

FINANCING LOW-CARBON INFRASTRUCTURE



About TheCityUK

TheCityUK is the industry-led body representing UK-based financial and related professional services. In the UK, across Europe and internationally, we promote policies that drive competitiveness, support job creation and ensure long-term economic growth. The industry contributes over 10% of the UK's total economic output and employs 2.3 million people, with two thirds of these jobs outside London. It is the largest tax payer, the biggest exporting industry and generates a trade surplus almost equivalent to all other net exporting industries combined.

About the Centre for Climate Finance & Investment at Imperial College Business School

The Centre for Climate Finance & Investment undertakes cutting-edge research on how capital markets are responding to global climate change. Building on Imperial College London's international reputation for multi-disciplinary analysis, the Centre is helping investors and policymakers overcome the lack of clarity about risk and return in clean energy, low-carbon technologies, and green infrastructure. Our mission is to help shape a global energy transformation through the fusion of business, technology and an entrepreneurial mindset.

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FOREWORD

Climate change has risen rapidly up the political and social agenda in many countries around the world. Achieving net zero carbon emissions will require, among other things, an unprecedented transformation of global infrastructure. The private sector—working through the financial markets—will have a key role to play in meeting this challenge. Delivering this change will require deploying private financial flows in pursuit of clean, resilient and sustainable economic growth.

Institutional investors are often cited by asset managers and policy makers as an alternative source of financing for low-carbon infrastructure. However, despite the potential and growing investor interest in this space, the amount of capital needed to meet the Paris Agreement targets has not yet been forthcoming. Meeting the Paris Agreement targets means aligning short-term infrastructure investment plans with long-term, climate-resilient development strategies. This will require a step-change in policy focus, new financing solutions and faster technological progress.

Governments are taking action. For example, the UK government's Green Finance Strategy, published in July 2019, is clear about the need to "align private sector financial flows with clean, environmentally sustainable and resilient growth, supported by Government action." For its part, the EU, through its Sustainable Finance Action Plan, intends to reform the financial sector in support of the transition to a more sustainable economy. The Chinese government has endorsed several 'Green Investment Principles' for the Belt and Road Initiative to incorporate low-carbon and sustainable development practices.

But access to timely, reliable and authoritative data on low-carbon infrastructure is of paramount importance to investors. Academic institutions and research centres working with private sector participants have a key role in collecting the necessary data to produce independent analysis. The emergence of a "low-carbon infrastructure asset class" through a standardised definition and creation of appropriate benchmarks will enhance overall transparency in the sector, facilitating investment at scale.

In this report, we add to these efforts by examining strategies to mobilise private capital and facilitate further financial sector development in support of the transition to more sustainable economic growth. Our research summarises some of the general challenges that investors take into account when considering low-carbon infrastructure investments, as well as the specific constraints that different investors face when making investment decisions. Finally, we conclude with suggestions for mitigating some of the difficulties currently associated with low-carbon infrastructure investment. We hope that by increasing the information available to investors and policymakers, this research can contribute to the further development of the green infrastructure sector.

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EXECUTIVE SUMMARY

TheCityUK and Imperial College Business School have undertaken joint research to analyse investment in green infrastructure - by which we mean infrastructure that will further the achievement of net zero carbon emissions targets. Our research focuses mainly on low-carbon infrastructure investment in developed economies (primarily the UK and the EU; the US, for example, is not covered because to date it has no national-level net zero carbon emissions policy or target). This report seeks to explain the wider economic and policy context and barriers to investment. The key points covered in this report are:

- The UN estimates that the world would need to increase its efforts between three- and five-fold in order to restrict climate change to a temperature rise of 1.5°C and avoid escalating the climate damage already taking place around the world. Debate as to whether practical pathways exist to meet the 1.5°C target is ongoing. Achieving net zero emissions will require an unprecedented transformation of infrastructure systems.
- Investment in low-carbon infrastructure occurs through both equity and debt channels. Private-sector investors are generally incentivised by a combination of financial return and increasing social and policy pressure (stemming, for example, from growing shareholder activism and the changing regulatory landscape). Investors range from institutional investors such as pension funds and insurance companies to corporates (traditionally utilities, but increasingly, oil and gas firms as well) to lenders such as commercial banks and national development banks.
- Despite the current supportive macroeconomic conditions for infrastructure investment—including low-carbon infrastructure investment—and the increase in such investment in recent years, financing of green infrastructure appears to be below potential in most major markets. This is partly because the incentive structure is currently insufficient to mobilise large sums of money, and partly because structural barriers to investment in low-carbon infrastructure remain significant.
- Barriers to low-carbon infrastructure investment include those that apply to infrastructure investment generally (such as regulatory risk, currency risk, and the challenges of ‘free-riding’), as well as those specific to green infrastructure. The latter include a relative lack of distinctiveness of projects and unpriced negative externalities.
- The range and persistence of these barriers means that current momentum towards green infrastructure investment is being driven by non-financial considerations as well as standard risk/return calculations. Such considerations include rising awareness of the green agenda, and consideration of potential future reputational and/or regulatory risks associated with traditional carbon-intensive infrastructure.
- To mobilise private finance for low-carbon infrastructure investment, policies need to be designed that match expected returns with acceptable levels of risk. This will include establishing robust, long-term policy frameworks to give certainty to investors, and improving access to finance for green investment through risk mitigation instruments and blended finance.
- Improving how the financial system works to support investment in low-carbon infrastructure will include:
 - increased disclosure of climate risks
 - increased standardisation of definitions of low-carbon infrastructure
 - support for initiatives to create infrastructure benchmarks that will in turn help to describe infrastructure as an asset class.

1. THE URGENCY OF ACHIEVING NET-ZERO EMISSIONS: THE INFRASTRUCTURE INVESTMENT IMPERATIVE

The UN estimates that the world will need to increase its efforts between three- and five-fold in order to restrict climate change to a maximum temperature rise of 1.5°C relative to pre-industrial times and avoid escalating the climate-related damage already taking place around the world. In the words of United Nations Secretary-General António Guterres, “the climate emergency is a race we are losing, but it is a race we can win.”¹

To win this race we need to reduce net carbon emissions to zero by mid-century, in an effort to keep average global warming well below 2°C, as per the 2015 Paris Agreement stipulating that a “balance” between anthropogenic sources and sinks of greenhouse gases must be reached by 2050-2100. Governments, businesses and civilians around the world need to rise to the challenge.

At the Climate Action Summit in September 2019, the European Union (along with 65 other countries) committed to net zero CO₂ emissions by 2050. The UK’s new target to reach net zero greenhouse gas emissions by 2050—a revision to its existing 80% target—means the UK is the first major economy in the world to put such a target into law, putting clean growth at the heart of its modern Industrial Strategy.

Achieving net zero emissions will require an unprecedented transformation of the global infrastructure system. Different economies will face different challenges, but the transformation of the global economy to be environmentally sustainable and resilient includes decarbonising industry and transport, building smart energy systems, and increasing access to affordable, clean energy.

Major infrastructure decisions need to be made in the near future and implemented quickly to avoid the ‘lock-in’ of fossil fuels infrastructure and carbon-intensive assets. Infrastructure projects also need to be resilient to extreme weather events and flooding themselves, which are becoming more commonplace as the effects of climate change make themselves felt more readily.

How much infrastructure will need to be developed will depend on the specific pathway to achieving net zero emissions. Decisions about the pathway, taking into consideration the role of innovation and societal change, have important implications for required investment and finance.

The UN’s estimates are understandably imprecise. But what is clear is that to meet the Paris Agreement target, the amount of finance deployed into low-carbon infrastructure must be expanded significantly. This is typified by the International Energy Agency’s estimate that an additional \$1.1 trillion will need to be invested annually in both supplying power and altering how end users consume power between now and 2040 to meet the IEA Sustainable Development Scenario.²

The private sector—working through the financial markets—will have a key role to play in providing the solution to this challenge. Delivering this systemic change requires the deployment of private financial flows in pursuit of clean, resilient and environmentally sustainable economic growth. While infrastructure development is ultimately funded by taxpayers or users, it may be financed by public authorities (national and/or subnational governments, development banks, or other public financial institutions) and/or the private sector (corporate or project finance) (OECD 2017).

The potential role of institutional investors is often cited among asset managers and policy makers as an alternative source of financing for low-carbon infrastructure. However, despite

1 UN Climate Action Summit, ‘Press Communique’, (23 September 2019), available at: <https://www.un.org/en/climatechange/press-materials.shtml>

2 International Energy Agency, ‘World Energy Outlook 2018’, (November 2018), available at: <https://www.iea.org/weo2018/>

investor interest in this space, the amount of capital needed to meet the Paris Agreement target has not yet been forthcoming. This is due in part to a lack of viable projects, and also a mismatch in the risk and returns offered to institutional investors (i.e., new projects in emerging markets). Ultimately, the size of the low-carbon infrastructure market will depend on current and future political decisions made about how to deliver low-carbon infrastructure services to the public. In order to encourage greater numbers of institutional investors into low-carbon infrastructure, a better understanding of the investors is needed.

