

Why investors should act in response to climate-related risks and opportunities: a survey of current evidence

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Executive summary

Since the publication of the Stern Review on the economics of climate change late in 2006 there has been a significant increase in awareness and understanding of the huge climate-related economic and financial risks we face. The nature of climate change means the risks are characterised by high uncertainty overall and a need to pay attention to extreme scenarios and so-called ‘tail risks’. Climate change will affect both the value of assets and the capital return on assets over the long-term, which is why understanding its impacts is relevant to the fiduciary duty owed to savers and fund beneficiaries.

This report provides a summary of currently available evidence and analysis in response to the commonly posed questions below:

1. What risks does climate change pose to the value of and income from financial assets and portfolios?
2. What are the financial (transition) risks for high-carbon and fossil fuel assets, including the risk of asset stranding?
3. What are the risks for investments in sectors with secondary exposure?
4. What evidence is there that climate risk is not adequately priced into the market?
5. What investment opportunities are raised by the climate change transition?

The evidence shows that there are clear trends emerging and irreversible shifts under way, although the impacts of climate change and the dynamics of related social and economic transitions are characterised by high levels of uncertainty at the level of specific outcomes. These changes will have highly significant impacts on the success, income and value of companies directly exposed to climate change risks (e.g. fossil fuel companies), on sectors with secondary exposure (including banking and finance, insurance, transport, and construction) and on the economy as a whole.

Risks and opportunities related to the climate and energy transition can be identified and factored into investment strategies and decisions, as well as company business models, although this is not yet happening to the extent required. Some markets are not adequately pricing in climate risks and opportunities and so long as this continues the prospect of larger disruptions, shocks and sudden corrections is becoming an increasingly significant risk factor. Investors need to position their portfolios to take advantage of trends that can be identified now and be resilient to unpredictable disruptions and shocks that may manifest in future.

Integrating climate risks into investment policies, strategies and decisions is becoming easier. The legal and regulatory frameworks are being progressively clarified, providing assurance to boards and trustees that perceived barriers to pension funds (and investors) integrating climate risk factors are often based on misunderstandings or are surmountable. Pension funds and

other investors are already changing their strategies to ‘tilt’ portfolios towards low-carbon and climate-resilient sectors, to divest from high-carbon sectors like fossil fuels, and to invest in areas of opportunity like infrastructure and renewable energy technologies. The market is responding to provide better and more cost-efficient solutions to investors’ needs, and to ensure these are adaptable to fit the specific approaches and needs of different customers including those of long-term investors like pension funds.

Market analysis is showing that climate-tilted investment portfolios and benchmarks can match, and in some cases outperform, conventional benchmarks on measures including overall returns, risk-adjusted returns and income. Some climate-aligned sectors such as green infrastructure and renewable energy offer the prospect of return characteristics that are in many ways at least as good a match for the needs of investors like pension funds (e.g. for reliable and consistent income in the long-term) as traditionally important sectors like oil and gas.

Overall, the imperative to act in response to climate-related financial risks and opportunities is becoming clearer all the time while the case in favour of a ‘wait-and-see’ approach is now difficult to support. The question now is ‘how’, rather than ‘if’, investors should integrate climate risk into their investment strategies and decisions.

1 What risks does climate change pose to the value of and income from financial assets and investment portfolios?

Climate-related financial risks can be grouped into **physical risks** (from changing weather and climate), **transition risks** (from market shifts involved in a low carbon and climate resilient economy), and **liability risks** (e.g. negligence, misrepresentation or regulatory compliance). Climate change also raises systemic risk for natural systems in the environment, and to social, economic and financial systems.

Recent years have seen improvements in the modelling of climate change impacts and related financial risks. There are a range of risk analysis methods and models in use by different actors and seeking to address a range of objectives, including both assessing the expected impact of climate transition and also the effect of ‘unexpected’ or unlikely events which are possible and material. It is important to avoid relying solely on linear risk assessments, which may forecast likely outcomes in relation to specific risks but are unable to shed light on impacts arising from the combination of changes in complex systems with high uncertainty and a wide range of possible outcomes.

Researchers using a range of data and methodologies have quantified the range of risk to the global stock of tradable or manageable financial assets estimated at \$143 trillion and several reports have estimated the value of assets at risk from climate change impacts:

- In June 2018 a team from Cambridge University, Radboud University, the Open University, Macau University, and Cambridge Econometrics published research in the academic journal Nature which finds that a sizable shift away from fossil fuels will occur regardless of whether or not more stringent policies are adopted. Collapsing demand could lead to a rapid shift from high to low value sometime before 2035 – a bursting of the carbon bubble where the global economy could see **between \$1 trillion and \$4 trillion slashed from the value of fossil fuel assets alone**.¹
- Analysis published by the Economist Intelligence Unit in 2015 puts the **average value at risk for financial assets globally across a range of climate scenarios to 2100 at \$4.2trn** – roughly the value of all the world’s listed oil and gas companies. Warming of 5°C could result in \$7trn of losses, with 6°C warming bringing \$13.8tn of losses.²
- A 2016 report from the Grantham Research Institute at the LSE puts the **value at risk at \$2.5trillion in a business-as-usual scenario and \$24.2 trillion at the 99th percentile** of the probability distribution.³

¹ J-F Mercure et al (2018), ‘Macroeconomic impact of stranded fossil fuel assets’, Nature Climate Change 8, 588-593. Summary of findings available at, <https://www.camecon.com/news/carbon-bubble-could-wipe-trillions-from-global-asset-values/>

² Economist Intelligence Unit (2015), ‘The cost of inaction: recognising the value at risk from climate change’. Value at risk is calculated as the effect of climate change this century on the global stock of tradable financial assets, which total \$143tn, in present value terms.

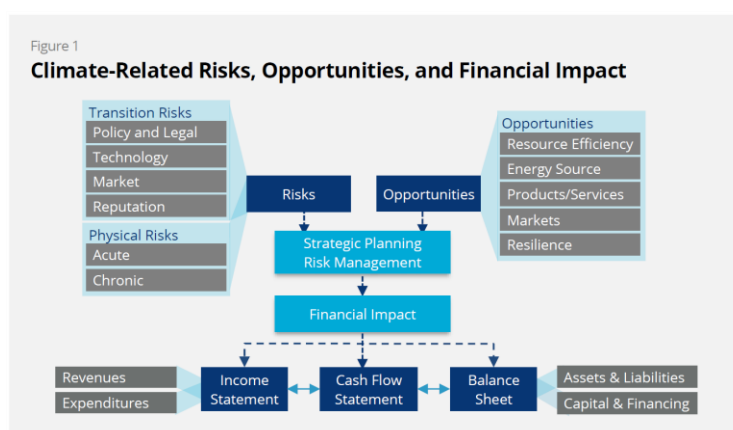
³ Dietz, Simon, Bowen, Alex, Dixon, Charlie and Gradwell, Philip (2016), ‘Climate value at risk’ of global financial assets. Nature Climate Change. Value at risk quantified as the loss on a portfolio of assets over a given time horizon, at a given probability. In this

- Schrodgers has calculated that limiting temperature increases to **2°C limits the hit on global GDP to 2% by 2100, while a 4°C increase reduces GDP by 10% and a 6°C increase reduces GDP by 50%**. They estimate we are on course for a 4.1°C temperature rise.⁴

The analysis by the Economist Intelligence Unit indicates much of the impact will come from weak growth and low asset returns across the whole economy, but that climate change mitigation action can halve the total losses. This suggests investors need to be proactive in supporting climate change mitigation rather than simply avoiding vulnerable asset classes and sectors. The fact that climate change generates systemic risks combined with the extreme and unpredictable nature of some of the relevant risks means that seeking to address the impact on societies, economies or portfolios in a piecemeal way or in isolation is of limited use.

