abrdn's climate scenario analysis – year 4

Navigating a delayed and more disorderly transition

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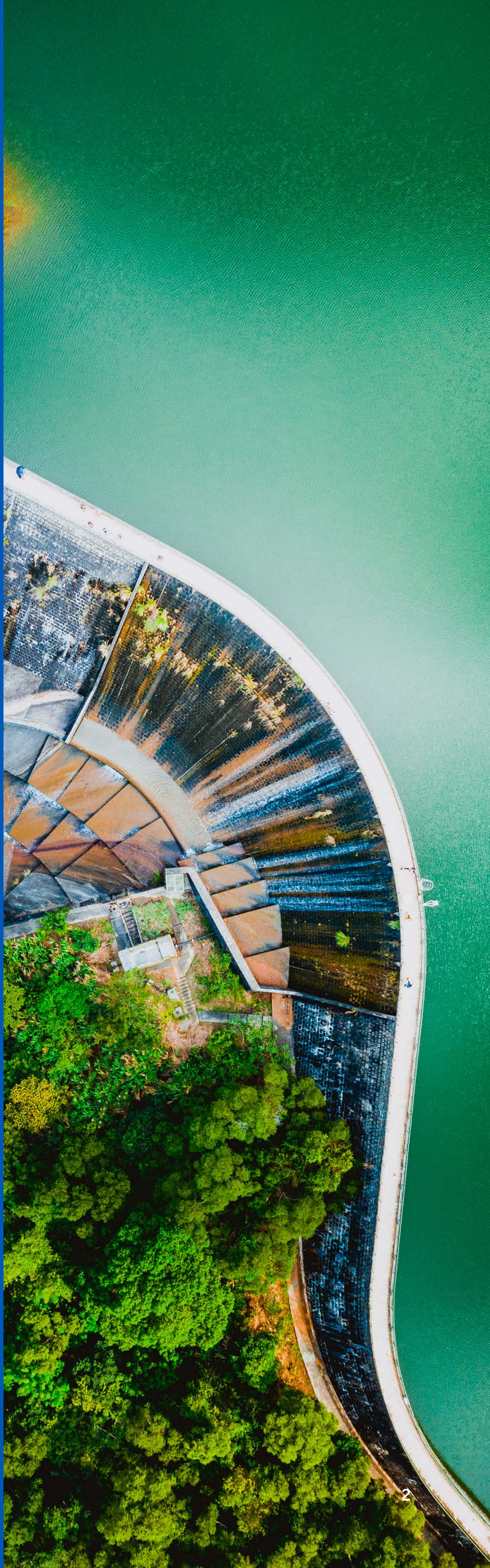


Executive summary

abrdn has developed a comprehensive approach to climate scenario analysis to help address regulatory requirements, add value to investment decision-making and respond to growing client needs. Since establishing our climate scenario approach in 2020, we have crafted a proprietary method to overcome many of the challenges inherent in typical climate scenario analyses. This approach not only supports regulatory compliance but also aims to deliver added value to our clients through enhanced investment insights and decision-making capabilities.

Recognising the complexity of climate-related risks and opportunities, abrdn has introduced a suite of complementary tools known as our climate building blocks. As one of these building blocks, climate scenario analysis provides a top-down lens which can help investors better understand the uncertain energy transition.

The key findings from our Year 4 climate scenario analysis report:

- Climate policy ambition continues to increase, but implementation is delayed. This is a key feature of a disorderly energy transition, creating nuanced consequences for investors.
- Climate risk is both a sector-specific and stock-specific phenomenon, but dispersion within sectors is the most pronounced feature, providing an opportunity for actively managed strategies to tilt portfolios towards climate-transition winners and away from losers.
- Short-term demand creation presents upside opportunities driven by improvements in technology readiness, improved competitive dynamics for electrification climate solutions, and infrastructure capex cycle.
- We have observed an expansion in the climate-solutions investment universe.
- Over the medium to longer term, there is greater stranded-asset risk for energy-intensive assets as policy implementation is delayed and low-carbon infrastructure takes time to displace carbon-intensive sources of energy.
- Equity and credit risks are driven by the same issues of demand dynamics and carbon cost, but risks are skewed to the downside for credit.

The material risks of climate change and the need for a forward-looking view

Climate change poses a highly material risk to our societies and economies. Its physical manifestations are increasingly visible and are already having severe impacts around the world. Each decade since the 1980s has been warmer than the previous one, and the warmest eight years on record have all been seen since 2015. The year 2023 was the warmest yet[1], contributing to the severe storms, floods, droughts and bushfires witnessed across the globe. Even if we are able to keep global temperature rises to 1.5°C above pre-industrial levels, the world faces an increase in physical climate disruption.

In response, energy systems and patterns of economic activity are being profoundly changed by the growing array of policy initiatives, private-sector commitments, technological advances and shifting consumer preferences that aim to constrain greenhouse-gas emissions and limit climate change.

For the third year in a row, climate change has topped the World Economic Forum's list of the most severe risks over the next 10 years (annual Global Risks Perception Surveys[2]).

It is therefore vital that investors are able to understand and quantify:

- How these climate-related physical and transition risks affect the potential returns of the companies and markets in which they invest
- How the assets they invest in are addressing their exposure to risks and taking actions to limit their impact.

As an asset manager, we believe that doing so will enable us to build more resilient portfolios and generate better long-term returns for our clients.

Climate scenario analysis has emerged as one of the key tools to assess the exposure of assets to such risks. Importantly, it provides the means to conduct a forward-looking, quantitative assessment of the potential financial implications.

Meeting regulatory requirements and more

The physical and transition risks of climate change are well recognised by financial regulators. As such, climate scenario analysis has become mandatory across a number of jurisdictions. abrdn has sought to take a thoughtful and transparent approach to scenario analysis since we developed our first climate scenario framework in 2020. In doing so, we have developed a proprietary approach that aims to address many of the limitations that currently restrict the insight and utility of much of the climate scenario analysis used within the financial industry.

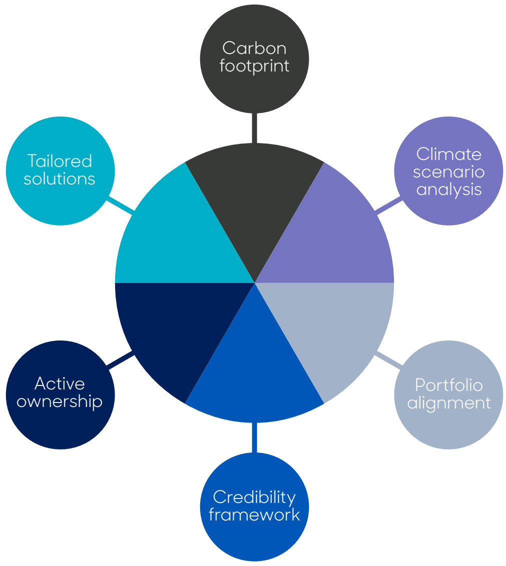
The aim is not just to meet regulatory requirements but to add value to investment decision-making and respond to growing client needs. To enable this, we have also developed other tools and frameworks that can be used alongside our climate scenario analysis to provide a more holistic view of the risks and opportunities that climate change presents to our clients. We call these our climate building blocks.

1 The Met Office, 2023: The warmest year on record globally. Published 12th Jan 2024. Accessed 16/12/2024. www.metoffice.gov.uk/about-us/news-and-media/media-centre/weather-and-climate-news/2024/2023-the-warmest-year-on-record-globally

2 The Global Risks Report, 2024, 19th edition, Insight Report, World Economic Forum, Published 10th January 2024, Accessed 16/12/2024. www.weforum.org/publications/global-risks-report-2024/in-full/appendix-b-global-risks-perception-survey-2023-2024

abrdn's climate building blocks

Figure 1: abrdn's climate building blocks



Source: abrdn, 2024

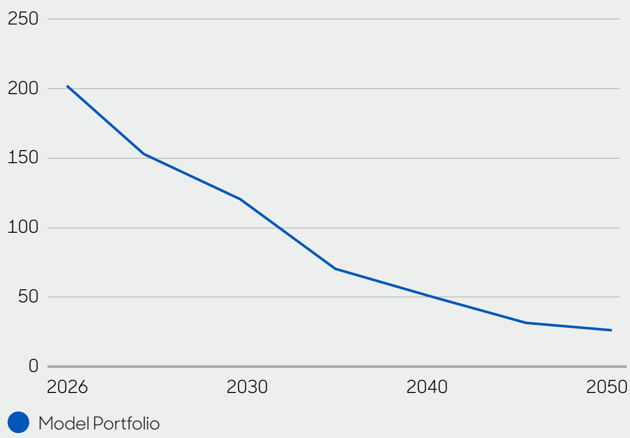
Our climate building blocks have been designed to complement one another, while providing value in isolation (Figure 1). A feature of our climate building blocks is their embedded flexibility to meet specific client needs (see case study).

Climate scenario analysis is specifically required for regulatory reporting, but it also provides a top-down lens through which investors can understand an uncertain energy transition.

Case study: Complementary building blocks in action

Some clients have set forward-looking carbon targets against their portfolios. A robust ***carbon-footprinting*** tool is necessary to monitor progress against the objective. However, forward-looking tools play a similarly critical role in delivering the targeted outcome. abrdn's ***climate scenario analysis*** provides a forward-looking, top-down assessment of financial impacts but also emissions pathway projections.

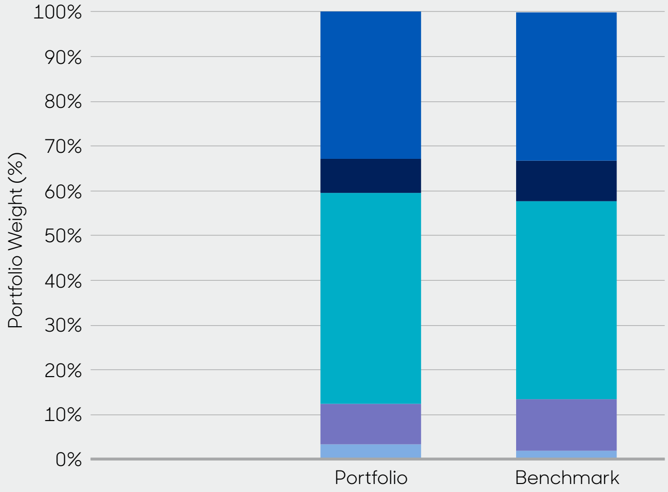
Top-Down Scenario Emissions Projections



Source: abrdn (2024)

Our probabilistic, bespoke approach, underpinned by a range of scenarios, offers a level of insight beyond that provided by typical industry approaches. (See the next section for details.)

