

Funding and financing infrastructure for a net zero future



with contributions from



Global
Infrastructure
Hub



Purpose of this report

This report explores some of the lessons that are being learned globally about different ways to fund and finance green and circular infrastructure, the common characteristics of successful funding and financing solutions and best practices related to the roles of government and the private sector.

Achieving a lower carbon, more sustainable economy demands radical changes to how infrastructure is planned, constructed and operated. These changes will only be possible if governments and other asset owners can fund and finance infrastructure that is greener and more circular.

This report extends work on green and circular infrastructure that PwC undertook in partnership with the Global Infrastructure Hub (GI Hub) as part of the GI Hub's Innovative Funding and Financing for Infrastructure initiative. The aim of this report is to stimulate discussion and action across the infrastructure industry.

Foreword



Marie Lam-Frendo
CEO, Global Infrastructure Hub

In 2021, the G20 has identified sustainable infrastructure as a priority, and the green and circular economy as key topics under this priority. To support this agenda, the Global Infrastructure Hub (GI Hub) is producing several deliverables, notably our work on Infrastructure and the Circular Economy and the extension of our Innovative Funding and Financing (IF&F) initiative to include green and circular infrastructure case studies.

We are pleased to see PwC extending this work further by creating this report to explore in detail the lessons for funding and financing green and circular infrastructure from a private sector perspective, with due reference to the unique social, economic and policy considerations that surround these topics.

The infrastructure industry faces a historic opportunity to create a more sustainable and resilient future with a transition to net zero. With the ideas and insights presented in this paper, we now also have more solutions for funding and financing the infrastructure that will help us shape this future. And we look forward to continuing to work with G20 governments on the next steps.

About the Global Infrastructure Hub

The Global Infrastructure Hub (GI Hub) is a not-for-profit organisation that advances the delivery of sustainable, resilient and inclusive infrastructure.

Formed by the G20, the GI Hub works collaboratively with the public and private sectors to produce data insights, knowledge tools and programs that equally inform policy and delivery, helping decision-makers and practitioners create positive impacts through infrastructure.

www.gihub.org

Key findings

The G20 has identified sustainable infrastructure as a priority, including as part of its Quality Infrastructure Investment (QII) principles introduced in 2019. In 2021, the Italian G20 Presidency reiterated the priority of sustainability and named the green and circular economy as key topics. PwC was engaged by the GI Hub to contribute to work on green and circular infrastructure that the GI Hub was delivering in support of the G20 infrastructure agenda.

This report reviews the lessons learned from global case studies of innovative approaches to fund and finance green and circular infrastructure, with a focus on practical applications. Our aim is to stimulate discussion and ultimately action that moves toward a net zero future.

The case studies demonstrate that significant innovation is already underway globally, with some common characteristics:



Coalitions of sponsors have been critical to scaled and innovative programs, driving collaboration across delivery agencies.



Government programs address technology risk by supporting scale and 'industrialisation'.



Long-term savings or avoided costs can amortise high capital costs, proving suitable to private finance, where government can guarantee payments.



Incentives can be aligned so that savings from improved performance are captured by the funder or financier.



For first-mover technologies, wholly or partially government-run lenders and investors have played a significant role.



Circular infrastructure has gained traction across the water and energy industries.