The economic analyses presented here should not distract from the fact that the impacts of climate change (particularly above two degrees of warming) on people and social and natural systems are likely to be huge. Climate change and related environmental causes are expected to displace hundreds of millions of people in the course of this century, with steady and sudden mass migration alongside disruption to food and water supplies leading to severe conflict and security risks as well as economic and political consequences.⁵

Climate change and related transitions will have a major impact on the economic performance of companies, sectors and asset classes right across the global economy. Regardless of which scenarios unfold and which outcomes occur within them, changes will be significant and come with a high degree of uncertainty. These changes will in turn affect the shape and performance of investment portfolios. Investors need to take steps to assess risk and account for it in decision making to avoid suffering losses or missed opportunities.



Source: TCFD, Final Report: Recommendations of the Taskforce on Climate-Related Financial Disclosures, 2017

case, a measure of potential for asset price corrections due to climate change on the global stock of tradable financial assets (\$143tn).

⁴ Schrodgers (2017), 'Climate Change: calibrating the thermometer'.

⁵ Stapleton et al, ODI (Nov 2017), 'Climate change, migration and displacement: the need for a risk-informed and coherent approach'.

1.1 Transition risks

As described by the Task Force on Climate-related Financial Disclosures (TCFD) and represented in Figure 1 (above), transition risks describe those risks to organisations resulting from the extensive policy, legal, technology and market changes associated with meeting the requirements for climate change mitigation and adaptation, including shifting to a low-carbon economy. These risks will vary according to the nature and speed of the changes that occur. Those same categories of changes form a key set of drivers for companies and investors to change their assumptions, strategies and decisions over time.

Government policy and regulations, from national and international emission reductions targets to carbon pricing/trading to environmental and energy efficiency standards, drive much of the action by businesses and investors. Landmark steps like the Paris Agreement add clarity and substance to policy change and help set market expectations about future shifts. The 2016 New Climate Economy Report assesses how many businesses are also moving ahead of policy – responding to pressure from stakeholders and the opportunity for reputational gains, cost savings and opportunities in growing markets, as well as the desire to reduce climate change impacts.⁶ The report identifies a wide range of collaborative corporate initiatives including those galvanizing collective commitment, seeking to transform markets or systems, and to engage directly in policy making or implementation.

The following table contains just a few examples from dozens of national and international initiatives where business are taking up leadership roles and collaborating with governments and civil society organisations. June 2018 has seen, for example, IKEA launching new science-based targets to become climate-positive by 2030 while calling on other companies to follow suit,⁷ and Vodafone becoming the latest business to commit to sourcing 100% renewable electricity by 2025.⁸

⁶ New Climate Economy (2016), 'Driving Low-Carbon Growth Through Business and Investor Action'.

⁷ https://www.ikea.com/us/en/about_ikea/newsitem/061318-IKEA-Group-climate-positive-2030

⁸ <https://www.businessgreen.com/bg/news/3033516/vodafone-targets-100-per-cent-renewables-and-40-per-cent-co2-cut-by-2025>

Science Based Targets Initiative ⁹	Provides companies with tools and resources to set targets in line with keeping global temperature rise below 2°C. As of July 2018 over 430 companies are participating and 120 have approved science-based targets.
Powering Past Coal Alliance ¹⁰	Global alliance led by 20 countries, bringing together governments, business and civil society to achieve a rapid phase-out of coal power. Companies are making commitments to power their operations without coal and to collaborate on how to do so.
RE100 ¹¹	RE 100 is a global initiative of The Climate Group and CDP. 100 major international companies have committed to sourcing 100% renewable electricity. This initiative is helping to support demand for renewables and innovative financing arrangements such as renewable energy Power Purchase Agreements (PPAs).
Tropical Forest Alliance 2020 ¹²	Public-private partnership connecting private sector, government and civil society leaders to reduce deforestation in tropical forests. The aim is to shift the market dynamics for the commodities driving deforestation – palm, soy, beef, paper and pulp.

Analysts Kepler Cheuvreux report that overall direct portfolio exposure for all financial investors to fossil fuel sectors ranges from 4-13% of total assets, but that combined exposure to sectors that may be affected by climate change and energy transition shifts is 45-47%. Their research shows that insurers and pension funds have over \$3 trillion of exposed equity holdings in affected sectors, of which substantially over \$1 trillion is in highly exposed fossil fuel, utilities and energy-intensive sectors.¹³ A significant financial impact is implied for stocks in these sectors, especially where transition risks are not yet properly priced in to the market.

Kepler Cheuvreux also explain that risks may materialise much sooner and more rapidly than anticipated, citing the rapid decline in the share prices of European power utilities such as EDF, RWE and EON, and the business challenges that result from policy or technological setbacks (or breakthroughs). They cite scenario analysis from the Bank of England, which finds that if energy stock dividends start to fall by 5% per year (from 2020) the energy firms affected would lose 40% of their equity value.¹⁴ The anticipated fall in power utilities' share prices is the result of multiple difficulties in the sector, affecting both costs and revenues. These are not necessarily linked directly to climate change (narrowly defined), but they are strongly linked to the large-

⁹ <https://sciencebasedtargets.org/>

¹⁰ <https://unfccc.int/news/more-than-20-countries-launch-global-alliance-to-phase-out-coal>

¹¹ <http://there100.org/re100>

¹² <https://www.tfa2020.org/en/>

¹³ Kepler Cheuvreux, 2018, 'Investor Primer to Transition Risk Analysis'

¹⁴ Ibid

scale energy transition that is unfolding, and of which climate change and other environmental and technology shifts are major drivers.

The Bank of England explains that while the risk of a large and system-wide adjustment may not be immediate, this risk can rise in coming years if portfolios are not aligned with climate targets. Misallocation will grow and could result in a sudden and abrupt re-pricing of financial assets (a so-called 'Minsky moment'), which could have system-wide implications well beyond immediate financial losses. Risks to financial stability are minimised if the transition begins early and follows a more predictable path.¹⁵ Other less dramatic sudden adjustments are quite possible in future. For example, the Climate Action 100+ group of investors represents a combined total of nearly \$30 trillion in assets under management.¹⁶ It is quite possible that their combined action may shift the balance from engagement towards divestment strategies, if there is insufficient action from the world's largest corporate GHG emitters in the next few years. Some members of the group, such as the Church of England's investment funds, have committed to a deadline of 2023 to divest from companies that do not meet their requirements.¹⁷

Survey data published in 2018 by UKSIF and The Climate Change Collaboration found that fund managers who responded agreed that transition risk will significantly affect oil company valuations in the next 5 years, while 90% expected at least one risk to significantly impact valuation within 2 years.¹⁸ This survey represents managers of funds amounting to £13 trillion of assets under management, although at the same time it is acknowledged that this group represents those asset managers with a relatively high level of focus and awareness on sustainability and climate risk.