In this report we examine strategies to mobilise private capital and reforms needed in the financial sector to support the transition to a more sustainable model for economic growth. The role of the private sector will depend on the type of investment needed to reach net-zero emissions. This report summarises some of the challenges that investors must take into account when considering low-carbon infrastructure investments, as well as the specific constraints that different investors face when making investment decisions. Finally, we conclude with suggestions for mitigating some of the difficulties currently associated with low-carbon infrastructure investment.

Green finance and green infrastructure: definitional challenges

The terms 'low-carbon infrastructure', 'green infrastructure', 'green finance' and 'climate finance' refer to overlapping policy areas, financial decision making and capital flows.

Green infrastructure or low-carbon, climate resilient (LCR) infrastructure, refers to projects that will either mitigate greenhouse gas emissions and/or support adaptation to climate change in the area of transport, energy or buildings (OECD, 2012).³ Typical low-carbon infrastructure includes mitigation projects such as clean energy generation, networks, green transport, buildings and energy efficiency projects, but also adaptation projects such as dams and flooding protections.

The terms climate finance and green finance broadly refer to resources that catalyse low-carbon and climate resilient development.

'Climate finance' as defined by the UN's Framework Convention on Climate Change (UNFCCC) is "local, national or transnational financing, which may be drawn from public, private and alternative sources of financing. Climate finance is critical to both reduce emissions and to allow countries to adapt to the adverse effects and reduce the impacts of climate change".⁴

'Green finance' is generally used to convey something broader than climate finance, in that it addresses other environmental objectives and risks. It tends to be understood with a greater focus on greening broad flows of private investment rather than mainly concerning public and public-leveraged financial flows. In research published in 2017, TheCityUK and Imperial College Business School put forward the following definition: "Green finance matches sources of funding to new capital and operating expenditures that generate measurable progress towards the achievement of a well-recognised environmental goal".⁵

'Green labels': beyond these high-level definitions, more detailed environmental and performance specifications for a particular 'green' label or source of finance have been developed in the context of the global financial system, national financial systems, financial institutions (e.g. 'green banking') and financial instruments (e.g. 'green bonds').

3 OECD, 'Towards a Green Investment Policy Framework: The Case of Low-Carbon, Climate Resilient Infrastructure', (18 June 2012), available at: http://www.oecd.org/env/cc/Towards%20a%20Green%20Investment%20Policy%20Framework_consultation%20draft%2018-06-2012.pdf

4 United Nations Climate Change, 'Introduction to climate finance', (October 2019), available at: <https://unfccc.int/topics/climate-finance/the-big-picture/introduction-to-climate-finance/introduction-to-climate-finance>

5 TheCityUK and Imperial College Business School, 'Growing green finance', (September 2017), available at: <https://www.thecityuk.com/assets/2017/Reports-PDF/21ef6f5fef/Growing-Green-Finance.pdf>

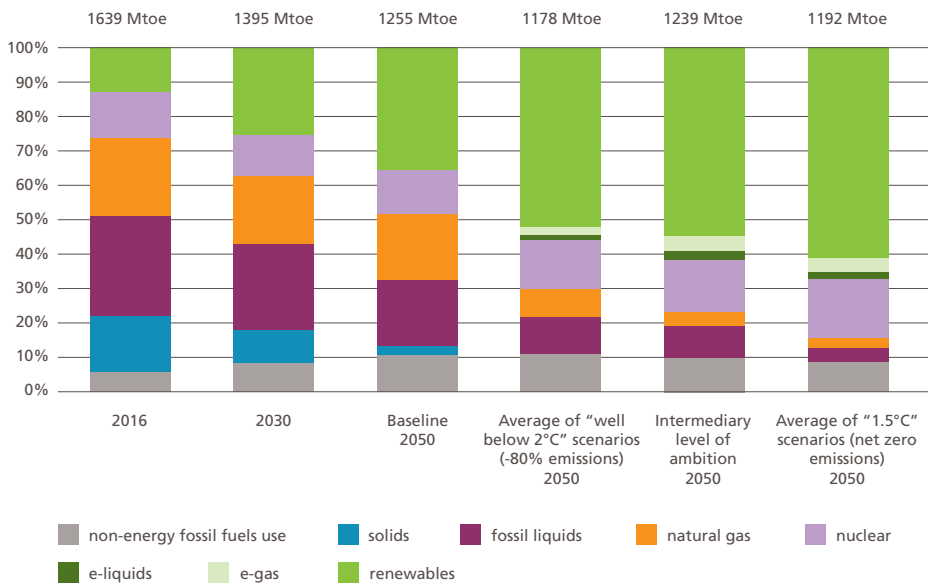
2. SCENARIOS FOR NET ZERO EMISSIONS

Debate as to which pathways society should take to meet the 1.5°C targets required to minimise the effects of climate change is ongoing.⁶ Given the complexities of predicting the exact mix of technologies and behaviours that will best meet the challenge of reaching net zero greenhouse gas emissions, the use of scenario analysis gives an improved understanding of what a sensible mix might look like.

Scenarios recently considered by the EU and the UK include: lower demand for energy across the economy driven by more resource efficiency and energy efficiency; clean mobility; circular economy (which refers to the use of closed systems encouraging reuse, recycling, refurbishment, etc); and tackling remaining emissions with carbon capture and storage. Extensive electrification is expected, particularly of transport and heating. In Europe, approximately 80% of electricity is to be supplied by renewable energy sources,⁷ while in the UK the doubling of electricity demand will be supported in full by low-carbon sources (compared to 50% of electricity demand met by low-carbon sources today).⁸ Hydrogen may also have a role to play in this transition.

Figure 1: Gross Inland Consumption

Source: European Commission



In Europe, in order to reach these goals, investment in energy systems and infrastructure will require the equivalent of 2%-2.8% of GDP (€520–575m per year), equivalent to additional investments of €175–€290 billion a year. In the UK, the extra investment required is equivalent to around 1% of GDP in 2050.⁹

6 UN Intergovernmental Panel on Climate Change, 'Special Report: Global warming of 1.5°C', (October 2018), available at: <https://www.ipcc.ch/sr15/>

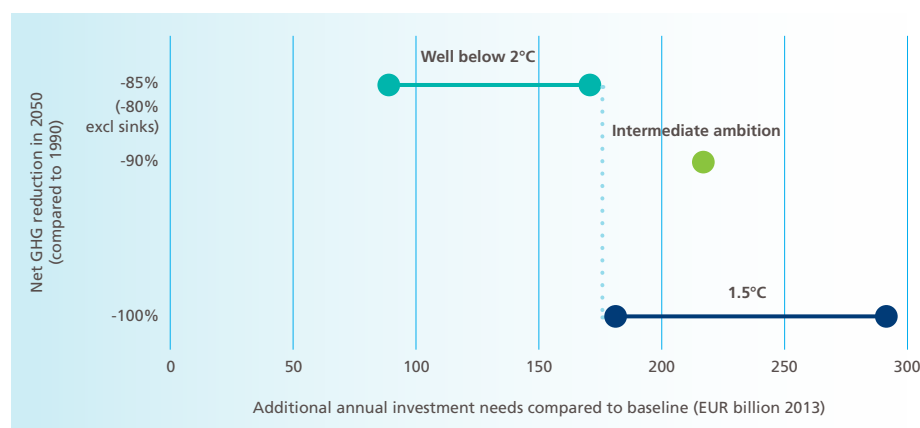
7 European Commission, 'A Clean Planet for all A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy', (November 2018), available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52018BDC0773>

8 Committee on Climate Change, 'Net Zero - The UK's contribution to stopping global warming', (May 2019), available at: <https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/>

9 European Commission, 'A Clean Planet for all A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy', (November 2018), available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52018BDC0773>

Figure 2: Annual Investment

Source: European Commission



To meet these investment needs, the European Commission has proposed having 25% of the next EU budget (2021-2027) contributing to climate objectives, and has established a dedicated channel for financial support for sustainable infrastructure investments through the 'InvestEU' programme.

Meanwhile, a recent study has shown that the share of global carbon emissions of the countries involved in the infrastructure-focused Chinese Belt and Road Initiative (BRI)—excluding China—could increase from 28% in 2015 to 66% by 2050 if those countries were to follow conventional growth models.¹⁰ This demonstrates the urgent need for targeted investment to ensure that the Initiative does not inadvertently undermine global efforts to mitigate climate change.