Green & circular infrastructure case studies



30+
countries



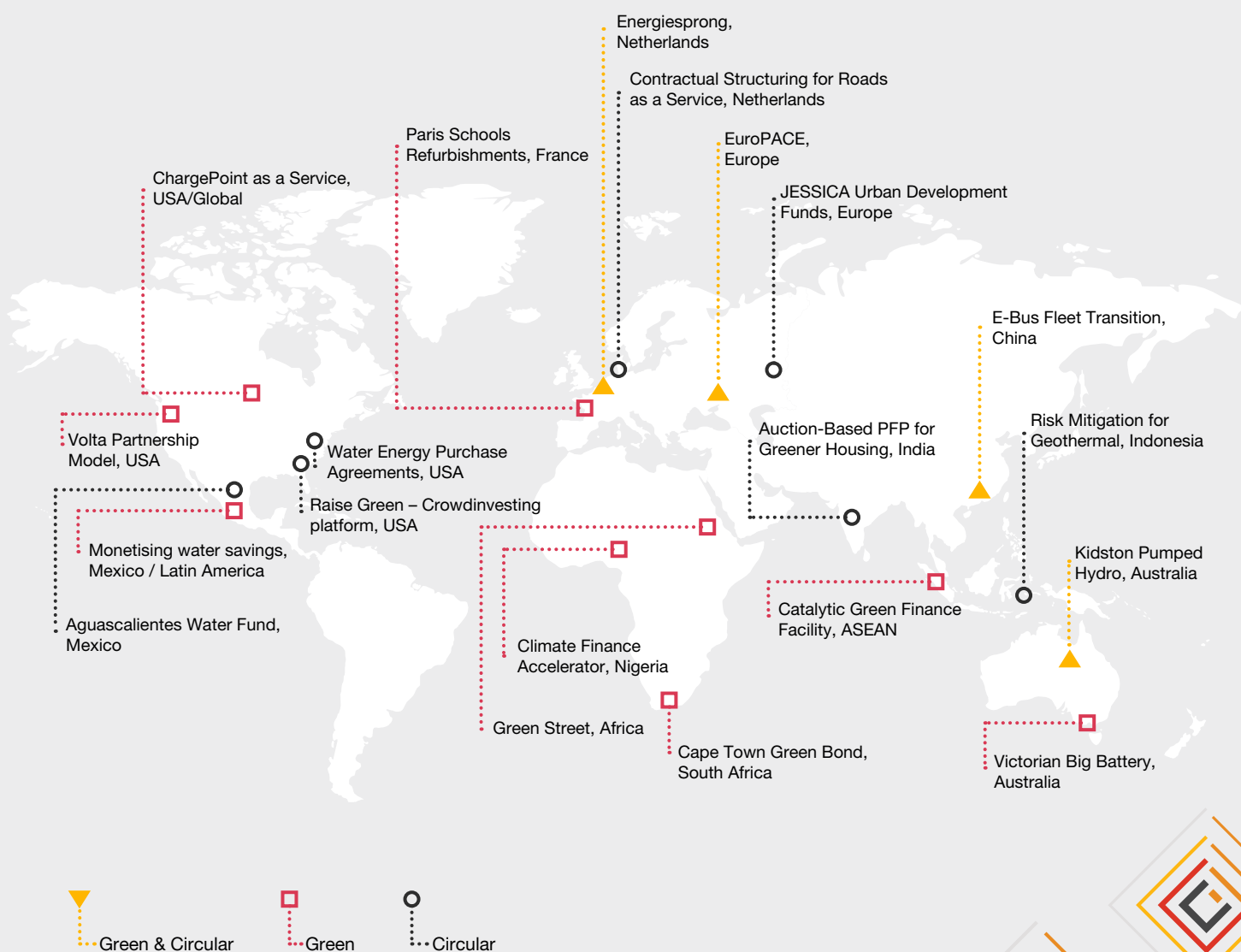
100+
longlisted
case studies



20
shortlisted
case studies



10
global practitioner
interviews



View the detailed case studies at the [GI Hub Innovative Funding and Financing tool](#).



The global decarbonisation challenge

The scale of the decarbonisation challenge

In 2019, prior to the emergence of COVID-19, the rate of global decarbonisation was 2.4 per cent.¹ This rate has increased slightly since 2019, against a backdrop of rising overall global emissions. However, analysis by PwC and others indicates that this decarbonisation rate is far below the rate needed to limit global warming to less than 2°C above pre-industrial levels. Restricting warming to the even more ambitious target of a maximum of 1.5°C will require a global rate of decarbonisation nearly five times greater than was achieved in 2019.

¹ The decarbonisation rate is the reduction in carbon intensity or energy-related emissions.

Double-digit decarbonisation is required to meet the target of limiting warming to 1.5°C

Built environment opportunities

The global response to the COVID-19 pandemic resulted in a slight decrease in global emissions in 2020 that almost put the world on track for annual decarbonisation targets. However, recent data show that emissions are rebounding rapidly as societies begin to open up and economic activity resumes.