1.2 Physical Risks

Physical risks from climate change include the impacts of **extreme weather** such as storms, floods and droughts, and long-term **climate variability** bringing higher temperatures, rising sea levels, and shifting weather patterns. Extreme weather events can be extremely costly to economies and companies in the short and medium term. Hurricane Sandy, which hit New York in 2016, caused \$30 billion of losses. Drought in California has lasted seven years so far and cost the economy \$2.7 billion in 2015.¹⁹

Physical risks can result in large financial losses to companies, specific sectors and investment portfolios which, even if not directly exposed, are likely to be affected via exposure to index-linked investment products. Even if those losses are adequately insured this can still have a large impact on insurers (and, in turn, investors), despite losses for households or firms being

¹⁵ Bank of England (2017), 'The Bank of England's response to climate change', Quarterly Bulletin Q2

¹⁶ <http://www.climateaction100.org/>

¹⁷ <https://www.ipe.com/countries/uk/church-investors-set-2023-climate-engagement-deadline/www.ipe.com/countries/uk/church-investors-set-2023-climate-engagement-deadline/10025750.fullarticle>

¹⁸ UKSIF and The Climate Change Collaboration (2018), 'Not long now: Survey of fund managers' responses to climate-related risks facing fossil fuel companies'.

¹⁹ Victoria Barron, Newton IM (2017), 'Investment implications of global warming'.

potentially reduced. Disruption to established insurance arrangements (for example linked to increased incidence of flooding in the UK) and increases in regulatory capital requirements for insurers are not the only impacts. Disasters can lead to claims related to supply chain disruptions as well as direct damage to property or physical assets. Financial asset values may be affected directly (as for real estate) and through indirect real-economy effects, which will affect large parts of investment portfolios for pension funds and life insurers, and may have an impact on overall investor sentiment and market expectations.²⁰

1.3 Climate action is a ‘necessity’ and is perfectly possible

Blackrock acknowledges that many investors will aim to act in support of climate objectives as well as in an effort to capitalise on opportunities and reduce risk. Blackrock Investment Institute’s 2016 report on Adapting Portfolios to Climate Change is unequivocal in stating that climate aware investing is a necessity. Moreover, it does not have to entail giving up returns or taking on a greater tracking error against a benchmark. Their analysis shows that the carbon footprint of a portfolio can be cut by 70% while keeping within a 0.3% tracking error versus the benchmark.²¹ Blackrock has developed a composite climate score for US companies which found that a simulated portfolio overweighting the highest performing companies versus the Russell 3000 Index had average CO₂ emissions 50% below the benchmark and outperformed the benchmark by seven percent from 2012-15.²²

The Swedish public pension fund AP4 has demonstrated that is possible to address the climate impact of a portfolio in a sector-neutral way whilst maintaining a close link to benchmark performance. It divested holdings of stocks in companies with the highest carbon footprints across a wide range of sectors and reduced the carbon footprint of its portfolio by 50%, while remaining within a tracking error of 0.8% against the S&P 500 index.²³

It is important to highlight here that carbon footprint is not the same as climate change risk, but rather just one measure of potential exposure to climate risk (and contribution to harmful climate change) – albeit in many cases an important one. For example, carbon footprinting does not take account of a range of other important factors, such as the pricing power of a company in key markets or the adaptability and resilience of a company’s portfolio of assets in the face of various climate change and financial risk scenarios.²⁴ Focusing on the carbon footprint of a portfolio is unlikely in isolation to be sufficient to manage climate-related risks, but rather it is one of a range of valuable tools to inform decision making and to monitor performance.

²⁰ Bank of England (2015), ‘The impact of climate change on the UK insurance sector’.

²¹ N.B. limiting tracking error and matching the performance of benchmarks is not, of course, the ultimate goal or responsibility of pension funds, which strive to manage assets in order to meet long term liabilities in the shape of payments to beneficiaries. However, within portfolios, these metrics are influential due to their role in fund selection and management.

²² Blackrock Investment Institute, 2016, ‘Adapting Portfolios to Climate Change: Implications and Strategies for Investors’.

²³ Economist Intelligence Unit (2015), ‘The cost of inaction: recognising the value at risk from climate change’.

²⁴ For an example of how go beyond carbon footprinting to adapt an investment portfolio to address climate risk, see: Impax Asset Management (2016), ‘Carbon risk for investors: Building a “Smart Carbon” portfolio’.

GMO investment management has analysed the returns on the S&P 500 and its predecessor, the S&P 90 over the period from 1957 to 2017 and from 1926 to 2017. Over that 90-year time period the impact of excluding any of the 10 main market sectors is negligible. The data shows that excluding any group of stocks tends to have a much smaller effect than we assume, and that the change is as likely to be positive as negative.²⁵ Research commissioned by Newton Investment Management found that fossil fuel screens had no significant impact on portfolio returns, volatility and income in developed markets over a shorter study period of 2004 to 2015. In fact, returns were marginally higher and volatility marginally lower. In emerging markets, the benefit of fossil fuel exclusion was significantly greater over all rolling 3-year periods in the study.²⁶

“What does this mean for divestment? It means that if investors take out fossil fuel companies from their portfolios, their starting assumption should not be that you have destroyed the value. Their starting assumption should be until proven otherwise, that it will have very little effect and is just as likely to be positive by 17 basis points as negative. That is an amazing contradiction to what every investment committee has ever said, as far as I am concerned... Ethical arguments for divestments are simply not necessary. They are a pure bonus.”

Jeremy Grantham, 2018²⁷

1.4 Unhedgeable risk – compounding the need to take action

Research from the Cambridge Institute of Sustainability Leadership has shown that even robust steps to change asset allocations and investment selections cannot offset all the negative effects of climate change on financial portfolios. Without significantly quicker and more far-reaching system-level interventions (policy and regulatory action) this gap, which they term ‘unhedgeable risk’, could account for half of the negative portfolio impacts.²⁸ Far from undermining the case for action, this analysis is a reminder of the need and opportunity for investors to take action with a dual motivation:

1. To offset negative portfolio financial impacts and capitalise on opportunities, in line with the duty to optimise returns for beneficiaries;
2. To contribute to climate change mitigation which will benefit society and economies as a whole, as well as reducing levels of unhedgeable risk.

²⁵ See discussion at: <https://www.advisorperspectives.com/articles/2017/12/21/jeremy-grantham-and-lucas-white-on-climate-change-investing> . Data presentation at: <https://www.advisorperspectives.com/pdfs/SP-Indices1.pdf>

²⁶ Newton IM (2017), ‘The impact of ethical investing on returns, volatility and income’.

²⁷ <http://www.lse.ac.uk/GranthamInstitute/news/the-mythical-peril-of-divesting-from-fossil-fuels/>

²⁸ CISL, 2015, ‘Unhedgeable Risk: how climate change sentiment impacts investment’.