Bottom up Maturity Scale Portfolio Alignment



	Portfolio	Benchmark
Insufficient Data	32.80%	33.20%
Not Aligned	7.60%	9.10%
Committed to Aligning	47.20%	44.20%
Aligning towards a Net-Zero Pathway	9.00%	11.50%
Aligned to Net-Zero Pathway	3.40%	1.90%

Source: abrdn (2024)

NB Charts are for illustrative purposes only

This can then be combined with our bottom-up ***portfolio alignment and credibility framework***. The framework provides a view of companies' alignment with a decarbonisation trajectory (normally through the targets they have set) and our view on how credible it is that they will achieve those targets. The combined insight can then inform our **thematic engagement**.

This enables us to take a holistic approach to climate integration in portfolio construction and reporting, and helps us to create tailored solutions that meet long-term client climate and investment objectives.

Why we developed our climate scenario analysis approach

Since 2020, we have developed our own approach to climate scenario analysis. We blend abrdn's investment expertise with Planetrics[3] climate modelling, with the aim of:

- Supporting the integration of climate change considerations into investment strategies (see case study above)
- Meeting current and future regulatory demands
- Bringing in our house view to inform forward-looking insights, rather than using standard 'off-the-shelf' scenarios.

Our approach aims to address the limitations of off-the-shelf scenarios:

Limitation	Typical approaches	abrdn's approach
Assumption of uniformity	Make uniform assumptions of climate policy across countries and sectors. This improves comparability but does not reflect the real world.	We build bespoke scenarios that apply more realistic assumptions across sector and country groupings. The assumptions are underpinned by our own research insight.
Navigating the uncertainty of future pathways	Rely on just a few scenarios considered to be equally probable. This can produce misleading results and limit the investment insight.[4]	We use 16 bespoke and off-the-shelf scenarios to represent a broad range of potential pathways. We apply probabilities to this suite, allowing us to calculate the most likely scenario.
A missing middle ground	Tend to focus on the tail risks of achieving 'net zero' and 'no action', largely ignoring the broad spectrum that lies between.	Our bespoke scenarios fill the middle ground between tail events, allowing us to consider differing policy and technology pathways within the most likely outcome range.
Single technology pathway	Tend to focus too much on a single technology pathway for decarbonisation. This can lead to misleading results if the pathway is more complex.	Our analysis is not 'technology restricted' to the assumptions of a single model. This enables us to consider a diverse range of technological pathways.
Baseline unreflective of the market	Tend to use overly simplistic baselines. Typically, a current policy scenario is used. We believe this to be short-sighted.	Our baseline uses our sector and regional insights to reflect current market prices, allowing it to vary across different regions and sectors, and better reflect market values.
Credibility of company transition plans	Tend to ignore credible company transition plans. Many companies have set a net-zero objective, with varying degrees of credibility. These should be integrated into climate scenarios.	We consider company targets, creating a more dynamic, forward-looking view of company behaviour. We also assess the credibility of the targets being achieved, reducing the risk of overestimating their impact.

We think that a probabilistic and transparent methodology is crucial for effective investment integration. Our research-rich approach to developing our bespoke scenarios also relies on developing a good understanding of the assumptions built into the models on which they are based. In doing so, we also recognise their limitations.

Continuous improvements

While our approach aims to mitigate some of the common limitations of scenario analysis, we know we still have improvements to make. An important limitation with most climate scenario analysis is that the economic models do not capture the potential for climate 'tipping points' and 'cascading effects' that could significantly alter the acceleration and magnitude of physical risk, and thereby underestimate the economic impact.[5] Addressing this limitation is a priority for the future development of our approach.

3 Planetrics, now part of McKinsey Sustainability, helps financial institutions assess climate risk and opportunity by offering cutting-edge tools to quantify, report and manage climate impacts. They have been our climate modelling partner since 2020.

This report has been created by abrdn Investments, drawing on selected data provided by Planetrics, a McKinsey & Company solution. It represents abrdn's own selection of scenarios. abrdn is solely responsible for all assumptions underlying these scenarios, and all resulting findings, conclusions and decisions. McKinsey & Company is not an investment adviser and has not provided any investment advice.

4 Environmental Finance 2024 www.environmental-finance.com/content/news/investors-scenario-testing-not-recognising-full-climate-risk-warns-academic.html

5 The Emperor's New Climate Scenarios. Lenton et al. 2023 https://ifoa-prod.azurewebsites.net/news-and-media-releases/news-articles/2023/july/04-july-23-emperor-s-new-climate-scenarios-a-warning-for-financial-services

How we build our climate scenario framework

To take a probabilistic approach, we use our comprehensive suite of 16 bespoke and off-the-shelf scenarios (see Figure 2), assign probabilities, and from these produce two probability-weighted scenarios:

1. **A probability-weighted mean scenario** (based on the full suite), which reflects our base-case view of the most likely energy-transition path
2. **A Paris-aligned weighted scenario** (based on the probabilities assigned to the seven scenarios that are Paris-aligned, limiting warming to below 2°C).

We update our 16 scenarios and their assigned probability weighting every year,[6] incorporating changes in the underlying climate models and our observations of climate technology readiness and policy changes in the real economy.

All our climate scenario output is relative to our bespoke Baseline scenario. This captures our estimate of policy and technological developments already reflected in market-implied future earnings across sectors and regions.[7] Our process ensures that the annual review and revision of the Baseline draws on regional and sectoral expertise from across our investment desks.

6 Our previous papers are available on request: ESGClientQueries@abrdn.com

7 We believe that currently, on balance, markets are not pricing in future physical risk from climate change. For this reason, our scenario output is considered as relative to a baseline where no physical risk has been priced in. For the calculation of our probability-weighted mean scenario, however, the warming inherent in our baseline scenario is included.

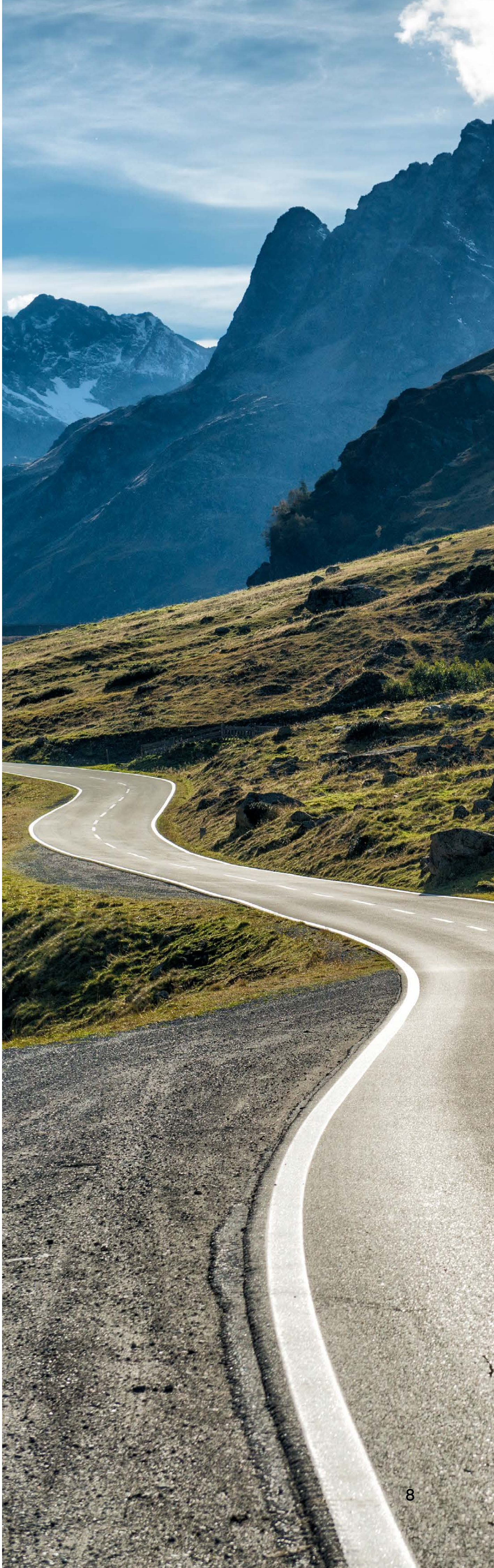
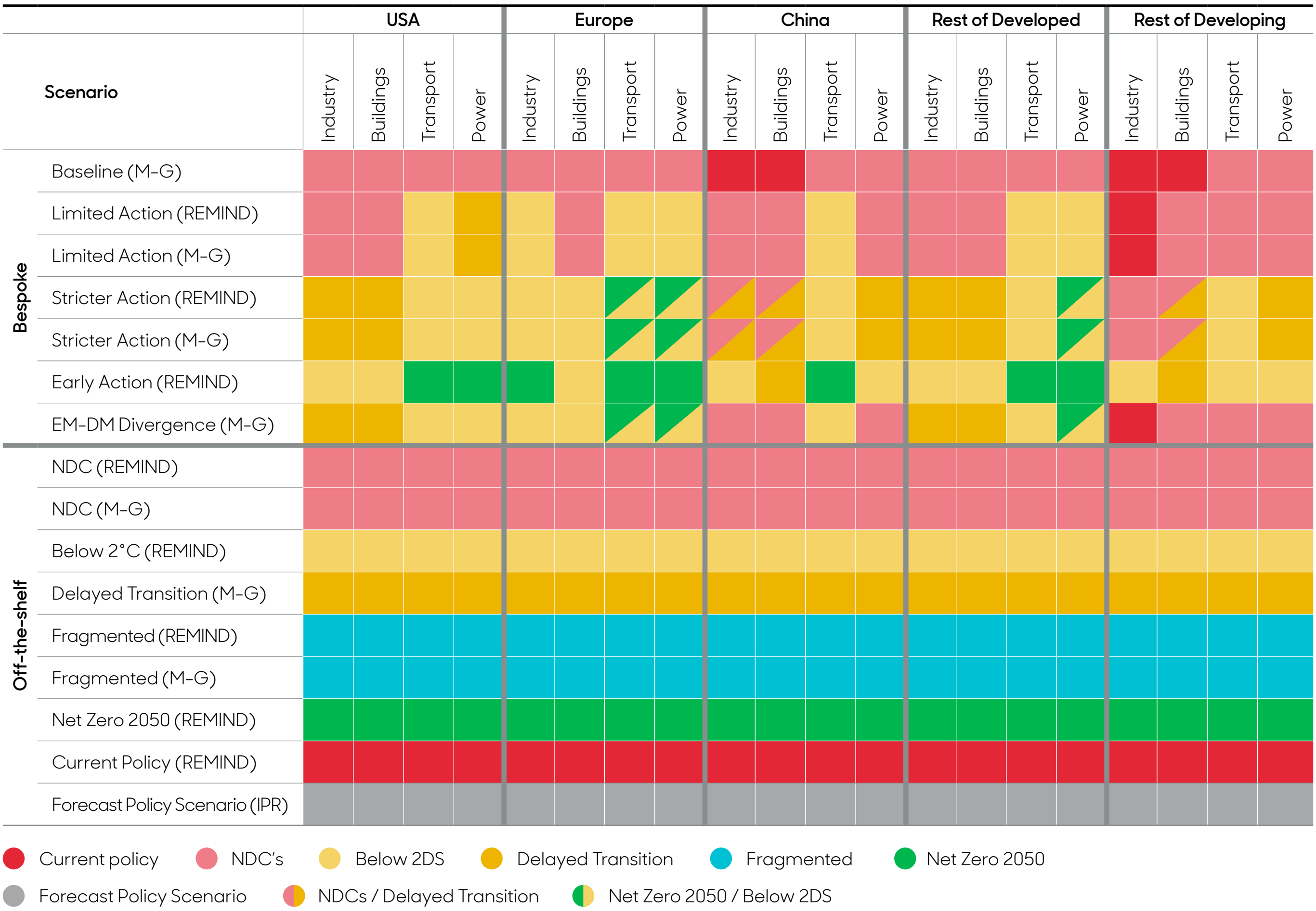


