainable infrastructure loans of these thirteen DFIs amounted to above USD 102 billion in between 2008 and 2018, just over USD 10 billion per year. It is important to highlight that the research reflected in Table 9 contains important differences to the work on quantifying green finance from the IDFC Green Finance Mapping Report, which estimates a total of USD 228 billions of green finance in 2017 (IDFC 2018). The largest difference stems from the fact that our calculations focus on finance flows to non-G20 recipients. Other differences result from the fact that the IDFC report includes grants, technical assistance, policy support,

finance instruments and investments in some fossil fuels. For detailed description of what is included in our figures, please see the methodology Annex.

Table 10: Selected Sustainable Infrastructure Loans by MDBS and G20 DFIs (USD million) to non-G20 Recipients 2008 -2018

	Energy	Water	Transport	Waste	Natural Infrastructure	Total (USD million)
Multilateral Development Banks						
AIIB	379	508			80	967
IFC	5,094	123	125	376	135	5,853
World Bank	7,159	5,950	4,807	1,631	1,367	20,913
AfDB	729	2,284	114		382	3,508
IDB	5,609	4,190	1,663	1,228	658	13,347
ADB	3,974	1,481	2,859	539	372	9,226
Subtotal MDBs	22,944	14,536	9,568	3,773	2,994	53,815
National Development Finance Institutions						
CDC*	189					189*
BNDES	324	928	1,281			2,533
JBIC*	430	2,836				3,266
AFD	391	668	192			1,250
CDB*	6,265					6,265
CHEXIM*	25,433					25,433
KFW	3,520	1,899	1,764	1,678	252	9,113
Subtotal NDBs	36,552	6,330	3,237	1,678	252	48,049
TOTAL (USD million)	59,496	20,866	12,805	5,451	3,246	**101,864**

*Only a subset of CDC data is trackable. JBIC, CDB and CHEXIM data is not transparent and accessible, and has been estimated from existing BU GDP center research (Jin 2018, Gallagher 2018).

Source: Authors calculations based on DFI web pages and IDFC, 2014 (see appendix for methodology)

To our knowledge, this paper is the first to provide an estimate for the level of *trackable* sustainable infrastructure financing in the overseas[27] operations of NDBs. Roughly half of the trackable finance belongs to MDBs, and the other half to NDBs. However, this only applies to trackable finance, that is, finance reported in a transparent and accessible way as described earlier. Both MDBs and NDBs with significant portfolios (and, presumably, a large sustainable infrastructure loans portfolio) were not tracked because their data was either not transparent or difficult to access (see Table 9). These include DFIs such as EIB, IsDB, EBRD, Korea's EDCF and the Saudi Fund for Development.

With respect to NDBs, Chinese and German trackable NDB finance for sustainable infrastructure in non-G20 countries are just as important as MDBs elsewhere. The KfW is a weighty example of an institution that has led domestic transformative investments in sustainable infrastructure in Germany to creating a large overseas portfolio. Gumb (2012), Griffith-Jones (2016), Cochran *et al.*, (2014) and Schroder *et al.*, (2011) vividly describe how Germany's KfW has contributed to green infrastructure development at home. KfW Germany works at a local level to promote energy efficiency and renewable energy projects in three major business areas: the Mittelstandsbank, which promotes SMEs, entrepreneurs, environmental and climate protection business start-ups, the Privatkundenbank, which promotes

27 Non-G20

housing, modernization, education, infrastructure and social development, and the Kommunalbank, which works to finance municipal infrastructure projects within Germany and Europe.

Enting (2013) portrays the contents of KfW's international and domestic portfolios. IPEX Bank and the Development Bank are the constituent parts of KfW's international portfolio. IPEX Bank is described as Germany's Export Credit Agency (ECA) and, as such, provides loans to German businesses looking to export their products and services. IPEX Bank also guarantees a Hermes cover insurance: an export credit guarantee that protects German companies in the event of non-payment by foreign debtors due to economic and political risks. The Development Bank works with developing countries and provides financing for large infrastructure projects. The KfW-financed projects highlighted by Enting (2013) include various renewable energy projects, facilities for a feed-in tariff system in Uganda and participation as an investor in the Global Climate Partnership Fund.

