

# Unlocking capital for Net Zero infrastructure

Aligning policy and private capital to provide the infrastructure backbone to a Net Zero economy

November 2020



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Promoting Private Investment in Infrastructure

GIIA is the membership body for the world's leading institutional investors in infrastructure. Our members operate in 55 countries across 6 continents and are responsible for over US\$800bn of assets under management globally with over one third of that value invested in the UK.

GIIA members are making significant and ongoing investments across the length and breadth of the UK to deliver the vital infrastructure relied upon by both current and future generations.



# Foreword

In June 2019 the UK became the first major economy to set a legally binding commitment to reach Net Zero emissions by 2050. Alongside government commitments, we are now seeing a sea change in societal demands with consumers increasingly choosing companies who share their environmental concerns. This shift is driving an unprecedented level of confidence in the benefits of investing in a cleaner, more sustainable future.

Investing in infrastructure is essential for Net Zero. Real Assets with high upfront costs and long asset lives need to be planned, financed and built. Clearer investment signals are required if this is to happen at the pace and scale required. Significant progress has been made in decarbonising the UK's power sector, but much more is needed to decarbonise buildings, industry and transport.

The UK's success in becoming a leading developer of offshore wind power demonstrates that, with the right balance of government policy support and private sector investment, significant strides can be taken towards meeting Net Zero by 2050. Today's emerging technologies and Net Zero innovations require the same level of strategic direction and partnership between government and private investors in order to accelerate the pace of decarbonisation.

We know that much investment can be achieved within existing regulatory structures, but many new and emerging technologies such as batteries and electric vehicle charging require new frameworks and incentives to enable timely and efficient roll out of these assets. With UK government support, we believe there is an opportunity to create an environment for investment that will 'crowd in' the same low cost, patient capital available from institutional investors such as infrastructure funds, sovereign wealth funds and pension funds that has driven investment in renewable energy. These funds are a critical catalyst to unlocking capital to build a low carbon world. If these funds are unable to invest then it is likely that new Net Zero infrastructure, as well as measures to increase the resilience of existing assets, will not be developed at the scale and pace required.

We have researched and written this report to better understand the investment environment and explore how government and private investors can work effectively together to understand how the UK can become the most competitive destination for investment into new infrastructure enabling the transition to a Net Zero future.

## Our approach and acknowledgements

PwC has been commissioned by GIIA to undertake research to understand the environment and dynamics of asset investments in energy, transport and digital infrastructure that will enable a viable pathway to achieving Net Zero.

The conclusions in this report are based on interviews with some of the largest and most active investors in UK infrastructure and internationally. The interviews are also underpinned by secondary research on the required technology assets and investment needed to roll these out at scale to achieve Net Zero.

This approach brings together the deep sector specialism of infrastructure investors with the strategic and analytical expertise of PwC Strategy&.

We would like to thank everyone who contributed to the analysis for their insights and time including Lawrence Slade, CEO of GIIA, whose support enabled valuable insights to be gained from the UK infrastructure investment community. We also interviewed a number of other investor entities who preferred to remain anonymous and we would also like to extend our thanks to them.

- Aviva Investors
- Canada Pension Plan Investment Board (CPPIB)
- Dalmore Capital
- IFM Investors
- Infracapital
- InfraRed Capital Partners
- Macquarie Infrastructure and Real Assets
- Ontario Teachers' Pension Plan
- Vantage Infra

# Executive summary: key themes

**Existing UK infrastructure requires significant investment to be capable of delivering Net Zero**

We estimate around £40bn per year is required on average to be invested in new low carbon and digital infrastructure over the next ten years. This represents about a doubling of capital requirements for UK infrastructure investment across energy, water and telecoms.

**There is a deep pool of low cost, patient, private capital already primed to accelerate investment**

Net Zero infrastructure needs to be delivered at scale, pace and at the lowest cost to maximise the benefit of Net Zero and to keep the costs to consumers and taxpayers down. Harnessing capital which is ready to invest from private infrastructure funds and corporates will avoid further burdens on government finances.

**Government can build on recent success with a clear road map for Net Zero infrastructure**

Success in scaling UK renewables shows that with access to the right capital, great progress can be made quickly. Momentum must be maintained through the creation of a long-term Net Zero infrastructure road map and supporting policies to "crowd in" more private capital.

**Policy intervention is required to enable low cost financing for less mature Net Zero technologies**

Over 50% of the Net Zero infrastructure investment identified in this report will be unable to attract the low cost, patient capital required. Other sources of private capital (such as private equity) can invest but the cost of capital is much higher.

**Government funds to be deployed on early stage projects where revenue model is undeveloped**

Investors want government to focus primarily on creating a stable environment for private investment through policy frameworks. However, there is also a role for government in the development of certain early stage technologies to provide targeted public financing support.

**Maintaining UK's reputation as a great location for infrastructure investment is vital**

Investors cite recent regulatory trends and negativity towards the private sector as having an adverse impact on the UK's attractiveness. Recent signals by the Competition and Markets Authority (CMA) are important and if followed through should help secure a supply of foreign capital into UK regulated infrastructure.



# Executive summary: key interview findings and recommendations

**Our interviews, with leading infrastructure investors, identified several opportunities and challenges when considering accelerating efficient private infrastructure investment:**

Global infrastructure investors are becoming more sophisticated and specialist meaning the UK increasingly needs to stand out to attract a global pool of private capital.

Historically, the UK has been seen as the 'gold standard' by many investors but recent regulatory trends and political uncertainty are cited as increased risks.

Net Zero infrastructure has the potential to fit the investment characteristics of infrastructure investors, but more long-term certainty is required.

Infrastructure investors are attracted to Net Zero infrastructure which investors see will future proof their portfolios – ensuring they remain relevant in the long-term.

Accelerating Net Zero infrastructure investment with sources of private capital will keep costs down and bring forward the benefits of Net Zero.

## Recommendations to UK Government to accelerate efficient private infrastructure investment

**1** Create a detailed Net Zero infrastructure roadmap (targets and policies) for each of the asset classes identified within this report.

**2** Identify and further develop revenue support mechanisms to drive efficient, timely and scaled roll-out of each Net Zero asset class.

**3** Work with private sector investors to deliver increased public/private investment in emerging infrastructure technologies.

**4** Implement best practice in infrastructure funding across UK regions and in other countries to accelerate investment.

**5** Provide clear strategic policy guidance to regulators to strike the right balance between consumer interests today and in the future.

# Existing UK infrastructure is not capable of delivering Net Zero and significant investment is required to meet the 2050 target

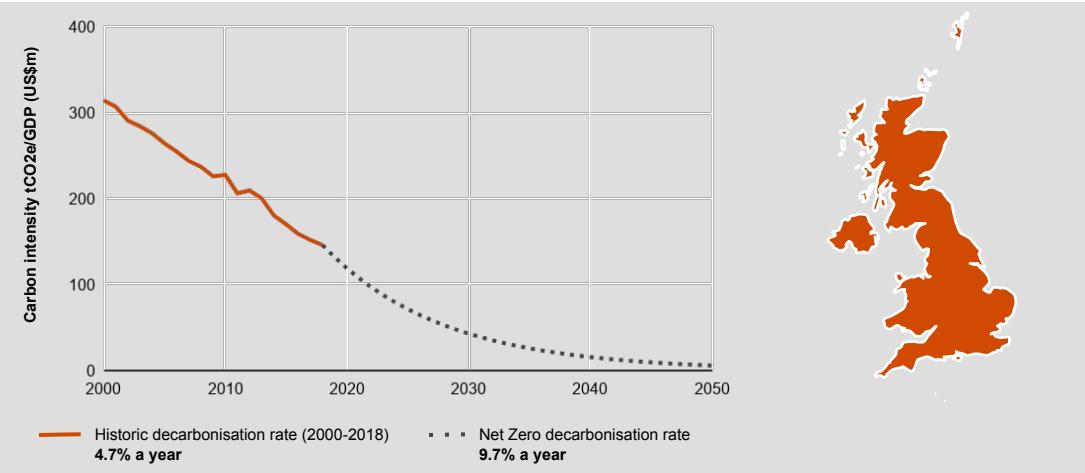
## Importance of the UK Net Zero target

Achieving Net Zero by 2050 is essential for the long-term prosperity of the UK. Transitioning to a low carbon economy post-COVID-19 provides us with an opportunity to drive a green-led recovery for a cleaner, fairer and more resilient economy.<sup>1</sup>

Failing to meet this target could leave the UK lagging in technological progress, as well as in protecting the health of the nation through preventing such things as air pollution.