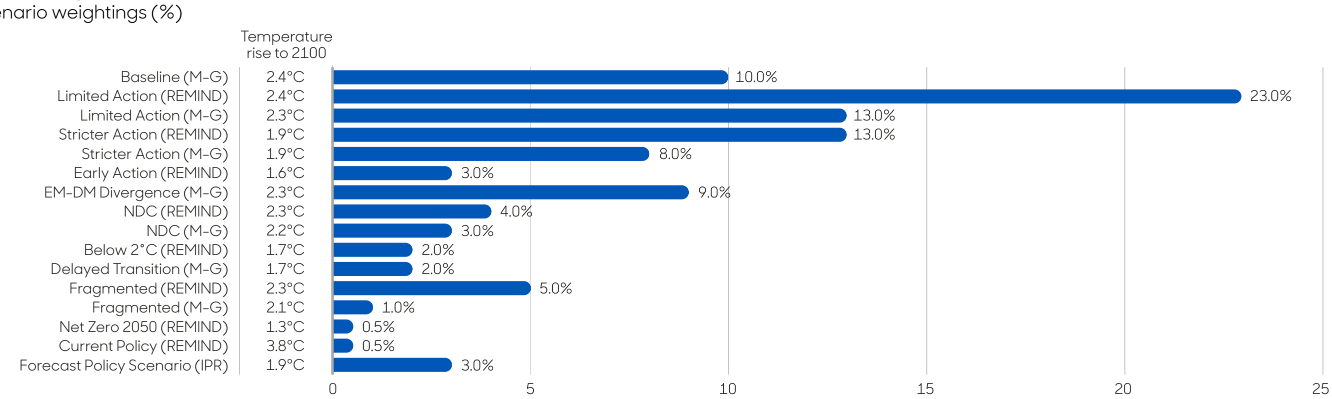
Figure 2: Year 4 scenario framework – the 16 scenarios and their probability weighting



Source: abrdn/Planetrics, 2024. Temperature rise is relative to pre-industrial level

Probability

Scenario weightings (%)



Source: abrdn/Planetrics, 2024. Temperature rise is relative to pre-industrial level.

How do we structure our scenario framework?

Table A1 in Appendix 1 provides further details on individual scenarios.

Building in real-world variation to avoid the assumption of uniformity

Using the Stricter Action scenarios as an example (Figure 2), these are custom scenarios with a globally 'disorderly' transition. Policies are introduced to keep the global temperature rise below 2°C, but most actions are delayed until after 2030, requiring strict measures later. Unlike the 'off-the-shelf' Delayed Transition scenario, our bespoke approach identifies which sectors and regions cause delays. Figure 2 shows delays mainly in the Industrial and Building sectors, plus Power in developing markets, while Europe's transition is more orderly and advanced.

Using probabilities to navigate the uncertainty of future pathways

Using the power sector as an example, we have taken very different probabilistic views across the US, Europe and China. In Europe we assume more decarbonisation, given that the power sector is shifting away from coal, driven principally by power companies being fully exposed to a carbon price. In contrast, the US has a greater skew to a delayed transition scenario, since there is no uniform carbon price, with less regulatory and policy consistency across states. In China we place more weight on NDCs.[8] Despite the country being one of the largest investors in renewable energy, China is still adding carbon-intensive generation, increasing the risk of lock-in.[9]

Our 'off-the-shelf' scenarios (8-16 in Figure 2) are those developed by the Network for Greening the Financial System (NGFS).[10] The NGFS is a network of central banks and supervisory bodies that aims to define and promote best practice across the financial industry.[11]

The NGFS scenarios are updated annually,[12] and we use them as the starting point for building our bespoke scenarios. These scenarios have become one of the most widely used systems by the financial industry for analysing the impacts of climate change and policy.

Underpinning the NGFS scenarios we use two Integrated Assessment Models (IAMs). A key strength of our approach is to use more than one model, as this avoids a bias towards one set of technology pathway assumptions. See the explanation box for further detail.

What are Integrated Assessment Models?

Integrated Assessment Models (IAMs) are complex models used to evaluate and understand the interactions between human and natural systems. They integrate knowledge from various disciplines, such as economics, environmental science and policy analysis.

IAMs include various assumptions about energy systems across countries and sectors, as well as the technology pathways for decarbonisation. We utilise two models in order to capture two quite distinct potential pathways:

- **REMIND-MAgPIE** (hereafter called REMIND) – tends to favour the electrification of technological and energy pathways
- **MESSAGEix-GLOBIOM** (hereafter called M-G) – tends to favour molecular fuels, specifically the use of natural gas as a transition fuel.

We have utilised these two models since we began our analysis in 2020, as they were consistent with the observed take-up of different energy technologies over the previous decade, as well as with our views of the most likely evolution of low-carbon technologies in the future.

In Figure 2, the relevant model is shown in brackets at the end of each scenario name.

8 Nationally Determined Contributions (NDCs) include all pledged policies, even if not yet implemented.

9 However, the recent carbon targeting announcements out of China may warrant future revisions to our probabilities.

10 We also use an additional 'off-the-shelf' scenario: The Inevitable Policy Response (IPR) Forecast Policy Scenario www.unpri.org/sustainability-issues/climate-change/inevitable-policy-response

11 Membership | NGFS www.ngfs.net/en/about-us/membership

12 www.ngfs.net/sites/default/files/medias/documents/ngfs_climate_scenarios_for_central_banks_and_supervisors_phase_iv.pdf

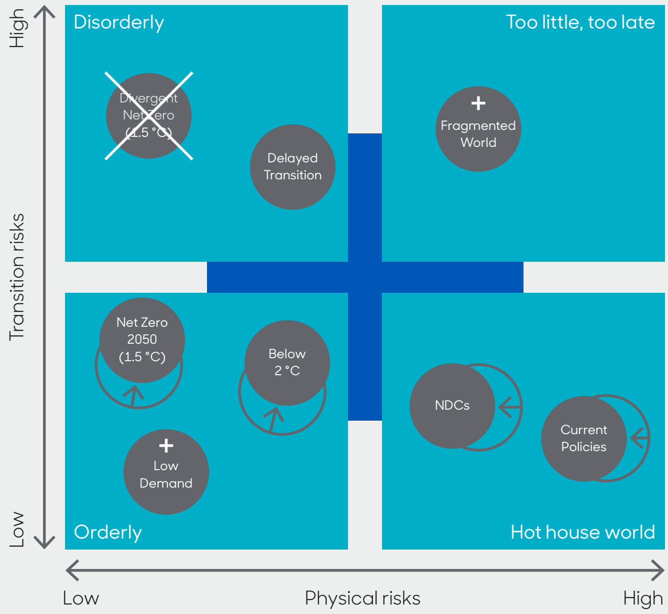
What has changed in the NGFS scenarios?

The annual updates to the NGFS scenarios have implications for our own scenarios. In addition to any changes in the suite of scenarios available, the updates reflect the latest economic and climate data, trends in energy-transition technologies, and significant energy-market changes, as well as new country-level climate-policy commitments.[13]

Figure 3 shows how the NGFS scenarios are positioned relative to transition and physical risks, the arrows indicating changes from last year.

Figure 3: Important changes in the NGFS scenario framework since our last (Year 3) analysis

NGFS scenarios framework in Phase IV



Positioning of scenarios is approximate, based on an assessment of physical and transition risks out to 2100.

Source: NGFS, 2023

More detail on these changes (and those in the underlying energy-system models) and their impact on our Year 4 analysis is available in Appendix 2.

[13] The latest NGFS update, in November 2023, includes policy commitments made up until March 2023.

How have these changes, and our wider insight, altered our probability weightings?

- Table 1 shows that most of the weight (79%) continues to be in our bespoke scenarios, but it has been slightly reduced due to the inclusion of the new NGFS Fragmented World scenario. We have assigned a relatively large total likelihood (6%) to this off-the-shelf scenario.
- Whilst our probability-weighted mean scenario has a slightly lower projected global temperature rise (2.2°C versus 2.3°C in Year 3), the probability we attach to global climate policies aligning with the objectives of the Paris Agreement has reduced to less than 1/3.
- In addition to 'orderly' scenarios becoming inherently more 'disorderly', we have increased the proportion of probability we assign to delayed ('disorderly') scenarios.
- In Year 4, we have put a greater weight on REMIND versus M-G models, increasing electrification of the energy system in our probability-weighted scenario.

Table 1: Summary of probability weightings across the scenario framework

	Year 3	Year 4
Bespoke scenarios	83%	79%
Paris-aligned scenarios (<2°C global temperature rise)	34.5% (of which 77% is 'disorderly')	31.5% (of which 79% is 'disorderly')
REMIND vs M-G	43.5%: 52.5%	51%: 46%

The 'Methodology overview' section in Appendix 3 provides a summary of how our scenario pathways are translated into financial impacts.

How can the results provide investment insights?

The following sections describe how the results of our scenario analysis have implications across different thematic investment areas and asset classes. We also provide an overview of significant shifts in impact we have observed when comparing our Year 4 analysis with Year 3.