Scenarios for UK net zero greenhouse gases in 2050

In June 2019 the UK became the first major economy in the world to pass laws to end its contribution to global warming by 2050. The target will require the UK to bring all greenhouse gas emissions to net zero by 2050, compared with the previous target of at least 80% reduction from 1990 levels. The Committee on Climate Change (CCC) has recently described how the UK can reach net zero greenhouse gas emissions by 2050.¹¹

The scenarios considered by the CCC include lower demand for energy across the economy driven by more resource and energy efficiency; societal choices (i.e. changes in diet) with different land and agricultural use; development of a hydrogen economy; and carbon capture and storage. A major expansion of renewable and other low carbon power generation will support extensive electrification, particularly of transport and heating.¹²

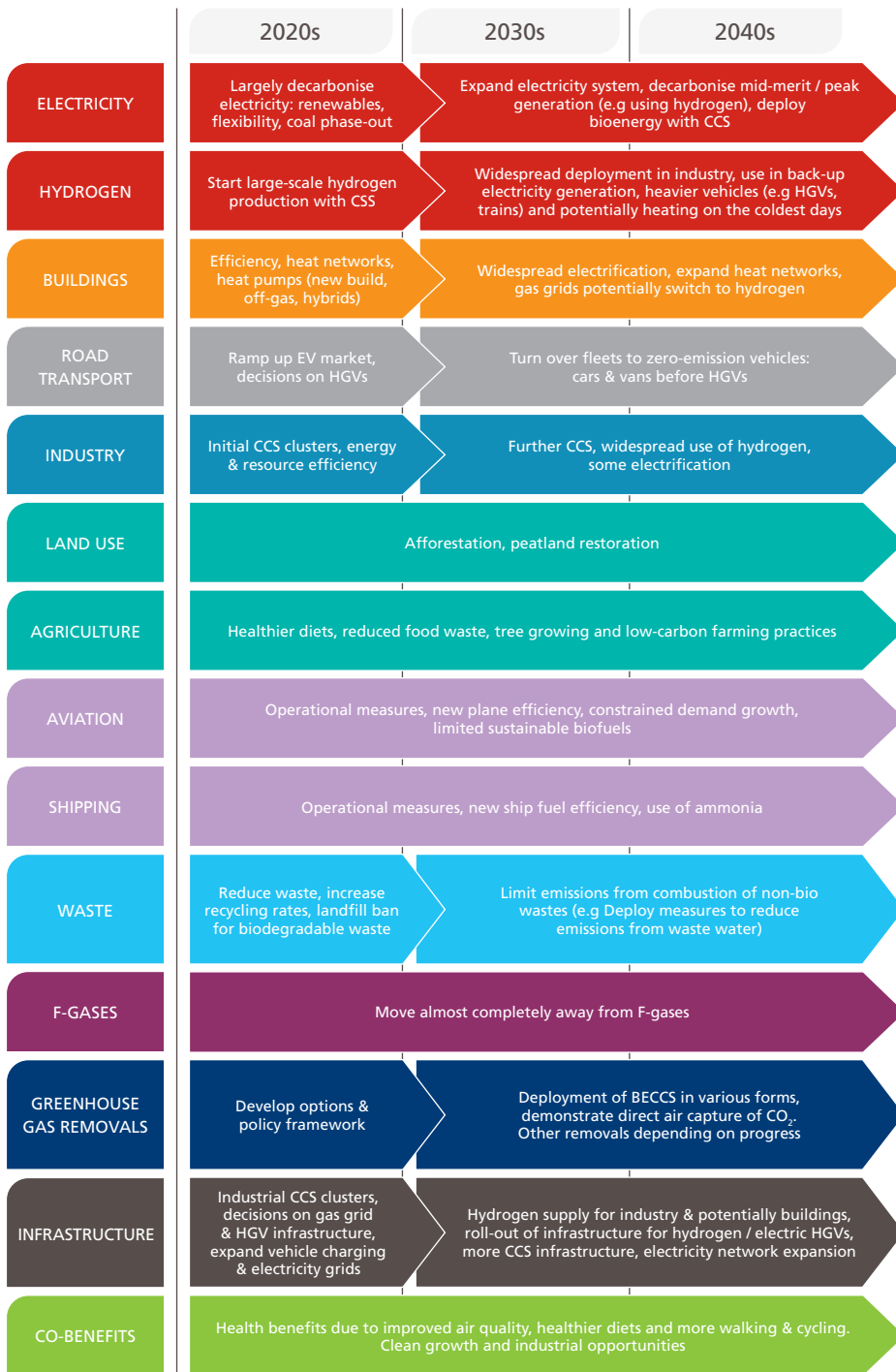
¹⁰ Tsinghua University Center for Finance and Development, Vivid Economics and the Climateworks Foundation, 'Decarbonizing the Belt and Road: A Green Finance Roadmap', (September 2019); available at: <https://www.vivideconomics.com/wp-content/uploads/2019/09/Decarbonizing-the-Belt-and-Road—Final-Report-English.pdf>

¹¹ Committee on Climate Change, 'Net Zero - The UK's contribution to stopping global warming', (May 2019), available at: <https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/>

¹² That could for example require 75 GW of offshore wind in 2050, compared to 8 GW today and 30 GW targeted by the Government's sector deal by 2030.

Figure 3: UK Net-Zero Greenhouse Gas Scenario

Source: Committee on Climate Change analysis



Notes: CCS = carbon capture and storage. EV = electric vehicle. BECCS = bioenergy with CCS.

Infrastructure investment increases in the scenarios analysed are highest for the power and buildings sectors. Power sector annual investment rises to around £20 billion. Investment in buildings is around £15-20 billion higher in 2050 than it would have been without decarbonisation (the precise figure will depend on the mix of technologies deployed). By comparison, investment in the power sector averaged around £10 billion over 2013-2017.

European Union and Net Zero Emissions

The European Union committed to net zero CO₂ emissions by 2050 at the September 2019 Climate Action Summit in New York, along with 65 other countries. Recognising that previous efforts of reducing emissions of around 60% by 2050 were insufficient, the European Commission had in November 2018 presented its strategy, with the main goal of becoming a climate-neutral economy by 2050.¹³ To achieve this, the EU has established a strategy based on seven blocks, inclusive of several new interim (2030) targets:¹⁴

- energy efficiency (new binding energy efficiency target of 32.5% by 2030)
- deployment of renewables (new renewables target of 32% of the EU's total primary energy supply by 2030) of the EU's total primary energy supply
- clean, safe and connected mobility
- competitive industry and circular economy
- infrastructure and interconnections
- bioeconomy and natural carbon sinks
- tackling remaining emissions with carbon capture and storage.

Greening the Belt and Road Initiative

The Belt and Road Initiative (BRI) was introduced by China in 2013 and revolves around the concept of re-establishing the ancient Silk Road trade routes, accompanied by a 21st century 'Maritime Silk Road'. The project involves more than 100 countries and focuses on infrastructure projects—many in low-income, developing countries. The recent attention on, and debate about, climate change has also prompted some critical evaluation of the BRI with regard to the impact the planned projects may have on future carbon emissions.

Research published in September 2019 calculated several possible carbon scenarios for the BRI and the countries involved in it. The results show that the share of global carbon emissions of the BRI countries could increase from 28% in 2015 to 66% by 2050. This implies that even if the rest of the world reduced carbon emission generation in line with a 2-degree scenario, the growth in carbon emissions from BRI projects would offset this and result in global warming of approximately 3 degrees. Even under a "Best In Class" scenario, representing the most carbon-efficient growth pathways, carbon emissions would still exceed the aggregate 2-degree scenario by a margin of 17% by 2050.¹⁵

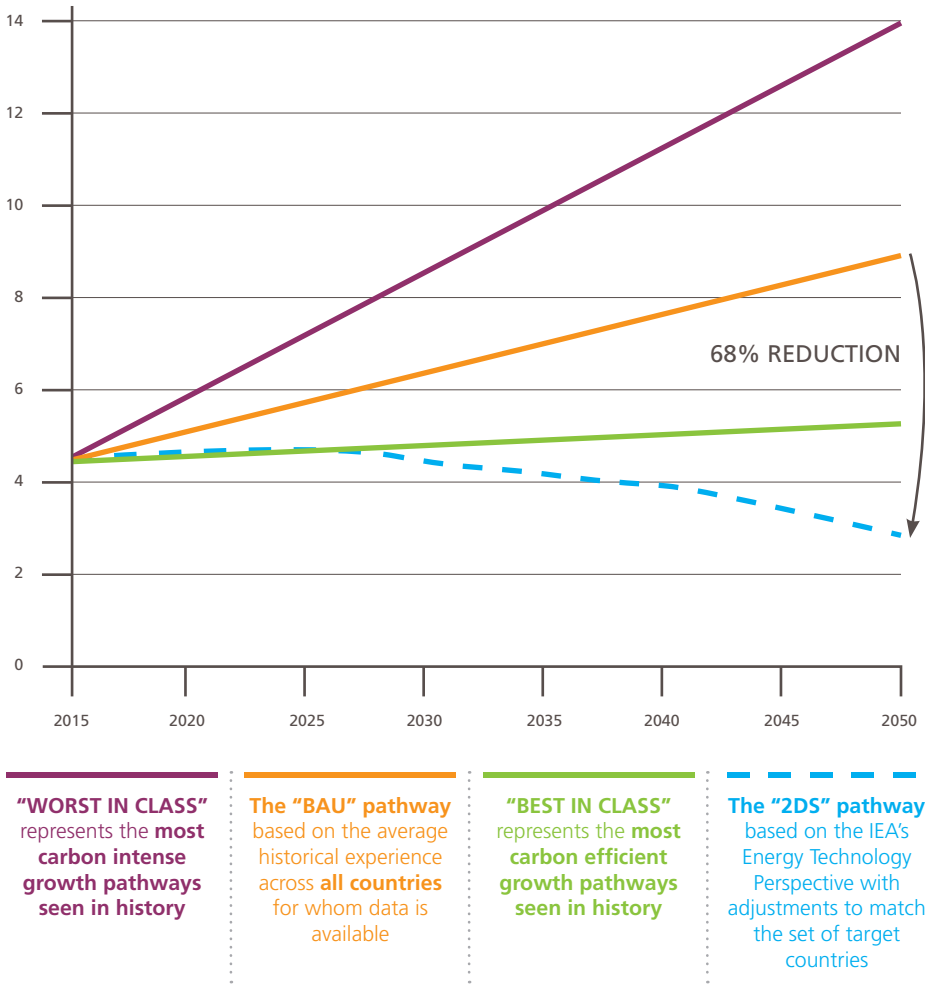
13 European Commission, 'A Clean Planet for all A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy', (November 2018), available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52018DC0773>

14 European Commission, 'Going CLIMATE-NEUTRAL by 2050 – a strategic long-term vision for a prosperous, modern, competitive and climate-neutral EU economy', (July 2019), available at: <https://publications.europa.eu/en/publication-detail/-/publication/92f6d5bc-76bc-11e9-9f05-01aa75ed71a1>

15 Tsinghua University Center for Finance and Development, Vivid Economics and the Climateworks Foundation, 'Decarbonizing the Belt and Road: A green finance roadmap', (September 2019), available at: <https://www.vivideconomics.com/wp-content/uploads/2019/09/Decarbonizing-the-Belt-and-Road-%E2%80%93-Final-Report-English.pdf>

Figure 4: Compared to Business as Usual, a 2 Degree Scenario requires 68% lower carbon emissions in Belt and Road Countries by 2050

Source: Tsinghua University Center for Finance and Development, Vivid Economics and the Climateworks Foundation.