To date, the UK has been a high performer with a decarbonisation rate of over 4% per annum. However, this pace is at risk of stalling as we now look to tackle greenhouse gas (GHG) emissions from buildings, industry and transport at the same time as increasing the average rate of reduction in carbon intensity of our economy to almost 10% per year.

**Figure 1: UK Net Zero Decarbonisation Requirement**



Source: PwC Low Carbon Economy Index 2019

1. For more detail on the benefits of a green-led recovery please refer to our report: [Rebuilding the UK economy: fairer, cleaner, more resilient](#).

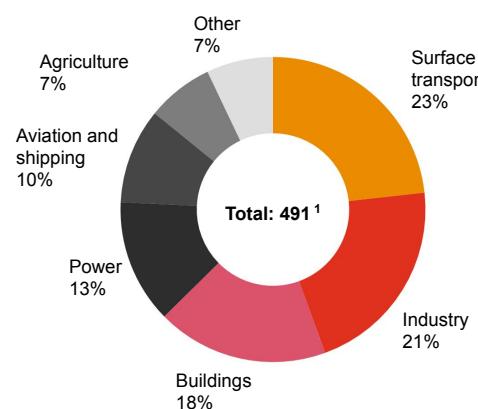
## UK emissions so far

To achieve the long-term goal of delivering Net Zero, every sector of our economy has a role to play.

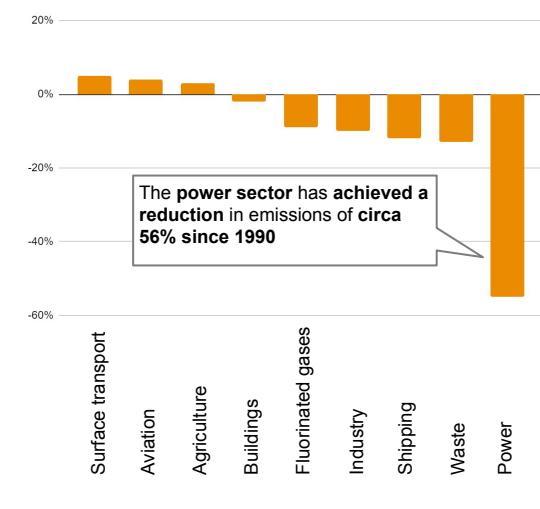
Surface transport, buildings and industry, plus the power sector remain the largest emitters, accounting for 75% of UK emissions in 2018 and are the areas most requiring big infrastructure expansion and renewal. Agriculture is a major carbon emitter. However, it has relatively low levels of infrastructure and reduction in this area will not necessarily be achieved through asset investment.

Strong progress has been made in decarbonising the power system, but other sectors need to now start making a contribution to decarbonisation and new infrastructure is key to this progress.

**Figure 2: UK Emissions in 2018 MtCO<sub>2</sub>e**



Source: BEIS, PwC Strategy& analysis.



Source: BEIS, PwC Strategy& analysis

# In our view there are four key asset classes where significant infrastructure investment is needed to meet Net Zero

## The key Net Zero infrastructure

Due to their high emissions profile, a focus on the infrastructure asset classes of power, buildings and industry and transport will be key to achieving Net Zero. Additionally, digital infrastructure is an important enabler of decarbonisation, such as remote working and smarter energy systems. Within this categorisation there exist various technologies that together will contribute significantly to meeting Net Zero,<sup>2</sup> with the mix of technologies required largely based on scenario pathways defined by the Committee on Climate Change's analysis, plus other analyses where applicable:

Overview	Power system	Buildings and industry	Transport	Digital
	 <b>Power system</b> <p>The power system remains critical for the continued decarbonisation of our UK economy. Progress needs to now accelerate in this area. Much greater levels of investment in low carbon generation, flexible power infrastructure and network upgrades will be needed.</p>	 <b>Buildings and industry</b> <p>Technologies to provide low carbon fuel alternatives into homes, businesses and industrial (including utility networks such as water and gas). For example hydrogen, or biomethane. Plus reducing wasted energy through energy efficiency infrastructure.</p>	 <b>Transport</b> <p>Decarbonisation of transport is required across road, rail, shipping and aviation infrastructure assets. Electric vehicles (EVs) and associated charging infrastructure have a key role to play but other solutions, in particular hydrogen and related infrastructure, as well as greater electrification of rail are required.</p>	 <b>Digital</b> <p>Digital infrastructure has an important role in enabling a reduction in work-related travel emissions and also in facilitating more energy-efficient, smart energy systems.</p>
<b>Key Infrastructure</b>	 <b>Low carbon generation:</b> Subsidised renewables, merchant renewables, CCUS (carbon capture utilisation and storage) with power generation, nuclear. <b>Flexible power solutions:</b> Battery storage, peaking plants, other storage such as pumped hydro. <b>Power Grids:</b> Interconnectors/OFTO (offshore transmission owner), transmission, distribution.	 <b>Industrial CCUS and hydrogen:</b> Capturing carbon from industrial processes and replacing methane for industrial heat/processes with hydrogen. <b>Residential low carbon heating and energy efficiency:</b> Heat pumps, insulation, batteries and other domestic smart energy technology. <b>Industrial energy efficiency and emissions reductions:</b> Onsite energy reduction, smart systems and low carbon energy alternatives.	 <b>Electric vehicle charging infrastructure</b> <b>Rail:</b> Electrification and low carbon fuel alternatives for rolling stock. <b>Other low carbon transport:</b> For example hydrogen for heavy vehicles, shipping and aviation.	 <b>Infrastructure for (5G) cellular networks</b> <b>Fibre broadband networks</b> <b>Data centres</b> <b>Smart meters</b>

2. Agriculture has been excluded as emission reduction is expected to be tackled predominantly through land management and animal feedstock changes with only a small amount of infrastructure for biogas capture.

# Bringing in the necessary funding to upgrade infrastructure is critical and the UK has a strong track record in attracting private investment

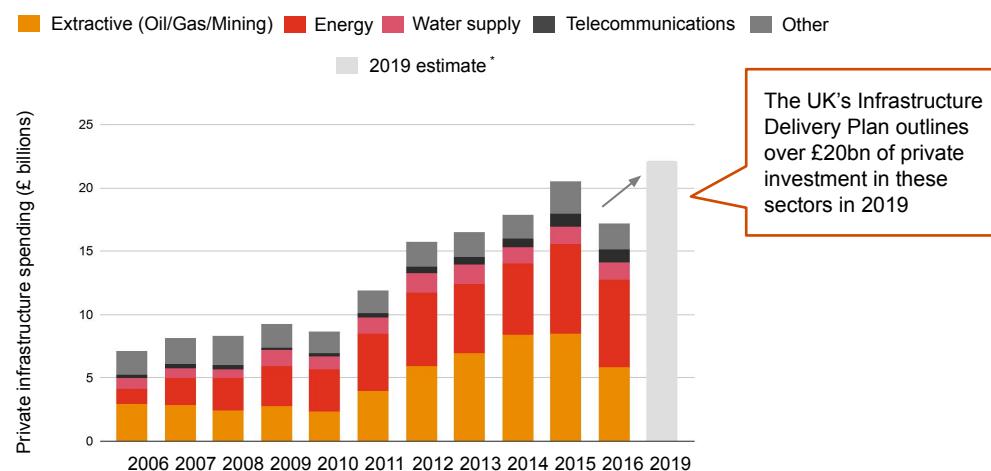
## UK infrastructure investment to date

Private investment into the broad segments that are relevant to delivering Net Zero has been growing over the last decade.