Summary of the investment insights

1. **Portfolio view**
   - **Sector- and stock-specific impacts**: Climate risk and opportunity vary significantly by sector and individual stock, with large dispersions within sectors.
   - **Active management advantage**: Actively managed strategies can tilt portfolios towards climate-transition winners and away from losers.
2. **Equity**
   - **Reduced impairment**: This year's analysis shows a smaller equity valuation impairment in all scenarios.
   - **More demand creation**: Equity impairment change is largely driven by doubling of demand creation, plus lower carbon costs.
3. **Fixed income**
   - **Differential impact based on model**: Lower carbon prices in the M-G scenarios reduce aggregate impairment.
   - **Energy sector**: Dominates the downside.
   - **Correlation with equity**: But risks are skewed to the downside in credit.
4. **Impacts on sectors**
   - **Energy**: Still the most negatively impacted sector, but impairment has reduced significantly.
   - **Utilities and Materials**: Positive uplift due to lower carbon costs and higher demand creation.
   - **Information Technology**: Slight but significant positive impact, due to the sector's high index share.
   - **Consumer Discretionary**: Positive impact, driven by demand for electric vehicles (EVs).
5. **The theme of electrification is an expanding investment universe**
   - **Electrification**: Greater role in decarbonising the energy system, with improved technology readiness and policy support.
   - **EVs**: Beneficiaries of falling battery costs and increased demand creation.
   - **Expanding investment universe**: Wider breadth of companies offering climate solutions.
   - **Regional variation in climate-solution potentia**l: China leads the US, driven by domestic incentives and a large market. Southeast Asian countries are significant green-tech players. Europe has a strong decarbonisation agenda but benefits less from demand for green products.
6. **Lower demand destruction**
   - **Markets are pricing in more ambitious policy**: A decrease in the delta between the Baseline and Probability-weighted mean scenario is reflected in a reduction in demand destruction.
   - **Fossil-fuel dynamics**: Oil sees near-term growth. In the longer term, coal and oil see significant impairment risk, while the role of natural gas is less clear and problematic.
   - **Stranded-asset risk**: Delayed policy implementation has pushed out stranded-asset risks.
7. **Timing of impacts**
   - **Uplift in the near term**: Improvements in climate policy and technology readiness pull climate-solution opportunities forward.
   - **Impairment after 2030**: Policy implementation is disorderly and has a significant time lag.
   - **Bond duration critical**: Short-dated bonds face less risk relative to longer-dated bonds.
8. **Carbon pricing**
   - **Lower**: Driven principally by decarbonisation technologies becoming cheaper, but regional variations are wide.
   - **Regional differences**: Carbon prices in Europe, China and the US are projected to be above the global average.
   - **Emerging markets – one to watch**: Policy developments such as CBAM[14] may bring global economies closer to a single global carbon price.

[14] The EU Emissions Trading Scheme Carbon Border Adjustment Mechanism (CBAM)

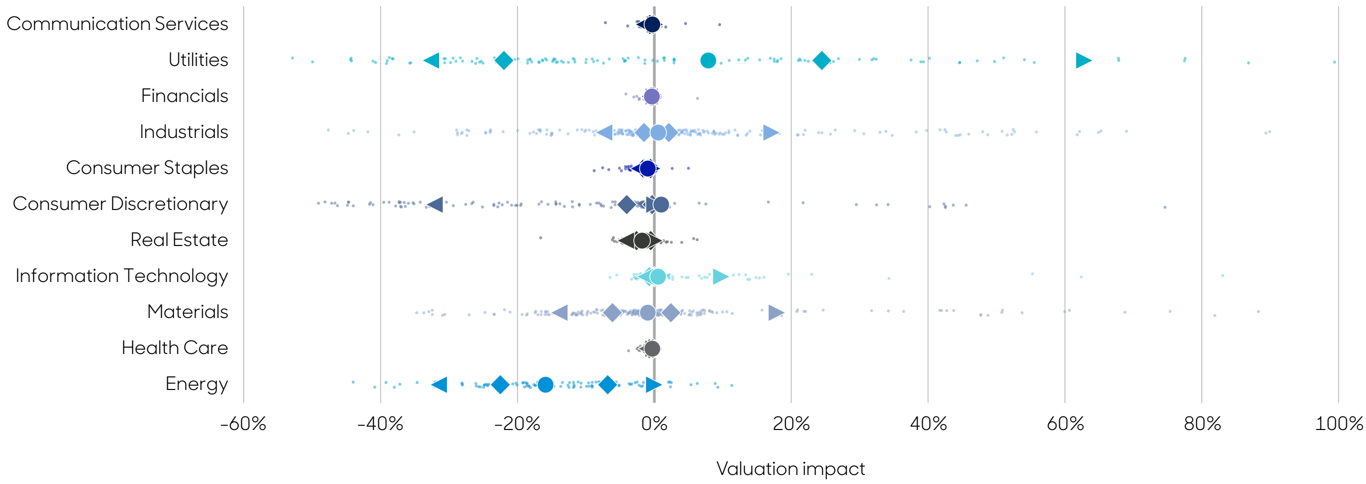
9. **Portfolio emission pathways**
   - **Time lag**: From when climate policy and low-carbon investments materially impact real-world emissions.
   - **Utilities lead the way**: Driven by a rapid reduction in renewable costs, supported by long-established policy mechanisms.

These insights highlight the importance of sector-specific strategies and the potential for active management to capitalise on sector climate-transition opportunities.

Portfolio view

The most significant takeaway from our climate scenario analysis is that climate risk and opportunity is both a sector- and stock-specific phenomenon. Notably, dispersions within sectors can be particularly large (Figure 4). This implies that actively managed investment strategies can tilt portfolios towards climate-transition winners and away from losers.

Figure 4: Impairments are highly dispersed within most sectors

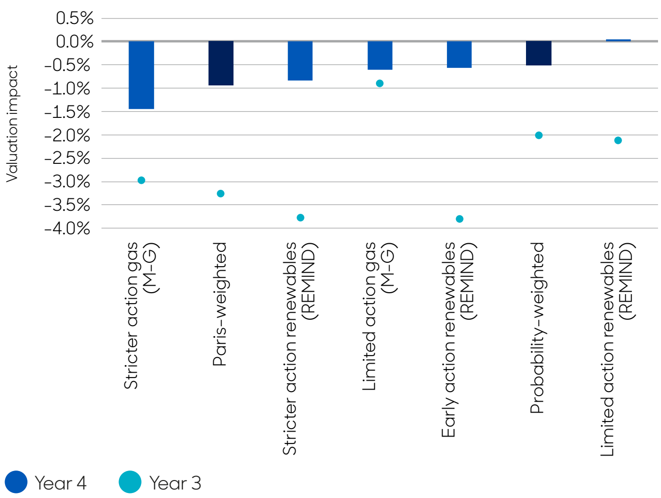


Source: abrdn, 2024. MSCI ACWI.[15] Probability-weighted mean scenario. Diamonds represent the 25th and 75th percentiles; triangles represent the 10th and 90th percentile

Equity

This year's results indicate a reduced equity valuation impairment versus Year 3 (Figure 5). The Probability-weighted mean scenario sees an aggregate impact of just a -0.5%, versus -2% in the Year 3 analysis.[16]

Figure 5: Global equity valuations, 2023 (Y4) and 2022 (Y3)



Source: abrdn, 2024. MSCI ACWI Index weighted by market capitalisation

15 MSCI ACWI is used as an illustrative portfolio to showcase the insights from the Year 4 analysis.

16 It is important to note that results are relative to a baseline that reflects present market valuations (at the time of modelling).

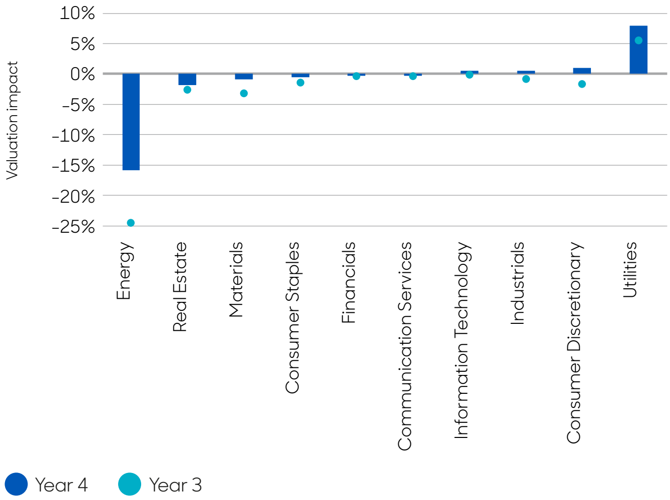
The major difference comes from a doubling of demand creation and a decrease in carbon costs.[17] (See the overview of the methodology in Appendix 3 for further details on the different impact channels.)

Sectoral summary

We provide additional details on how specific sectors are being affected by the energy transition, but the main year-on-year insights are:

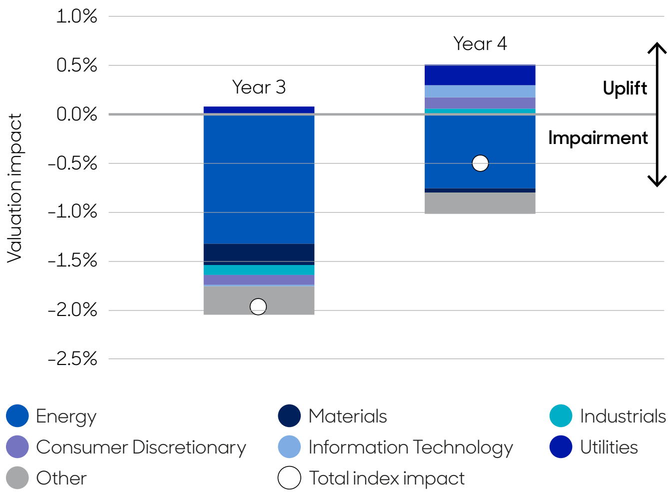
- **Energy** sees the biggest shift, going from -25% to -16% value impairment (Figure 6). Whilst it remains the sector most negatively impacted by the energy transition, the lower demand destruction (in comparison with the Baseline) continues to account for the significant reduction in impairment. Its impact is lower this year but still contributes to over half the aggregate impairment in the MSCI ACWI index (Figure 7).
- **Utilities** makes the largest positive contribution, and its impact has more than doubled. Similarly, **Materials**, which was the second-largest negative driver last year, now has a limited contribution, and the impact for **Industrials** has turned positive. These sectors benefit from lower carbon costs and greater demand creation.
- **Information Technology**, as a sector, is only slightly positively impacted, but because of its high share in the MSCI ACWI index, it makes a significant contribution with its shift from impairment to uplift. Semiconductors, and semiconductor materials & equipment supporting green technologies, are the main contributors.
- **Consumer Discretionary** has a positive aggregate impact in Year 4. EV automakers enjoy large demand creation, although this is partly offset by more acute demand destruction for traditional automakers.

Figure 6: Equity valuation impacts by sector



Source: abrdn, 2024. MSCI ACWI Index weighted by market capitalisation. Probability weighted mean scenario

Figure 7: Sector contribution to valuation impact of the MSCI ACWI index



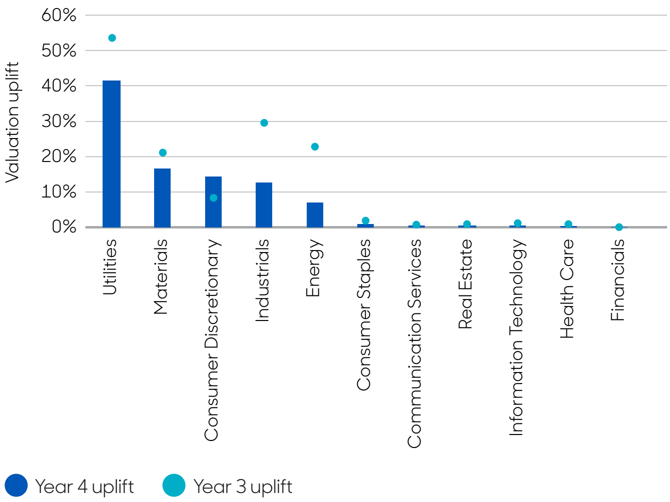
Source: abrdn, 2024. MSCI ACWI Index weighted by market capitalisation. Probability-weighted mean scenario

17 The Direct Carbon Cost channel matters less this year due to lower carbon prices, but the effect is balanced by the lower Abatement and Cost Pass-Through channels.

