



BANK OF ENGLAND

Speech

Climate change – Plotting our course to Net Zero

Speech given by

Sarah Breeden, Executive Sponsor Climate Change and Executive Director,
UK Deposit Takers Supervision

University of Edinburgh and Environmental Association for Universities and Colleges
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Introduction

Good afternoon everybody. Thank you for the kind introduction Peter and to the University of Edinburgh and the Environmental Association for Universities and Colleges for hosting this event. Making sustainability a core part of education is essential for inspiring the leaders of tomorrow and initiating the research and innovation that is needed for the momentous task ahead of us. I am honoured to be here today.

Over the past year, we have seen scientists and academics, universities, pharmaceutical companies and governments work together at unprecedented speed in a race to develop Covid-19 vaccines. A task that was seen as nigh on impossible back in March 2020 has been achieved through urgency, innovation, and collective action.

We must bring that same urgency to tackling climate change. Yet the race to achieve net-zero emissions ('net zero') by 2050 is a multi-decade marathon, where the starting gun has already fired, and getting to the finish line will require a sprint start, with a reduction in global emissions of a half by 2030 [figure 1 in the Appendix].¹

What I would like to talk about today is how we get there – both what we know and what we don't know - and the important role of climate scenario analysis in helping us plot the best course.

Governments will of course play a central role in laying the track, removing hurdles and setting the pace as we move to net zero. Over 110 countries, including the UK, have now moved to enshrine net zero emission targets in policy or law and are working on detailed plans of what these look like in practice.²

But climate change and climate policy will affect everyone - businesses from all sectors of the economy, public bodies like the Bank of England, households and individuals. And so we all have a stretch of the race to run. Some will perform strongly, others may struggle, and some, particularly in less developed countries, might need a helping hand. But let's be in no doubt. We need everyone to finish.

Role of the financial sector

Let me first say a few words about financial institutions given the unique role they play in this race. As corporates, these firms have some direct emissions but they are not significant. Their success in reaching net zero will instead be driven by their ability to reduce the emissions of the businesses and households they lend to, insure or invest in – their so-called "financed emissions".

¹ Preliminary analysis for the updated [NGFS Climate Scenarios](#).

² See United Nations, [Race to Zero](#).

One perhaps obvious way for them to deliver such rapid reductions is to immediately divest exposures to companies with high emissions and instead invest in companies with low emissions. Financed emissions would fall sharply.

However, while individual investors can divest, the financial system as a whole cannot. And with a fixed budget of emissions to reach net zero, if the real economy transition is simply delayed, the sharper and riskier it will be. In this way, seemingly rational individual actions can make our collective future problems bigger.

Instead we need those with high emissions today to make the biggest effort to reduce emissions tomorrow. And we need the financial sector to steward them through that transition, as well as to help to build greater resilience to physical risks.

This can be done through the provision of finance and risk management solutions that support firms in making changes to business models and operations to align with the transition. And through support of investment in new green companies and technologies that help pull the transition forward. If managed smoothly, this represents a great opportunity.

As a supervisor and central banker, however, I worry about outcomes where this smooth transition does not occur. Either because temperatures continue to rise as the transition is eluded; or because we face a disorderly transition - a so-called climate Minsky moment – as a significant number of otherwise productive assets have to be abandoned; or as asset prices adjust whilst risk and return are repriced.

To avoid such outcomes, financial firms need to manage these risks not as they materialise but instead by looking ahead over much longer time horizons than they are used to. And, as our supervisory expectations of banks and insurers make clear, they need to act strategically and pre-emptively, taking different decisions today, well before the consequences of inaction become clear.³

Climate scenario analysis

Climate scenario analysis provides us with the toolkit for doing just that. To look forwards not backwards, with a horizon of decades not years. In recognition of the uncertainty we face about what might happen to our planet and our economy, some scenarios show the most efficient pathway to net zero, while others highlight the risks of fragmented policies or insufficient action. They can all help guide actions today.

³ See [PRA supervisory expectations on the financial risks from climate change](#).

Plotting the transmission channels of climate risks into economic and financial risks is a fiendishly complicated task [figure 2].

The channels from climate to financial risk are numerous, with significant interdependencies. The data and methodologies to translate climate outcomes into macroeconomic and financial risks are incomplete and inadequate. And of course the future path of the climate risks themselves is subject to huge uncertainty. But given the urgency of our challenge, we cannot let uncertainties and complexities lead to inertia and inaction.