If emissions return to 'business as usual' after the pandemic, the world will not achieve the emissions reductions needed to limit global warming. The 2021 United Nations Climate Change Conference (COP26) must be an inflection point towards achieving the necessary global decarbonisation rate.

The emissions intensity of the built environment and infrastructure must also be a priority. Cities produce 80 per cent of GDP, consume 75 per cent of natural resources, produce 50 per cent of waste and emit 60-80 per cent of GHG emissions while occupying only 3 per cent of land space.²

Urban areas are very high-density sources of resource consumption, waste production and carbon emissions, making them focal points for the global decarbonisation challenge. Infrastructure has a crucial role in accelerating circularity and lowering emissions in urban areas through various channels including through renewable energy, restoration of natural regeneration cycles and better waste management.

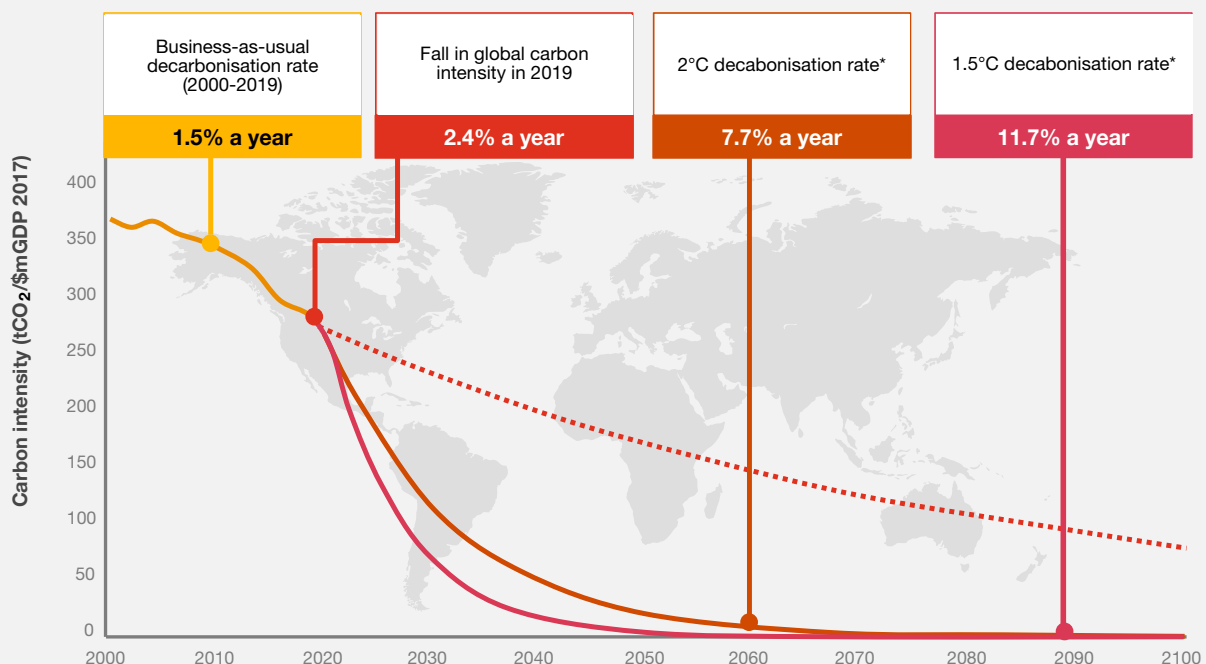
² Ellen MacArthur Foundation (2021) 'Circular cities: thriving, liveable, resilient', ellenmacarthurfoundation.org/

