



## Climate change: calibrating the thermometer

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### Introducing the Climate Progress Dashboard

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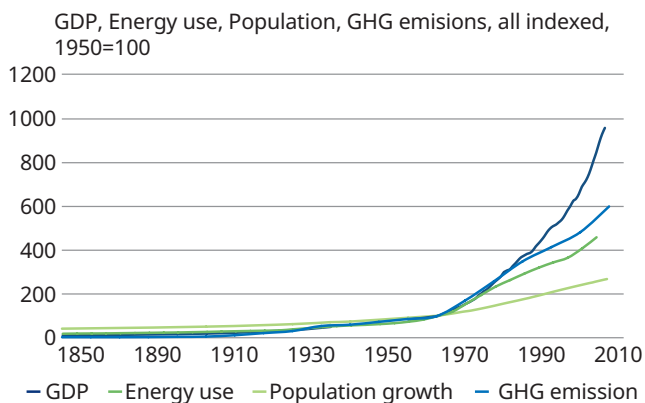
**Climate change will be a defining driver of the global economy, society and financial markets over coming years, decades and beyond. Whether the global economy is rebuilt on less carbon intensive foundations or the temperature continues to escalate, investors will be unable to avoid its impacts.**

The commitments made by nearly 150 countries which signed the Paris climate change agreement in 2015 imply significant changes across economies and industries<sup>1</sup>. Even with the US decision to jettison the accord, a clear consensus for action remains among global leaders. Indeed, President Trump's announcement looks more likely to have galvanised global action than hindered it.

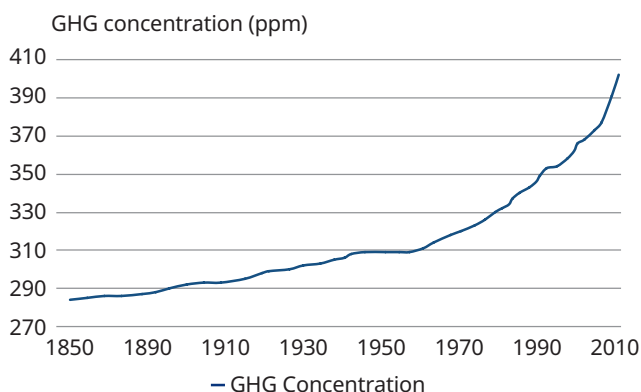
As the first chart in Figure 1 demonstrates, for over a century, the global economy has grown in lockstep with energy demand, population growth and greenhouse gas (GHG) emissions. This is leading inexorably to rising amounts of greenhouse gases remaining in the atmosphere (second chart) and rising global temperatures (third chart). The challenge is becoming more acute every year.

<sup>1</sup> United Nations Framework Convention on Climate Change: [http://unfccc.int/paris\\_agreement/items/9485.php](http://unfccc.int/paris_agreement/items/9485.php)

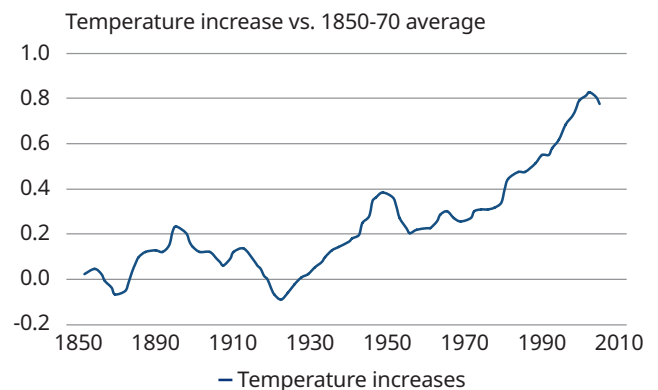
**Figure 1: Economic development has been carbon intensive...**



**...driving atmospheric concentrations of GHGs upward...**



**...and global average temperatures**



Source: BP Statistical Review, EU Europa, NOAA, OECD (Maddison), UK Met Office, Vaclav Smil. Based on most recent data available as of May 2017

### Accelerating towards a cliff edge

The concentration of greenhouse gases in the atmosphere will lead directly to temperature increases in the future<sup>2</sup>. Political consensus has settled on 2°C as the furthest temperatures can rise over pre-industrial levels while limiting physical risks to acceptable levels. Scientific consensus has settled on 450ppm (parts per million) as the highest concentration of carbon dioxide or equivalent gases possible to be more likely of achieving that target than missing it.