Scenarios are generally comprised of three key components:

- **Transition models** that set out how energy production and land-use can adjust to lower emissions and meet a given carbon budget or temperature target;
- **Physical models** that set out projections for how living conditions and extreme weather would shift given a pathway for emissions; and
- **Economic models** that quantify the potential impacts from both transition and physical risk on the economy.

This is unfamiliar territory for most central banks, businesses and the financial sector. It is however territory we all need to get familiar with if we are to find the right climate path.

Our desire to improve our understanding and capability to measure and monitor these risks inspired us to launch a project to co-design climate scenarios together with world leading climate scientists and 60 other central banks and supervisors that are part of the macrofinancial workstream of the Network for Greening the Financial System or NGFS.⁴

It has been a truly interdisciplinary effort. We have had to integrate a suite of models across each of the areas – physical, transition, economic, financial – to deliver insights [figure 3]. The scenarios the NGFS have produced pull together, for the first time, both transition risks and physical risks, and their economic and financial consequences, in a coherent way. As a result, they are decision-useful, reflecting the totality of risks we will face.

A guiding principle has been to try to shine a light on some of the uncertainties that exist. We have focused on multiple scenarios and multiple models to highlight the range of potential outcomes. Since modelling these impacts is subject to significant uncertainty and extensive academic debate, our work is open source and we seek your expertise and challenge.

⁴ The [NGFS](#) was founded by 8 central banks and supervisors including the Bank of England in 2017. Members are committed to sharing best practices, contributing to the development of climate and environment-related risk management in the financial sector and mobilising mainstream finance to support the transition towards a sustainable economy. It is currently comprised of 90 members and 14 observers.

The first iteration of these scenarios, published in June 2020, drew from the existing work on mitigation pathways, climate change and adaptation that supported the Intergovernmental Panel on Climate Change (IPCC) Special Report on Global Warming of 1.5°C.⁵ The NGFS will next month release an update, which will include bespoke scenarios, detailed macroeconomic modelling and a new online portal that can be used to explore physical risks.

Insights from the design of the NGFS climate scenarios

I would like to share some of the insights I've gleaned from this work.

First, we often talk about how much we don't know, but this doesn't do justice to how much work has been done.

We know that today three quarters of our emissions come from surface transport, heating our buildings, manufacturing goods, the food we eat, and producing electricity [figure 4]. By 2050 these emissions will have to be almost completely eliminated.

Any remaining emissions, mainly from aviation and animal methane, where there are currently no viable alternatives, would need to be offset by increasing the lungs of the earth. For example, through planting more trees, sequestering carbon in soils and biomass crops.

Although there are many differences across models, the key building blocks of the transition are pretty clear [figure 5].

Eliminating emissions from fossil fuels will require an increase in the share of renewables in the energy mix, greater electrification, improving energy efficiency, finding substitute fuels (like hydrogen or synthetic fuels) for use in heavy industry and transport, and capturing and storing emissions where it is most feasible or necessary to do so.

Eliminating emissions from land-use requires us urgently to prevent deforestation and implement more sustainable agricultural processes related to tillage, crop cover, fertilizer use and animal-related emissions.

A number of different types of policy measures can take us there. Carbon pricing – like the UK emissions trading scheme – is one tool to provide clarity on the route ahead.⁶ Other tools include changing business regulation (such as preventing the sale of internal combustion engines), fiscal policies (such as changes in subsidies and taxes) and research funding to spur on private and public sector research and development.

⁵ See [IPCC Special Report on Global Warming of 1.5°C](#).

⁶ See [Participating in the UK ETS](#).

In aggregate, these policies will need to internalise the costs of emissions to drive the shift in activities that I have just described.

Our preliminary NGFS analysis suggests that these policies will need to add up to an equivalent global shadow carbon price of over \$150 a tonne within a decade if we are to meet Paris goals and reach net zero by 2050 [figure 6].⁷ Considering what that forward shadow carbon price should be is an essential consideration when making any investment decision today.

Second, the cost to the economy in aggregate of getting to net zero need not be substantial.

Our experience of the transition so far has been that costs for nascent technologies tend to fall much more quickly than we initially expect once they start to gain traction and momentum.

Many transition models, including those leveraged for the NGFS scenarios, have for example underestimated how quickly the price of renewables has fallen in recent years. Well-designed policies and new technologies also bring new jobs and can lead to higher growth.