Infrastructure being planned today has the unique opportunity to reduce the impacts of climate change while also ensuring we are more resilient to its effects. However, the scale of change required to reshape infrastructure is an enormous challenge that will require unprecedented levels of regulatory coordination, funding and financing.

Chris McLean

Partner, PwC Australia

Figure 1. Net Zero Economy Index 2020



* Global carbon budgets refer to the global estimated budget of fossil fuel emissions taken from the IPCC Special Report on Global Warming of 1.5°C. A series of assumptions underpin these carbon budgets, including the likelihood and uncertainties of staying within the temperature limits, and the use of carbon dioxide removal (CDR) technologies.

Sources: bp, World Bank, OECD, IPCC, PwC data and analytics

Note: GDP is measured on a purchasing power parity (PPP) basis.



What is green and circular infrastructure?

In infrastructure, there are no universally accepted definitions of the 'green' and 'circular' economy, and the concepts often overlap. In this report, we adopt the GI Hub's definitions, using the phrase 'green and circular economy' to encompass both of these concepts as well as the broad agenda that is widely accepted by public and private sector stakeholders. This section provides an overview of types of infrastructure that can be considered 'green' and 'circular' (please refer to definitions on pages nine and 10).

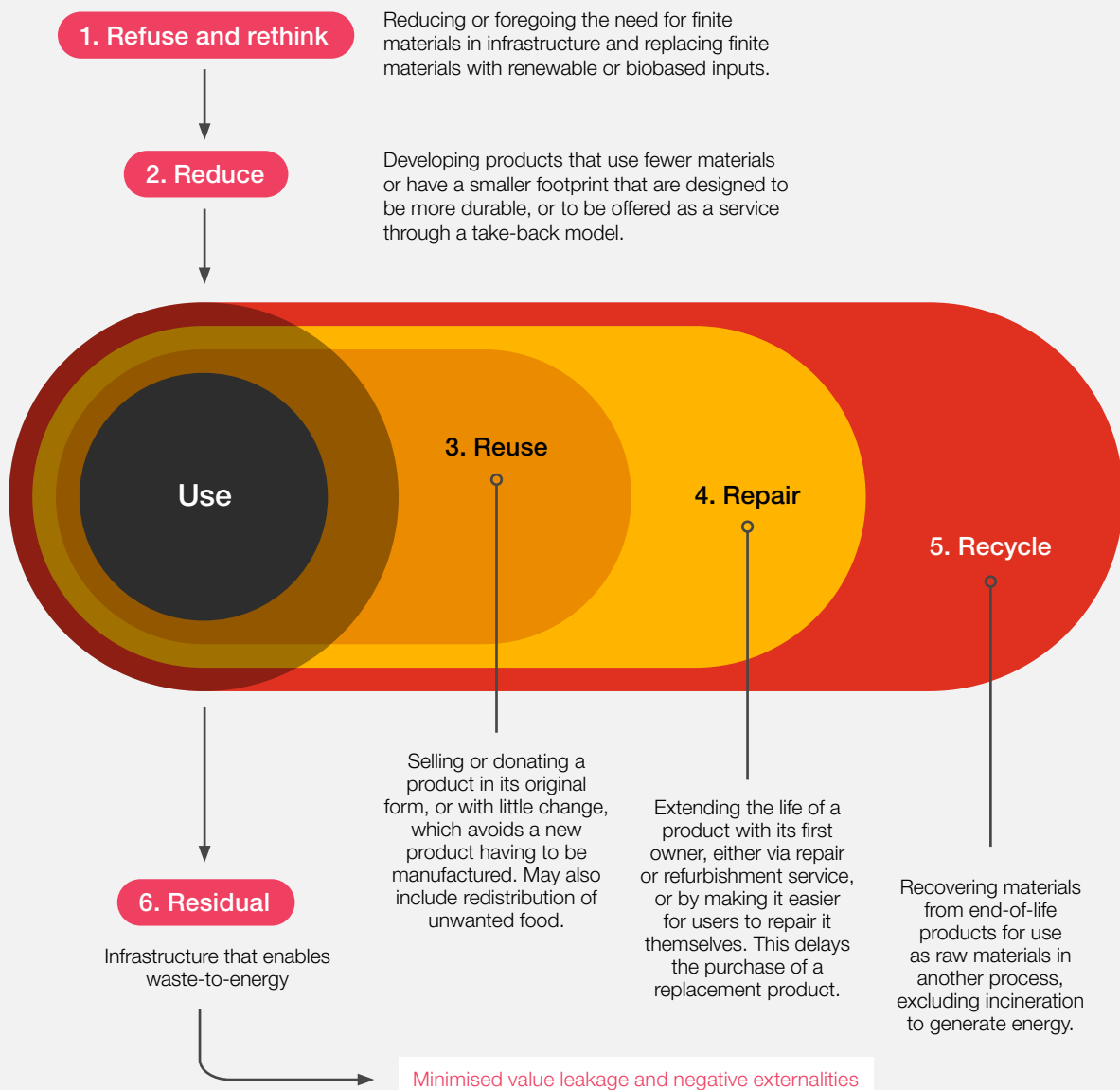
Circular economy infrastructure

The concept of a circular economy is an alternative economic model inspired by nature's ecological cycle – creating a closed loop of materials and energy. A circular economy involves a range of stakeholders, such as manufacturers, distributors, consumers and governments. The concept can be applied across all industries.

To transition to a circular economy, changes are needed to the way infrastructure is designed, constructed, used and its materials discarded.

The circular economy centres around the '6R' principles: refuse, reduce, reuse, repair, recycle, residual. The ultimate aim is to 'refuse' or significantly reduce the amount of new materials entering the system. This is achieved by 'closing the loop' and maximising the amount of materials recovered and subsequently reused, repaired, refurbished and recycled. Residual materials are those that can no longer be reused or recycled. The pathways for residual materials are extraction of embedded energy (e.g. through waste-to-energy processes) or safe disposal.

Figure 2. Circular Economy Concept



Green infrastructure

Green infrastructure is a broad concept covering everything from renewable energy to more efficient waste and energy infrastructure.

Renewable energy infrastructure that aims to reduce GHG emissions is inherently green – but is not necessarily circular. Currently, technologies such as solar power, wind power and battery storage are not circular, because effective mechanisms are not yet in place to recover or reuse materials at the end of the operational life of the infrastructure.

All circular infrastructure can be green, but not all green infrastructure is circular.

The role of infrastructure in reaching net zero

A study by the Ellen MacArthur Foundation shows that moving to renewable energy can only address 55 per cent of global emissions.³ The remaining 45 per cent of global GHG emissions stem from extraction, manufacturing and production of materials. This indicates that restricting warming to 1.5°C can only be achieved by combining current efforts on renewable energy and energy efficiency with circular economy approaches.

The circular economy is therefore a powerful solution for achieving long-term climate policy objectives. A circular economy can also reduce supply chain risks and short-term supply shortages by requiring less material input and establishing local supply of secondary materials.

³ Ellen MacArthur Foundation (2021) 'Fixing the economy to fix climate change', climate.ellenmacarthurfoundation.org/



45%

Circular practices can potentially address a substantial part of global GHG emissions.

Energy efficiency and switching to renewable energy can address 55% of global GHG emissions.



Funding and financing green and circular infrastructure

Securing funding and financing for green and circular infrastructure projects is an ongoing challenge, particularly in emerging industries where technology is new or immature. Despite the significant potential for private capital to bridge the infrastructure gap, the hesitancy of investors about novel green and circular projects and technologies has made it difficult to unlock this source of financing.

With nascent technologies, investors may be deterred by risk and may expect higher returns as compensation. For novel green and circular projects to be bankable, the project owner must be willing to take on the technology risk to prove that it works.

Many new technologies require greater government support to accelerate their development and to become competitive and scalable. Project owners as large as governments can incubate the market for the technology to develop until it is economical enough to compete without assistance.

The need to integrate new technologies into complex systems can limit their uptake and impose costs on users. Redesigning existing infrastructure to be compatible with new technologies requires significant upfront investment, which is often only possible with government support. For example, government investment is needed to stabilise the electricity grid and accommodate the intermittency challenges of more renewables in the electricity system.