More worryingly, the report finds that “estimates for existing planned investments in all [Belt and Road countries] from the CGIT database imply that a total 38GW of additional coal generation capacity is already earmarked to be delivered by 2030”.¹⁶ If these investment plans for coal (and oil) are executed, there is significant risk of a “lock-in” of future emissions, which could prove very difficult to turn around.

Overall, it is estimated that to stay in line with a global 2-degree pathway, close to \$1.1 trillion of investment in green energy would be required for the 17 core countries of the BRI alone. If this analysis is expanded to all BRI countries involved, the total investment required increases to \$11.8 trillion out to 2030.

¹⁶ Ibid.

The table below summarises the main green investment needs identified by the research:

Table 1: The power and transport sectors require most future green investments in the B&RCs

Source: Tsinghua University Center for Finance and Development, Vivid Economics and the Climateworks Foundation.

Green Investment Needs to 2030 (\$Trillion)	B&RCs 126	India	China	Total - Countries
Power	5.2	1.5	4.3	11.5
Transport	3.2	2.2	2.6	7.9
Buildings	2.9	1.0	1.7	5.6
Industry	0.53	0.11	0.53	1.2
Total - Sector	11.8	4.8	9.1	25.6

Nonetheless, the BRI has the potential to turn this negative outlook around by supporting and prioritising investment in low-carbon infrastructure. However, the urgency of such a turnaround should not be neglected, as the nature of these projects require long design and lead times, and the decisions to be taken have a long and often irreversible lifetime. Recommendations put forward by the UK-based Green Finance Initiative, in research produced in collaboration with partners in China, are designed to help ensure that new infrastructure development in the BRI is green from conception:

- a Belt and Road Initiative (BRI) Investor Alliance including a majority of Multilateral Development Banks (MDBs) should agree to a set of harmonised standards for efficient green BRI funding across BRI countries
- the BRI Investor Alliance should scope the requirements for a monitoring body to help add transparency to the green BRI asset class
- sinosure policy should be revised to relax the 70% lower limit on Chinese bank participation in BRI infrastructure finance, to allow further expansion of the diversity of risk guarantees available and appropriate
- a new political risk insurance vehicle needs to be developed that can work with both Chinese and foreign banks to help mobilise sufficient capital
- a definition of a green BRI finance instrument needs to be created to build a transparent market for primary and secondary issuance against a defined criteria driven by investor demand.¹⁷

17 Green Finance Initiative, City of London, Green Finance Committee, Renmin University of China, 'Greening the Belt and Road', (October 2017), p.15, available at: <http://greenfinanceinitiative.org/wp-content/uploads/2017/10/Greening-the-Belt-and-Road-English.pdf>

3. UNDERSTANDING THE INVESTORS - THE SHIFTING GLOBAL LANDSCAPE OF PRIVATE FINANCE FOR LOW-CARBON INFRASTRUCTURE

Current macroeconomic conditions are supportive of infrastructure investment. Loose monetary policy across developed countries means that the cost of borrowing remains low. In addition, relatively weak economic growth means that governments have an incentive to support economic activity through fiscal policy. Increases in government spending are likely to boost infrastructure investment in the next a few years.

These conditions, combined with sector-specific factors, have enabled a steady increase in investor interest in low-carbon infrastructure and clean energy over the past decade. Traditional investors that are new to this space, such as pension funds, sovereign wealth funds and insurance companies, have begun to make allocations to this relatively new alternative asset class.

In addition, corporates and institutional investors have started to decarbonise their own business models and portfolios. For example, through the UN Global Compact, companies with a combined market capitalisation of more than \$2.3 trillion and annual direct emissions equivalent to 73 coal-fired power plants pledged to take action. From the investing side, the Asset Owner Alliance, a group of the world's largest pension funds and insurers, collectively responsible for directing more than \$2 trillion in investments, is committed to transitioning to carbon neutral investment portfolios by 2050.

Private-sector investment in low-carbon infrastructure is motivated by three main factors, independently or in combination:

- **Risk and return:** private-sector investors seek the highest return given a certain amount of risk. However, there is as yet limited evidence to show that the returns for low-carbon infrastructure investment are higher than the returns on conventional infrastructure given the same amount of risk, or indeed that (real or perceived) higher-risk investment in low-carbon infrastructure would be compensated for with higher returns, relative to investment in conventional infrastructure.
- **Government mandates:** explicit government intervention in capital markets to require investment in low-carbon infrastructure is rare, particularly in developed countries. However, government policies that are increasingly emphasising sustainable economic growth and, by extension, the need for low-carbon infrastructure, may indirectly incentivise some investors to reorient their asset allocations.
- **Social pressure and asset owners' instruction:** some asset owners may feel increasing social pressure either to deploy their capital in environmentally friendly projects, including low-carbon infrastructure, or to avoid allocating capital to environmentally unfriendly sectors (e.g., coal).

To continue to scale up private investment in infrastructure, it is vital to reach a fuller appreciation of the changing sources of finance, and the differences between traditional actors such as utilities and commercial banks and non-traditional ones such as institutional investors and capital markets.

The major types of low-carbon infrastructure investor can be categorised as follows:

Equity investors

Corporates. As climate change has moved rapidly up the political and societal agenda in Europe (and some countries in other regions), the number of corporates looking to invest in low-carbon infrastructure appears to have increased. Traditionally utilities have been the main corporates investing in infrastructure, but in recent years different types of corporates have become increasingly active in the low-carbon infrastructure space. This is typified by the major oil and gas companies, which have started to invest in low-carbon infrastructure - albeit from a very low base. According to research from the CDP (formerly the Carbon Disclosure Project), oil and gas companies have made 148 deals in alternative energy and Carbon Capture, Utilisation and Storage (CCUS) since 2016. They invested \$22bn in alternative energy over 2010-18, although the alternative energy spend in 2018 represented only 1.3% of total capital expenditure in that year.¹⁸ Among recent developments, Shell, for example, plans to invest \$300m in natural ecosystem-based projects in Spain and the Netherlands over 2019-21 for the purpose of reducing emissions. Equinor, the largest energy operator in Norway, is also focusing more on renewables – for example, by developing its offshore wind projects abroad. In July 2019, Equinor won the bid to build the Empire Wind, an offshore wind project in the US.

These corporate investors' primary focus is to invest in companies that are in line with the companies' long term strategic goals and as such have few specific constraints if the business is viewed as a strategic priority.

In recent years, various **institutional investors** have stated an interest in increasing their exposure to low-carbon infrastructure.

Sovereign wealth funds (SWFs) appear increasingly interested in low-carbon infrastructure. According to analysis by PwC, SWFs' investment into green assets increased to \$11bn over the period 2015-2017. The top three investors were China's State Administration of Foreign Exchange (with investment of \$3bn), Abu Dhabi Investment Authority (\$1.4bn) and Mubadala Investment Company (\$1.3bn).¹⁹

An **infrastructure fund** is a specialist fund that provides opportunities for investors to pool their capital together to invest in infrastructure assets such as roads, rails, ports, airports and utilities. The largest fund managers tend to be located in North America and the Asia-Pacific region (see Table 2 for details). The target size of infrastructure funds (that is, the amount of capital the funds seek) is around \$185bn globally.²⁰ Larger funds have been actively seeking opportunities to invest in low carbon infrastructure. For example, in 2017 Global Infrastructure Partners, along with other infrastructure funds such as the Public Sector Pension Investment Board (one of the largest pension funds in Canada) and CIC Capital Corporation, bought Equis Energy, one of the largest renewable energy companies in Asia. In July 2019, Stonepeak Infrastructure Partners bought 95% of Swancor Renewable Energy, an offshore wind company in Taiwan, from Swancor. Brookfield Asset Management has a 61% stake in Brookfield Renewable Partners, one of the largest renewable companies globally. Brookfield Renewable Partners has total asset under management of more than

18 CDP, 'Beyond the cycle: Which oil and gas companies are ready for the low-carbon transition', (November 2018), p.3, available at: https://6fefcbb86e61af1b2fc4-c70d8ead6ced550b4d987d7c03fcdd1d.ssl.cf3.rackcdn.com/cms/reports/documents/000/003/858/original/CDP_Oil_and_Gas_Executive_Summary_2018.pdf?1541783367

19 Prequin, 'Special report: Sovereign wealth funds', (August 2018), available at: <https://www.pwc.co.uk/industries/assets/prequin-special-report-august-2018.pdf>

20 Infrastructure Investor, 'Infrastructure funds in market', (October 2019), available at: <https://www.infrastructureinvestor.com/funds-in-market/>

\$40bn. Some smaller players have also been active in this area. A typical recent example is Quinbrook Infrastructure Partners. This UK-based asset manager closed its Low Carbon Power Fund with \$1.6bn assets under management in March 2019.