Our latest economic modelling suggests that reaching net zero, if the transition is managed well, might have a small or negligible effect on economic aggregates such as GDP, unemployment and inflation [figure 7]. Indeed depending on what investment means for productivity, there is a chance the transition could prove positive overall.

However, these costs depend crucially on whether the transition follows an orderly or disorderly path. Emission reductions may not follow a straight line as shown in many scenarios. It takes time for policy to work and policy adjustments will also be needed along the way.

There may be higher investment uncertainty. Markets will not allocate capital perfectly, and without certainty about policy and technological outcomes, there may be bumps in the road as they absorb news about our path.

In the NGFS we explicitly capture some of these transmission channels in our disorderly scenarios, for example by modelling delays in policy action and policy fragmentation across countries and sectors. They result in much higher impacts, particularly in countries with greater dependence on fossil fuel consumption or exports.

This work underlines that central banks and supervisors, and the financial firms and system that we oversee, need to be prepared for a range of outcomes. But it also underlines that early action brings lower risks.

⁷ Preliminary analysis for the updated [NGFS Climate Scenarios](#).

Third, the impacts from physical risks will be significant. Even where we manage to limit the rise in global mean temperatures to 1.5 degrees, physical risks are likely to dominate the potential impacts of transition. And if instead we continue on our current trajectory, losses just from the impact on productivity could be as high as 13% of GDP.⁸

In addition, many of the leading studies, including those we used in the NGFS, start from past correlations and so find it hard to put an accurate number on the type of low-probability, high impact events that will become more common. As high levels of warming will be unprecedented, we don't yet fully understand the delicate balance between the climate, living conditions, ecosystems and the economy - for example, the level at which ice melts might accelerate; or methane stores under permafrost might be unlocked.

What is clear is that investment is needed now to help adapt to these inevitable changes. And that we should recognise the gaps in our understanding of how large changes to our climate might affect our economies.

Challenges in applying scenarios

While these key themes are clear, I know from our own experience, and from the firms we supervise, that applying the scenarios in practice is not straightforward.

The models, data and analytical frameworks are new, and the transmission channels are complex and subject to much uncertainty. The results can be sensitive to input assumptions and type of model used.

This leads to a tendency to focus on a limited number of transmission channels and pockets of risk – for example, focusing on the costs of emissions in the most carbon-intensive sectors and ignoring other channels like changes to demand or costs of energy and materials. But these are important channels too. We need to capture all potential dependencies and feedback loops.

There are obvious dangers too in relying on past data and historical correlations for what is an unprecedented challenge. We need to re-examine existing models and consider whether climate change will cause some of these relationships to shift. There are perhaps parallels to the financial crisis where models provided false comfort. The most obvious case for this is in physical risk where we know there are non-linearities that are not well captured.

All of these factors lead me to believe that financial firms and businesses are significantly underestimating the potential impacts, and 'green swan' events are not just possible but likely until capabilities, understanding and management of these risks are greatly improved.

⁸ Preliminary analysis for the updated [NGFS Climate Scenarios](#).

I would offer a few pieces of advice to users of scenarios.

- **Don't get bogged down in a spurious amount of precision.** This can be unhelpful and unnecessary for decision-making. Sound qualitative assessments supported by some quantitative analysis and reasonable assumptions can be even more insightful. That is why, for the Bank's own Climate Biennial Exploratory Scenario exercise which we formally launch next month, we are putting emphasis on the qualitative questionnaire and an assessment of business model changes, rather than the traditional capital-adequacy metrics.⁹
- **Look at both physical and transition risks coherently as you undertake your analysis and as you determine your strategic response.** Some combination of these risks will materialise. If you are assuming there is no price on carbon in your risk models, you're implicitly assuming a high degree of warming. If you do believe some policy action is inevitable but don't know what the shadow price of carbon is, don't assume it is zero. That is equivalent to not knowing for sure how Bank rate will evolve but assuming it away when discounting over 30 years.
- **Given the sensitivity to core assumptions, there is considerable value in running credible, independent, standardised scenarios.** That will make your results more easily comparable to others, even if you use in addition other scenarios and models that you find more relevant to your business.
- **Don't be afraid to share lessons learned, disclose key assumptions and limitations in your analysis and where possible work together to improve understanding.** Here it is worth highlighting the excellent work being done by the Climate Financial Risk Forum in the UK which brings together senior financial sector representatives to build capacity and share best practice in managing climate-related risks and opportunities. The working group on scenario analysis has produced some really useful guidance and tools that should be useful both to financial firms and to businesses.¹⁰

Next steps

It is critical that financial firms recognise now that the race to net zero has started. Indeed many have.¹¹

⁹ See [Climate Biennial Exploratory Scenario](#).