2 What are the financial (transition) risks for high-carbon and fossil fuel assets, including the risk of asset stranding?

Financial assets in high carbon and fossil fuel sectors are most clearly and highly exposed to climate change risks. They are most likely to be affected by transition risk, including via changes in regulation and social and market shifts to cleaner (and increasingly cheaper) alternatives. In many cases, their projects and facilities (many of which require huge capital expenditure and have a very long operating life) are also among the most exposed to the physical impacts of climate change, whether this be power stations and oil and gas refineries located in coastal areas, or offshore drilling platforms exposed to extreme weather conditions as well as the challenge of rising sea levels. Further, they are exposed to litigation risks linked to regulatory compliance or failure to act to adapt, mitigate, and disclose material risks. This report focuses on transition risks.

Markets are already shifting, alongside technological, political and social changes. Political shifts may become significant for new exploration and reserves extraction. In 2017 France passed a new law banning new fossil fuel extraction permits and preventing the renewal of existing licenses beyond 2040, and New Zealand has since announced it will not grant any new extraction licenses.

The Institute for Energy Economics and Financial Analysis (IEEFA) notes that the energy sector comprised 16% of market capitalisation in the S&P 500 in 2008, but that today this figure stands at 6%. Investors are looking away from the sector as it fails to adapt to key global trends including the energy sector transition, the shift of value to technology companies,²⁹ and a generational transfer of wealth as younger people are aligning their investments with values and choosing cleaner and more forward-looking business sectors.³⁰ While some oil majors are taking steps to engage with the shift a low carbon economy - albeit too slowly and accounting for much too little of their investment - other companies like ExxonMobil have had an uncomfortable relationship with investors concerned about climate change. Even when compelled by major shareholders to publish a climate change risk assessment of its business, Exxon produced a report that has drawn severe criticism from commentators who say it falls short on details and approach.³¹

As the value and profits of the traditional energy companies decline in absolute terms, and as a proportion of overall portfolios, there may be a snowball effect as it becomes easier for investors

²⁹ This shift of value stems from a structural change in the global economy, reflecting massive rise in the value of internet-enabled services and the central importance (and high value) of data, and the ability of the largest technology companies to establish dominant positions and huge levels of income in these new markets as well as likely positions of dominance in potentially very large sectors such as energy grid services.

³⁰ IEEFA, <http://ieefa.org/ieefa-update-as-exxonmobil-doubles-down-on-oil-and-gas-investors-go-elsewhere-2/>

³¹ See, for example, the following responses: <https://www.ceres.org/news-center/press-releases/new-exxon-report-step-forward-investor-disclosure-climate-change-falls>; <http://ieefa.org/wp-content/uploads/2018/03/ExxonMobils-Climate-Risk-Report-Defective-and-Unresponsive-March-2018.pdf>

to underweight the sector and look elsewhere. For example, investors looking for so-called 'smart beta' strategies may find it easier to incorporate a tilt away from high-carbon sectors and stocks.

Perhaps the most commonly cited analysis of transition risk for fossil fuel extraction and power sectors is the 'stranded assets' analysis pioneered by Carbon Tracker. The fundamental thesis is based on measurement of the available global 'carbon budget' for GHG emissions if we are to limit warming to 2°C in relation to the fossil fuel reserves being extracted and burned. Combining scenario data about future demand and supply for fossil fuels with information about the planning assumptions (e.g. demand, capital and production cost, breakeven oil price) and asset portfolio (location, type of resource, carbon intensity, lifetime) of individual companies enables calculation of the likelihood that specific assets will become uneconomic and 'stranded', as well as the degree to which company cash flows and valuation may be affected overall.

This analysis (like all others) has limitations, for example due to reliance on International Energy Agency (IEA) scenario data that makes contested assumptions, limited ability to capture non-linear dynamics and shifts in market sentiment, and the risk of giving the impression that some oil and gas investments are reasonable and safe (as well as that others are definitively unsafe). Despite these limitations, the analysis remains a useful and powerful tool, particularly in its ability to provide a relatively simple and clear expression of the type and scale of risks associated with investment in fossil fuel assets.

The assets that are most likely to become uneconomic and be stranded are those which require high capital expenditure, have a long lifetime, and require high demand and prices to break even. Allocating capital expenditure (capex) budget to these assets should be considered very risky. Recent Carbon Tracker analysis, looking at the range of IEA scenarios, provides a clear indication of the severe transition risks that apply to many existing, and especially new, oil, gas and coal mining assets:

- \$1.6 trillion of capex (33% of the total) is at risk under the IEA Beyond 2 Degrees Scenario (B2DS), aligned with a 50% chance of limiting warming to 1.75°C, relative to the New Policies Scenario (NPS), aligned with 2.7°C warming.
- Coal is the biggest threat and the most financially at risk, but accounts for less than 10% of investment under all IEA scenarios.
- No new coal mines should be developed except in India in all IEA scenarios (due to India's desire to eliminate reliance on imported coal), although even in India there is real uncertainty about viability.
- Over 40% of new oil and gas capex is not needed in the B2DS. No new thermal coal mines in the US or China or the seaborne export market (some possible in India), and no new oil sands projects under the Sustainable Development Scenario or B2DS. Very little Arctic Oil should be extracted.
- A large amount of exposure to high-risk oil and gas projects is in the private sector (and part-listed state-owned companies). Less so for coal, although nearly half of private capex in coal is at high risk.

- In general new projects are far more risky than existing ones, for all fuels and scenarios. Gas fields decline more slowly than oil, but gas demand also declines much more slowly, so many existing projects are viable for a long time.³²

In fact, it is arguable that some of the CTI figures are estimates at the low-end of possible value at risk. Given the use of IEA scenarios that allow for more fossil fuel development than many experts feel is allowable, far greater quantities of capex may be at risk of impairment or stranding. Research published by Oil Change International in 2016 finds that potential emissions from currently operating oil, gas and coal fields would take us beyond the thresholds for 2°C of warming, and oil and gas alone would breach limits for 1.5°C.³³

Coal power generation is highly exposed to transition risks. The story for US coal in particular has been one of precipitous decline in recent years. From 2008 to 2016 its share of generation in the US fell from 50% to 30%, coal production fell by 38%, coal mines have closed and six coal companies filed for bankruptcy between 2015 and 2017. Financial analysts see little hope for US coal, despite the changes of policy in the Trump Whitehouse. Although coal plants were hit by environmental regulations many were already failing on economic terms, while carbon capture and storage (CCS) projects have proved expensive and ineffective and unlikely to come to the rescue.³⁴

CTI analysis finds that:

- Cashflow is negative for 54% of coal power assets in the EU, rising to 97% by 2030, meaning that companies rely on securing capacity market payments and avoiding air pollution regulations.
- Operating cost for coal could be higher than the average lifetime cost for onshore wind by 2024 and solar power by 2027.
- No unabated coal plants are compatible with a 2°C climate scenario, and CCS technology remains unproven, unreliable and much too expensive to be economic.³⁵
- The EU could avoid €22bn in losses by phasing out coal plants early in line with the Paris agreement. RWE alone could avoid losing €5.3bn by retiring their coal units.³⁶
- In the US, stranded value for coal power owners under the B2DS scenario is measured at £104 billion out to 2035, with Dominion having an estimated 60% of stranded value.