Unlocking private sector investment

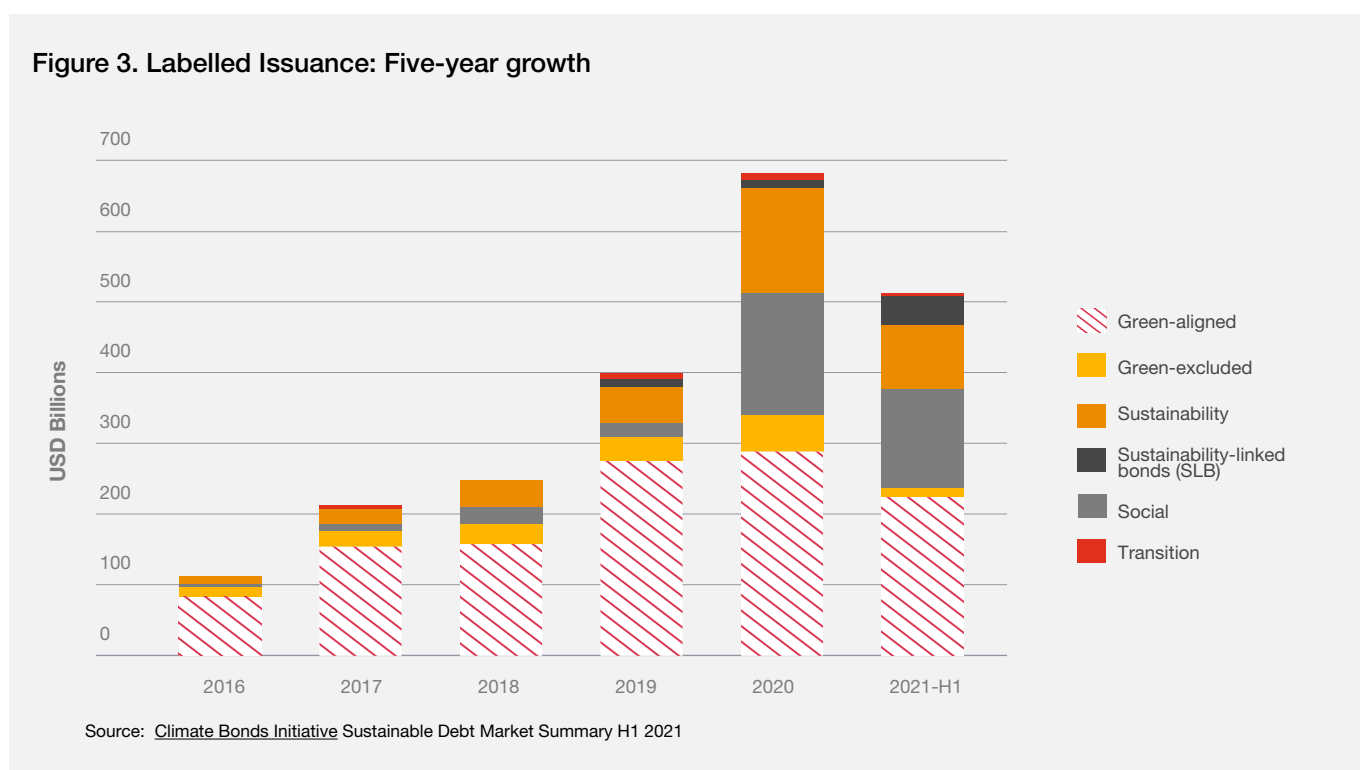
Innovations in funding and financing, such as structured financial incentives and the creation of scale through coalitions of sponsors, can help attract private sector investment.

Finance for projects is abundant. Investors have record levels of cash reserves at their disposal and are seeking commercially attractive projects. Alongside this, as Environmental, Social and Corporate Governance (ESG) ratings and metrics are increasingly being attached to financing, the issuance of green, sustainable and social debt products is growing across all sectors.

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It is clear that financiers are looking for more green and sustainable projects, but is there enough funding for the scale of change required?

Financiers do not fund public works projects. These projects are funded by users or taxpayers through government taxes or user charges (which may be supplemented with ancillary revenue sources such as advertising or sale of user data). As such, the challenge for the public sector is to make these projects bankable to tap available finance.



Is financing green infrastructure different from financing circular infrastructure?

Funding and financing of green and circular infrastructure projects do not differ in principle. All projects can use the same levers to improve their financial profile.

However, green infrastructure technology is generally more mature than circular technology, with an established record particularly in sectors such as photovoltaic solar, hydro and wind. Circular technology is still in earlier stages of development.

The role that governments play in funding and financing green and circular projects directly relates to the maturity of the technology and market. The current state of financing and funding for the circular economy resembles where green technologies were a decade ago – with uncertainty regarding the scalability and compatibility of new initiatives, and a reliance on government support to accelerate development.



Funding and financing lessons for green infrastructure

A review of over 100 green and circular international case studies revealed some significant innovations in funding and financing green infrastructure, as well as common characteristics and lessons that can be learned.



Coalitions of sponsors are critical to extending the global reach of green and circular infrastructure

The transition towards a lower carbon future and greater renewable energy infrastructure is a global challenge. To achieve the necessary decarbonisation required globally, developed and developing economies alike must move rapidly to adopt greener and more circular infrastructure and technologies.