¹⁰ See [Climate Financial Risk Forum](#).

¹¹ The [Glasgow Financial Alliance for Net Zero](#) includes 87 asset managers representing US\$36.95 trillion in assets under management; 43 banks with US\$28.5 trillion in assets; and 58 asset owners with US\$7.4 trillion in assets under management.

In support of their ambitions, and consistent with our expectations, they need to run climate scenarios as part of business as usual risk management and embed climate risk management within day-to-day decision-making. Time is running out. Perfection tomorrow cannot be the enemy of progress today.

We also need experts from academia, think tanks and consultancies to fill in the blanks, helping turn the high-level into ground-level decision-useful material. A lot of promising work is already happening – including NGFS-led work to increase the sectoral granularity of risks and to quantify the impacts from flooding and tropical cyclones. But more research is needed. I will highlight three areas in particular:

- What are the implications of government policy design on the transition, particularly on jobs, productivity, prices and different sectors of the economy?
- What will the impact of physical risks be on assets and on the economy – taking into account different possible transmission channels and non-linearities?
- What will the impact be on the financial sector, and constructively, how can the financial system play a role in climate mitigation and adaptation?

Conclusion

Let me conclude.

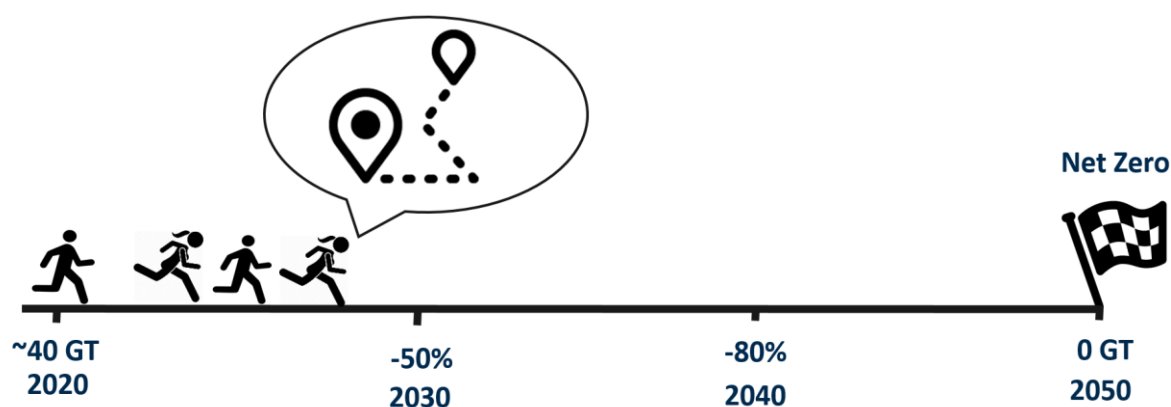
Dealing with the climate crisis is an unprecedented challenge. Building the toolkit to help us do that is similarly unprecedented. But climate scenarios can help us plot the best course to net zero and they can highlight the dangers of straying from that path. The private and the public sector need to build on our early progress, both by recognising what we do know and urgently filling in the gaps for things we do not.

Through climate scenario analysis, we have seen much closer collaboration between different groups of academics, other specialists, the financial sector and businesses. This has led to some fantastic work and insights that can drive the action we need now. If we are to rise to the climate challenge, we need to continue in this spirit and tackle some of these big outstanding questions together.

In the race to net zero everyone needs to participate, and there are no silver medals. Do join the team.