³² Carbon Tracker (2018), 'Mind the Gap: the \$1.6 trillion energy transition risk'.

³³ Oil Change International (2016), 'The Sky's the Limit: Why the Paris climate goals require a managed decline of fossil fuel production',

³⁴ David Schlissel, IEEFA, (2017), 'Can the US coal industry come back', in Forum, Issue 111, The Oxford Institute for Energy Studies. <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2018/01/OEF-111.pdf>

³⁵ In 2017 Forbes analysis in the US showed coal plants equipped with CCS were three times as expensive as onshore wind and more than twice as expensive as solar power, <https://www.forbes.com/sites/energyinnovation/2017/05/03/carbon-capture-and-storage-an-expensive-option-for-reducing-u-s-co2-emissions/#5e78c5ad6482>

³⁶ Carbon Tracker (2017), 'Lignite of the Living Dead'.

- Regulatory risk is estimated at \$185 billion to 2035, and merchant utilities have lost around half of their market capitalisation over the past 2 years (to December 2017).³⁷

Analysis from IEEFA finds:

- The majority of the EU's 600 coal power facilities are not compliant with regulations under the incoming new Emissions Directive (BREF), even at the upper limit of the ranges imposed, (i.e. the lowest standards that may be implemented).³⁸
- IEEFA's assessment of the way in which the energy transition is affecting large utilities around the world sees fossil fuel and nuclear fleets suffering severe losses. The group of 'underperforming utilities' in this study suffered a loss of market capitalisation of \$185 Billion from 2007 to 2016, amounting to a loss of market share of 67%.³⁹

An increasing range of analysts and other organisations are now recommending that investors not only focus on potentially stranded assets, but tilt portfolios heavily or entirely away from poorly performing fossil fuel assets in general. CTI recommends that investors should adjust the value ascribed to coal power assets and companies. They argue that a turning point has now been reached. New coal is no longer competitive, and existing coal will increasingly struggle to justify extended operation. This demands assessment of which power units need to close in certain timeframes. Vattenfall's Moorburg plant in Germany is newly built and came online in 2015. Its capital cost was over €3 billion and yet CTI analysis in 2015 found that it is likely to be cash flow negative throughout its lifecycle and potentially has a negative net present value.⁴⁰

New investment in coal is considered highly risky, and power companies and investors are being strongly urged to reconsider investment in coal and prepare for a low carbon future where there are increasing opportunities in renewable energy and battery storage.⁴¹ Renewables are already out-competing fossil fuel power on cost in new bids, and though it will take time before they are the dominant source of power, their rise is now established and inevitable. Incumbent energy sector players consistently underestimate the progress of renewables by large margins. This is in part due to over-reliance on outdated data in a sector undergoing rapid change and also linked to their failure to account for the ability of renewables to provide for the marginal change in increasing energy demand. Marginal change is critical for financial market valuations as it is a sign of coming success or failure, which will be priced in long before the system has fully transformed.⁴²

This is not to say that fossil fuels will not continue to be extracted, bought and burnt in large quantities for many years to come, particularly for hard-to-replace heavy industrial uses like steel production. The momentum in the system and the variable pace of economic and energy

³⁷ Carbon Tracker (2017), 'No Country for Coal Gen: Below 2°C and regulatory risk for US coal power owners'.

³⁸ IEEFA (May 2017), 'Europe's Coal Fired Plants: rough times ahead'.

³⁹ IEEFA (2017), 'Global Electricity Utilities in Transition: Leaders and Laggards – 11 case studies'.

⁴⁰ Carbon Tracker (2015), 'Coal: caught in the EU utility death spiral'.

⁴¹ Carbon Tracker (2017), 'Lignite of the Living Dead'.

⁴² Kingsmill Bond (2017), 'Revolution not evolution: Marginal change and the transformation of the fossil fuel industry', University of Oxford.

transitions around the world make this inevitable. But a growing body of analysis and opinion proposes that a fundamental shift is now under way. It has long been argued that the potential of renewable energy to supplant fossil fuels is constrained by limited ability to provide guaranteed supply and balance load across the power grid. Recent studies show that improvements in grid infrastructure (such as enhanced interconnection and responsiveness/flexibility) mean that wind and solar power can supply at least 50% of total electricity - even without potential breakthrough technologies in areas like battery storage.⁴³

3 What are the risks for investments in sectors with secondary exposure

The climate-sensitivity of different sectors and asset classes may vary significantly and in according to particular risk factors. Mercer have produced analysis breaking down the level of sensitivity:

- Policy is the most significant risk factor. The industries expected to be most sensitive are energy and utilities and the sector with the highest negative sensitivity to policy change is coal-generated energy. Renewables have the highest positive sensitivity. Energy and utilities also have the greatest negative sensitivity to resource availability and physical impacts, with industrials also especially sensitive to physical impacts.⁴⁴
- Within each sector there will be “winners and losers”. Corporate debt could be subject to downgrade and defaults, with a knock-on effect for banks and investors with large lending books or corporate debt holdings.
- Over the long term (35 years), for a well-diversified portfolio, a **Transformation** scenario where timely action limits temperature rises to 2°C does not jeopardise financial returns, a common misconception. The **Fragmentation** (Higher Damages) scenario, where limited action results in warming of 4°C or above, is increasingly detrimental to returns over time and the Transformation scenario becomes increasingly favourable.
- At a total portfolio level, under the Transformation scenario, there are key areas that investors should focus on: e.g. developed market equities versus emerging market equities and real assets.
- The most apparent differential between winners and losers is at an industry sector level and investors can position themselves accordingly, for example by underweighting or overweighting certain climate transition-sensitive sectors in order to manage the downside risks as well as position for favourable opportunities.⁴⁵

The work of the TCFD and the research and leadership of the Bank of England (and other central banks and regulators) demonstrate very clearly the scale of concern about the exposure of the financial system and financial sector companies to climate change risks.⁴⁶ Financial

⁴³ IEEFA (2018), ‘Power-Industry Transition, Here and Now’.

⁴⁴ N.B. Mercer’s sector categorisation here uses a broad ‘energy’ sector category, rather than the clear splitting of sub-sectors used at other times in their analysis.

⁴⁵ Mercer (2015), ‘Investing in a Time of Climate Change: Environment Agency Pension Fund report’.

⁴⁶ Bank of England (2017), ‘The Bank of England’s response to climate change’, Quarterly Bulletin Q2.

institutions carry exposures to the sectors most exposed to physical, transition and liability risks. They are also vulnerable to the onset of system-wide shocks, which become more likely if policy measures, economic decisions and asset allocations remain out of line with targets for climate change mitigation and adaptation.