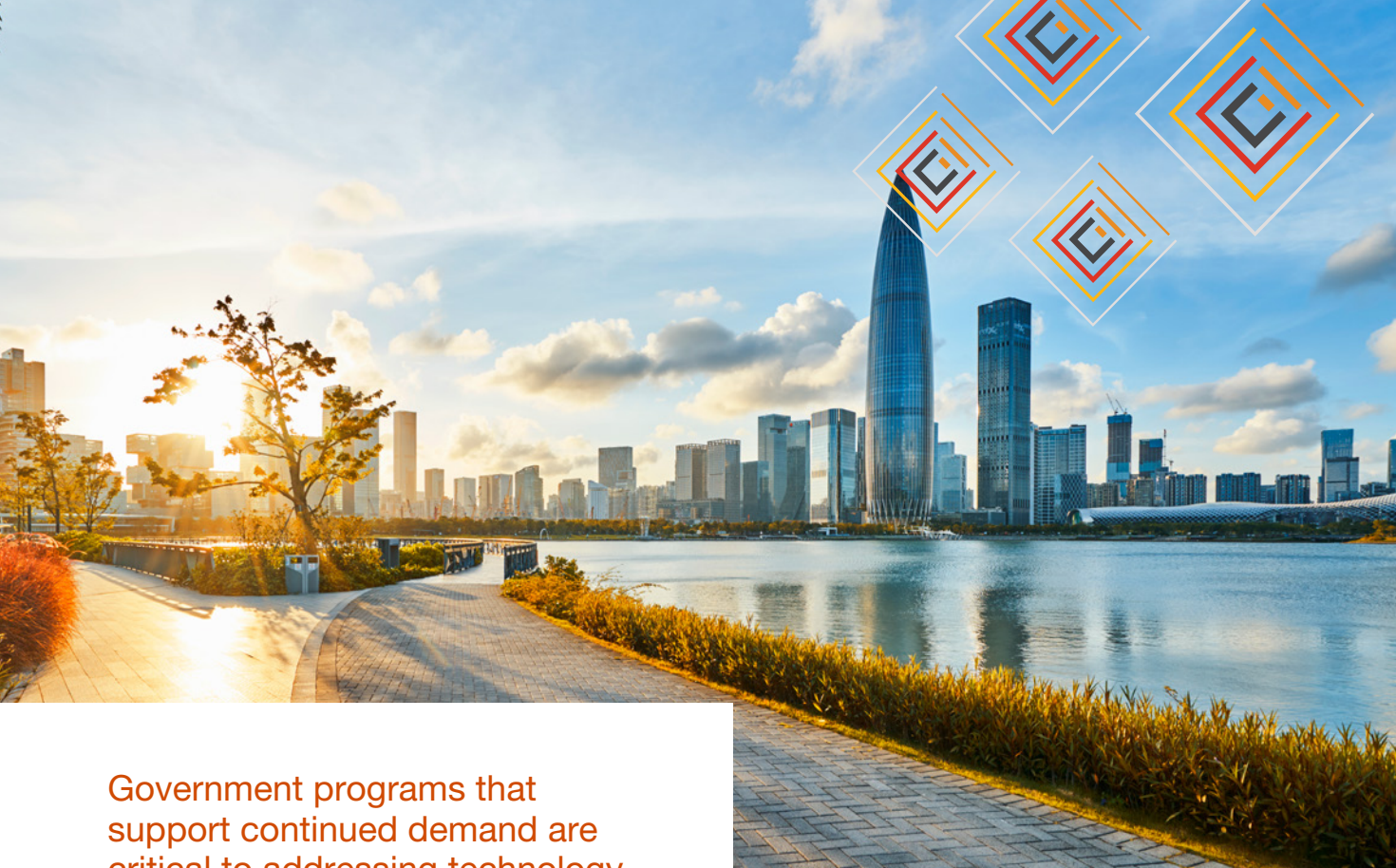
Coalitions of sponsors are playing a critical role in extending the lessons learned about green and circular infrastructure and related renewable technologies into developing economies.

Major green infrastructure programs in areas such as solar and wind power have been implemented in developing countries by a mix of multilateral development banks (MDBs) and national development bank (NDBs), alongside other financing partners. For example, the ASEAN Catalytic Green Finance Facility (ACGF) is accelerating green infrastructure investment in South-East Asia with over US\$ 1.4 billion in loans from co-financing partners. This has a spill-over effect, as when programs are proven in one country, they are often exported to others.

Case study

ASEAN Catalytic Green Finance Facility (ACGF)

Facilities such as the ACGF are critical to stimulating investment in emerging technologies and assisting in decarbonisation. By mid-2021 the ACGF's ASEAN Infrastructure Fund (AIF) had committed around US\$ 500 million to nine projects with a value of approximately US\$ 3 billion, along with US\$ 1.4 billion in co-financing commitments obtained. The Green Climate Fund committed US\$ 300 million to deliver a Green Recovery Program post COVID-19.



Government programs that support continued demand are critical to addressing technology risk that may deter investors

Government programs have proven crucial in creating the conditions for greater demand for investment in green infrastructure projects globally. A number of green infrastructure case studies demonstrated the importance of government programs in addressing technology risk. These programs also provide a pathway towards 'industrialisation' of emerging green infrastructure technologies by enabling a more viable scale. An example of this can be seen in Shenzhen, where national subsidies and matched funding from the city government enabled the e-Mobility system to grow and eventually become self-supporting.

Case study

Shenzhen e-Mobility System

Across the world, public bus fleets are transitioning from internal combustion engines to electric. In 2017, Shenzhen became the first city to transition, motivated by carbon emissions reduction targets and a desire to stimulate investment in the manufacturing supply chain. National and city government funding and financial support were critical, along with bus-leasing models (instead of outright purchasing) that incentivised circular design and durability. This 'seed' funding has incubated the supply chain and has helped to establish China's EV bus industry.



‘Energy efficiency savings’ can help overcome the upfront capital costs of green infrastructure projects

A significant barrier to green infrastructure projects is high upfront capital costs. Performance guarantees and other innovative forms of contracting using a pay-for-performance mechanism are proving useful in addressing high initial upfront costs associated with the installation of green infrastructure or refurbishment of existing infrastructure. Energy performance contracts (EPCs) are an example of this, and have been used to finance energy-efficiency refurbishments as well as renewable energy installations on a large scale. The high capital costs of these energy-saving technologies are offset by long-term cost savings or other benefits.