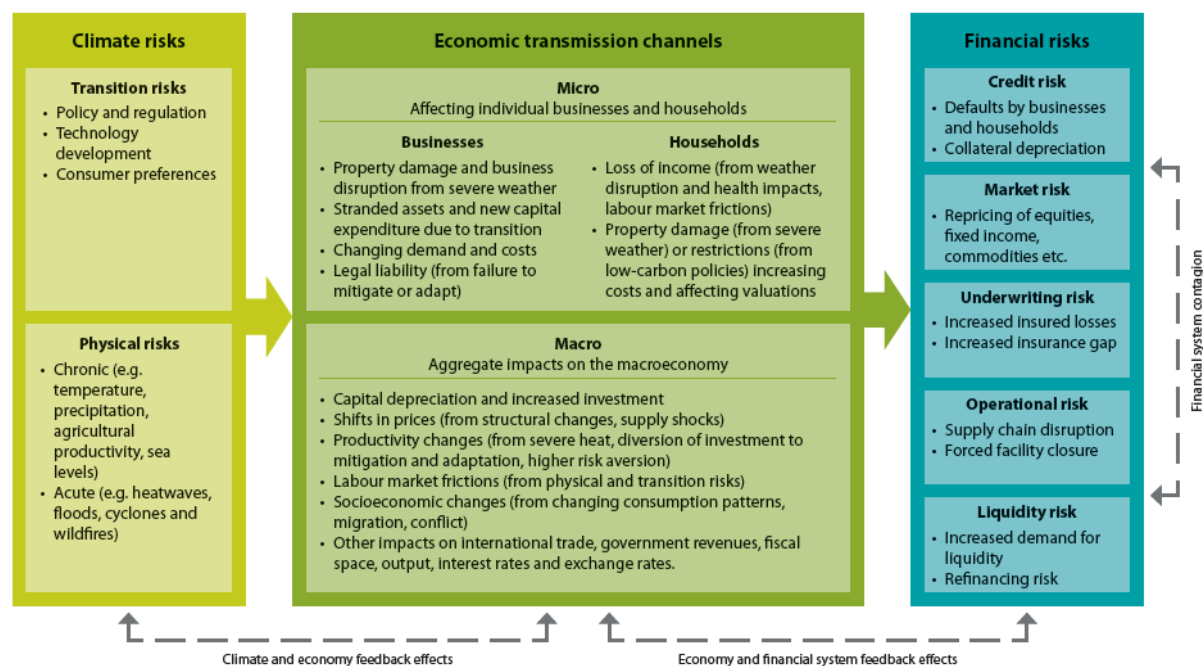
APPENDIX

Figure 1 – The Race to Net Zero emissions by 2050



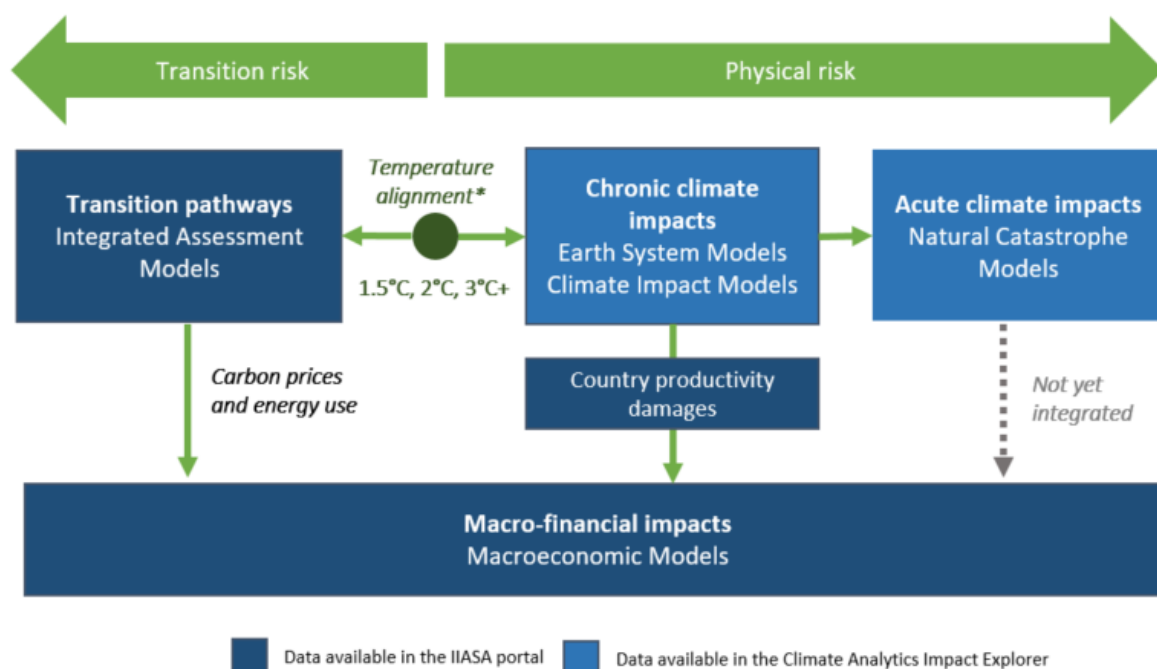
Source: Bank graphic based on NGFS data

Figure 2 – Transmission channels from climate risks to financial risks