4 Evidence that climate risk is not adequately priced into the market

Analysis by the 2 Degree Investing Initiative (2Dii) and Generation Foundation shows how certain types of non-cyclical, non-linear and long-term risks (including climate change-related risks) are not adequately measured or included in investor decision making, despite the fact that they are actually predictable in important ways. These risks are described as ‘white swans’, left in the dark by financial analysis that suffers from critical flaws:

- Financial analysts tend to provide recommendations over a 1-3 year timeframe (often just 1 year for equity analysts), so they usually only value risks that are expected to affect company cash flows in that short timescale.
- Cash flow forecasts used by sell-side analysts rely on historic data and forecasts for the next 3-5 years. In some cases this is extended to 7-11 years in sectors with unusually stable and predictable profiles.
- Risks (and opportunities) linked to the energy transition are one of the clearest examples of climate-related risks that can be assessed but in practice are not priced into market intelligence or decision making. This mispricing may fundamentally alter capital flows in carbon-intensive sectors.
- Pension funds, as long-term investors, aim to optimise returns over 15-30 years, and on this basis as much as 80% of net present value is based on cash flow beyond 5 years’ ahead.⁴⁷

“At its heart, carbon risk focuses on the potential for consumption of fossil fuels to be materially lower than is implied by today’s prices. A recent literature review indicates that it is unclear whether market prices reflect climate risk, while our review of methodologies used by sell side analysts indicates that most do not factor potential carbon pricing into their calculations. The apparent mis-pricing of coal stocks in 2011 indicates that markets may indeed be blind to significant risks.”

Impax Asset Management, April 2016⁴⁸

Analysis from Carbon Tracker shows how recent reforms to the EU Emissions Trading Scheme (ETS) market have already seen the price of carbon allowances treble over less than one year, rising recently to €16 per tonne. The arrival of the Market Stability Reserve, which comes into force in January 2019 and will limit the supply of allowances, is driving the shift in price.

⁴⁷ 2Dii and Generation Foundation, 2017, ‘All swans are Black in the Dark: How the short-term focus of financial analysis does not shed light on long term risks’.

⁴⁸ I Simm et al, Impax Asset Management (2016), Carbon risk for investors: building a “smart carbon” portfolio.

Moreover, Carbon Tracker analysis projects prices of €20/t in 2019 and €25-13/t over 2020-21. Making the ETS Paris-compliant would require a far bigger squeeze on supply up to 2030 and implies EUA prices averaging €45-55/t over the 2021-230 time-period. Rises of this magnitude would, of course, have a very significant impact on high carbon sectors.⁴⁹ The latest World Bank report on the State and Trends of Carbon Pricing (2018) finds that there is continued growth in commitments and implementation of ETS and carbon taxes at national and sub-national levels, with a 56% increase in the value of those taxes from 2017 to 2018, and with technological progress enabling new systems for monitoring, reporting and analysing carbon emissions and the state and impact of carbon markets or taxes.⁵⁰

The lack of adequate data from companies (in general and on long-term risks/scenarios in particular) remains a critical obstacle preventing those risks being well understood or properly priced into markets.⁵¹ The progress of the TCFD initiative is important in driving a clearer and more urgent focus on both voluntary and mandatory disclosure of information on risks and their financial implications. Analysis of the climate risk disclosures of the eight largest oil and gas companies argues that there are serious omissions, inaccuracies and inconsistencies in reporting, despite the latest reports being of a higher quality than those previously published.⁵²

Analysts report that current market expectations about commodity prices and share prices in the oil sector remain based primarily on historical norms and mainstream projections of demand. This means that if, and when, there is a clear increase in the likelihood of a low carbon scenario manifesting, there could be a rapid market sell-off in the oil sector (and related sectors) as markets correct.⁵³ As the abovementioned research finds, company analysis and reporting is failing to provide the information the market requires. It is not providing sufficient clarity or detail about the way in which long-term strategy intends to address the energy transition away from reliance on fossil fuels.⁵⁴

Unreliable scenario analysis can hinder rather than help climate action and distort investment decisions and asset values in the near term. The energy sector scenarios published by the IEA are by far the most influential and widely used at present. Company and investor strategies are benchmarked against them, and large energy projects are sometimes justified directly by reference to how they fit and perform within the IEA scenarios. Analysis by Oil Change International and IEEFA argues that the IEA scenarios contain weaknesses and assumptions that enable the justification of projects and investments that are in fact highly problematic in

⁴⁹ Carbon Tracker Initiative, 2018, 'Carbon Clampdown: closing the gap to a Paris-Compliant EU-ETS'.

⁵⁰ World Bank (2018), 'State and Trends of Carbon Pricing 2018'.

⁵¹ See 2Dii (2017), 'Limited Visibility: the current state of corporate disclosure on long-term risks', for analysis of weaknesses in reporting.

⁵² Carbon Tracker (2018), 'Under the Microscope'. https://www.carbontracker.org/reports/under-the-microscope/?mc_cid=6b6348367e&mc_eid=c6f7083288

⁵³ Cornerstone Capital Group (Dec 2017), 'Peak Uncertainty: Evaluating oil company governance at the dawn of the electric transport age'.

⁵⁴ See Ingrid Holmes, E3G (2017), 'Pathways to 1.5/2°C-compatible oil: is managed decline the only way', for analysis of oil and gas company strategies, including the non-strategies of 'drift' and 'ostrich'.

terms of climate impact and investment risk.⁵⁵ The World Energy Outlook (WEO) is published each year and is built around three energy sector scenarios:

- **Current Policies Scenario (CPS)** – assumes no new policies are introduced
- **New Policies Scenario (NPS)** – assumes ‘cautious implementation’ of new policies that have already been announced
- **Sustainable Development Scenario (SDS)** – formerly called the 450 Scenario, this assumes policies will be implemented to achieve the SDGs and the Paris Agreement goals.

In 2017 the IEA published two new and more ambitious scenarios – albeit outside of the flagship WEO publication. The **Faster Transitions Scenario (FTS)** and the **Beyond 2 Degrees Scenario (B2DS)** do reach a 66% probability of keeping warming below 2C but neither scenario approaches 1.5 degrees and both rely heavily on unproven technologies like CCS and negative emissions technologies. Critics argue that the IEA is compromised by the influence of its 30 member governments and energy companies and that its use of scenarios appears to reflect this fact. According to Oil Change International and IEEFA’s analysis:

- The NPS is the overwhelming focus of the WEO and surrounding communications, occupying 80% of the narrative in the main report. It is often taken as a default reference case.
- The content of the various IEA scenarios is arguably inadequate to support climate action:
 - NPS – implies a temperature rise of between 2.7 and 3.3 degrees and so is far from being in line with climate policy objectives.
 - SDS – fails to comply with Paris goals. Analysis shows it would exhaust the 1.5 degree carbon budget by 2023 and the 2 degree budget by 2040, and gives only a 50% chance of keeping warming below 2 degrees.⁵⁶

The SDS is often used by investors as a benchmark for climate resilience. Oil and gas and coal companies choose to make statements declaring that their portfolios are resilient to the 450S or SDS – neither of which are Paris-compliant. These include: ExxonMobil, Shell, BP, Total, Glencore, BHP Billiton, and Chevron. The analysis from Oil Change International and IEEFA argues that many investors are mistakenly using 450S or SDS to assess whether investee companies are meeting requirements for climate action. These include Barclays, HSBC, CalPERS, and the Asian Infrastructure Investment Bank.⁵⁷

The problems with the transparency, understanding and use of scenarios, including those from the IEA, may seriously affect understandings of climate risk. Usage of problematic or opaque

⁵⁵ Oil Change International and IEEFA, April 2018, ‘Off Track: How the IEA guides energy decisions towards fossil fuel dependence and climate change’.