A period of disruption following the oil price crash from 2014 slowed investment into extractive sectors (such as North Sea oil and gas).

However, as outlined in the government's 'Infrastructure Delivery Plan',<sup>3</sup> growth in energy infrastructure, especially networks and renewable generation, has been successful. In fact private capital contributed to around £20 billion of UK energy and utility infrastructure financing in 2019, as illustrated in the chart below.

**Figure 3: UK Private Infrastructure Investment 2006 – 2019**



Source: UK government, PwC Strategy& analysis.

\* 2019 PwC estimate based on assumption that 50% of national infrastructure pipeline privately financed across relevant sectors.

3. Infrastructure and Projects Authority National Infrastructure Delivery Plan 2016-2021

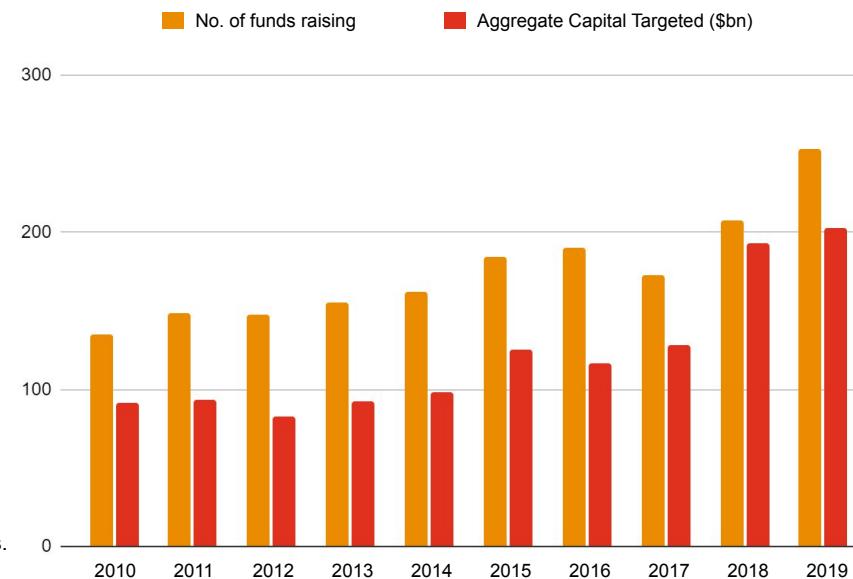
## The global market for infrastructure investment

Much of the UK's strong performance has been due to it being competitive in an increasingly globalised market for infrastructure investment.

The global private infrastructure financing market has grown to record levels during 2019 in terms of volume of capital and number of funds raising capital, as illustrated in the chart below. This indicates there has never been a deeper pool of private capital and more funds to be utilised in the journey to Net Zero.

With a strong track record of private sector involvement, successfully executed initiatives and robust project pipeline, the UK is poised to attract international funding to create a positive economic future for the country.

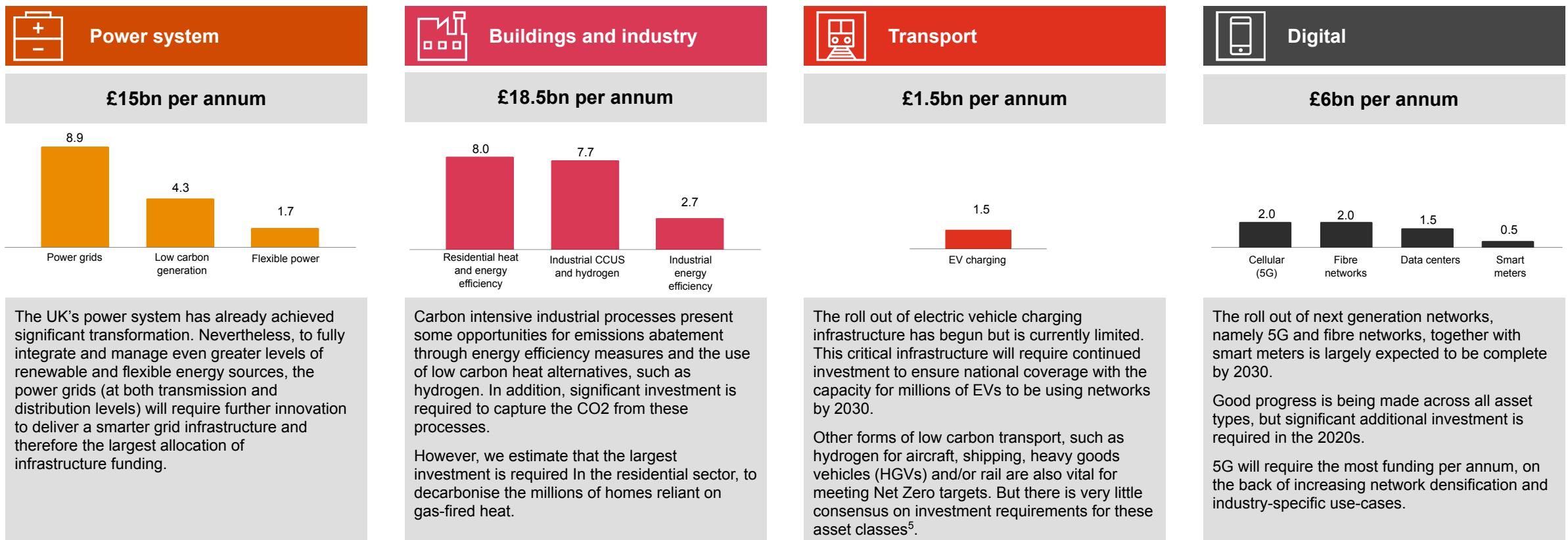
**Figure 4: Unlisted Infrastructure Funds in Market 2010 – 2019**



Source: Preqin Pro, PwC Strategy& analysis.

We estimate £40bn of investment in these infrastructure classes is needed, year-on-year, to ensure a credible pathway to Net Zero decarbonisation

**Figure 5: Average Funding Required to 2030 by Sector<sup>4</sup>**



4. Combining a wide range of sources including the analysis carried out by BEIS, CCC, RIIO investment cases, regulator assessments (Ofgem/Ofwat/Ofcom) and industry projections. Please see appendix for more information.

5. There is a high degree of uncertainty about the extent to which different technologies will contribute and therefore the infrastructure requirements have not been estimated.