The above shows how the mean valuations have shifted in our standard analysis (where companies do not update their business models). But we can also look at the impact of companies fully implementing their decarbonisation and revenue targets (see the company-target approach in the Methodology section in Appendix 3).

In comparison with our Year 3 results, the uplift from target implementation for almost every sector has been reduced. But the impact of targets remains significant, especially for emission-intensive sectors (Figure 8). The valuation uplift decrease is most significant for Industrials and Energy, because of the lower carbon costs. Consumer Discretionary is an exception: the target analysis shows a more significant uplift. This is driven by autos and the widening impact between Internal Combustion Engine (ICE) and EV businesses.

Figure 8: Implementing decarbonisation targets significantly improves the valuation impact in emission-intensive sectors

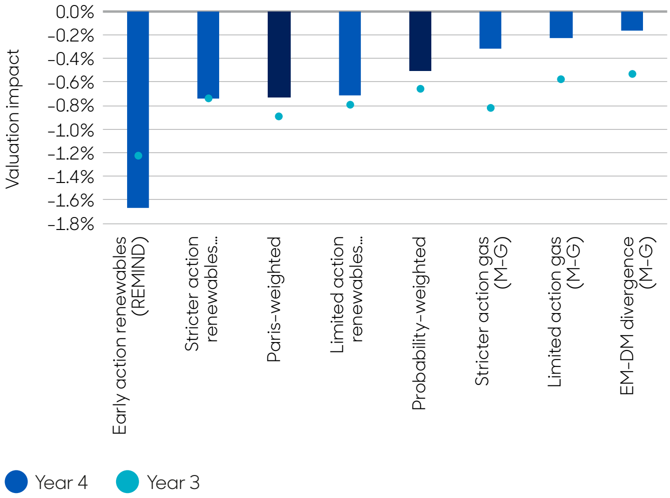


Source: abrdn, 2024. Probability-weighted mean scenario. Universe limited to companies included in the company-target approach only

Fixed income

The impact across scenarios for fixed income depends on the technological model. In the REMIND scenarios, where carbon prices have increased, we observe greater aggregate impairment. Conversely, lower carbon prices in the M-G scenarios (compared with Year 3) have reduced the aggregate impairment observed in Year 3 (Figure 9).

Figure 9: Global fixed-income valuations, 2023 (Y4) and 2022 (Y3)

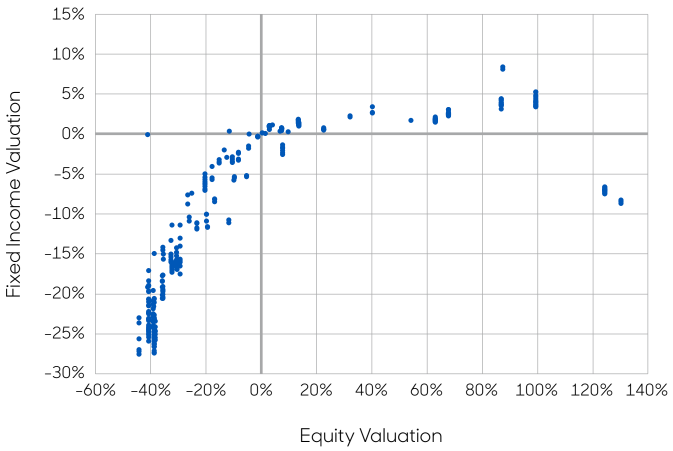


Source: abrdn, 2024. Bloomberg Global-Aggregate Total Return Index weighted by market value

At sectoral level, the results are very similar to previous findings. All sectors are negatively impaired, but, as with equities, the sectoral impact is concentrated in the Energy and Utilities sectors. In Utilities there is a wider dispersion of positive and negative financial impacts than in the Energy sector, where the impacts are largely downside.

In this context, it is insightful to compare equity and credit impacts within the Utilities sector. In Figure 10, we see that there is a correlation between equity and credit impacts. However, risks are skewed to the downside in credit, while upside and downside equity impacts are more evenly distributed. There are some outliers with a large positive equity impact and fixed-income impairment; these are companies marked by significant uplift in some scenarios and large impairment in others. While the equity effect is positive in aggregate, for credit the uplift is limited.

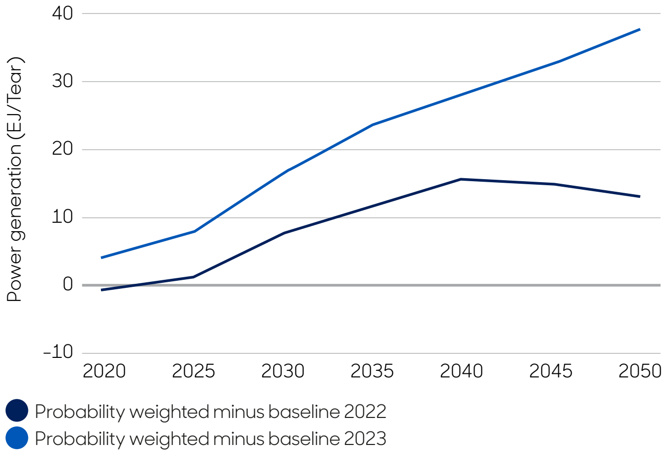
Figure 10: Utilities sector – equity vs fixed-income valuation impact



Source: abrdn, 2024. Bloomberg Global-Aggregate Total Return Index, MSCI ACWI. Probability-weighted mean scenario. Bonds >15 years maturity

Figure 11: Change in electricity demand relative to the Baseline

Change in electricity demand relative to baseline



Source: abrdn/Planetrics, 2024

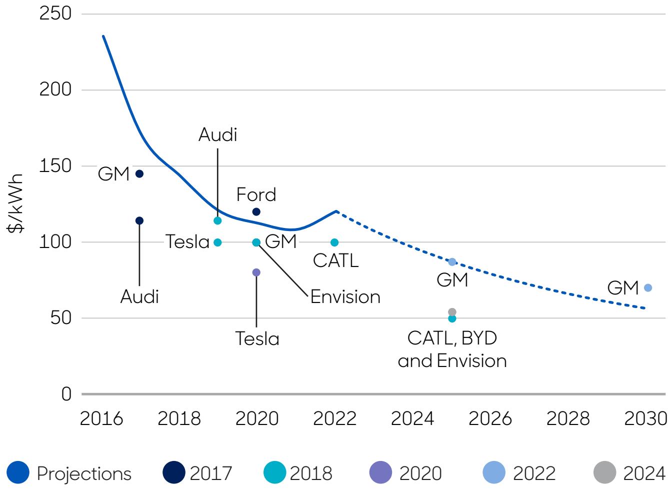
Thematic deep dives

Higher demand creation

The Probability-weighted scenario projects a greater role for electrification to decarbonise the energy system versus the baseline than in our last analysis (Figure 11). We believe that the technological readiness for electrification solutions is broadly higher than for alternative green molecular fuels, and the fundamental technological and policy drivers have improved for electrification climate solutions.

An example of this is within the transport sector, where we continue to see a trend of falling EV battery costs, which improves technology readiness and competitiveness (Figure 12).

Figure 12: EV lithium-ion battery costs falling faster than projected

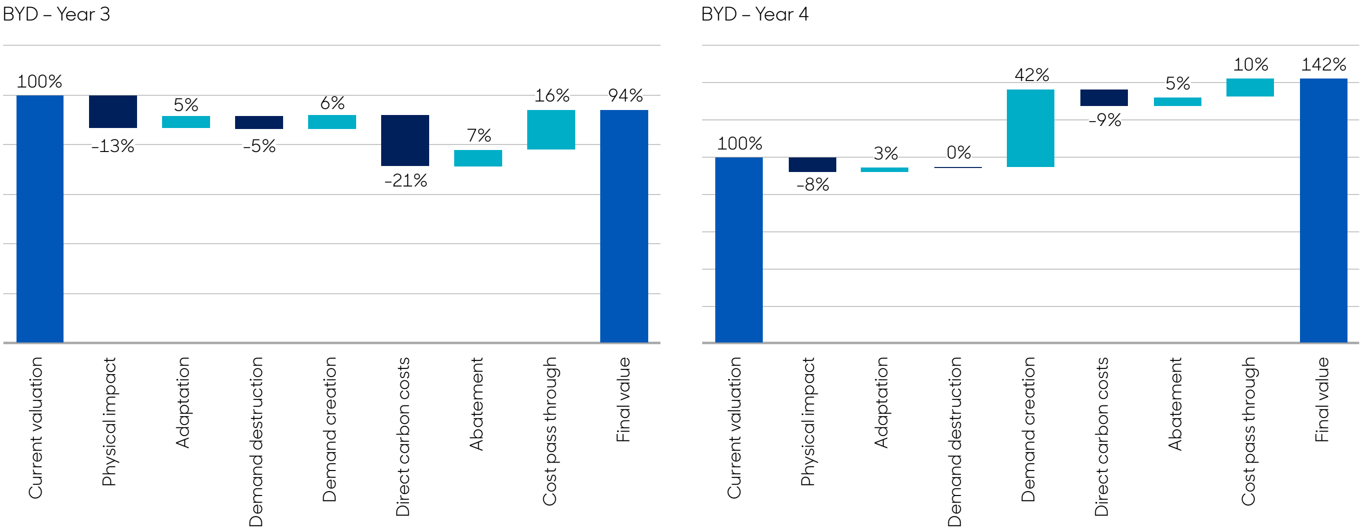


Source: BNEF, 2023

Companies included for informational purposes only and not as an investment recommendation, or indication of past, current or future holding status in any abrdn product.

At the same time, we have seen short-term hurdles in EV penetration, while the longer-term picture looks intact. Consequently, EV automakers are large beneficiaries in our scenario analysis results, such as BYD, where we see demand creation being the largest valuation impact driver (Figure 13).