⁵⁶ Oil Change International and IEEFA, April 2018, ‘Off Track: How the IEA guides energy decisions towards fossil fuel dependence and climate change’.

⁵⁷ Oil Change International and IEEFA, April 2018, ‘Off Track: How the IEA guides energy decisions towards fossil fuel dependence and climate change’.

scenarios, or of a limited range of scenarios, risks perpetuating mispricing of fossil fuel and energy assets as well as inadequate or ill-informed investment strategies and decisions. With such complex systems, drivers and variables involved in understanding climate-related financial risks and opportunities, it is imperative that investors have access to a range of scenarios in order to understand the range of possible shifts and impacts.

The TCFD has made it clear that scenario analysis is important for understanding the impact of future changes on individual assets or investments, and on particular sectors or regions.⁵⁸ Discussions convened by the Bank of England and TCFD in November 2017 provide important insights on the use of scenarios, including the following:

- Understanding and questioning key assumptions is vital – e.g. many 2°C scenarios assume very significant CCS deployment despite the fact the technology is not working and lacks investment.
- Small differences in scenario assumptions or data inputs can make very large differences to a business or financial strategy, so detail is very important.
- Corporate and investor scenario analysis tends to focus too much on short-term performance when valuing long-dated assets. Valuations are heavily influenced by current commodity prices and historic supply/demand dynamics.
- The energy sector tends to base asset pricing on a single central case scenario, rather than testing against a range of scenarios.⁵⁹

‘Anchor Scenarios’ are hugely important to ensure comparability alongside scenarios developed by individual organisations and groups. These anchor scenarios need to be publicly accessible, relevant, internally consistent, and have highly transparent assumptions and documentation.⁶⁰ The range of scenarios that can be described as ‘in line with’ or ‘compliant’ with a 2°C pathway and/or the Paris Agreement illustrate the difficulties that are experienced in the absence of such reliable benchmarks.

5 What investment opportunities are raised by climate change transition?

MSCI’s fossil fuel divestment brief explains the range of active and passive approaches now available to investors wanting to account for climate risk and opportunity. Within the scope of divestment strategies alone, there are many options available and these are further expanded when adding other approaches like use of low carbon indices, which can reduce carbon footprint and risk across a portfolio while minimising the tracking error to the benchmark. Evidence over the last 5 years for MSCI indexes which exclude all companies with coal or fossil fuel reserves does not show any negative impact on financial performance in an otherwise diversified

⁵⁸ TCFD Final Report, 2017.

⁵⁹ Details of the event, presentations, and summary of discussions available online at: <https://www.fsb-tcf.org/event/tcf-d-boe-conference-climate-scenarios-financial-risk-strategic-planning/>

⁶⁰ Ibid.

portfolio. In fact, both showed returns that were slightly better than the benchmark MSCI ACWI index in this timeframe, while significantly reducing associated carbon emissions.⁶¹

Given the fact that emerging market economies are expected to grow faster than advanced economies in the long-term, it is instructive to look at the returns for environmental, social and governance (ESG)-tilted investments in these markets. The MSCI Emerging Markets ESG Leaders Index weights companies in the standard MSCI Emerging Markets Index according to the sustainability performance. Gross annualised returns since 2007 for the ESG Leaders Index, at 6.25%, are more than twice as high as those for the benchmark, at 2.35%.⁶²

Research commissioned by Newton Investment Management found that fossil fuel screens had no significant impact on portfolio returns, volatility and income in developed markets in the study period of 2004 to 2015. In fact, returns were marginally higher and volatility marginally lower. In emerging markets, the benefit of fossil fuel exclusion was significantly greater over all rolling 3-year periods in the study.⁶³

Analysis from Mercer shows that a 2°C climate change scenario need not harm overall returns at portfolio level up to 2050 for long-term diversified investors, and provides better protection in the longer term, provided they take prudent steps to adapt their investments.⁶⁴

5.1 Sector opportunities in a climate and energy transition

Demand for new infrastructure could generate \$90 trillion of investment from 2015-2030 (more than the value of the entire current stock), 60% of which will be in the energy and transport sectors, according to the 2014 New Climate Economy report.⁶⁵ Action for climate change mitigation and adaptation will play a critical role in how this money is invested, and the scale of this market will shape value and returns across a substantial proportion of any large investment portfolio. FTSE Russell has undertaken work to define the shape and size of the 'green economy'. They find that the green economy is already approximately as large as the fossil fuel sector, and that in contrast to fossil fuels it is growing, is diverse by company size and sector, is global, and has outperformed the benchmark over the last 5 years.⁶⁶

As this report has already highlighted, electricity generated from renewable resources is already competitive with or cheaper than new fossil fuel power in many markets around the world, and its advantage is likely to grow substantially in coming years.⁶⁷ Renewables have strong backing

⁶¹ MSCI (Sept 2016), 'Fossil Fuel Divestment: a practical introduction'.

⁶² <https://www.msci.com/documents/10199/c341baf6-e515-4015-af5e-c1d864cae53e>

⁶³ Newton IM (2017), 'The impact of ethical investing on returns, volatility and income'.

⁶⁴ Mercer and CIEL (2016), 'Trillion Dollar Transformation: a guide to climate change investment risk management for US public defined benefit plan trustees'.

⁶⁵ The New Climate Economy, 2016, 'The Sustainable Infrastructure Imperative'.

<http://newclimateeconomy.report/2016/misc/downloads/>

⁶⁶ FTSE Russell (2018), 'Investing in the green economy: busting common myths'.

⁶⁷ Green Finance Initiative, 2017, 'The Renewable Energy Investment Opportunity for UK Pension Funds'.

from governments, including in the UK, and in any case increasingly do not need to rely on subsidies to compete and succeed financially. Despite the issues with its scenarios explained above, the IEA forecasts that renewables will reach a 30% share of global power generation in 2022, rapidly catching up with coal as the largest power source.⁶⁸

Renewable energy makes up a large and increasing proportion of infrastructure deals and investments by volume and value. Bloomberg New Energy Finance (BNEF) analysis sees more than two thirds of investment in new power generation capacity going to renewables from 2018 to 2050, with opportunities in every geographic region of the world. Most investment will be in emerging markets, where growth rates are expected to comfortably outstrip those in the advanced economies. BNEF expect wind and solar to provide almost 50% of global power in 2050, with coal providing just 11%, compared to 38% currently.⁶⁹

While sovereign wealth funds and institutional investors in some countries (e.g. Canada, Australia and to some extent the Netherlands) have made significant portfolio allocations to infrastructure, many have not.⁷⁰ There is a major opportunity for funds to rebalance asset allocations to support and benefit from global infrastructure investment in general and the financing of low carbon and climate resilient infrastructure in particular. The financial returns on offer are assessed to be attractive in terms of risk and return profile and may be a good fit for long-term investors like pension funds who prioritise the predictable income associated with real assets as well as growth in asset value. Renewable energy infrastructure offers the prospect of stable and low risk returns of 5-10% or more per annum (in some cases infrastructure funds yield considerably in excess of 10% per annum), and energy price structure means it acts as a good hedge against inflation.⁷¹⁷²