Table 2: Top 10 infrastructure funds as of 1st October 2019

Source: Infrastructure Investor

Fund Name	Fund Manager	Target Size (\$bn)	Region focus
Global Infrastructure Partners IV	Global Infrastructure Partners	17.5	North America
Brookfield Infrastructure Fund IV	Brookfield Asset Management	17.0	North America
Stonepeak Infrastructure Fund IV	Stonepeak Infrastructure Partners	10.0	North America
Energy Capital Partners Fund IV	Energy Capital Partners	6.0	North America
Antin Infrastructure Partners IV	Antin Infrastructure Partners	5.5	Europe
European Diversified Infrastructure Fund III (EDIF)	First Sentier Investors	3.8	Asia-Pacific
AMP Capital Infrastructure Debt Fund IV	AMP Capital	3.5	Asia-Pacific
Global Energy and Power Infrastructure Fund III	BlackRock	3.5	North America
AMP Capital Global Infrastructure Platform II	AMP Capital	3.0	Asia-Pacific
Westbourne Infrastructure Debt Opportunities Fund II	Westbourne Capital	3.0	Asia-Pacific

Exchange-traded funds provide a vehicle for institutional and retail investors to access green investments and thus provide a platform for indirect investment in green infrastructure projects. Investors can invest in sustainable equities and bonds. Examples of sustainable equities are:

- iShares MSCI World SRI UCITS ETF
- iShares Global Clean Energy UCITS ETF
- iShares MSCI EM IMI ESG Screened UCITS ETF.

Insurance companies also allocate their funds to low-carbon infrastructure through equity and direct investment. For example, the Phoenix Group, a UK insurance provider, invested £27m in the Walney Extension Project, an offshore wind project in March 2018. In September 2018, this group further allocated £50m in Anglian Water's green projects.

Pension funds can provide capital for equity investment in low-carbon infrastructure. For example, a UK local government pension scheme, the Avon Pension Fund, has committed to investing 2.5% of its assets (£115m) to renewable infrastructure funds.

Debt Investors

Institutional investors

A wide variety of **commercial banks** have expressed interest in increasing their asset allocation into renewables. However, commercial banks, like most other organisations, have specific constraints. One of the main constraints faced by banks in recent years is the increased cost of lending for long durations—a requirement for financing long-term infrastructure projects. Basel III, a set of measures that aim to improve regulations in the banking sector globally, addressed many of the solvency issues that were in the market, but simultaneously increased the cost of lending. For example, Basel III increased the amount of capital that banks must hold, but this increased the cost of lending, particularly lending to riskier assets. Recent Bank for International Settlements research finds a consensus around the idea that higher capital ratios levied on banks increase bank lending rates. More specifically, these studies estimate a one percentage point increase in the capital ratio raises bank lending rates by 0-0.25%.²¹

Most investment in green infrastructure by **pension funds** is made via debt rather than equity. As pension funds are interested in low-risk investments with steady cash flow, infrastructure (including green infrastructure) debt is of interest as an asset class. For example, Stichting Pensioenfond, the Netherlands' largest pension fund, increased its green bond investment by \$2.4bn, totalling \$6.1bn in 2018. The bond is to finance green projects, including low-carbon infrastructure.

Insurance companies also allocate their funds to low-carbon infrastructure through green bond investment. Research by BlackRock cites Credit Agricole as noting 'Insurers were among the first investors in green bonds and are major holders of them'.²² Insurers' high exposure to climate risk (relative to other parts of the financial sector) mean that they may have a greater interest in financing projects that would mitigate this risk.

Governments and development banks

To encourage the development of low-carbon infrastructure, governments have used various vehicles to promote investment into low-carbon infrastructure.

State and international development banks have been among the most common vehicles used to encourage investment in infrastructure generally, and low-carbon infrastructure specifically. These organisations provide various functions beyond the remit of traditional banks to increase investment in low-carbon infrastructure. These include de-risking projects; being an early mover and taking on some of the risk inherent in developing a new or novel technology; and being able to send positive market signals based on the knowledge gained as an early mover.

21 'Bank for International Settlements, 'The costs and benefits of bank capital - a review of the literature, Working paper 37', (June 2019), available at: <https://www.bis.org/bcbs/publ/wp37.pdf>

22 BlackRock, 'Insurers and green bonds: an attractive entry point into sustainable investing', (31 May 2018), available at: <https://www.blackrock.com/institutions/en-gb/literature/whitepaper/insurers-and-green-bonds.pdf>

For example, Brazil's Banco Nacional de Desenvolvimento Econômico e Social (BNDES), one of the world's largest development banks, disbursed a total of \$22bn in 2017, of which 22.5% went to green projects. Another example is the Development Bank of Southern Africa, which allocates around half of its assets to green projects. Multilateral development banks, such as the World Bank, Asian Development Bank and the Asian Infrastructure Investment Bank, also provide capital for green infrastructure. These institutions lend money to governments and public-private investment entities to finance green infrastructure in Asia and other regions.

Green bonds

A green bond is a fixed-income financial security sold with a promise to devote the funds raised to environmentally beneficial projects.²³ As such, although not all green bond proceeds are used to finance green infrastructure projects, these bonds do represent an important source of financing for green infrastructure. Green bonds were initially designed by large supranational organisations, such as the World Bank and the European Investment Bank (EIB). The EIB issued the first Climate Awareness Bonds in 2007.²⁴ In recent years, issuance by sovereign and corporates has been on the increase. Recent examples include the government of Chile, which in June 2019 raised \$523m from a green bond issue which it will invest into renewable energy projects, and Vattenfall, a Swedish energy company, which launched a green bond worth £438m in the same month to fund the greening of its energy system, including investment in renewable energy and electrification of transport and heat.

Green bond issuance totalled \$167.3bn globally in 2018, up 3% from 2017.²⁵

The World Bank provides a list of selected green bonds investors. This shows that insurers, asset managers and pension funds are among the most prominent investors in green bonds (for the full list, see the Appendix).

The above taxonomy demonstrates that the universe of institutions with an interest in financing infrastructure, including green infrastructure, is extensive and varied. Despite this, and despite the current supportive macroeconomic conditions, investment in low-carbon infrastructure appears to be below potential in most major markets (comprehensive aggregate data do not yet exist).

The current below-potential flows of capital into low-carbon infrastructure can be attributed partly to the fact that the incentive structure is currently insufficient to mobilise large sums of money. As such, a sizeable proportion of green infrastructure investment currently occurs with the support of an explicit external subsidy—i.e., from governments or multilateral lenders—which help make the project financially viable; or, with an internal cross subsidy—e.g., a bank offering a green infrastructure project loan at a rate of interest insufficient to make the project viable—as an incentive to the developer to engage in low-carbon development.

It is also partly attributable to the fact that structural barriers to investment in low-carbon infrastructure remain significant. These barriers are the focus on the next section of this report.

23 TheCityUK and Imperial College Business School, 'Understanding green bonds', (May 2018), available at: <https://www.thecityuk.com/assets/2018/Reports-PDF/bf2095d362/Understanding-Green-Bonds.pdf>

24 Ibid.

25 Climate Bonds Initiative, '2018 Green bond market summary', (January 2019), available at: <https://www.climatebonds.net/files/files/2018%20green%20bond%20market%20highlights.pdf>

4. BARRIERS TO INVESTMENT

Infrastructure, and particularly low-carbon infrastructure, faces several barriers to investment. To understand these barriers it is necessary to look in turn at the constraints around investing in infrastructure generally, and investing in low-carbon technologies.

Overall infrastructure investment challenges

When constructed by the private sector, infrastructure development is often structured as a Public Private Partnership (PPP). This partnership often leaves investors heavily reliant on the host government(s), which presents particular risks. These risks can take many different forms but typically relate to the risk that regulations and/or laws relating to infrastructure are changed (McKinsey, 2016), which can prove to be a major deterrent when considering investments in infrastructure. In conjunction with this, governments frequently face short-term political pressure, forcing them to prioritise short-term fiscal targets at the expense of the long term investment commitments that are required to finance new infrastructure (Ilmi Granoff, 2016).

Another regulatory risk stems from international rather than national regulation. Financial regulation such as Basel III and Solvency II have made investing in long-term projects more expensive. The long-term nature of infrastructure and its particularly large capital-expenditure requirements make these projects less appealing once Basel III and Solvency II are accounted for (McKinsey, 2016).