On current trends, that limit will be breached within another three decades. Concentrations have already passed 400ppm in the last few years, having risen by around 30ppm since the first major UN climate talks at the Rio Earth Summit in 1992. To put that in context, the level stood at around 270ppm before the world economy began to industrialise in the late 1800s, meaning around three-quarters of the distance between that starting point and the threshold of 450ppm has already been covered. Indeed, average global temperatures are up by about 1°C over the same period. Climate change is not a future possibility, it is well underway.

This gloomy picture is tempered by the renewed interest most global leaders are showing in addressing the challenge, albeit slowly and belatedly. Major changes lie ahead if their ambitions are to prove close to being realistic. Emissions cuts on the scale needed have implications for every corner of economies and markets, not just those most obviously exposed.

<sup>2</sup> Scientific consensus on the link between greenhouse gas emissions is clear, see <http://www.ipcc.ch/>

On the other hand, if political rhetoric is not backed up by tangible action, long-term environmental damage will accelerate and economic costs escalate. We have mapped out three possible routes for the world in Figure 2, based on different possible rises in temperature. Whatever path emerges will put enormous financial risks and opportunities on the table.

The changes to the global economy, societies and industries needed to cut emissions far and fast enough to meet a 2°C goal will reshape the investment landscape. Until now, financial markets have been unconvinced that political leaders will take the necessary steps, or that societies will make the changes needed without political intervention. As a result, investment valuations do not yet appear to discount significant climate impacts.

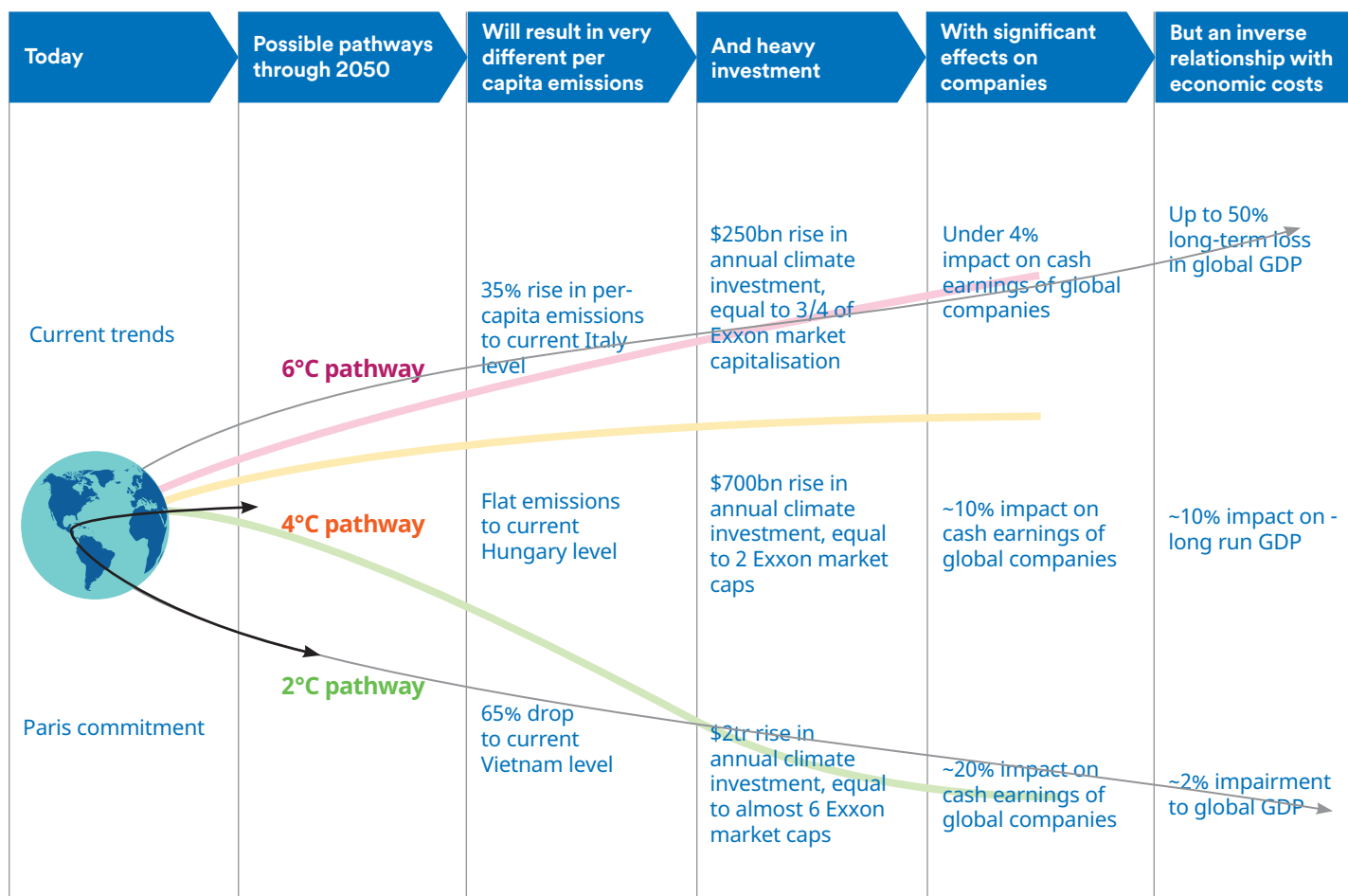
That reluctance is understandable. Measures of tangible change lag far behind political rhetoric. But the gap is closing as policies strengthen and momentum builds. Despite negative news headlines, policies have continued to spread.