Figure 13: Comparison of valuation impacts on BYD – Year 3 vs Year 4



Source: abrdn, 2024. Probability-weighted mean scenario

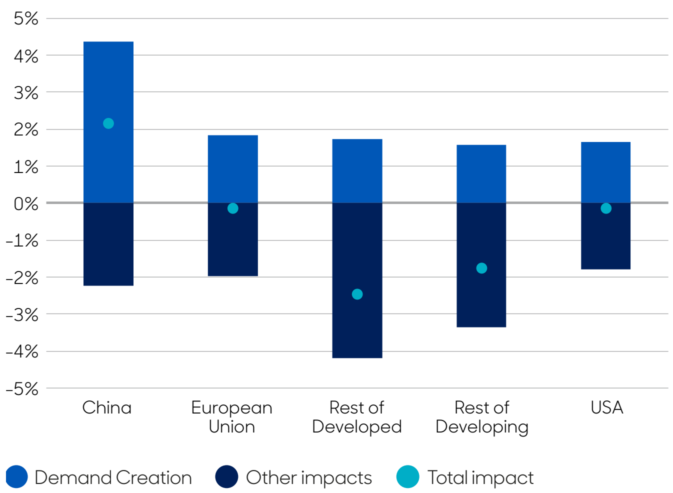
Within transport, EVs have the highest technology readiness level when compared with other modes of transport, such as shipping or aviation. We are already observing how rapidly the vehicle market can transition.[18]

[18] The Guardian, 2024 www.theguardian.com/environment/2024/sep/17/norway-electric-cars-outnumber-petrol-for-first-time-in-historic-milestone

A regional view: China dominates climate solutions

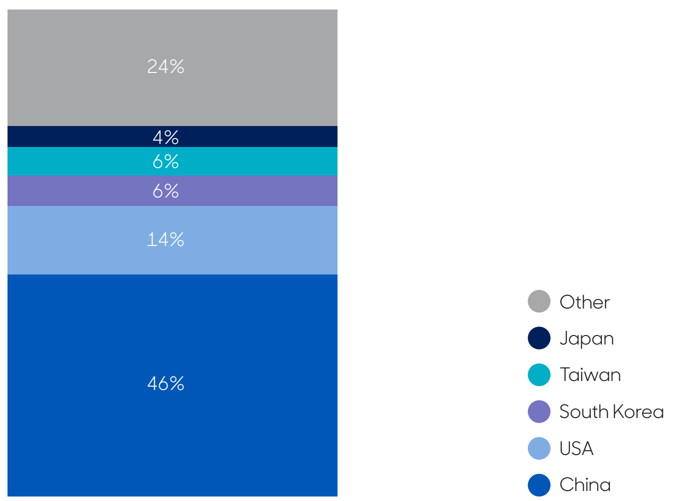
When looking across geographies, China clearly stands out in terms of demand creation uplift, which we consider as an indicator of potential climate solutions (Figure 14). If we look at the companies with a demand creation uplift of more than 25%, we can see that China clearly dominates, making up nearly half the global share of climate solutions in this segment (Figure 15).

Figure 14: China has a larger demand creation than other regions



Source: abrdn, 2024. MSCI ACWI Index weighted by market capitalisation. Probability-weighted mean scenario

Figure 15: Green-technology companies – geographical split



Source: abrdn, 2024. Entire equity universe equally weighted. Charts show companies with a demand creation uplift above 25% (a proxy for green-technology companies). Probability-weighted mean scenario

The US ranks second – while industrial competition between the two regions is intensifying, the US currently lags behind its geopolitical rival in green tech. The top five is completed by three Southeast Asian economies: South Korea, Taiwan and Japan.

Europe shows a differential performance between the 'decarbonisation' and 'demand creation' pillars of the energy transition. The region has the most ambitious decarbonisation agenda, and many European companies would gain a competitive advantage from it, as they would be incentivised to reduce their carbon costs more quickly. But on the other side, few European companies benefit significantly from additional demand for green products. This raises the question of whether the region's dependence on other countries to implement the energy transition could risk dampening its industrial basis and competitiveness.

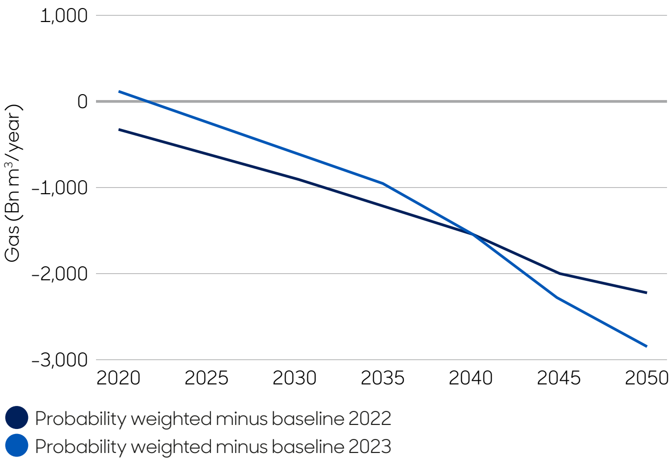
China's dominance has been driven by large domestic incentives, which have been supported by a large and growing domestic market. However, there is currently an overcapacity – driven by China – in some green technologies, including solar photovoltaic (PV) and EV. While cheaper products can accelerate the climate transition, this is creating headwinds for manufacturers, which are likely to persist until the industries consolidate. It also incentivises Chinese companies to increasingly rely on export markets. This is leading to growing trade tensions, such as the recent EV tariffs placed on Chinese automakers by the EU.

Lower demand destruction

In this year's Probability-weighted scenario, fossil fuels play a more prominent role versus the Baseline, at least in the near term. This is partly because the new Baseline embeds the latest and more ambitious NDC targets – and therefore a more significant decline in fossil fuels than in Year 3. This material decrease in the delta between the Baseline and the Probability-weighted mean scenario is then reflected in a reduction in demand destruction.

However, we have identified significant stranded-asset risk as we move out through time. Since financial valuations are based on discounted cash flows, impacts that extend further out in time have a smaller impact relative to the shorter term. In Figure 16, we see this play out when comparing this year with last year's assessment of natural-gas demand: post-2040, we can see a particularly pronounced increase in demand destruction. This signifies heightened risk of permanent loss of capital for certain fossil-fuel assets.

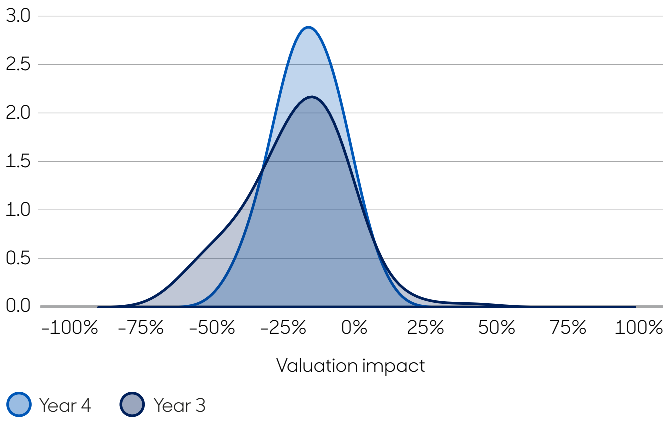
Figure 16: Change in gas demand relative to baseline



Source: Planetrics, 2024

Nevertheless, energy companies benefit from less demand destruction overall, as reflected in Figure 17, where the left leg (valuation impairment greater than -35%) is notably lower. Despite this improvement, most companies remain significantly impacted. More than a quarter of the sector would face an impairment larger than -25% if they maintained the same business model.

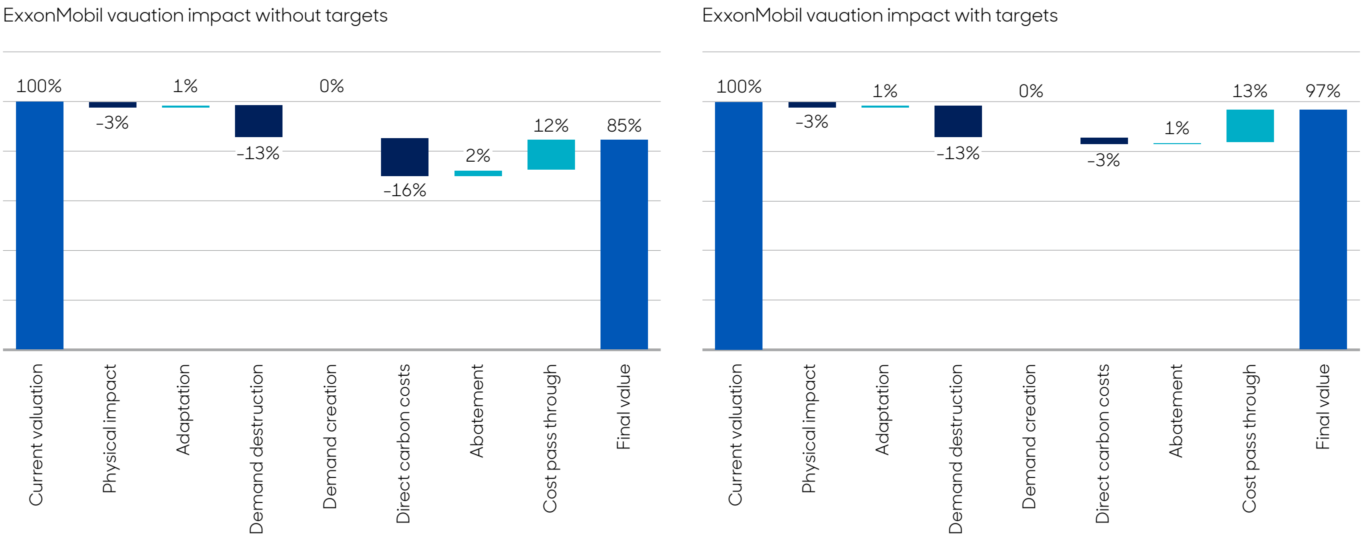
Figure 17: Energy-sector valuation impact – distribution comparison between Year 3 and Year 4