Other infrastructure-investment risks are more directly financial. Currency risk is present if the revenues for infrastructure projects are received in the local currency, while the project is often financed in another currency. To mitigate this risk, currency hedges can be used but this increases the cost of the project, which in turn reduces the number of credit-worthy investments. This is a particular problem in non-OECD countries, as currency hedges for long durations can be prohibitively expensive. In addition, infrastructure investments typically have lower liquidity levels than more traditional assets such as publically traded bonds or equities.

A final challenge is the notion of free riding. When new infrastructure is built, the benefits of this infrastructure are often not split equally between all the stakeholders, although the costs are shared more equally, via the tax base.

Low-carbon infrastructure investment challenges

In addition to these general challenges, low-carbon infrastructure investment brings with it a set of additional constraints. The lack of a clear benchmark for measuring investment performance is seen by many as one of the main disincentives to investors increasing their exposure to low-carbon infrastructure. This fragmentation of results can manifest itself in various different ways, some of which include:

- **Varying definitions of low-carbon infrastructure.** There is no agreed, standardised definition of low-carbon infrastructure, which makes a comparison of infrastructure from different sources problematic. This lack of clarity becomes even more acute when considering that low-carbon infrastructure requires assumptions around the amount of carbon each asset will produce (for a fuller discussion of definitions and taxonomy, see page 27).

- **Distinctiveness of projects.** Low-carbon infrastructure projects are often large projects that require a significant commitment of resources. This results in a limited number of projects of a similar type. In addition, the projects are also heavily dependent on factors that are specific to the location of the project, such as the local regulatory frameworks, contract structures, and population density. Making comparisons between different low-carbon infrastructure projects is therefore particularly complex and time consuming.
- **Validity of commercially available information.** Commercially available data sources provide project-level information on low-carbon infrastructure. However, these data sources are not currently validated and as such may contain inconsistencies.
- **Lack of available data.** With a large proportion of infrastructure assets being unlisted and held by various different entities, data collection is currently ad hoc rather than systematic. Some publications provide data around various transactions, but many of the transactions are not disclosed due to non-disclosure agreements.

Additional challenges around low-carbon infrastructure investment include:

- **Unpriced negative externalities.** The negative externalities of carbon-intensive assets are not fully priced. Without costing these externalities, an implicit subsidy is provided for more carbon-intensive infrastructure, making low-carbon infrastructure relatively more expensive.
- **Use of novel technology.** Low-carbon infrastructure often uses newer technology than the conventional infrastructure it is supplementing or replacing. The use of new and untested technologies presents—or at least presents the appearance of—additional risk that increases the cost of borrowing for the project.
- **Lock-in of existing infrastructure.** The long life cycle of most infrastructure projects means that once the infrastructure is in place, replacing it with an alternative can be prohibitively expensive. Meanwhile, as a technology or infrastructure type becomes established, institutions, vested interests and political interests can develop around the technology. These interests can cause a soft lock in, making the replacement of this technology more difficult (Echeverri, 2018).

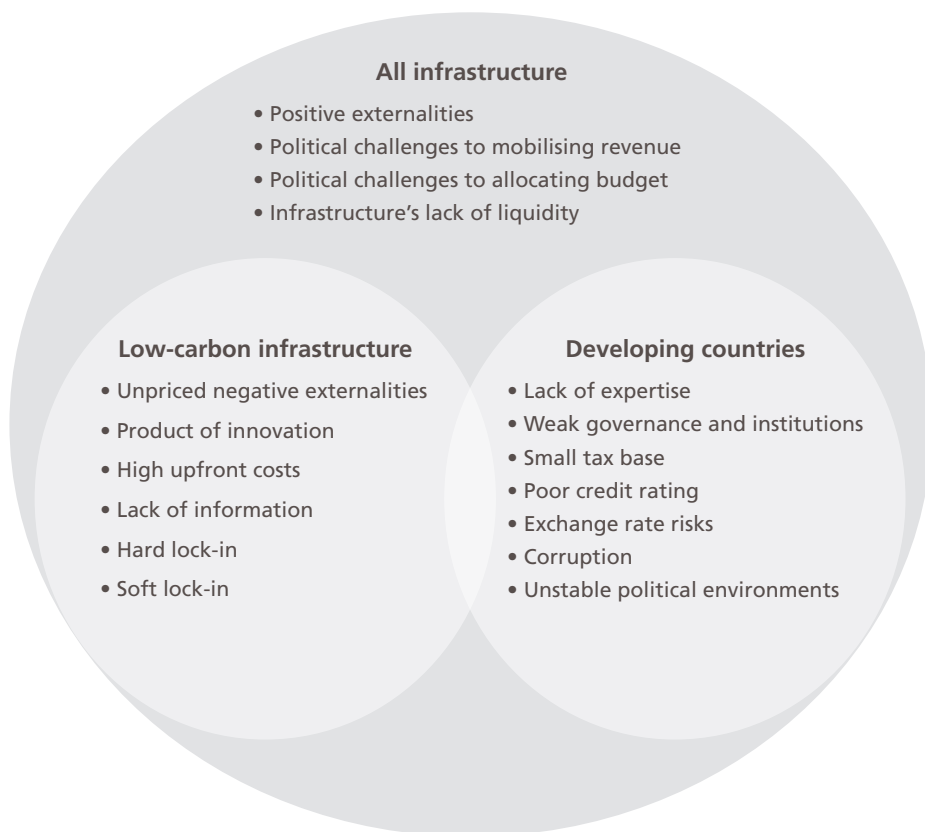
Additional barriers in emerging markets and developing economies

This report focuses mainly on low-carbon infrastructure investment in developed economies (primarily the UK and the EU; the US, for example, is not covered in this research because to date it has no national-level net zero carbon emissions policy or target). It is worth noting, however, that in addition to the above, there are additional barriers to green infrastructure investment in developing economies. These either present a larger impediment to investment or are unique to investment in developing and emerging markets; they include a relatively small tax base; limited expertise; corruption; unstable political environments; and relatively high sovereign risk.

The universe of challenges is summarised in the figure below:

Figure 5: Nested barriers to low-carbon infrastructure investment

Source: Imli Granoff, Hogarth and Miller.



5. MOBILISING PRIVATE INVESTMENT FOR ZERO-EMISSION, CLIMATE-RESILIENT INFRASTRUCTURE

Meeting the Paris Agreement target means aligning specific infrastructure investment plans with broader long-term, low emission, climate-resilient development strategies. This will require a step-change in policy focus, new financing solutions at consumer and bulk power levels, and faster technological progress, including more research and development, amid sustained spending on electricity grids. All of this requires timely, reliable and authoritative data and analysis.

Public sector funding is particularly crucial in accelerating climate action in difficult to reach areas like adaptation and resilience. Nevertheless, given the fiscal constraints faced by most governments, public sector funding alone will be insufficient to meet the investment needed for the global transition to environmentally sustainable growth, making significant private-sector involvement imperative.

For example, the UK government's Green Finance Strategy, published in July 2019, is clear about the need to "align private sector financial flows with clean, environmentally sustainable and resilient growth, supported by Government action."²⁶ Public interventions must therefore focus on mobilising private finance and removing market barriers to such investment. The volume of additional investment required for the transition means that the private sector will need to contribute a significant proportion through a global financial system that supports and enables these outcomes.

For its part, the EU, through its Sustainable Finance Action Plan, intends to reform the financial sector in support of the transition to a more sustainable economy. To this end, the European Commission unveiled in March 2018 a ten-point Action Plan for financing sustainable growth with the aim of mobilising private capital to fund sustainable projects and activities, by changing incentives and culture at all points along the investment chain. Work has already started on these long-term priorities. The Commission put forward a proposal to require the European Supervisory Authorities to take ESG (Environmental, Social and Governance) risks into account and three legislative proposals included in the Action Plan were adopted:

- establishing a unified EU classification system of sustainable economic activities ("taxonomy")
- improving disclosure requirements on how institutional investors integrate environmental, social and governance (ESG) factors into their investment process and—if they claim to be sustainable—how they achieve these objectives
- creating a new category of benchmarks which will help investors compare the carbon footprint of their investments.