The City of Paris has used EPCs to improve the energy efficiency of schools across the city. The pay-for-performance mechanism allowed the City of Paris to overcome the initial upfront costs associated with installing and retrofitting energy-saving infrastructure in schools, allowing the government to recoup its investments from energy savings realised over time.



Case study

City of Paris energy performance contracts

The City of Paris has been implementing EPCs in its school infrastructure since 2011. These contractual arrangements have proved a useful mechanism to help reduce the city’s energy consumption, with 64 per cent of Paris’ energy consumption coming from the building sector. The EPCs involve an energy service company (ESCO) refurbishing schools to be more energy efficient and providing a performance guarantee. With the ESCOs financing these projects, the government and other building owners are able to repay the ESCO over a set period with the savings on energy consumption based on the performance guarantee.





Funding and financing lessons for circular infrastructure

The case study review also highlighted a number of important insights for funding and financing circular infrastructure projects. Many of the common characteristics and lessons learned from the green infrastructure case studies are also applicable to circular infrastructure. However, some funding and financing innovations relate specifically to circular infrastructure.



Clear legislative agendas, action plans and roadmaps are critical as circular models emerge

Government intervention and policy mechanisms are key to reducing risks and incentivising financial investment in circular infrastructure projects – perhaps to an even greater degree than for green infrastructure. This is because circular economy infrastructure projects are often complex, requiring collaboration across value chains, and difficult to industrialise as the models are not ‘one size fits all’.

Comprehensive national action plans and roadmaps for the circular economy are critical to attracting funding for projects. This includes initiatives such as setting targets for resource recovery and defining priority government interventions (such as extended producer responsibility initiatives, tax reforms, blended finance and investment guarantees). In Europe, national circular economy frameworks have been adopted, contributing to the delivery of successful circular infrastructure projects.

Case study

European Circular Economy Action Plan

The European Union (EU) introduced its vision of the circular economy in 2014. The Circular Economy Action Plan was the first of its kind, setting out a dedicated and comprehensive strategy to transition toward a circular economy. The action plan clearly defined priority initiatives, including legislative and non-legislative measures, along the entire life cycle of products. The action plan has been critical to the success of the European market leading the world in the transition toward a circular economy. The policy certainty and clear agenda has provided greater certainty to innovative circular infrastructure models to establish themselves in Europe.



Utilities are leading the circular infrastructure transition

Particularly in the water and energy sectors, utilities have advanced their circular infrastructure models, possibly because of the opportunity to apply the model to operation and maintenance without construction. As a result, funding and financing has been more able to assist with circular infrastructure in these sectors.

The most successful applications of circular models have been in operation and maintenance of utilities due to their relative simplicity compared to construction. Examples include monetising water savings in Mexico and use of a water energy purchase agreement (WEPA®) in the United States. Although some examples can be seen in construction, more exploration is needed to determine how to increase adoption of circular models in more complex areas of infrastructure.

Case study

Water energy purchase agreements

A key enabler of a circular economy is the pricing of whole-of-life costs. An example is the WEPA® created by Cambrian, which is a service-based wastewater-to-resources solution. Essentially, Cambrian finances the upfront installation of an on-site wastewater treatment system. Cambrian owns the asset over its life, providing maintenance and management services. The client simply pays a charge for use of the system on a volumetric basis.

One such client is Rombauer Vineyards in the Napa Valley. Implementing the system reduced the vineyard's carbon footprint (due to managing wastewater on site, removing the need for waste removal) by 4,150 metric tonnes and reduced water consumption by 28 per cent in two years.



Key to the circular infrastructure business case is ensuring that the whole-of-life costs and risks of linear alternatives – such as the availability, flow and prices of raw materials – are reflected in price estimates

The ability to demonstrate not only the positive impacts of the circular infrastructure project but also the risks associated with the more wasteful alternatives is crucial to attract financing for a circular infrastructure project.

Circular infrastructure projects have been successful where they have been able to demonstrate the long-term risks associated with linear alternatives. This includes the risks associated with forecasted fluctuations in raw material prices (due to climate change or resource scarcity), as well as uncertainty in the availability and flow of raw materials, which can lead to even higher prices.

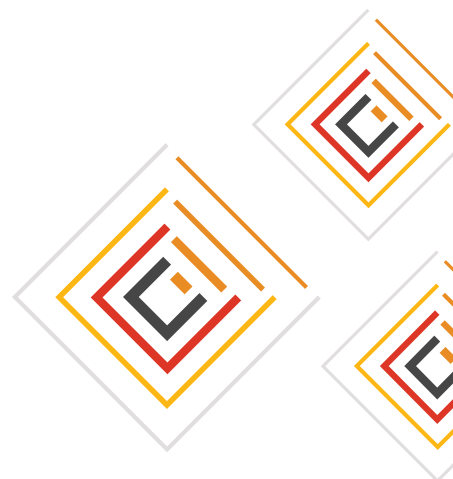
Demonstrating reduced whole-of-life costs associated with circular infrastructure projects is also important for attracting financing. A circular infrastructure project can lead to significantly reduced material and energy bills, whether it be through more careful design in the planning phase, or designing for disassembly and recovery of materials at the end of a project's life.