The disruptive impacts of climate change will become a bigger influence on valuations in time. Measuring these impacts has two components:

- Understanding the investment impact of moving to a low carbon global economy
- Predicting the likely timing and speed of that transition

The shift to a widespread recognition that the competitive landscape in many industries will be reshaped is unlikely to be smooth. Most investors base their world view on a single snapshot of the future and struggle to incorporate other possibilities.

**Figure 2: Responding to climate change: three possible paths**



Source: Schroders based on data from UN climate registry, IEA, Datastream, "Climate change & the global economy: Quantifying the impact Climate change and the global economy: quantifying the impact, by Keith Wade, Schroders, July 2015. Keith Wade" 23 July 2015. Based on latest data available in May 2017

Climate progress is widely seen as reliant on government action. Such action has proven intermittent, undermining investors' convictions. However, policy now seems to be strengthening, at least outside the US. Moreover, the economics of many drivers of decarbonisation have improved enough to reduce or remove the need for political support.

To date, investors have relied more on anecdotes and headlines to gauge climate progress than on objective analysis. Individual drivers, like national climate commitments or carbon prices, have provided some measure of progress but tell only part of an increasingly complex story. Similarly, company comments can paint very different views of the world, depending on their perspectives and biases. As a result, we understand that it's challenging for investors to form a clear view of how much things have already changed or will change.

On the other hand, a clearer view is becoming more important as activity picks up and rhetoric becomes action. At some point, we expect markets to recognise this new momentum and to reassess valuations for a much more aggressive pace of decarbonisation in the future.

Investors who are unprepared or who have relied on overly simplistic analysis risk losses and missed opportunities. This is why gauging the timing and depth of market discounts for climate impacts is as important as analysing their effect.

### The Climate Progress Dashboard

We have developed the Climate Progress Dashboard as a way of making sense of the many disparate trends that mark our progress towards a decarbonised world. It provides an objective and transparent view of change. It should help investors base decisions on the outcomes that are likely, rather than those they would like to see.

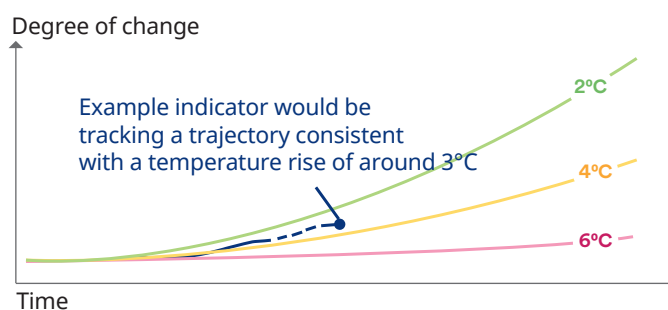
The Dashboard brings together perspectives from different angles: politics, business, finance, technology and fossil fuel industries. An all-round view is important. No single measure on its own is a sufficient barometer of progress: reshaping the global economy as a carbon-light version of itself will require a range of markets to expand or contract rapidly in coming decades.

What this means is that plotting progress across different markets provides a more rounded picture than any one in isolation. Oil producers may insist limiting temperature rises to 2°C is impossibly optimistic, whereas electric car manufacturers are already on a road that will take them closer to that outcome.

The Climate Progress Dashboard is based on analysis of the changes required in key markets to reduce GHG emissions to levels that would limit temperature rises to a number of different outcomes. We have chosen 2°C, 4°C and 6°C temperature rises in line with other organisations that have investigated climate change (Figure 3). We have relied on analysis by the International Energy Agency (IEA) as far as possible<sup>3</sup>.