²⁶ HM Government, 'Green Finance Strategy: Transforming Finance for a Greener Future', (July 2019), p.7, available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/820284/190716_BEIS_Green_Finance_Strategy_Accessible_Final.pdf

Green Infrastructure investment in the UK: Driving financing opportunities in low carbon and resilient infrastructure

The UK government has made green finance, including green infrastructure finance, a strong focus of economic policymaking in recent years. Examples include:

- The **Clean Growth Strategy** (October 2017), aimed at growing the economy while shrinking carbon emissions, emphasises the need to produce clean energy, improve the energy efficiency of buildings, and move towards low-carbon transport, among other things.
- The **Industrial Strategy** (November 2017) emphasises the need for clean energy.
- In the National Infrastructure Assessment (October 2018), the National Infrastructure Commission recommended that the government deliver low carbon energy and achieve heating and energy efficiency. The forthcoming **National Infrastructure Strategy** is expected to expand on the role of green infrastructure in the UK's overall infrastructure planning.
- In June 2019 the government announced a **target of zero net carbon emissions by 2050** and became the first government to legislate such a goal.
- The **2019 Spending Round**, announced in September 2019, allocated £30m for infrastructure decarbonisation schemes and £200m to lower emissions from buses. In addition, an extra £30m will be allocated to the Department for Business, Energy and Industrial Strategy to develop decarbonisation schemes that help support the UK to move towards its target of net zero greenhouse gas emissions by 2050.²⁷

It is clear that in order to meet these goals, large-scale investment in green infrastructure will be essential. According to research from the Aldersgate Group, the UK's low-carbon infrastructure sector needs £693bn of investment between 2011 and 2031.²⁸

²⁷ HM Treasury, 'Spending Round 2019', (September 2019), p.15-19, available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/829177/Spending_Round_2019_web.pdf

²⁸ Aldersgate Group, 'Towards the New Normal: Increasing Investment in the UK's Green Infrastructure', (March 2018), p.8&10, available at: <http://www.aldersgategroup.org.uk/asset/1009>

5.1 MATCHING EXPECTED RETURNS WITH ACCEPTABLE LEVELS OF RISK: PROVIDING OPTIMAL INVESTMENT OPPORTUNITIES

To mobilise private finance for the low-carbon transition in G20 countries and beyond, policies need to be designed with investors in mind in order to match expected returns with acceptable levels of risk. This section discusses returns and risks related to infrastructure, and looks at policies and tools available to policy makers and regulators to help de-risk investments and thus facilitate the engagement of investors in infrastructure projects. These tools include:

- establishing robust, long-term policy frameworks to give certainty to investors
- improving access to finance for green investment through risk mitigation instruments and blended finance to facilitate private investment.

Given the required increase in capital-intensive investment, clear and stable mechanisms that facilitate greater targeted flows of capital will be needed in order to meet, for example, the UK's net zero greenhouse gas target by 2050. To increase investment opportunities for the private sector, more investable propositions (i.e., low carbon assets with suitable risk-return profiles) need to be provided.

Private sector investment in infrastructure is based on matching the expected risks and returns of infrastructure assets with the investor's own tolerances for returns and risks. The involvement of the private sector can also help to increase operational efficiency, thus providing support beyond mere financing. Projects that are clearly commercially viable are typically able to attract private sector finance. When projects face financing shortfalls, governments can use risk mitigation techniques and incentives to reduce risks to match a suitable level of return, or increase return to match a given level of risk, facilitating the pricing of investment.

Lowering project costs can also improve the economic viability of some projects and improve the overall efficiency of public capital for low-carbon infrastructure. Reducing the cost of finance, both for debt and equity, can dramatically improve the ability of renewable energy technologies to compete with fossil fuels, especially in developing countries (UNDP, 2015).

Establishing robust, long-term policy frameworks to give greater certainty to investors

The long economic lifetime of most infrastructure projects means that public policy plays an important role in reducing the risk arising from regulatory uncertainty. A relevant example in Europe is the gas network that is likely to face lower utilisation rates by 2050.

Setting out clear and stable long-term goals and signalling governments' commitment to carbon emission reduction targets, as well as commitments to policies and projects to achieve these targets, can reduce policy risk and consequently reduce risk premiums and the costs of financing low-carbon investments.

In Europe, providing clarity to investors is one of the goals of the Long-Term Decarbonisation Strategy. European energy policy has strived to provide coherent and timely signals to the market, notably with the adoption of review of the EU Emissions Trading System, the Clean Energy for All Europeans legislative package, the Mobility Packages adopted in 2017 and 2018, and the establishment of the National Energy and Climate Plans which should include investment needs foreseen by member states for fulfilling their energy and climate goals.

Even before setting its new target to reach net zero emissions by 2050 in legislation, the UK was the first country in the world to introduce long-term legally binding emission reduction targets through the Climate Change Act 2008. The Act provided a statutory framework for keeping the UK on a pathway to achieving 80% reduction in emissions by 2050, guided by five-year caps on emissions – 'carbon budgets' – with independent statutory oversight by the Committee on Climate Change.

Improving access to finance for green investment through risk mitigation instruments and blended finance²⁹

Enabling a pipeline of bankable low-carbon infrastructure projects will require continued efforts to mitigate the risks that investors face, and “crowd in” private capital. Governments, development banks and development finance institutions utilise a range of tools to achieve these aims, including guarantees, insurance and hedging, as well as syndication and debt subordination. Each tool mitigates different types of risk. Guarantees can be useful in protecting investors from the risk of governments not honouring their obligations, for example, while currency hedging can reduce exposure to fluctuations in exchange rates.

Many such approaches are supported by “**blended finance**” – the strategic use of public capital, concessional or non-concessional, to mobilise additional investment. For example, in some subordinated debt approaches, transactions can be structured so that public capital can take a “first loss” position to attract private capital to the project. While such tools are useful in engaging private capital, particularly for technologies that are yet to mature or in countries where the perceived risk of investment is high, there is a need to balance blended finance interventions—and risk mitigation tools more broadly—against issues of moral hazard and market distortions.

The involvement of Multilateral Development Banks (MDBs) can facilitate increased inclusion of private sector financing. For example several MDBs have committed to support the BRI and its greening efforts.³⁰ By introducing MDBs, early-stage risks can be taken care of and private capital necessary for the scale of these projects can be “crowded in”. Furthermore, MDBs can support efficient public and private investment by lowering costs of capital, increasing transparency. The UK government has in the past made specific interventions to accelerate green financing, through the Green Investment Bank (GIB). Working alongside over 100 private sector and third-party investment partners, GIB committed £3.4 billion of its own capital to 100 projects with a total value of over £12 billion.

Green projects need to be able to develop new revenue streams or policy mechanisms that provide rewards for the environmental benefits they deliver. In the UK action has been taken to develop new approaches to financing natural habitats, expanding carbon finance, enhancing resilience and reforming regulatory frameworks. The UK government’s success in encouraging private sector investment in offshore wind through the Contracts for Difference scheme is an example of how good policy design, with appropriate risk allocation, has helped reduce the cost of capital. The results of the Round 3 auction—comprising six offshore wind projects, four remote islands and two Advanced Conversion Technology projects—were announced in September 2019. The lowest auction price was £39.65, 30% lower than the lowest Round 2 auction (held in 2017) price of £57.50.

In order to systematically re-orient private capital towards more sustainable investments, more transparency and long-term thinking are needed in financial and economic activity. Climate and environmental risks should be mainstreamed in economic and financial decision-making and the valuation of assets. Once investors, banks and credit risk agencies explicitly price in climate risks (that is, physical risks, liability risks and transition risks associated with climate change), borrowing and investment conditions will adjust to favour sustainable investments.

²⁹ These instruments build on previous recommendations endorsed by the G20 in the G20/OECD Guidance Note on Diversification of Financial Instruments for Infrastructure and SMEs.

³⁰ The Asian Development Bank, the Asian Infrastructure Investment Bank, the European Bank for Reconstruction and Development, the New Development Bank, the World Bank, and the European Investment Bank

5.2 'GREENING FINANCE': LOW-CARBON INFRASTRUCTURE AS AN ASSET CLASS³¹

This section discusses the 'greening' of the financial system, looking at the way misalignments in the global financial system affect low-carbon infrastructure investment, and demonstrating how transparency and signalling can improve its capacity to respond to opportunities arising from the transition, while strengthening the system's resilience to climate risks. Improving how the financial system works to support investment in low-carbon infrastructure includes:

- disclosure of climate change risks for infrastructure assets
- green standardisation, taxonomy and definitions.
- support for initiatives to create infrastructure benchmarks that will in turn help to describe infrastructure as an asset class

Disclosure of climate change risks for infrastructure assets

While a spectrum of financial instruments that channel capital across the value chain to infrastructure investments is needed in order to mobilise investors, the range of instruments needs to be accompanied by better transparency and disclosure of climate risks to enable investors to move away from carbon-intensive assets.

Properly pricing climate risk in financial decision making will align investment flows towards infrastructure capable of withstanding a changing climate. Providing a robust methodology to quantify the economic and financial benefits of low-carbon infrastructure investment will provide a substantial and critical incentive for financial markets to embed resilience up front.

To improve transparency concerning the exposure of infrastructure assets to climate risks, countries could, for example, promote or require the embedding of ESG criteria into reporting disclosures for infrastructure assets, including carbon emissions, potential contribution to country decarbonisation strategies, level of alignment to Nationally Determined Contributions agreed as part of the Paris Agreement, potential contribution to the UN Sustainable Development Goals, energy and water use, social impacts, and governance of infrastructure assets.

The Financial Stability Board's private sector Task Force on Climate-related Financial Disclosures (TCFD), has been endorsed by 785 institutions, including 374 financial firms. Their latest report, published in June 2019, noted '340 investors with nearly \$34 trillion in AUM are asking companies to report under TCFD'. Overall, the report is sanguine about the general increase in climate risk disclosure, but notes that disclosure is 'still insufficient for investors'.³²

Central banks and financial supervisors are also taking action to address the far-reaching financial risks associated with climate change.