# Without access to low cost private capital, achieving roll-out of infrastructure at scale and pace will be difficult and expensive – de-risking is critical

## The dimensions of risk

Low cost sources of capital can only invest in businesses and assets that have a relatively low risk. For Net Zero infrastructure, the main investment risks are driven by the following:

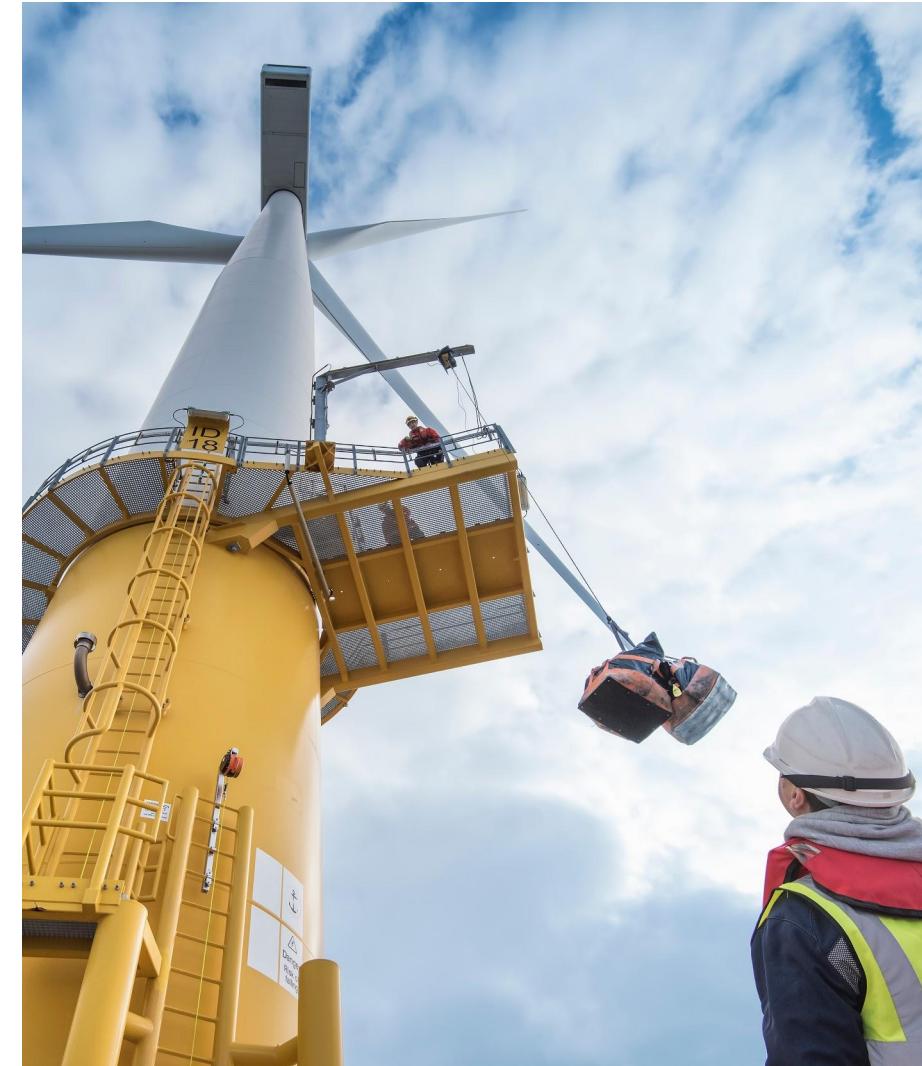
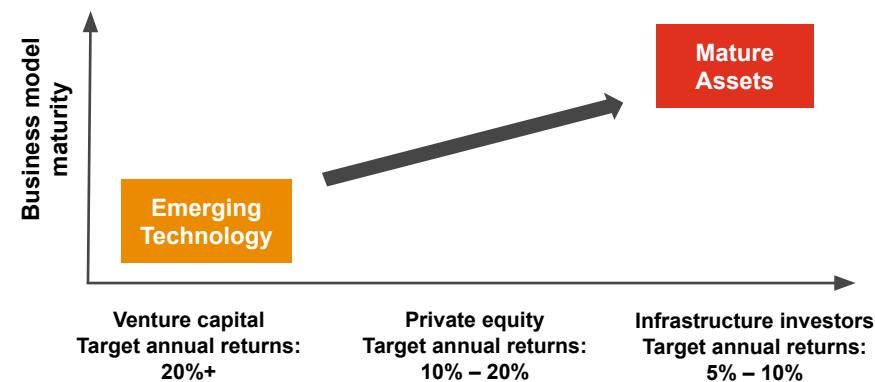
- **Technology risk:** The technology is relatively immature with a limited track record and unproven over the life of the asset.
- **Business model risk:** The infrastructure asset class has an unproven or relatively immature revenue model.
- **Policy risk:** There is a lack of clarity about how regulatory or government policy could change in the future to affect the returns of an investment in a certain asset class.

Often, it is a combination of these risks that make a particular infrastructure class unable to attract low cost capital. This means that privately financed infrastructure assets can only be rolled-out at pace and with the scale and efficiency required for Net Zero once the technology and business model have reached a certain level of maturity. Crucially, this is the point when assets can access low cost infrastructure capital.

Although some progress has been made in de-risking emerging infrastructure technologies, such as renewables, many essential Net Zero asset classes remain unable to access the lowest cost capital.

**Government has a vital role therefore in derisking the roll-out of Net Zero infrastructure assets** where there is a high degree of confidence that these assets are required to meet Net Zero targets. The aim of any government intervention would be to reduce the overall cost of delivering Net Zero.

## Business model maturity vs. type of investor



# We have interviewed investors to understand which Net Zero infrastructure technologies are deemed sufficiently low risk to attract low cost capital

## Our hypothesis

Mobilising low cost, private capital from sources such as infrastructure funds, sovereign wealth funds, pension funds and some corporates is the key to maximising the UK benefit of a Net Zero economy, through minimising costs and reducing pressure on the public balance sheet – particularly in light of the scale of public spending and the fiscal response to the COVID-19 pandemic.

We know that certain Net Zero asset classes are already seen as investable by low cost, patient capital from infrastructure investors. But a large proportion of Net Zero assets can only attract more expensive capital.

The UK government can act to create an investment environment which will encourage infrastructure investors to invest in more Net Zero asset classes to accelerate the benefits to the UK.

## Methodology

To test this hypothesis, we interviewed leading infrastructure investors who are also members of GIIA.

GIIA's members are responsible for over \$800 billion of assets under management globally with over a third of that value invested in the UK.

During these in-depth interviews, we explored each Net Zero infrastructure asset class as well as overarching drivers for Net Zero investment to understand which technologies are accessible to infrastructure fund capital.

From these interviews we identified the major themes and identified some key recommendations for UK government policy.

## Interview asset classes and topics



Power system



Buildings and industry



Transport



Digital



Drivers of Net Zero investment



Current Net Zero investments and rationale



Future Net Zero investments and rationale



Barriers to investment



Role of government



International best practice

# Our interviews highlighted how infrastructure investors have recognised the UK's past success in attracting investment...

## Future investment considerations

The interviews highlighted a strong consensus that the UK has a long history of developing innovative and effective policy mechanisms within a stable political and regulatory framework.

In particular, investors stated that the UK can be seen as a clear leader with mechanisms like Contracts for Difference (CfD), the Regulated Asset Base (RAB) regime and capacity markets.

As a member of the EU, investors highlighted how the UK has benefited from its shareholding in the European Investment Bank (EIB) and European Investment Fund (EIF). The EIB provided a cheap, long-term source of finance, addressed market failures and reduced the risk profile of projects in the energy sector. The EIF also delivered investment in high risk, high growth industries at the early stages of development.

In more recent years, a clear commitment on Net Zero and climate change has sent a powerful and clear message which appears to have cross-party support and is therefore seen by investors as an important and stable backdrop underpinning investment.

This investment environment has succeeded in driving investment across a wide variety of infrastructure assets. Significant private investment can be seen across some of the most critical 'Net Zero' areas to date.

Figure 6: Areas of Private Capital Activity to Date by GIIA Members

Sector	Number of assets*	Examples
Social	276	PFI projects (hospitals and student accommodation)
Renewable energy	137	Offshore wind in the North Sea
Transport	83	Major airports, train links (e.g. HS1)
Utilities	66	Water networks, gas networks
Telecoms and digital	23	Fibre network operators

\*Inclusive of individual projects up to company wide operations  
Source: GIIA, PwC strategy& analysis.

Critical sectors to enable Net Zero



"UK was the gold standard on policy, regulatory stability and the RAB system has been around for decades."