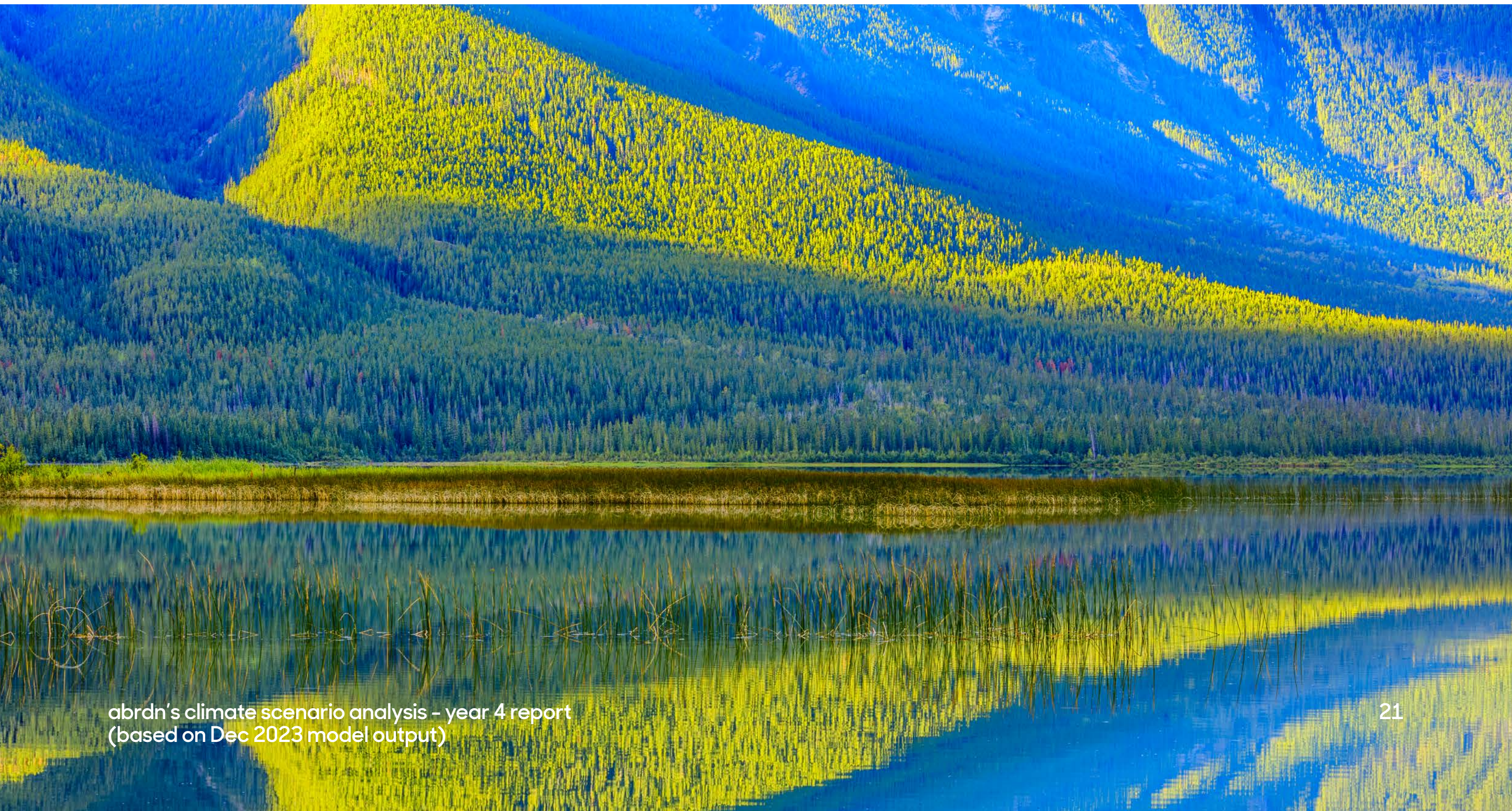
Source: abrdn, 2024. MSCI ACWI Index. Probability-weighted mean scenario

The observations remain similar even after accounting for company targets. The valuation impact is reduced but remains negative for around three-quarters of the energy companies. However, as illustrated by Exxon Mobil (Figure 18), the implementation of ambitious emission-reduction targets would enable the firm to gain a competitive advantage versus peers (as shown by the 'cost pass-through' channel more than offsetting carbon prices), but it would still be affected by the significant reduction in demand for oil.

Figure 18: Comparison of valuation impacts on ExxonMobil – with and without targets

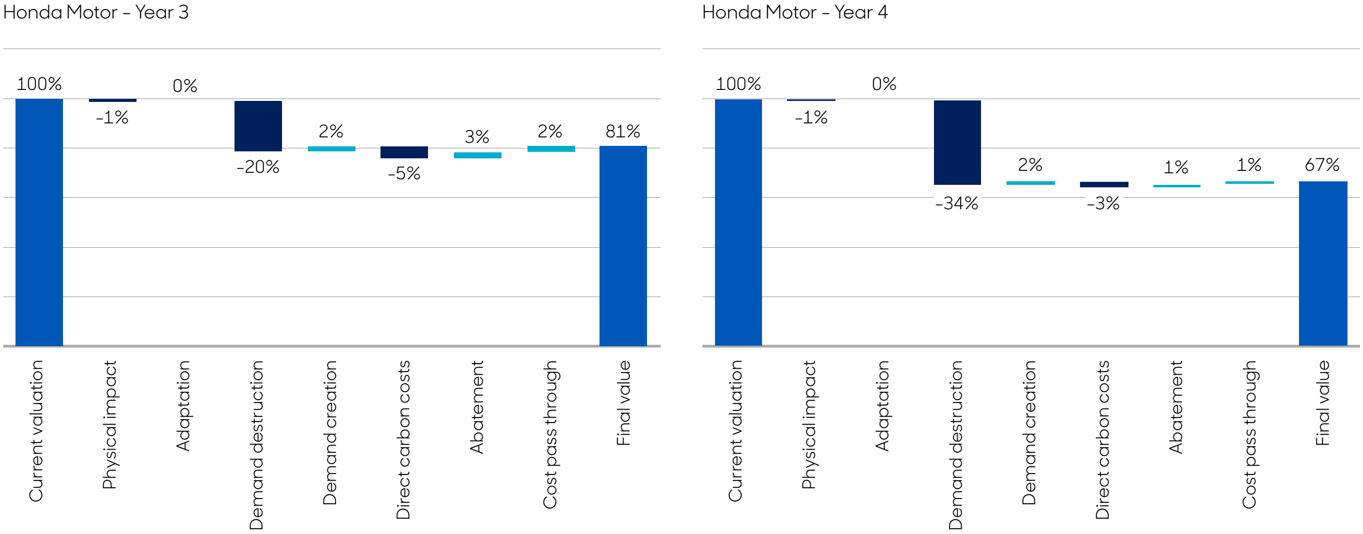


Source: abrdn, 2024. Probability-weighted mean scenario



In contrast, the increasing demand for EV also implies more acute demand destruction for traditional automakers (ICE), as seen for Honda Motor (Figure 19). Because the impact between ICE and EV has widened, traditional automakers are more likely to see a more significant uplift if they fully implemented their targets – especially for companies with an ambitious share of EV. Most automakers are negatively impacted, but the aggregate sectoral effect is positive because EV automakers with a large market capitalisation skew the impact upward.

Figure 19: Comparison of valuation impacts on Honda – Year 3 vs Year 4



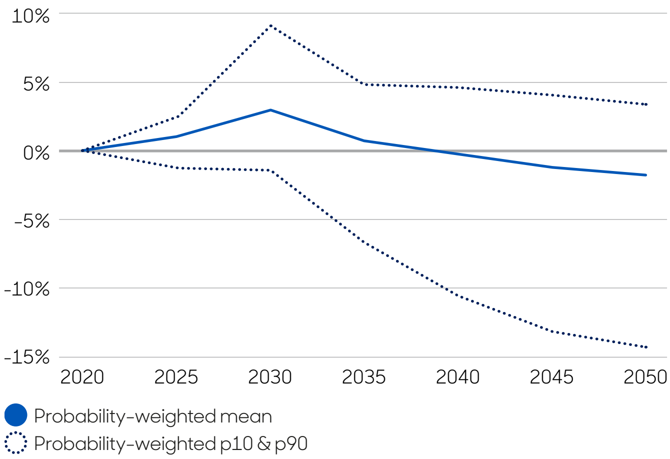
Source: abrdn, 2024. Probability-weighted mean scenario

Temporal valuation impacts

Assessing financial impacts through time is very informative, particularly from an investor asset-allocation point of view. The MSCI ACWI index has positive economic shocks overall until 2030, but over the longer term the impact becomes negative (Figure 20). There is a notable steep positive impact until 2030 for the top-decile (p90) securities, but the uplift is then steadily reduced over the rest of the period. For the bottom decile (p10), the impairment is fairly minimal until 2030, followed by a steady decline in value, resulting in a pronounced negative impairment of close to 15% by 2050.

In summary, improvements in climate policy and technology readiness are pulling climate-solutions opportunities forward, while climate risks are being pushed out. A key finding of this year's analysis is that despite heightened policy ambition, the actual implementation of policy is disorderly and has a significant time lag. This pushes out risks such as carbon-price increases to 2030 and beyond.

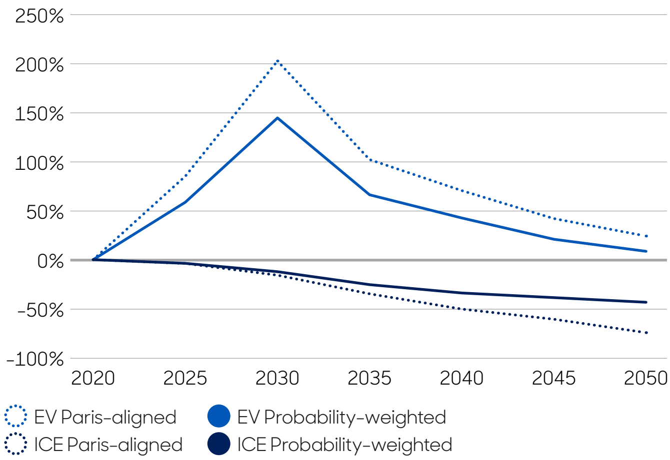
Figure 20: Economic temporal shocks of the MSCI ACWI index



Source: abrdn, 2024

Temporal valuation impact can help to inform the assessment of specific sectors and companies. Within the Consumer Discretionary sector, temporal shocks are positive, with a peak in 2030 followed by a shallow decline for EV, reflecting that the largest gap between our Probability-weighted and Baseline scenarios is reached in 2030 (Figure 21). For ICE automakers, demand for oil-fuelled vehicles sees a steady but steep decline over the next 25 years.

Figure 21: EV automakers would gain the most by 2030, while ICE automakers would be increasingly impaired over time



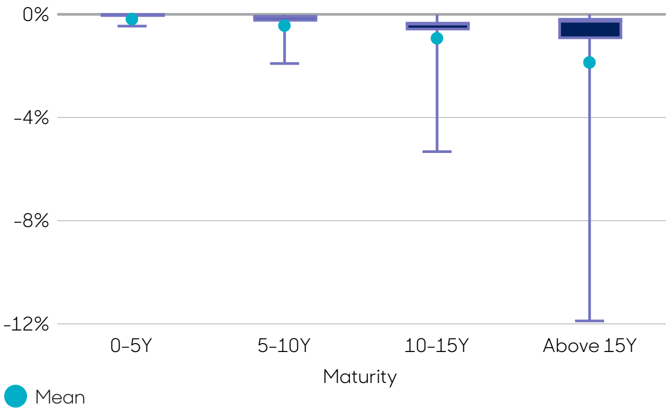
Source: abrdn, 2024

Corporate credit bond duration

The duration of bonds is a significant driver of results for corporate credit. Short-dated bonds face less risk than longer-dated bonds, as illustrated in Figure 22. When we remove those short-term bonds, which account for over half of the index, the valuation impact becomes more pronounced. However, there is an increasing rollover risk for short-dated bonds, as the climate risk will eventually materialise. This underscores the importance of active management.