Plotting electric car sales, petroleum industry capex, climate policy implementation and other measures against roadmaps for those markets, and then estimating the temperature pathway closest to current progress, allows us to estimate the temperature rise each trend implies, viewed in isolation.

Figure 3: Modelling trends against climate pathways



Source: Schroders

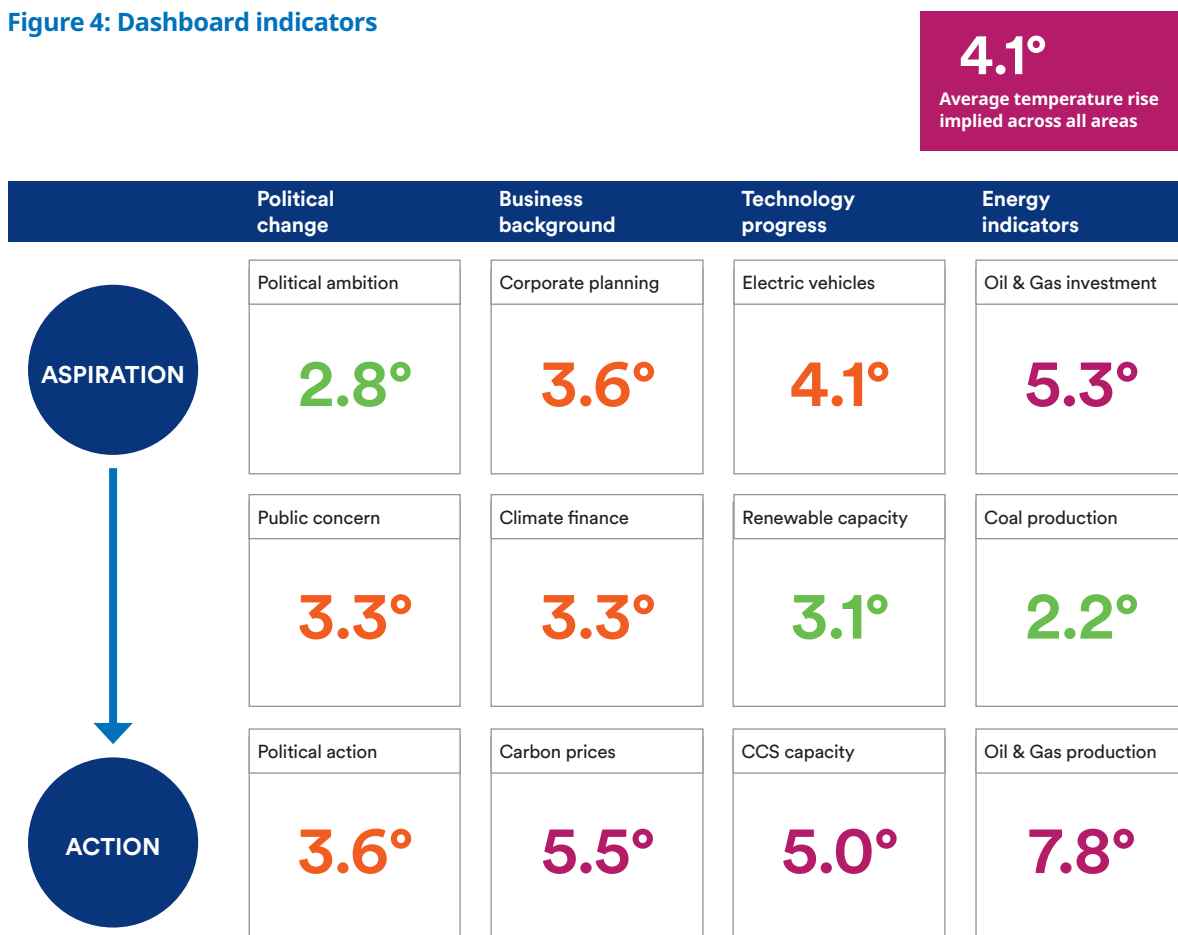
<sup>3</sup> Although based on one of many combinations of assumption, the IEA's analysis represents the most comprehensive, detailed and well-recognised assessment of future climate scenarios.

In most cases, we are in the early stages of changes that will play out over several decades. As a result, small adjustments in the trajectory now could result in big shifts in climate estimates over the long term. The results should therefore be seen as indicating the general direction of travel, rather than firm predictions of where we will end up.