"Mechanisms like the capacity market, contracts for difference, and regulated asset base have been very successful at bringing forward low cost capital from infrastructure funds."

# ...but interviewees also expressed concerns that the UK remains a competitive destination for capital

Interviewees highlighted that the global infrastructure investment sector has seen investors becoming increasingly sophisticated and focused on emerging Net Zero assets. This has created a deep pool of capital, but it also presents a challenge for the UK. These investors are now looking around the world to seek out the best and most supportive environments for investment. And so the UK must work even harder to stand out to attract large quantities of low cost capital.

Examples of expressed concerns included:

- Brexit and the threat of Scottish independence are flagged as concerns that could impact offshore wind financing and carbon taxes, while the potential policy of infrastructure nationalisation could re-emerge from a change in government.
- Investing under the RAB regime (historically a very effective mechanism for attracting investment in networks and utilities) has become more challenging as regulators have consistently increased demands on assets whilst reducing returns (note – recent signals from the CMA which may serve to somewhat reverse this regulatory trend are seen as extremely important by investors<sup>6</sup>).
- Several other retroactive policy decisions have been made, impacting the overall confidence of the regulatory environment. Examples include the embedded benefits policy decisions<sup>7</sup> as part of the Targeted Charging Review (TCR).
- The continued delay in publication of the energy white paper is also identified. There has been a challenge for regulators to step in to fill the gap left by these missing policy pieces.

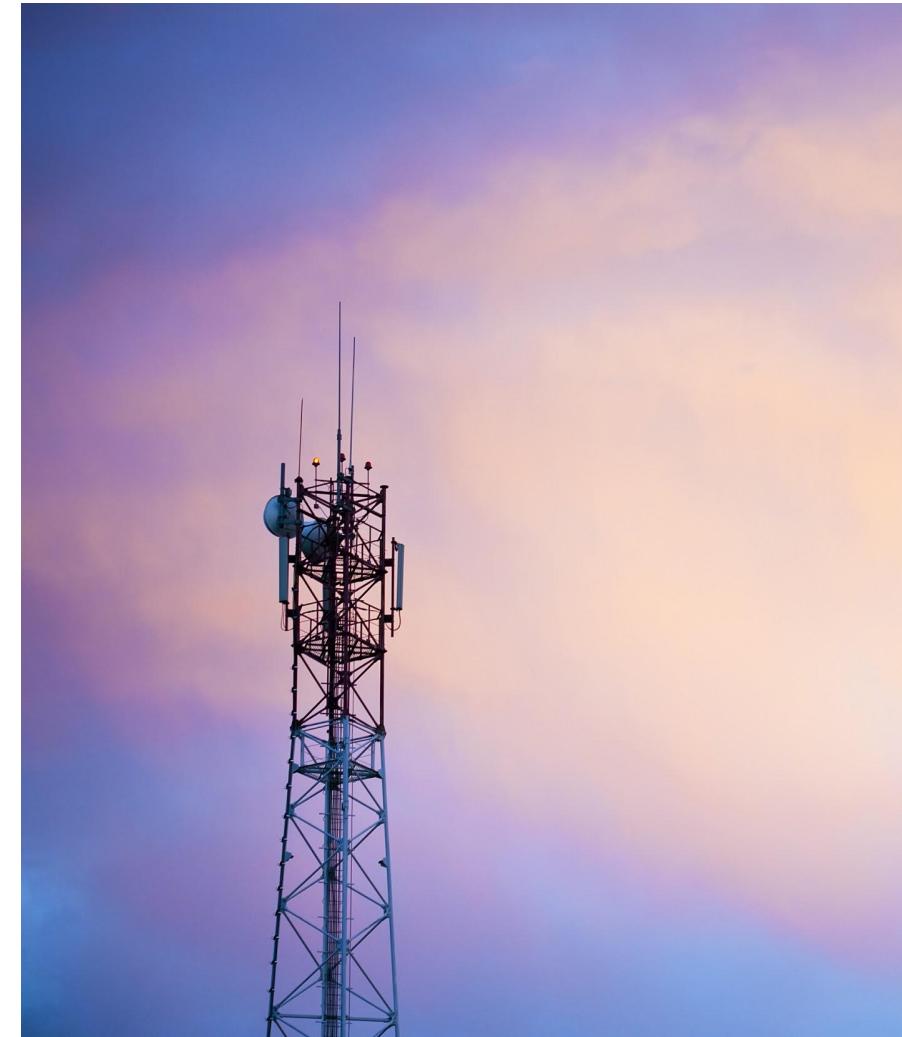
In conclusion, looking ahead, the government's ambition for Net Zero is strong, however investors highlighted there is a lack of clarity about the roadmap and long-term targets for different sectors. In addition, investors need to see regulators being given much clearer guidance for setting policy and ensuring it is aligned with Net Zero objectives.

“

"The UK has had an incredible track record of drawing in foreign investment. But it will become more challenging because of Brexit. The next few years are critical for some policy intervention and for the UK to become a world leader again."

6. CMA Summary of provisional findings report, September 2020.

7. Ofgem – Reform to non-locational Embedded Benefits.



# Interviewees agreed that the Net Zero agenda is increasingly appealing to their investors, shaping the focus of their investments



## Infrastructure investor aims

- The mandates of infrastructure investors focus on low risk, modest but stable return investments which match their investors' risk/reward appetites (for example pension funds).
- Funds like to invest in 'essential services' assets with high barriers to entry and with limited exposure to technology risk.
- Investors such as pension funds are increasingly more conscious of the need to invest in more sustainable ways of living, to protect the planet and leave a positive legacy for future generations.

## Risk mitigation

- Infrastructure investors are primarily focused on long-term predictability of revenues and 'survivability', that is the need to avoid stranded assets and minimise obsolescence risk. As a result they are shifting their portfolios towards more sustainable investment classes to mitigate this risk.
- The Paris Agreement and World Economic Forum (WEF) 2020 make it clear that investors have to proactively build ESG principles throughout their portfolios.
- The prospect of rising carbon prices is driving increased engagement with Net Zero as investors look to manage the downside risk to existing portfolio assets.