An example is Dura Vermeer's contractual structuring for Road as a Service (RaaS), where the business successfully demonstrated the benefit that could be gained with a higher upfront cost but a significantly longer-lasting asphalt road surface.

Case study

Road as a Service

Dutch civil contractor Dura Vermeer is currently developing the concept of a circular service contract (CSC) with provincial governments. The premise of the CSC is that Dura Vermeer will construct, maintain and operate a road over a set period. Besides a quarterly fee for operation and maintenance, Dura Vermeer would also receive a residual value payout at the end of the contractual term based on the state of the road. This is intended to incentivise durable and resilient construction practices to minimise maintenance costs and therefore optimise the residual value payout.



Committing to net zero

Climate change is one of the most pressing problems facing our world. Infrastructure can help us mitigate the effects of climate change, while also playing a role in decarbonising our economy.

Innovative examples of funding and financing offer global lessons that can help to scale the development of green and circular infrastructure.

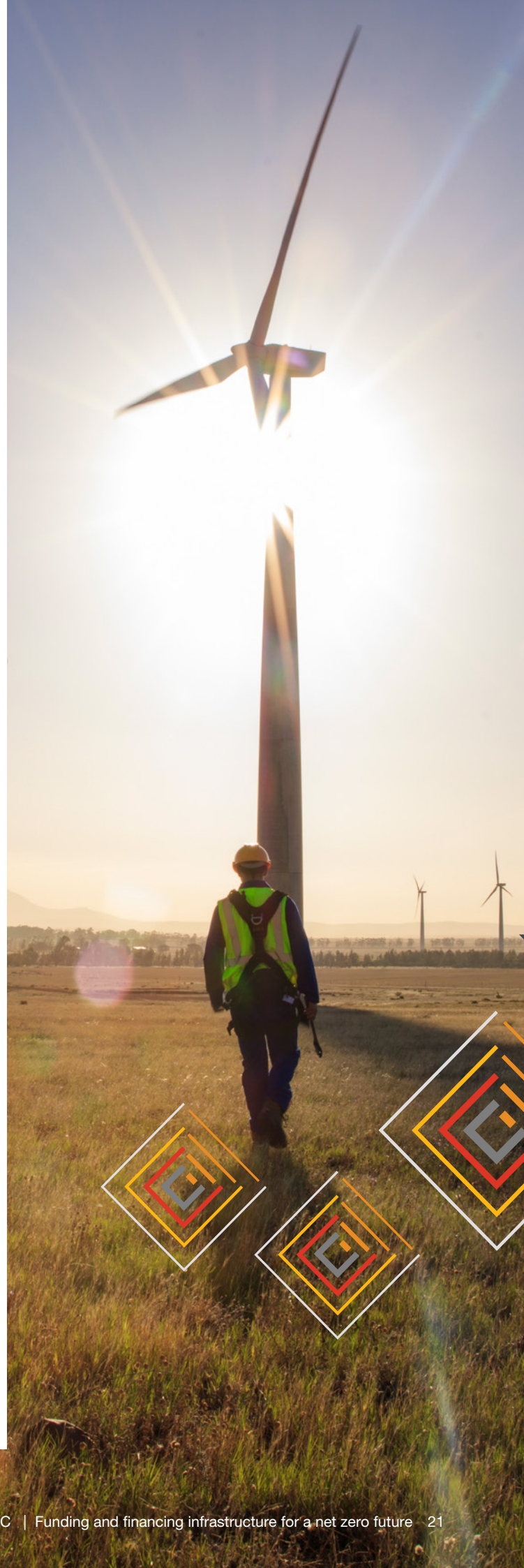
The scale of change required over the next decade as nations move towards net zero will demand unprecedented levels of funding and financing, as well as regulatory coordination.

PwC

PwC has made a science-based commitment to achieve net zero GHG emissions by 2030. PwC's net zero ambition will require a reduction in total GHG emissions by 50 per cent in absolute terms. We will achieve this by driving energy efficiency improvements in our offices and reducing the GHG emissions associated with our business travel.

PwC's commitment to net zero builds on our 2018 ambition to become 100 per cent renewable and to offset 100 per cent of air travel emissions from FY19 and residual energy use by FY22. It is also an extension of our commitment to be carbon neutral, which we have continued since 2008.

With global reach across 157 countries, broad industry coverage, and 284,000 people who support our clients – from reshaping strategy and transformation, to deals, reporting, audit, and tax – we have a huge opportunity to accelerate the transition to a net zero future together.



Integrated Infrastructure

A community of solvers building Australia's future

PwC's Integrated Infrastructure team delivers the end-to-end expertise to support Australia's growth today, and tomorrow. As a diverse community of solvers, we combine industry experience and insight to drive confidence in infrastructure outcomes - solving for clients, and communities alike. It's what we call, The New Equation.

Contacts



Janice Lee

Partner | Integrated Infrastructure
jc.lee@pwc.com



Jeremy Thorpe

Partner | Chief Economist
jeremy.thorpe@pwc.com



Chris McLean

Partner | Integrated Infrastructure
chris.mclean@pwc.com



Dr Lucas Carmody

Director | Integrated Infrastructure
lucas.carmody@pwc.com

www.pwc.com.au

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