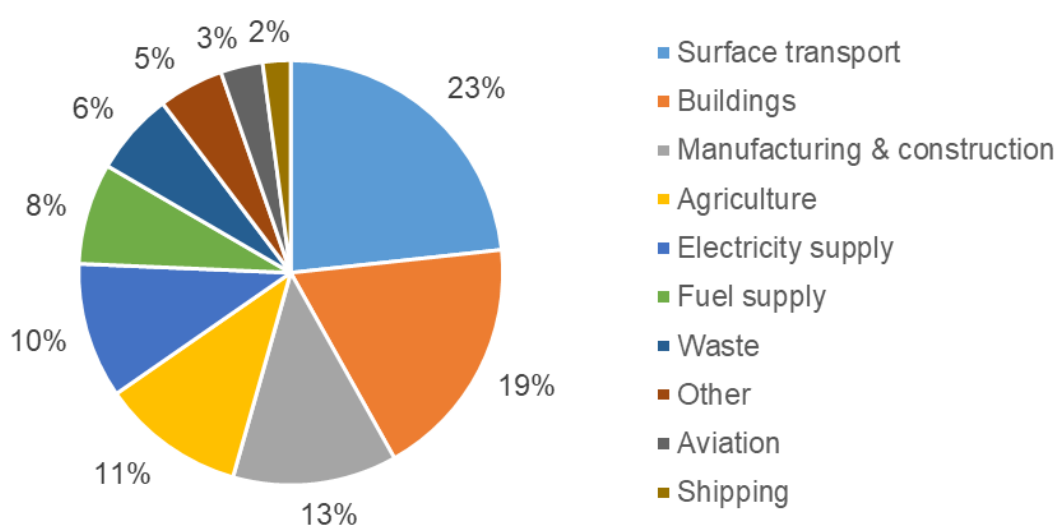
Source: NGFS Climate Scenarios for central banks and supervisors

Figure 3 – NGFS suite of models



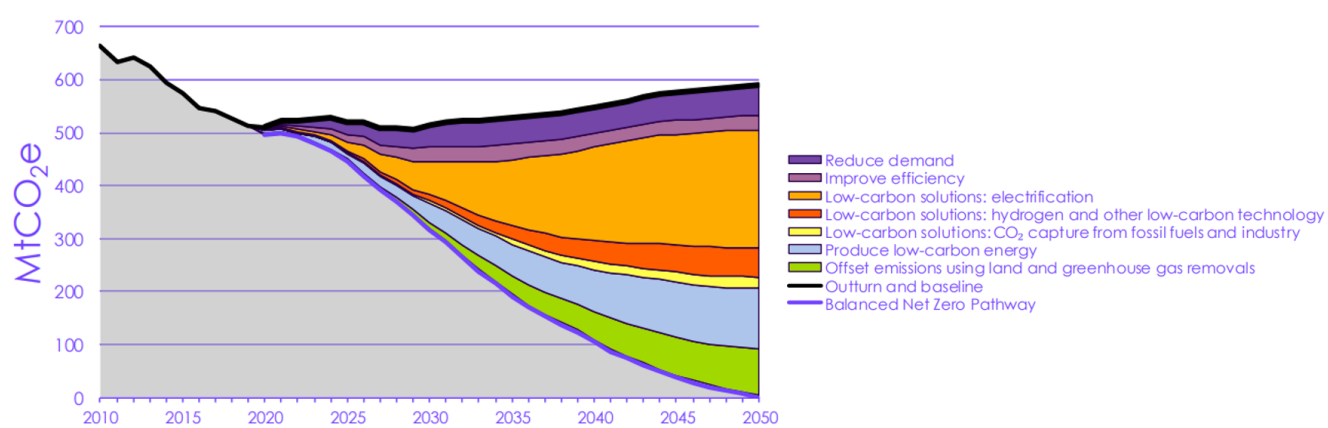
Source: NGFS Climate Scenarios for central banks and supervisors