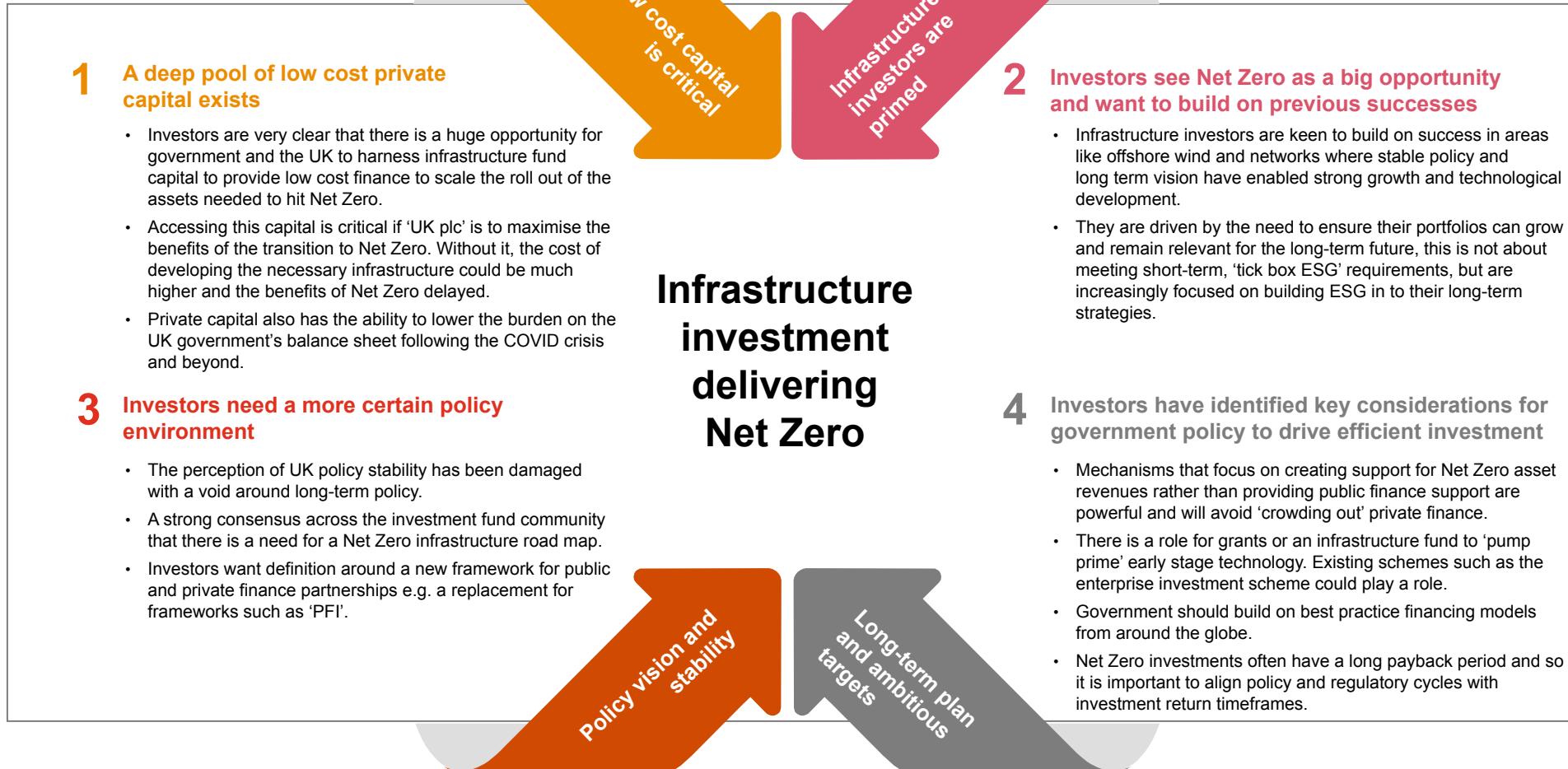
## Opportunities for growth

- Most funds see the scale of Net Zero investment required as an opportunity. However some remain more cautious due to the early stage nature of business models associated with many of the new asset classes.
- In emerging infrastructure classes, those funds that are able to invest are doing so by carving out separate 'development' funds either small enough to not be material within their main fund or with capital from investors with a different (higher) risk appetite and a correspondingly higher returns requirement.
- Investors cite successes in investing in low carbon assets such as solar and wind.
- Others have found that they can only invest in Net Zero assets 'behind the meter', that is, by taking steps to invest in existing assets to reduce GHG emissions in order to improve long-term value of the assets.

## Investor views

- Fund investors are increasingly applying pressure to funds to act and report on sustainability and therefore to invest in Net Zero assets.
- Sustainable investment and ESG (Environmental Social Governance) is now more than just a 'tick box exercise' as transitioning existing assets to or funding new assets in this space represents a growing opportunity.

# And there is a deep pool of private, low cost capital primed to invest in Net Zero infrastructure if the government sets the vision and policy framework



**"The challenges are that we are investing in something that is unproven but looks promising. So the government can help us get comfortable with that. As things become more uncertain the government can help and not necessarily by providing 100% subsidy."**

**"So much investment is needed in infrastructure, you need forward guidance by the government."**

# With regard to specific segments, infrastructure investors viewed the power system as highly investable but there are areas where policy is unsupportive

## Power systems

	Low carbon generation	Flexible power	Power grids
Overarching investor view	 Many investors are active in this space and see the market for subsidised renewables as mature. However, the merchant model is still developing and not considered investable by many investors.	 Assets such as batteries, peaking plants and demand side response technologies are seen as an emerging area where the certainty around revenue streams is insufficient to invest.	 Many funds have had, or continue to have, investment in UK networks. However, concerns were raised about the attractiveness of these assets and ability to invest in Net Zero innovations following current price control rounds.
Business model	<ul style="list-style-type: none"><li>Subsidised model is well understood and heavily invested by infrastructure investors. Significant competition is driving down returns.</li><li>Merchant projects are not attractive to most infrastructure investors but a few are already active and believe any further subsidies would result in overbuild and system inefficiency.</li></ul>	<ul style="list-style-type: none"><li>The contracted revenue streams for these types of asset are typically for a maximum of a few years – after this point, there is significant merchant power price risk. This makes them relatively risky investments unsuited to lowest cost capital.</li><li>Peaking plants also seen by some as having additional carbon risk (for example demand for gas declining).</li></ul>	<ul style="list-style-type: none"><li>The RAB model is well understood and there has been strong competition from investors for these assets.</li><li>It is unlikely that infrastructure investors will stop acquiring these assets but returns requirements might increase as the perceived regulatory price control policy risk is higher.</li><li>For Net Zero interventions on these assets (e.g. energy efficiency), the paybacks are often over a longer period than the price control and investors raised this as a concern.</li></ul>
Policy	<ul style="list-style-type: none"><li>The Contract for Difference (CfD), Feed in Tariff (FiT) and Renewable Obligation (RO) mechanisms have been highly effective at creating revenue stability.</li><li>Some of those that have invested in merchant projects have a view that if left alone, merchant renewables will continue to develop through a combination of Power Purchase Agreements (PPAs), merchant power revenues and other tools to improve income stability.</li><li>However, others are concerned that the PPA market will not have the depth or scale required and so there is a case for government intervention to keep the cost of capital down.</li><li>There are differing views on whether government needs to do more to support the development of a UK supply chain – some believe the job is done, others think more is needed.</li><li>Several investors highlight the need for government to enable more industry friendly planning rules and grid connection processes to aid faster development. As for nuclear, comments ranged from the need of early government support for mature and new technologies to assistance during the construction period.</li></ul>	<ul style="list-style-type: none"><li>Infrastructure investors see private equity type capital being well suited in this space but do see an argument for further revenue-based policy interventions by government.</li><li>Given the significant demand for batteries and therefore capital, there is an opportunity to de-risk investment and reduce the cost of capital. By intervening to create longer term revenue stability mechanisms, government could significantly reduce the cost of rolling out this infrastructure which is certain to have a role in the future system. This would be an example of 'picking a winner' but some investors believe this would have benefits to UK plc.</li><li>A few infrastructure investors have invested in this space but using a vehicle that is ring-fenced with a higher investor risk appetite and consequently higher returns requirements.</li></ul>	<ul style="list-style-type: none"><li>There is a widespread view that recent regulatory price control determinations have created a more challenging and risky environment for investment.</li><li>The view is that regulators have prioritised reducing consumer bills now at the expense of long-term performance and investment, exactly at the time when a long-term view is required to step up investment towards Net Zero and the longer term consumer benefit. This is felt particularly in the water sector but also applies to gas and power networks.</li><li>Several infrastructure investors stated that they would not look to increase their exposure any further to UK RAB based assets.</li><li>However recent statements by the CMA have indicated that a more balanced view between current and future consumers is required and this is seen as a very helpful intervention for infrastructure investors.</li></ul>



"Most pension funds are realising that power prices are volatile. Covid-19 shows that investing in renewables is not just about investing in stable subsidised power. It can be a volatile ride."