The China Development Bank and the Export Import Bank of China are also the largest financiers of infrastructure, a significant amount of which is sustainable from a climate change perspective.[28] The CDB has financed one of the largest solar plants in Argentina and wind power in Ethiopia and Ecuador (Gallagher, 2019). The largest bulk of Chinese DFI finance in the sustainable infrastructure space is in large hydroelectric dams. In terms of hydropower, it is important to highlight that, according to the IDFC definition, hydropower plants can be labelled green, 'only if net emission reductions can be demonstrated (IDFC 2018, 2014).' Especially in places like the tropical Andes, it is not clear whether all the cleaner energy projects in the region can actually be classified as sustainable. Tropical hydro-electric projects have long been associated with increases in methane emissions and emissions from associated deforestation. Comprehensive reviews of estimates find that tropical hydroelectric plants tend to emit 7 to 15 times more emissions than non-tropical hydropower, and 2 to 3 times more emissions than gas, oil or coal plants (Barro *et al.*, 2011; Steinhurst *et al.*, 2012). This is due to the fact that methane emissions are higher from tropical dams and because new roads and infrastructure sprout as a result of new dams possibly causing further carbon-emitting deforestation (Fearnside, 2015). Unfortunately, hydroelectric power projects have often proven to be the source of other environmental and social problems beyond climate change such as loss of water and habitats, displacement of people and indigenous communities, loss of livelihoods, and beyond (Laurance *et al.*, 2015), and therefore can have a potential negative impact on the achievement of SDGs.

28 What makes hydropower projects sustainable, see discussion on hydropower following Table 10. An even larger amount of finance has gone to fossil fuel power plants and other infrastructure investment that are not Paris-aligned investments.

IV. Leading G20 Investment and Finance for Quality Infrastructure

Although there has been notable progress in the shift to a low carbon economy from countries to cities to businesses, we are far from a sustainable growth path, carbon-neutral economies and the target of limiting global warming to 1.5 °C. The current pace of progress will not produce the scale and shift of investments required for meeting development and climate goals. Progress on underlying policies including the pricing of carbon is too slow and there are still many setbacks such as the rollback of regulations, continued deforestation and new coal-fired plants. The window of time available for necessary action is shrinking ever more rapidly, as the IPCC has underscored.

The G20 plays a central role in driving greater ambition and propelling a decisive shift towards a carbon-neutral, climate-resilient economy. Strong and decisive actions can enable countries to capitalise on opportunities offered by decarbonization, including boosting jobs, enhancing competition and productivity growth, and avoiding economic vulnerability. The G20 Hamburg Climate and Energy Action Plan for Growth has been the main instrument to set out the G20 contributions supporting the Paris Agreement, and has been endorsed by all G20 countries with the exception of the US. However, progress in implementing the action plan has been uneven and without further buttressing, the action agenda will not deliver the 1.5 °C target. It is important that collective ambition and effort is not undermined by a few that are less committed. Therefore, there is a need to build a strong coalition of G20 countries that are strongly committed to the scale and urgency of action needed.

The G20 has been engaged on the infrastructure development agenda since 2010. Most recently, the Argentinian Presidency in 2018 launched the roadmap on quality infrastructure that seeks to unlock high quality and sustainable investments and mobilise the financing that is needed, including from the private sector. The preparation of G20 principles for quality infrastructure during the Japanese Presidency in 2019 provides an opportunity to build on the G7 Ise-Shima principles that can guide global and national efforts in scaling up actions to deliver on sustainable infrastructure. The deliberations have emphasised several important elements including assessing economic efficiency from the perspective of life-cycle costs, a need for sharper focus on resilience, integrating environmental and social considerations and the central role of governance.