Figure 4 – UK emissions today



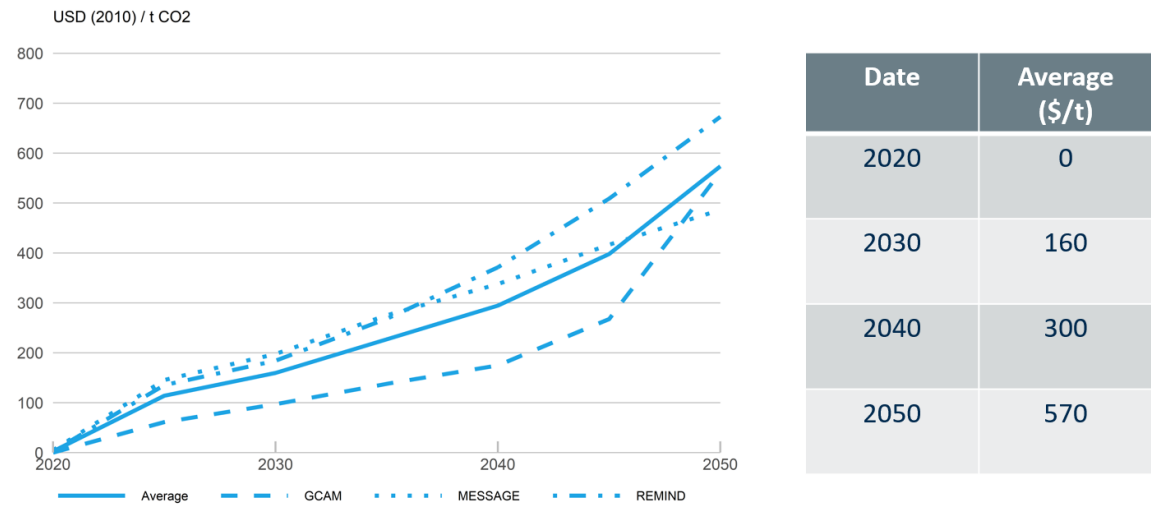
Source: Bank calculations based on the Committee on Climate Change 6th Carbon Budget Assessment

Figure 5 – Reaching Net Zero in the UK



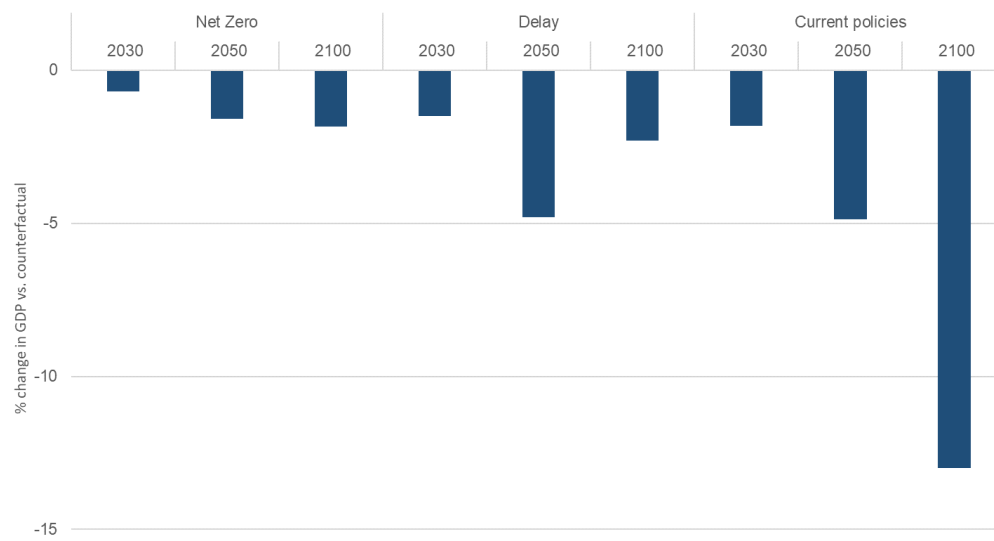
Source: Committee on Climate Change 6th Carbon Budget

Figure 6 – Global shadow carbon prices consistent with Net Zero 2050



Source: Preliminary analysis for the updated NGFS Climate Scenarios

Figure 7 – Impact on global GDP (relative to prior trend)



Source: Preliminary analysis for the updated NGFS Climate Scenarios