# Buildings and industry is viewed as challenging by infrastructure investors due to the lack of revenue models and limited scalability of energy efficiency projects

## Buildings and Industry

	Industrial CCUS and hydrogen infrastructure	Industrial energy efficiency	Residential heat and energy efficiency
Overarching investor view	 There is broad consensus across all infrastructure investors that investment in carbon capture, usage and storage (CCUS) for industry or power generation use remains at too early a stage for infrastructure investment capital. Similarly, hydrogen networks and related infrastructure are also seen as not yet investable with too much technology risk and business model uncertainty.	 A lack of clear targets and supporting policy and scalability are the key challenge. Most infrastructure investors see this asset class as too disaggregated and challenging to scale.	 Scalability of business model and lack of a comprehensive suite of home energy efficiency standards mean there is a lack of motivation from homeowners to install insulation, heat pumps and other low carbon energy interventions.
Business model	<ul style="list-style-type: none"><li>A major challenge for infrastructure investors is the lack of clarity about the revenue models for these assets, as well as the need for significant up front development capital.</li><li>It is thought that only strategic investors, such as oil majors with a big enough balance sheet, could take on this size of investment with such a degree of uncertainty about the business model.</li><li>Some investors have highlighted a high degree of uncertainty as to whether these technologies have a long-term role to play. This is especially true for hydrogen where there is a question around whether 20% hydrogen in the gas mix is sufficient to get to Net Zero.</li></ul>	<ul style="list-style-type: none"><li>Some funds have begun to invest in energy efficiency 'behind the meter', that is in assets already owned in order to enhance their long-term value, for example installing solar and heat pumps in a real estate portfolio.</li><li>Energy efficiency projects in regulated sectors can be hard to achieve payback within the five year regulatory cycles.</li><li>A few funds have invested in platforms to develop this infrastructure. For example by investing in an energy services business that can install efficiency assets and lease them back to a business energy consumer. However, scaling this model is challenging and unlikely to work in domestic premises.</li></ul>	<ul style="list-style-type: none"><li>None of the infrastructure investors interviewed see a way to achieve sufficient project scale and returns in this asset class.</li><li>There remains a market failure in terms of the drivers for investment in these essential assets because the payback period for most investments is too long for homeowners.</li><li>In addition, homeowners are unlikely to want to or be able to borrow capital to invest as the payback is often not sufficient to cover the financing costs.</li></ul>
Policy	<ul style="list-style-type: none"><li>Most investors share the view that a revenue model, such as RAB, would be effective at bringing forward private, lower cost capital and that support from government in the form of grants is required for the early development phases.</li><li>An alternative model mentioned in interviews is a CfD for hydrogen to enable hydrogen to compete with natural gas as an energy source.</li><li>Government needs to address the risk that hydrogen assets become redundant if the gas (methane) grid becomes unviable over time.</li><li>Government financial support at the development stage is important to get this technology off the ground</li><li>Australia and Germany were both cited as good examples of clear and effective policy in this space.<sup>8</sup></li></ul>	<ul style="list-style-type: none"><li>Investors cite a 'policy black hole' when it comes to decarbonisation of heat and this creates too much uncertainty associated with investment in UK energy efficiency.</li><li>There is also a view that government should continue to focus on creating incentives and mechanisms to enable existing energy efficiency services companies to install these assets.</li></ul>	<ul style="list-style-type: none"><li>Given the lack of opportunity for private financing to play a role in this asset class, it is likely that government funding through energy efficiency grants such as the 'Green Homes Grant' is a helpful intervention.</li><li>In addition, investors recommend that government should focus on developing buildings standards and other incentives to encourage or require homeowners to install these assets in the home.</li></ul>

<sup>8</sup> Follow links for more detail on the Australian and German hydrogen strategies.



"There is a policy black hole, particularly around gas and its future in the UK."

# In transport, decarbonisation technologies and business models, especially EV charging, are at a too early stage of maturity for low cost, patient capital

## Transport

	EV charging	Other transport (including rolling stock)
Overarching investor view		All infrastructure investors agree that this new asset class has a very immature and uncertain business model and is therefore generally unable to access low cost financing which can provide the significant scale of private funding required for this asset class.
Business model	<ul style="list-style-type: none"><li>The major challenge for infrastructure investors is a lack of confidence over revenue streams for EV charge point assets where utilisation levels are currently low due to the early stage of EV roll out.</li><li>In addition there are concerns around the risk of overbuild in urban centres such as London. Conversely it is recognised there is a risk of underbuild of these assets in rural areas.</li><li>Some funds also see continued uncertainty as to whether EVs are the technology of the future versus other options such as hydrogen-fuelled vehicles.</li><li>Funds are concerned about technical obsolescence of charge points.</li><li>Infrastructure investors flag that automotive OEMs may be investing in this infrastructure anyway, almost as a 'marketing' expense and not to make profits, distorting the risk profile. Similarly, destinations like supermarkets and gyms may look to offer these facilities for free – making a return on investment increasingly challenging.</li></ul>	 <ul style="list-style-type: none"><li>The technologies seen as most likely to have a role are at too early stage of development. In particular hydrogen fuel cells are viewed as having potential but none of the funds we spoke to were investing in this technology given the lack of a clear revenue model and the technology risk.</li><li>However, within rail, on the rolling stock side, several infrastructure investors have investments in rail rolling stock companies. These investors have been taking measures to future proof their rolling stock assets by beginning, at a small scale, to invest in low carbon fuel alternatives such as hydrogen.</li></ul>
Policy	<ul style="list-style-type: none"><li>Many funds pointed to a regional concession or utility style model being required to drive fast and efficient and more planned roll out of this infrastructure class in both urban and rural settings.</li><li>This could be delivered also via the regional power network utilities, but this goes against current government policy.</li><li>The government needs a clear plan with London EV charging described as similar to the 'Wild West'.</li></ul>	<ul style="list-style-type: none"><li>There is no clarity about the road map or targets for decarbonising other forms of transport. Long-term and ambitious targets are required to drive confidence and investment in each transport category.</li><li>Alongside this, a range of policy incentives, revenue mechanisms and financing support will be required to drive investment in the development and roll out of the technology options.</li><li>Electrification of the railways is seen to have a key role in decarbonisation but the Network Rail programme of electrification is viewed as having come to a halt.</li></ul>



"EV charging is interesting but the business case remains to be proven."

"The EV technology needs to evolve and the operation of the various networks need to consolidate."

"EV charging in London is like the wild west... everyone is trying to do it everywhere. We can imagine the end point which might see charging as a utility driven business but it doesn't feel like the government has a plan."

# Digital business models are attractive for investment but need scaling up through policy to have a greater impact

## Digital

	Mobile infrastructure	Fibre	Data centers
Overarching investor view	 <p>Significant investment has already been made by mobile operators, but density of mobile tower infrastructure is likely to be increased in the context of rapid traffic growth and 5G roll-out. There is also the potential for opportunities around dedicated small cell deployments in urban areas.</p> <p>Capital for 'sale and leaseback' model, in terms of existing tower infrastructure is the easiest point for infrastructure investors rather than greenfield assets.</p>	 <p>Fibre to the home (FTTH) coverage is currently low at 14% but there is significant momentum (financial and operational) behind rapid expansion.</p> <p>"It is a race to roll out fibre" but there are risks in some locations, (particularly around overbuild).</p>	 <p>Infrastructure investors' activity in the data centres market is somewhat more nascent than other areas of digital infrastructure but interest is growing.</p>
Business model	<ul style="list-style-type: none"><li>Attractive business passive infrastructure model where a single tower is sold to multiple mobile network operator (MNO) tenants.</li><li>Long-term stable (often inflationary linked) cash flows with growth opportunities associated with new tenants and 'amendment revenues' (where existing tenants add additional equipment on to towers), as well as fibre related revenue streams from linking various networks i.e. backhaul related income.</li><li>There remain large portfolios of towers in the hands of UK MNOs which could present attractive opportunities for infrastructure investors; albeit these assets are likely to be highly sought after including by international strategic players.</li></ul>	<ul style="list-style-type: none"><li>Long-term solid demand characteristics in a market which has historically been underserved with significant headroom remaining for expansion.</li><li>Some infrastructure investors cited a proven business model for rural roll-out but flag that competition can be high. In some locations this can deter some investors.</li></ul>	<ul style="list-style-type: none"><li>Complex space with diverse business models ranging from large hyperscale data centre platforms serving the largest global tech companies to smaller regional co-location asset serving local SMEs.</li><li>For attractive assets, there can be a lot of competition in this space as there is clear future demand which may be reflected in returns.</li><li>There is potential to match data centres to power stations in combination, as power costs can form up to half of the operating cost of a typical asset.</li></ul>
Policy	<ul style="list-style-type: none"><li>Public policy focused on removing barriers to infrastructure roll-out (such as planning and code powers for example), as well as improving coverage in very rural areas.</li></ul>	<ul style="list-style-type: none"><li>Highly supportive public policy and political environment with circa £5 billion of subsidy expected to support roll-outs in rural areas.</li><li>Other countries have developed models to encourage investment through guaranteeing revenue with public contracts or dividing the country into clear segments to bid (such as France and Poland).</li></ul>	<ul style="list-style-type: none"><li>To be attractive to long-term ESG focused investors, data centres must be future proofed and policy in the Netherlands is a strong example, as data centers there must have a high level of power usage efficiency and practice 'nature-inclusive construction'.</li></ul>