The G20 needs to ensure these principles are fully anchored in the SDGs and the 1.5 °C target, and build on them to set out a proactive agenda that delivers quality and sustainable infrastructure. There are eight areas where G20 leadership will be crucial in raising ambition and accelerating actions:

A. G20 Leadership Supporting Ambitious Outcomes on the Delivery of the Paris Agreement and the SDGs, including their own Pathways to Achieve these Goals.

The upcoming UN Summit in September 2019 on the 2030 development agenda, climate and financing for development, the COP25 in Chile in December and COP26 next year are important milestones for raising ambition and accelerating action on climate and sustainable development. G20 countries should individually and collectively support ambitious outcomes at these upcoming milestones.

A review mechanism to assess progress every 5 years is one of the key measures the Paris Agreement suggests to overcome the gap between ambition and action. The COP25 in 2019 will provide a first opportunity to reflect on the progress made since the Paris commitments. Revised NDCs should be submitted prior to COP26 in 2020.

The G20 can exercise leadership by implementing ongoing NDCs, increasing their ambitions and preparing even more ambitious NDCs for the subsequent five years in the lead up to COP26. These NDCs should be anchored in growth and development strategies geared to deliver on the SDGs and the 1.5 °C goal. All advanced G20 members should set pathways for a 50 percent reduction in emissions by 2030 and all G20 members to a net zero emission target by 2050. A few G20 countries announcing these revamped NDCs at an early stage can help raise ambitions more broadly. By 2020, G20 countries should also have set out their long-term emission pathways and development strategies to reach desired targets by the middle of the century. So far, only six countries have done so. The G20 should deliberate and agree on target dates for the key transformations needed to support the long-term targets for net zero emissions, such as fossil fuel free power generation, phasing out internal combustion engines, and mitigating hard-to-abate sectors.

B. Engage G20 Economic Decision-Makers in Climate and SDG Actions.

On April 13, 2018, at the IMF-World Bank Spring Meetings, finance ministers from 20 countries launched a new coalition aimed at driving stronger collective action on climate change and its impacts. This coalition endorsed a set of six common principles (the 'Helsinki Principles' conceived at a meeting convened by Finland and Chile) that aim to integrate climate policy in macroeconomic and fiscal policy notably through NDCs, support policies for climate action, including carbon pricing, and mobilising the necessary finance, especially from the private sector. This coalition can catalyse strong and proactive engagement by finance ministers on the climate agenda, and the links to quality and sustainable infrastructure. Collective leadership from the IFIs is also needed, including from the IMF, OECD and the MDBs.

The Network of Central Banks and Supervisors for Greening the Financial System (NGFS) is a network of 34 central banks and regulators committed to promoting the greening of the financial system and tackling potential impacts and transition risks for financial stability. So far, nine G20 countries and the European Central Bank are members of this network. Its impact would be significantly strengthened if all, or most, G20 countries become active members driving a strong collective agenda on sustainable finance and limiting risks to the financial system.

Trade ministers from G20 should also be tasked to introduce reforms to trade and investment treaties incentivising the acceleration of trade and investment in carbon neutral technologies and reducing incentives for trade and investment in sectors that need phasing out.

C. Mainstream Carbon Pricing and Eliminating Fossil Fuel Subsidies.

A credible carbon price is the most powerful signal to shape the investment decisions of market participants. Governments should play a leading role setting credible policies and price directions within their own jurisdictions, and should act coherently across jurisdictions. As they do, implementation trajectories will vary to account for specific national conditions, including distributional and transitional impacts. It will also be important to phase out fossil fuel subsidies tantamount to negative carbon pricing. As described in Section 2, both carbon pricing and elimination of fossil fuel subsidies can generate substantial revenues that can be used to finance an increase in sustainable investments and help facilitate a just transition.