Evidence shows that some infrastructure funds with a large allocation to renewable energy are producing consistent returns that exceed expectations. Toronto-based Brookfield Asset Management (BAM) specialises in real assets with a focus on renewable energy, transport and private equity assets. Two of the funds managed by BAM with high exposure to renewable energy target an investment return of 10 to 15% over the long term, with Brookfield Infrastructure Partners earning an annualised return of 18% since inception in 1998. The European Diversified Infrastructure Fund has a net asset value of €2.25bn and achieved an annualised return of 12.3% from inception in 2009 to the end of 2016.⁷³ These are just two examples of a range of funds that comfortably exceed benchmark returns. Although their performance cannot be taken as representative of infrastructure or renewable energy fund performance or risk in general, or in the long-term, it does indicate the potential that lies in the sector.

⁶⁸ IEA (2017), 'Renewables 2017: A new era for solar power', summary online at <https://www.iea.org/publications/renewables2017/#section-4>

⁶⁹ Bloomberg New Energy Finance, 'Energy Outlook 2016'

⁷⁰ Green Finance Initiative, 2017, 'The Renewable Energy Investment Opportunity for UK Pension Funds'.

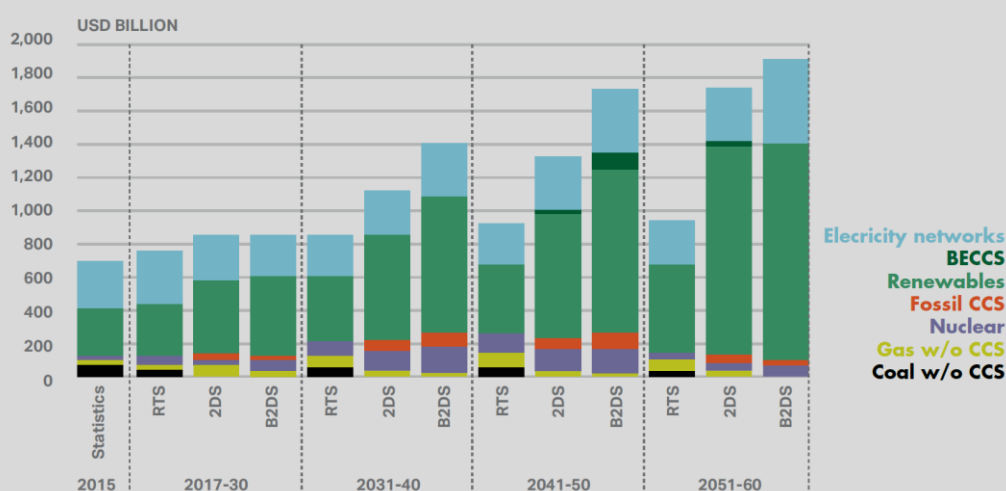
⁷¹ IEEFA, 2017, 'Making the case for Norwegian Sovereign Wealth Fund Investment in Renewable Energy Infrastructure'.

⁷² Green Finance Initiative, 2017, 'The Renewable Energy Investment Opportunity for UK Pension Funds'.

⁷³ IEEFA, 2017, 'Making the case for Norwegian Sovereign Wealth Fund Investment in Renewable Energy Infrastructure'.

UK pension funds have been slow to invest in infrastructure relative to those in some other countries. UK defined benefit pension schemes allocate on average only 2% of assets to infrastructure, compared to 5-10% for large pension schemes globally. The Local Government Pension Scheme contains 89 funds that have invested only 0.6% of assets in infrastructure. This is beginning to change, and local government funds are doubling their targeted allocation to infrastructure from 3.7% to 7.5% of AUM as part of the ‘pooling’ of local schemes.⁷⁴

FIGURE 6.
Projected annual investment in the power sector, 2017-2060,
compared with actual investment in 2015, \$ billion Source: IEA



31 <https://www.iea.org/Textbase/hpsum/WEI2017SUM.pdf>

32 <https://www.iea.org/Textbase/hpsum/WEI2017SUM.pdf>

33 <https://www.iea.org/etp/etp2017/>

Source: Green Finance Initiative, 2017.

Jeremy Grantham and Lucas White of GMO investment management have published detailed analysis of their approach to the huge investment opportunity of climate change. Perhaps unsurprisingly, they refute the idea that focusing on climate change-linked sectors is necessarily more risky, sacrifices returns, or requires a different approach to what they consider good practice for investors focusing on long-term value and with tolerance for some short term risk. As well as identifying the big opportunity to invest directly in more obvious sectors like renewables, battery technology and smart grids, they pinpoint other areas for growth:

- Input suppliers for clean energy systems, including lithium and copper
- Energy efficient building materials, lighting and (electric) vehicles
- Companies supporting adaptation in agriculture and food production, water use, treatment and recycling and engineering⁷⁵

⁷⁴ Green Finance Initiative, 2017, ‘The Renewable Energy Investment Opportunity for UK Pension Funds’.

⁷⁵ Jeremy Grantham and Lucas White, GMO (2017), ‘The good thing about climate change: opportunity’.

<https://www.advisorperspectives.com/commentaries/2017/08/25/the-good-thing-about-climate-change-opportunities>

The steep fall in the cost of solar and wind power generation are highly significant. IRENA research forecasts that by 2020 all renewable power technologies will be competitive with fossil fuel generation on a cost basis, with many renewables projects significantly cheaper.⁷⁶ The importance of the declining cost and rising efficiency of batteries is equally great. It contributes to the likelihood that electric vehicles will be cheaper than those with internal combustion engines in five to ten years, bringing a potentially rapid transition in the transport sector and many related economic sectors. Secular growth trends are becoming clear and a paradigm shift is well under way, albeit with significant uncertainty about dynamics for specific sectors and businesses around the overall trend.⁷⁷

Impax Asset Management argue for a focused approach for investors who may struggle to implement decisions based on comprehensive analysis of across-the-board shifts. Using the assumption that climate change policy in the shape of carbon pricing is not fully reflected in oil prices, they model expected changes in carbon price and use scenarios to estimate the impact on the cash flow of each company in the energy extraction and production (E&P) sector. Impax recommend a shift in exposure from E&P stocks to energy efficiency, rather than renewables – seeking to capitalise on energy transition trends while avoiding large exposure to a renewables market dominated by a small number of large cap companies.⁷⁸

⁷⁶ IRENA (2017), 'Renewable Power Generation Costs in 2017'.

⁷⁷ Jeremy Grantham and Lucas White, GMO (2017), 'The good thing about climate change: opportunity'.

<https://www.advisorperspectives.com/commentaries/2017/08/25/the-good-thing-about-climate-change-opportunities>

⁷⁸ I Simm et al, Impax Asset Management (2016), Carbon risk for investors: building a "smart carbon" portfolio

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