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"Digital is the utility of the future."

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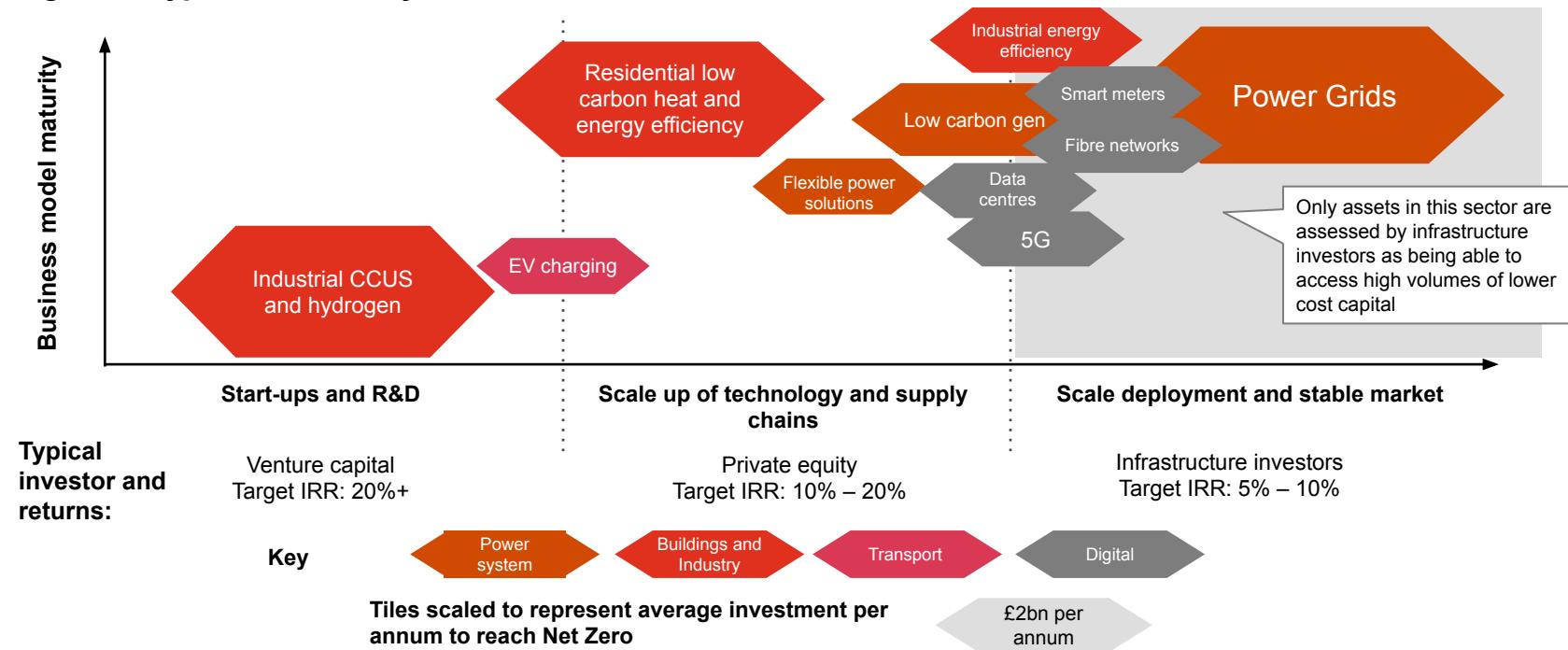
"Digital is one of the most transformational infrastructure classes."

Based on our research and interviews, we see that over 50% of the £40bn annual investment requirement cannot currently access low cost financing capital

### Net Zero infrastructure access to capital

- The technologies identified to progress the UK to Net Zero are at various stages of maturity and will attract investors with varying risk appetites and cost of capital requirements.
- Those where technology is being developed and/or those with nascent business models such as hydrogen or EV charging will not be able to attract the low cost infrastructure fund capital that has typically driven the scale of investment needed in other infrastructure categories.
- Given the huge investment sums required for investment in Net Zero infrastructure, this suggests that government needs to take action to facilitate efficient and ultimately low cost investment.

**Figure 6: Typical investor by asset class**



### The role of policy is to maximise investment

Our analysis indicates that asset classes representing only around **50%** of the Net Zero asset investment required are able to access low cost capital. This is due to these assets being too immature and presenting high technology, business model or policy risks that make low returns financing unviable.

Given that we know private capital is the key to unlocking investment in Net Zero infrastructure, we can see that intervention is required by the government to de-risk the roll out of less mature technologies. Only this way can we ensure that the low cost private capital can be harnessed for the Net Zero infrastructure programme.

The UK government has been successful at developing policy to drive low cost investment in sectors such as power networks. Now policy intervention should be focused on providing certainty for investors across the other Net Zero infrastructure classes.



"We are not a venture capital fund. We can bring a large amount of capital in one go. We are wondering if pension capital can make a contribution to these emerging technologies?"

# Therefore, we propose five key policy recommendations to channel efficient capital into Net Zero infrastructure investment



# About the authors



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# Appendix: Methodology for Net Zero investment outlook

Using a range of secondary research sources, PwC estimates that infrastructure investment in assets required to steer the UK towards achieving Net Zero will need to average over £40bn per annum to 2030, with similar levels to be sustained onwards to 2050.

To compile this estimate, we collected sources which as closely as possible matched our defined Net Zero asset segments (as seen on page 7).

There will inevitably be overlapping categories (e.g. EV charging and distribution networks) and as the CCC notes in its analysis, given likely cost decreases and technological advances in the future, estimates at current prices will likely be towards the upper end of any potential outcome.

The range of sources used include:

- Committee on Climate Change (CCC), Net Zero Technical Report Data Book, Further Ambition Scenario (2019).<sup>9</sup>
- Ofgem, RIIO-2 investment draft determinations.
- Water network operators' estimates (where available).
- Scottish Power, Zero Carbon Communities (2019).
- Telecom network operators' estimates (where available).
- Ofcom Communications Market Report 2020.
- Energy Systems Catapult, Storage and Flexibility Model, (2019).
- National Grid, Future Energy Scenarios, Leading the Way Scenario (2020).<sup>9</sup>
- BEIS, Smart meter roll-out: cost-benefit analysis (2019).
- Research and Markets, Data Centre Outlook (2020).

<sup>9</sup>This scenario is used as it is the pathway with highest likelihood of reaching Net Zero by 2050.



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