So far, the G20 has not explicitly committed to carbon pricing, including the Hamburg Action Plan, in contrast to the recently launched coalition of finance ministers for climate action. It is important to build a coalition within the G20 on carbon pricing. In the absence of an adequate carbon price, the G20 should pledge to a shadow price for carbon in line with the recommendations from the high-level commission on carbon prices.

The G7 target date for eliminating fossil fuel subsidies is 2025. Although some G20 countries remain opposed to clear targets, it is important to continue to press for an accelerate phasing out fossil fuel subsidies with a target date for their elimination. It will be important that these steps be accompanied by adequate support for transition adjustments for the most affected segments of society.

D. Phase out Coal and set Timelines to Generally Phase out all Fossil Fuels.

The recent UNEP emissions gap analysis shows that the global community must immediately begin to phase out coal-fired power plants and to move toward generally phasing out all fossil fuels in order to achieve a carbon-neutral global economy at the required pace. As policies align, and prices for coal and other fossil fuels are already higher in certain areas and are projected to be higher than renewable energy over the next decade globally, current investments in coal will become stranded assets incurring significant economic and social costs. Estimates suggest that mixed signals could lead to an amount of US$12 trillion in stranded fossil fuel assets by 2035 (NCE, 2018).

Consequently, G20 countries need to phase out coal and set timelines to generally phase out all fossil fuels, not only within their own countries, but also with regard to their overseas trade, investment and financial flows.

E. Unlock Quality and Sustainable Infrastructure Investment at Scale.

The G20 principles for quality infrastructure can help build consensus on an integrated action agenda to raise the quantity and quality of infrastructure investment in support of the SDGs and the 1.5 °C goal.

The G20 Principles on Quality Infrastructure provide an important opportunity to set out this agenda. Many of the elements being discussed — such as cost efficiency over the cycle, resilience, accessibility and debt sustainability — are important for sound investments. But special emphasis must be given to climate impact and resilience and natural capital more broadly, with agreed targets including the 1.5 °C goal.

The G20 should make systematic efforts to bolster upstream foundations and set common principles and standards to fully incorporate environmental risks including climate. Concerted actions are needed to bolster upstream planning and project prioritisation, regulations and legislation, fiscal and structural policies, procurement and public-private partnership frameworks, and effective institutional capacities and governance. There is significant scope to learn from evolving best practices to unlock robust pipelines of sustainable investments and identify replicable and scalable models. Platforms at global, regional and country levels can help take programmes to scale and enhance quality. SOURCE, the advanced project preparation platform, can be a powerful tool to support collective efforts in this regard.

F. Mobilizing Finance at Scale with a Strong Alignment to the SDGs and the 1.5 °C Target.

Given the scale of investment requirements for sustainable infrastructure, financing from all sources should be significantly scaled up — domestic, international, public and private — and the links between them made stronger. It will be important to create viable revenue models by tapping into spillover effects that can boost long-term returns and, together with improved credit enhancement mechanisms, can attract private capital, pension funds and sovereign wealth funds worth trillions of dollars, reduce costs of capital, and improve debt sustainability. The G20 can play an important leadership role on this agenda by applying the roadmap on financing quality infrastructure.

The G20 should reaffirm its support for the commitments made by developed countries to mobilise an additional $100 billion in climate finance, and in particular, deliver on the critical shortfalls in grant finance including successful replenishment of the GCF, the CIFs and adaptation finance. Adequate grant finance can anchor the 'billions to trillions' agenda to mobilise the scale of finance needed to deliver on the 2030 Sustainable Development Agenda and the Paris Agreement.

The G20 should re-engage in the sustainable finance agenda to shift the whole of finance. Key steps should be to make mandatory reporting against the *Task Force on Climate-Related Financial Disclosure Framework* and, as proposed by the NGFS, incorporate climate risk into prudential and risk assessment frameworks.