The status of each indicator is plotted in Figure 4, followed by explanations of how they are calculated. Our “traffic light” approach assigns a colour according to the degree of risk currently being flagged by each indicator. We will be updating the indicators on a quarterly basis and providing commentary on the main influences that have affected the figures in the intervening periods.

The latest Dashboard can be found on our climate change web page here <http://www.schroders.com/en/lu/professional-investor/featured/climate-change-dashboard/>

Figure 4: Dashboard indicators



Source: Schroders analysis based on industry sources. Based on data available in May 2017

## Schroders Climate Progress Dashboard: explaining the indicators

<h3>Political ambition</h3>	<h3>Corporate planning</h3>	<h3>Electric vehicles</h3>	<h3>Oil &amp; gas investment</h3>
<p>Tracks the level of political ambition expressed through so-called Intended Nationally Determined Contributions (INDCs). Those INDCs represent the targets individual countries have set to contain greenhouse gas emissions. The NGO Climate Action Tracker tracks individual countries' commitments and the temperature rises they imply, which is the analysis we use here. We calculate historical data from reported national commitments in past years.</p>	<p>Tracks the strength of corporate action to align their business strategies with a less carbon intensive global economy. We track the average CDP Performance Scores for large global companies created by CDP, a charity established to improve carbon disclosure. That score combines analysis of a range of performance, policy and target measures, based on companies' responses to CDP's survey. We assume a 2°C temperature rise would be consistent with all companies achieving a B rating in that analysis.</p>	<p>Meeting long-term climate commitments will probably require a significant rise in electric vehicle (EV) use. Our analysis compares the global stock of plug-in electric vehicles (using annual sales data and assuming an average eight-year vehicle life) to projections the International Energy Agency (IEA) has made for EV use under a range of temperature scenarios.</p>	<p>Compares the level of capital investment of listed global oil &amp; gas companies to the level of production growth implied by different climate scenarios over the next decade. That investment rate provides an indication of future production growth, after deducting the annual reduction in production from declines in established fields. We assume current operations deplete over 15 years on average. Our calculations are based on financial data from Thomson Reuters.</p>
<h3>Public concern</h3>	<h3>Climate finance</h3>	<h3>Renewable capacity</h3>	<h3>Coal production</h3>
<p>Tracks the level of public concern over climate change using the percentage of respondents to Gallup's annual global survey of major countries who identify climate change as concern. We assume that 90% concern equates to a 2°C temperature rise and 10% concern level to 6°C.</p>	<p>Compares the annual amount of climate finance identified in the UN Environment Programme's annual reports to the levels Bloomberg New Energy Finance estimates will be needed to achieve key global temperature targets. Decarbonising the global economy will require significant investment in clean energy infrastructure, a large proportion of which will depend on the availability of capital focused on environmental solutions.</p>	<p>Compares the level of renewables energy capacity (excluding hydro) available every year to the levels the IEA estimates will be needed to contain temperature rises to various key levels. We have used the BP Statistical Review as a source of renewable energy capacity. Insofar as containing and stabilising global temperature rises will probably ultimately require a complete move away from fossil fuels, renewable use must increase significantly in the future.</p>	<p>Compares the level of coal production to the levels required for key IEA temperature scenarios. Coal is the most carbon-intensive of the fossil fuels (producing approximately twice as much CO<sub>2</sub> as gas, for an equivalent amount of energy production). Consumption will have to fall significantly under more ambitious climate scenarios.</p>
<h3>Political action</h3>	<h3>Carbon prices</h3>	<h3>CCS capacity</h3>	<h3>Oil &amp; gas production</h3>
<p>Tracks the level of action governments have taken to implement policies and laws which will reduce future carbon emissions. Whereas our INDC analysis focuses on their statements of ambition, this analysis examines what has actually been done to achieve those goals. We use the work of the NGO Climate Action Tracker to monitor the stringency of those policies in each country and their aggregate global effect.</p>	<p>Compares carbon prices generated by the European Emissions Trading Scheme (ETS) and US Regional Greenhouse Gas Initiative (RGGI) schemes to the levels which are likely to be needed to create an economic incentive to cut GHG emissions far enough to meet a range of climate goals. To estimate the levels likely to be needed, we have combined the analyses of required carbon prices from a range of national and international organisations.</p>	<p>Compares the level of carbon capture and storage (CCS) capacity likely to be developed to the levels the IEA estimates will be needed in the future. We examine projects identified by the Global CCS Institute as being in operation, construction, planned or under consideration. We apply different probability weights to projects in each category.</p>	<p>Compares the level of oil and gas production to the levels required to achieve key IEA temperature scenarios. While less carbon intensive than coal, oil and gas are major contributors to global GHG emissions and their use will have to fall significantly in the future, ultimately to zero. Production will need to fall more quickly under more ambitious climate scenarios.</p>