In the UK, for example, the Bank of England will keep encouraging companies to disclose information related to climate risks and opportunities. The Bank expects that all listed companies and large asset owners will disclose the climate risks and opportunities related information by 2022.³³

31 The UK Green Finance Strategy is based on the twin pillars of 'greening finance' and 'financing green'. For detail, see HM Government, 'Green Finance Strategy', (July 2019), available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/820284/190716_BEIS_Green_Finance_Strategy_Accessible_Final.pdf

32 Financial Stability Board, 'Task Force on Climate-related Financial Disclosures: 2019 Status report', (May 2019), available at: <https://www.fsb-tcfd.org/wp-content/uploads/2019/06/2019-TCFD-Status-Report-FINAL-053119.pdf>

33 Bank of England, 'Financial Stability Report', (July 2019), available at: <https://www.bankofengland.co.uk/-/media/boe/files/financial-stability-report/2019/july-2019.pdf>

A private sector-led Coalition for Climate Resilient Investment, bringing together companies across the infrastructure investment value chain with assets totalling \$5 trillion, recently launched new work to create the first framework for the pricing of physical climate risks in infrastructure investing. The Coalition will develop a common approach to assessing climate risks, which will enable it to ensure all its members' investments are resilient, and will unlock additional private finance for resilient infrastructure investment.

Green standardisation, taxonomy and definitions

Currently there is no widely accepted, standardised definition of green or low-carbon infrastructure. There are numerous definitions of what a green investment is, with wide discrepancies between individual countries' definitions and international green standards (e.g. those set by International Capital Markets Association).

Various organisations have published a range of definitions of "green infrastructure", many of which conceive of infrastructure in the widest possible sense. For example, the European Environment Agency says that 'Green Infrastructure is based on the principle that protecting and enhancing nature and natural processes [...] are consciously integrated into spatial planning and territorial development.'³⁴ According to the OECD, Green infrastructure or low-carbon, climate resilient (LCR) infrastructure, are projects that will either mitigate greenhouse gas emissions and/ or support adaptation to climate change in the area of transport, energy or buildings.³⁵

In the UK, Natural England, the adviser to the UK government on the English natural environment, defines green infrastructure as a "strategically planned and delivered network comprising the broadest range of high quality green spaces and other environmental features."³⁶ The UK Green Building Council notes that 'Green infrastructure...can be described as the network of natural and semi-natural features within and between our villages, towns and cities – reaching out into the wider countryside. These features range in scale, from individual street trees, green roofs and private gardens through to parks, rivers and woodlands, transport corridors, verges and, at the larger scale, wetlands, forests and agricultural land.'³⁷

The point of commonality among these and other definitions is that green infrastructure includes green and natural features. However, coverage under the "green infrastructure" umbrella term varies greatly; for instance, some definitions include diesel railways, or rail for transport of fossil fuels; and other definitions do not.

Questions about taxonomy have no clear resolution at this stage. For example, the Climate Bonds Initiative lists nine different types of 'use of proceeds for green bonds', ranging from adaptation to energy. Some of these projects can very obviously be considered low-carbon infrastructure (for example, de-carbonising residential buildings). Other categories, for example, are less clear (for example, information technology and land use).

34 European Environment Agency, 'What is green infrastructure?', (29 March 2017), available at: <https://www.eea.europa.eu/themes/sustainability-transitions/urban-environment/urban-green-infrastructure/what-is-green-infrastructure>

35 OECD, 'Towards a Green Investment Policy Framework: The Case of Low-Carbon, Climate Resilient Infrastructure', (18 June 2012), available at: http://www.oecd.org/env/cc/Towards%20a%20Green%20Investment%20Policy%20Framework_consultation%20draft%2018-06-2012.pdf

36 Natural England, 'Green infrastructure guidance', (1 January 2009), p.7, available at: <http://publications.naturalengland.org.uk/publication/35033>

37 UK Green Building Council, 'Demystifying Green Infrastructure', (February 2015), available at: <https://www.ukgbc.org/wp-content/uploads/2017/09/Demystifying-Green-Infrastructure-report-FINAL.pdf>

This lack of clarity makes measuring the performance of individual assets problematic because without a widely-accepted definition of low-carbon infrastructure, there is no predefined benchmark to measure performance. In the near-term, this lack of standardisation is not an insurmountable barrier to investment in low-carbon infrastructure because each investing institution assess projects based on its own definition and will take investment decisions based on internal metrics.

On this basis, however, only the most obviously financially viable projects are likely to be financed. In the UK, for example, offshore wind projects are often extremely investible, and are therefore likely to be funded with or without a 'green' or 'low-carbon' label.

In the longer term, however, a common definition of low-carbon infrastructure and 'green standardisation' (a taxonomy) of financial frameworks will have to be established in order to promote low-carbon infrastructure investment at scale, and to ensure that less immediately obviously investible projects are funded. A standardised definition will in turn facilitate comparable credit ratings and enhanced transparency needed for risk assessment and due diligence. And ensuring that projects are green and sustainable from the very beginning will minimise the risk of such projects becoming stranded assets.

6. CONCLUSIONS

Empirical studies of the investment characteristics of **low carbon and climate-resilient infrastructure** as a new asset class are severely limited in both quantity and quality. Of the evidence-based analysis that does exist, most has been done to assess the risk-adjusted performance and portfolio diversification benefits of listed securities. Financial returns in private markets and among state-owned enterprises (where much of the action needs to be) is a 'black hole' as far as data are concerned.

This is a particular problem within the renewable infrastructure sector. Research by McKinsey estimates that 70% of the investable market for renewable infrastructure built between 2018 and 2030 will be away from the public markets.³⁸ The absence of a clear benchmark for measuring investment performance is seen by many as one of the main barriers in the longer-term to investors increasing their exposure to low-carbon infrastructure and 'clean tech'.

Providing more clarity to investors will be critical to make sufficient volumes of private-sector capital flow to low-carbon infrastructure and clean tech. For example, one option is to exploit the new technologies being developed around Big Data and, in particular, to look at the insights that can be gained using satellite data and artificial intelligence algorithms to interrogate the performance of existing assets. The insights gained from this process will allow for investors to make better informed investment decisions on future low-carbon infrastructure assets.

But that will not be enough. Investors face an unprecedented level of uncertainty about the size and shape of the global energy sector going forward. So the work of capital markets researchers must address the implications of future policy scenarios and technology developments supporting the energy transition. It will not be possible to meet net zero emission targets or to achieve the targets set out in the Paris Agreement without a wide-scale shift towards greening existing infrastructure and ensuring that new infrastructure incorporates green elements from the outset.

Private investment is expected to meet the vast majority of financing needs for this low-carbon infrastructure investment. Private-sector finance includes investment from entities spanning the corporate sector as well as institutional investors, and includes both debt and equity investment. However, as this report has made clear, private-sector investment in green infrastructure remains below its potential owing to persistent barriers to such investment.

Government policy will be an important driver, through market-based incentives and the progressive removal of barriers. There is also a role for the industry itself to increase the appeal of green infrastructure as an asset class. In summary, we recommend the following:

- governments and the private sector should together ensure that there is a sufficient pipeline of investable infrastructure projects that offer a suitable risk-return profile
- governments should ensure that infrastructure-related policy frameworks are designed for the long-term, in order to provide clarity and certainty to investors
- governments and private-sector investors should consider how blended finance can be used strategically to address project-specific financing shortfalls and mobilise additional investment.

38 McKinsey & Co., 'The market for unlisted renewable energy infrastructure: external perspective developed for the Norwegian Ministry of Finance', (December 2018), available at: https://www.regjeringen.no/contentassets/7fb88d969ba34ea6a0cd9225b28711a9/20181219-the-market-for-unlisted-renewable-energy-infrastructure_final.pdf

- financial market participants should explicitly consider climate and environmental risks in economic and financial decision-making and asset valuation, so that these risks are priced in to terms of lending and investment, which in turn would encourage a shift away from carbon-intensive assets.

The emergence of standardised definitions is sorely overdue. The aim of further standardisation is not to shackle innovation, but rather to facilitate benchmarking, enhance transparency and generate an improved narrative about the vast potential of low-carbon infrastructure investing.

APPENDIX

List of selected global investors in green bonds

Source: World Bank

Aberdeen Asset Management	Natixis Asset Management
ACTIAM (Formerly SNS AM)	New York Common Retirement Fund
Adlerbert Research Foundation	Nikko Asset Management
Aegon Asset Management	Nippon Life Insurance
AMP Capital AP2, AP3, and AP4 – Swedish National Pension Funds	Pax World Balanced Fund
Australia Local Government Super	Pictet
Australian Ethical Investment Ltd	PIMCO
Barclays Treasury BlackRock	QBE Insurance Group Ltd
Breckinridge Capital Advisors	Rathbone Greenbank
Caisse Centrale de Reassurance	Sarasin
California State Treasurer's Office	SEB Ethos rantefund / SEB Fonden / SEB TryggLiv
CalSTRS	Skandia Liv
Calvert Investments	Sonen
Central Bank of Morocco	Standish Mellon Asset Management
Church of Sweden	State of Illinois
Colonial First State Global AM	State Street Global Advisors
Deutsche Asset & Wealth Management	The Nobel Foundation
Everence Financial	TIAA-CREF
FMO (Netherlands Dev. Fin.)	Trillium Asset Management
Folksam	UN Joint Staff Pension Fund
Ikea Group	UniSuper
LF Liv	WWF-Sweden
Maryland State Treasurer	ZKB (Zürcher Kantonalbank)
Mirova	Zurich Insurance
MISTRA	Zwitzerleven

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