G. Revamping the Role of Development Finance Institutions to Deliver on the New Global Agenda.

As the G20 Eminent Persons Group on Global Financial Governance has underscored, DFIs — both Multilateral Development Banks and national level DFIs — are key to delivering on the ambitions of the 2030 development agenda and the Paris Agreement. DFIs can guide policy by increasing their commitment to low carbon finance and phasing out fossil fuel finance, enabling country strategies and platforms, and leveraging their balance sheets. What is more, DFIs are equipped to monitor debt sustainability and ensure access and benefit sharing among multiple stakeholders.

G20 countries have access to USD 5 trillion in assets in Multilateral and National Development Banks and provide more than USD 250 billion in foreign direct investment outside of the G20 that could be geared toward sustainable infrastructure every year. Yet, the G20 only invests 3 percent of GDP on infrastructure in their own countries and has only mobilised an average of USD 115 billion annually through development finance institutions — with a very small percentage flowing into low income countries.

Development Finance Institutions could potentially mobilise up to USD 2.5 trillion dollars per year if they shifted their balance sheets toward sustainable infrastructure, maximized their lending headroom, leveraged private sector finance much better than in the past, worked better as a system, and if they received support from the G20 for an adequate replenishment of their capital, consistent with the ambitions of the development and climate goals. The G20 should set out a clear agenda to revamp the role of the DFI system, building on the recommendations from the G20 Eminent Persons Group. In particular they should:

- scale up policy and institutional support to unlock investments and boost sustainability including through carbon pricing
- augment instruments and capacities for risk mitigation including by working better as a system
- expand environmental and social risk management (ESRM) systems beyond those that examine climate change
- measure and monitor progress and impact of investments, including alignment with the SDGs and the Paris Agreement, and toward debt sustainability.

DFIs should coordinate as a system to scale and concentrate financial flows in a manner that is aligned to the 2030 Agenda and the Paris Agreement. The DFIs should act as a comprehensive system that forges common goals and fosters monitoring and accountability systems.

H. Establish Measurement and Monitoring Systems for Transparency and Accountability.

If the G20 is serious about its commitment to scaling up and aligning its infrastructure investment with the climate and sustainable development goals, a key step is to set systems in place that enable the measurement, monitoring and evaluation of investment and finance flows for sustainable infrastructure. These systems should be open and allow easy third-party access for independent analysis. In order to develop these systems, we propose the following recommendations.

The G20 should endorse the development of a methodology to track sustainable infrastructure investment aligned with the Paris Agreement and the SDGs. This should explicitly include scenarios and pathways to achieve the 1.5 °C goal. GIHub should expand its needs estimates for sustainable infrastructure needs to include 1.5 °C and SDGs goals. This should comprise infrastructure needs for achieving all the SDGs as well as the Paris Agreement. Furthermore, these needs estimates should also include the sustainable infrastructure investment required to replace unsustainable infrastructure stocks. GIHub should track annual sustainable infrastructure investment made by G20 that are relative to the revised needs estimates.

The scale and urgency of the challenge cannot be overstated. Over the next 15 years, infrastructure stock is expected to more than double; world economy is likely to double over the next 20 years, and urban population will nearly double over the next 30 years. With the scale of investment that will have to be made, we cannot afford to lock-in polluting technologies and inefficient capital. Decisions made over these next crucial years will shape the trajectory of investments over the coming 10 to 15 years and these, in turn, will determine the future of the people and the planet for this century and beyond.