The Dashboard highlights the importance of having an all-round view of unfolding changes, rather than relying on a single indicator to inform investment decisions. Taken together, the indicators suggest we are on track for a 4.1°C rise in temperatures, far short of the 2°C commitment over pre-industrial levels global leaders made in Paris and on which many investors base their analysis. And while most indicators point to a change from historical business as usual trends<sup>4</sup> and are moving closer to a 2°C outcome, none of the measures we look at is yet on track to meet this target.

Part of the problem is that the Paris commitment to a 2°C rise is not reflected in the collective ambition of the national targets of the signatories. It is even further from the policies they have implemented. The good news is that the gap between global ambition and political action is closing with new policies and goals. And there is room for optimism in other areas.

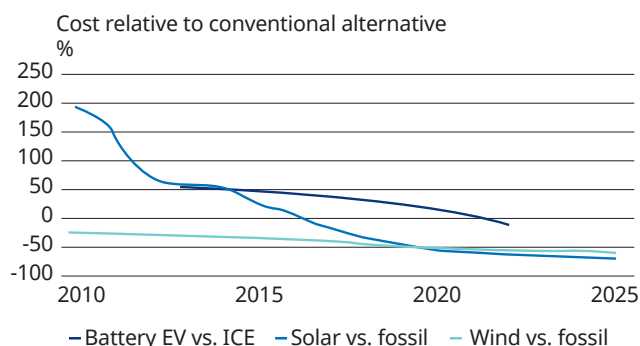
Clean energy technology in particular continues to power ahead without the political support it needed in the past. Costs of wind and solar have declined to the point where they are competitive with fossil fuels, even without subsidies (Figure 5). Early in 2017, the World Economic Forum pointed out that solar or wind is now as cheap as fossil fuel capacity in over 30 countries, arguing clean technologies have reached a tipping point in maturity<sup>5</sup>.

This is at odds with fossil fuel companies' frequent complaint that 2°C goals are too unrealistic to warrant serious attention. It is reflected in their continued investment in new capacity, despite trends in competing energy sources for the two key energy markets of transport and power, where electric vehicle growth and clean energy capacity point to cooler outcomes, as plotted in the Climate Progress Dashboard.

4 [http://www3.weforum.org/docs/WEF\\_Renewable\\_Infrastructure\\_Investment\\_Handbook.pdf](http://www3.weforum.org/docs/WEF_Renewable_Infrastructure_Investment_Handbook.pdf)

5 [http://www3.weforum.org/docs/WEF\\_Renewable\\_Infrastructure\\_Investment\\_Handbook.pdf](http://www3.weforum.org/docs/WEF_Renewable_Infrastructure_Investment_Handbook.pdf)

**Figure 5: Clean technologies' costs are falling rapidly compared to conventional alternatives**



Source: IEA, IRENA, NADA Guide and Schroders, May 2017

Driven as much by its weak profitability as climate enlightenment, the coal industry has begun shrinking in recent years. Recent production trends put it on track for faster decarbonisation than the more growth-focused oil and gas sectors. The IEA's relative generosity toward coal in its projections, helped by optimistic predictions for carbon capture and storage growth, flatter its progress, but its likely greater pain and earlier adjustment are nonetheless becoming clear.

In summary, while indications of progress are inconclusive and inconsistent, there is a clear and rising probability of rapid decarbonisation. Momentum is growing across the indicators we look at, with significant progress being made in many areas. Tracking these advances will be crucial in preparing for the investment impacts climate change will have.

## Conclusion

Until now, investors have faced a confusing, changeable and often contradictory range of climate signals. The industry's focus on what should happen, rather than what is happening, has become increasingly untenable as momentum builds and potential risks crystallise in the form of real financial impacts.

We developed the Climate Progress Dashboard to provide more clarity on the state of progress across a range of levers. While we recognise it is not comprehensive, and judgement plays a role, it is objective, relevant and tackles the key themes investors need to monitor – political climate, business climate, technology indicators and energy indicators. The insights it provides give investors a more accurate view of progress toward climate action and therefore the importance of managing the resulting effects on portfolios.

In future papers, we will discuss the insights, research and tools we have developed to help us translate the resulting changes into investment decisions.

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