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ACRONYMS

ADB	Asian Development Bank
AFD	Agence Française de Développement
AfDB	African Development Bank
AIIB	Asian Infrastructure Investment Bank
ASCE	American Society of Civil engineers
BAU	Business as Usual
BNDES	Brazilian Development Bank
BRBR	Belt and Road Bankers Roundtable Mechanism
BRI	Belt and Road Initiative
CAF	Development Bank of Latin America
CIF	Climate Investment Funds
CDB	China Development Bank
CDC	UK's development finance institution
CDP Spa	Cassa Depositi e Prestiti
CHEXIM	Export-Import Bank of China
CO_2	Carbon Dioxide
CO_2e	Carbon dioxide-equivalent
DBSA	Development Bank of Southern Africa
DFI	Development Finance Institution
EBRD	European Bank for Reconstruction and Development
ECA	Export Credit Agency
EDCF	Korea's Economic Development Cooperation Fund
EIB	European Investment Bank
EMDCs	Emerging Market and Developing Countries
ESG	Environmental, Social and Governance
ESRM	Environmental and Social Risk Management systems
EU	European Union
FDI	Foreign Direct Investment
FSB	Financial Stability Board
G20	Group of 20
G7	Group of Seven
GDP	Gross Domestic Product.
GDP Center	Global Development Policy Center at Boston University
GCF	Green Climate Fund
GEF	Global Environment Facility
GFSG	G20 Green Finance Study Group
GHG	Greenhouse gas

GIHub	Global Infrastructure Hub – (a G20 Initiative)
GRESB	Environmental, social and governance benchmark for real assets
IBRD	International Bank for Reconstruction (World Bank Group)
IDB	Inter-American Development Bank
IDFC	International Development Finance Club
IFC	International Finance Corporation (World Bank Group)
IFI	International Finance Institutions
IIB	International Investment Bank
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
IsDB	Islamic Development Bank
JBIC	Japan Bank for International Cooperation
KfW	KfW Development Bank (Germany)
LTIIA	Long Term Infrastructure Investors Association
MDB	Multilateral Development Bank
NCE	New Climate Economy
NDB	National Development Bank (also known as New Development Bank)
NDC	Nationally Determined Contribution
NGFS	Network for Greening the Financial System
OECD	Organisation for Economic Co-operation and Development
PPF	Project Preparation Facility
PPM	Parts per million
PPP	Public-Private Partnership
SDG	Sustainable Development Goal
SFD	Saudi Fund for Development
SFSG	G20 Sustainable Finance Study Group
TCFD	G20 Task Force on Climate-related Financial Disclosures
UAE	United Arab Emirates
UK	United Kingdom
UNCTAD	United Nations Conference on Trade and Development
UNFCCC	United Nations Framework Convention on Climate Change
US	United States of America
USD	United States Dollar
WB	World Bank
WCED	World Commission on Environment and Development (also known as the Brundtland Commission)
WTO	World trade Organization

ANNEX I: Methodology for quantification of G20 overseas investment and development finance into quality sustainable infrastructure

This section describes the methodology used to quantify the outflows of G20 FDI and trackable finance on sustainable infrastructure by MDBs and NDBs. It is important to observe that this paper does not intend to provide an exhaustive and meticulous quantification of such flows by every single institution, but rather to provide estimate figures to illustrate the authors' main recommendations, one of which is the need for increased data transparency and accessibility, as well as the development of operational and agreed upon methodologies to classify sustainable infrastructure finance and investments.

Data Sources and limitations. The data sources for this analysis are as follows. FDI calculations are derived from the FDI Intelligence Database, with data up to and including 2018. For the MDBs analyzed, data was downloaded from the respective institution websites in March-April 2019. For NDBs, data for AFD, BNDES, KfW and CDC was downloaded from the respective institution websites in March-April 2019. Data from CDB, CHEXIM and JBIC was adapted from previous research by BU GDP Center researchers (Jin 2018, Gallagher 2018). As discussed elsewhere in the paper, it's important to note limitations with data sources both in terms of transparency and accessibility. In the case of MDBs, data accessibility is particularly relevant for EIB, IsDB and EBRD, all with large portfolios with an aggregate total of over 25000 projects. As illustrated in Table 9, these institutions do not provide detailed sectorial information in their downloadable data and as such sustainable infrastructure finance could not be tracked.

Time Frame. All DFI finance flows and FDI flows have been calculated from the year 2008 to the most recently available date. The year 2008 was chosen because it was the year of the first G20 Summit, in Washington D.C., and it provided at least a decade of data for most institutions. Some of the graphs and calculations only depict data for the partial time period of 2011-2017.

Screening Criteria Sectors. The sectoral screening criteria for selecting which projects were counted as "sustainable infrastructure" are based on the principles set by the International Development Finance Club in its *Green Finance Mapping Reports* (IDFC 2018, 2015), and adapted to account for the Paris Agreement. Five large categories have been defined for this analysis, energy, water, transport, waste and natural infrastructure.

Energy includes investments on renewable energy, energy efficiency and other energy infrastructure explicitly linked to renewables, such as a dedicated transmission lines. Hydropower is counted as sustainable for this exercise, although the authors acknowledge that not all hydropower projects are necessarily sustainable from a climate, environmental or social perspective, as discussed earlier. While transition fossil fuels can play an important mitigation role in the short term, for this paper we have sought to assess infrastructure that aligns with the long term goals of the Paris Climate Agreement, specifically the goal of reaching zero net GHG emissions by 2050, as well as other intermediate targets being discussed such as net-zero electricity by 2040. In this context, investments in fossil fuels, including fuel switching to less GHG-intensive fuels such as natural gas have not been considered as sustainable.

Water includes all investments on sanitation, environmentally sustainable water management, adaptation of water supply systems to climate change and environmental disruption, environmentally sustainable irrigation, and resilience to climate change-induced hydrologic events, including coastal[29] and flood protection explicitly linked to climate change.

Transport includes urban mass transit, non-motorized transport, rail, waterways transport and other investments to reduce GHG. Aviation, maritime transport, roads and internal combustion engines[30] are not included.

Waste: Waste includes investments in infrastructure for the sustainable management of waste, recycling, and pollution control. Waste to energy is not included unless it is bioenergy.

29 For human settlements.

30 Other than biofuels and sustainable mass transit such as BRT or low-emission buses.

Natural infrastructure (Bhattacharya, Oppenheim, and Stern, 2015; The New Climate Economy, 2016) includes investments in afforestation and sustainable forest management, protected areas and biodiversity, erosion control, coastal protection of natural areas, mitigation in agriculture, and other generic climate mitigation not included above.

Screening Criteria for Infrastructure. While the IDFC (2018, 2015) provides a basis for eligible green finance, it does not provide a definition for infrastructure. For the purposes of this analysis, we have considered direct support to physical projects or projects with a physical component. Support for policies, capacity building, education, R&D, and financial instruments has not been counted. Support to dedicated manufacturing facilities (e.g. solar PV manufacturing plant) has been included. Support for rolling stock (rail, metro, BRT and clean bus fleets) has been included. In cases where it was unclear whether projects from sustainable sectors as described above were infrastructure, we have erred on the side of over counting rather than undercounting. In the case of natural infrastructure, institutional and generic support to protected areas, biodiversity and environmental systems has also been included. For FDI, all investments in maintenance, services, R&D, customer and technical support, education and training, design, and marketing have been excluded. FDI in electric automobiles and bicycles is not included because the database did not allow for discrimination with conventional automobiles and motorcycles.

Finance. For DFIs, only loans were considered. Grants and equity were excluded. Currency conversions were needed have been done as per the exchange rate on the date available for the project. When project date was not available for some projects (usually active projects) 2019 exchange rates have been used.

Countries. The countries considered to calculate DFI and FDI outflows are those of the G20, including all members of the EU, as follows: Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, China, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, India, Indonesia, Ireland, Italy, Japan, Republic of Korea, Latvia, Lithuania, Luxembourg, Malta, Mexico, Netherlands, Poland, Portugal, Romania, Russian Federation, Saudi Arabia, Slovakia, Slovenia, South Africa, Spain, Sweden, Turkey, United Kingdom, and United States. China's FDI estimate includes Hong Kong and Macau. FDI and DFI finance from a country listed above to another country listed above have not been included.

F20

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