The dispersion is equally important for equities: the bottom decile of bonds, with a maturity over 15 years, has an impairment greater than -11%.

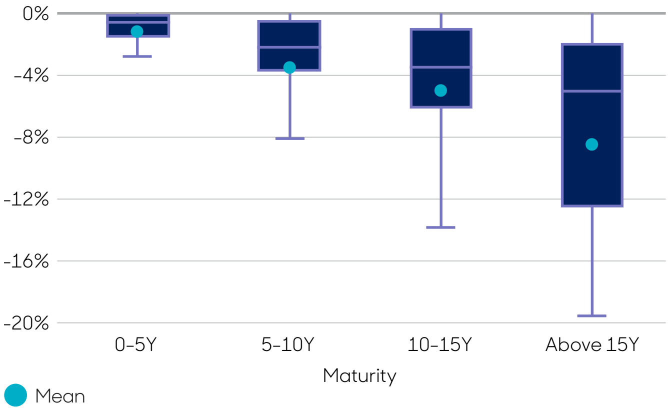
Figure 22: Climate risks are concentrated on long-duration bonds



Source: abrdn, 2024. Bloomberg Global-Aggregate Total Return Index

Figure 22 has a long tail of downside impacts. This is overwhelmingly dominated by the energy sector, as indicated in Figure 23.

Figure 23: Large dispersion in the valuation impact for energy bonds



Source: abrdn, 2024. Bloomberg Global-Aggregate Total Return Index

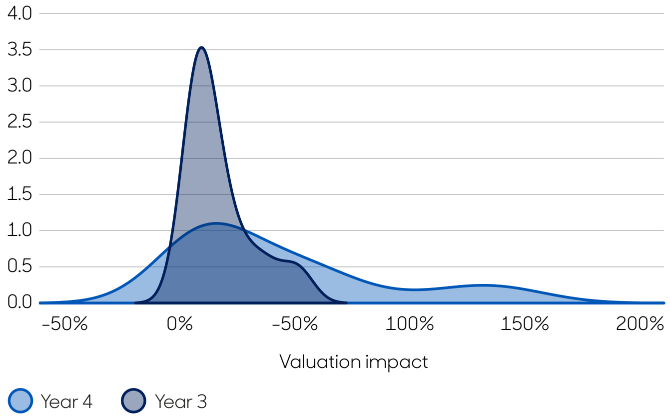
Whilst some major oil and gas (O&G) producers are increasing investment in the cleaner elements of their businesses, none of the major companies are making sufficient investments or setting up ambitious green revenue targets relative to the Paris Agreement. We see this as an aspect to monitor over the next updates. Moreover, many O&G players have pulled back their commitments, highlighting the technological challenge of decarbonising their traditional business models.[19]

Electrification: an expanding investment universe

As discussed above, we have observed higher demand creation positively impacting indices at the aggregate level. At the stock level, however, we are seeing a wider breadth of companies offering climate solutions, signifying an expanding investment universe of climate solutions.

End products like solar and EVs are the most well-known beneficiaries of the climate trend, but other segments, such as the associated equipment, would equally gain from it. It is important to consider the investment risks and opportunities through the entire value chain. Industrial companies that provide green-technology components have a positive outlook in our analysis. Figure 24 shows that the share of companies with a valuation impact above 25% has surged since our last exercise. We also find specific stocks in other sub-industries (for example, building materials, construction and engineering) that would benefit from providing key equipment and materials to clean technologies.

Figure 24: Electrical components and equipment – valuation impact distribution comparison



Source: abrdn, 2024. MSCI ACWI Index. Probability-weighted mean scenario

[19] E&E News by POLITICO, 2024 www.eenews.net/articles/bp-backs-away-from-us-offshore-wind

Semiconductor securities are marginally affected by the energy transition, but those that specialise in supporting green technologies see their valuation more than double under our model. Semiconductors have recently been of great interest for investors, benefiting from the rise of generative artificial intelligence (AI). Our analysis highlights that the energy demand could become another important factor shaping the sector.

When we move upstream of the supply chain, we see a similar impact of an expanding climate-solutions investment universe. The energy transition, to a degree, is characterised by a transition away from a fossil-fuel-intensive world to a material-intensive world – particularly if our electrification base case plays out. This creates a positive valuation impact for firms exposed to green 'future minerals' that are required to electrify sectors downstream (Figure 25).

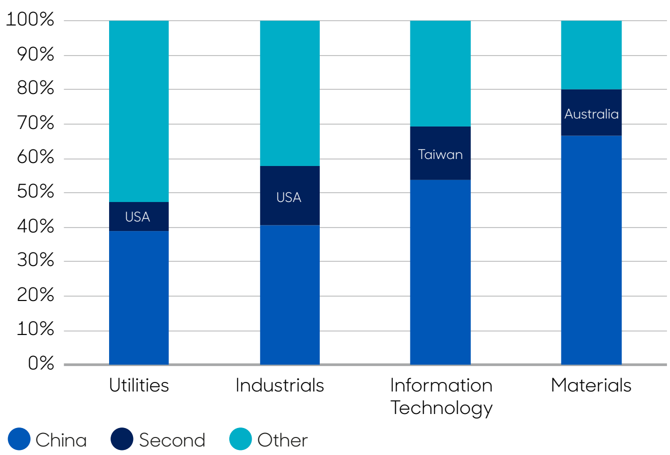
Figure 25: High dispersion across and within materials sub-industries

Source: abrdn, 2024. MSCI ACWI Index. Probability-weighted mean scenario

Conversely, there are a number of industries that face higher impairment because their manufacturing is focused on sub-industries that would be negatively affected by the energy transition. This includes multiple suppliers of heavy transportation equipment companies providing products to traditional automakers.

China consistently dominates climate solutions, although the extent of its dominance does vary across sectors (Figure 26).

Figure 26: China's green-technology dominance across the value chain



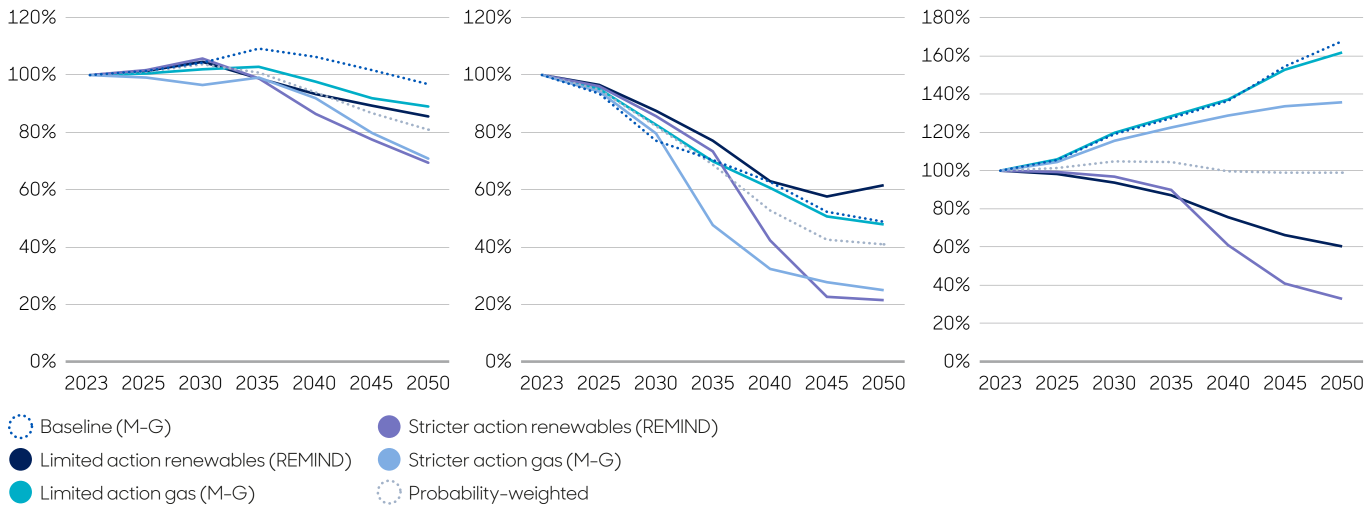
Source: abrdn, 2024. Charts show companies with a demand creation uplift above 25% (a proxy for green-technology companies). Based on all companies within these named sectors in our modelled equity universe. Probability-weighted mean scenario.

Fossil-fuel dynamics

As the energy transition plays out, investors need to be increasingly cognisant of long-term stranded-asset risks. Across the fossil fuels, we see very different probabilistic projected futures. Firstly, the projected coal phase-out has accelerated this year versus last year, while changes in the natural-gas and oil outlooks are more stable.

What is particularly relevant for investors is the probabilistic directional outlook for the different fossil fuels across the various scenarios. This is illustrated in the side-by-side comparison shown in Figure 27. Coal and oil have a negative outlook across all the scenarios, while natural gas.

Figure 27: Oil, coal and gas demand



Source: abrdn/Planetrics, 2024

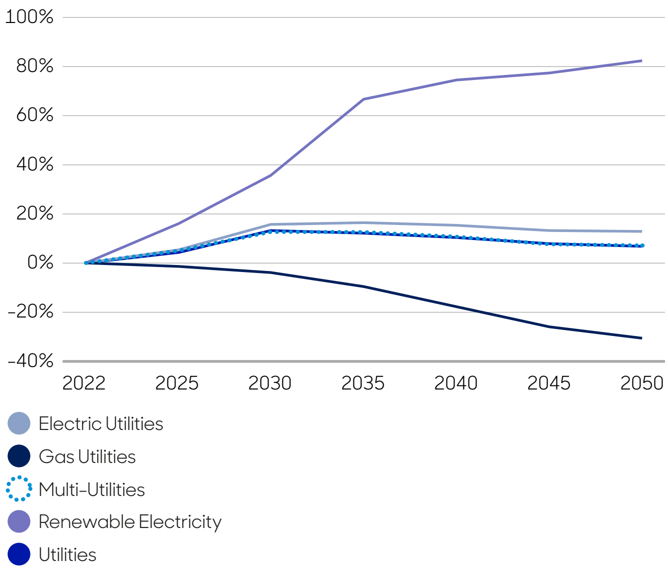
What is particularly pronounced is the competition between natural gas and coal. For example, if we look at the 'Stricter action gas (M-G)' scenario, we can see a larger implied role for natural gas but consequently an accelerated short-term phase-out of coal. In contrast, the 'Stricter action renewables (REMIND)' scenario implies a more gradual phase-out of coal: in this scenario, existing coal assets are used to complement renewable-energy build-out in the short term.

In the near term, the increase in gas prices resulting from the war in Ukraine results in some substitution to other fuels in both the REMIND and M-G models, reducing the relative share of gas in European industry. However, this decline is more than offset by an increasing share of gas in energy consumption by industry in Asia.

For oil, nearly all scenarios see a growth in demand this decade, up until 2030 and 2035, after which we start to see demand for oil fall. We are beginning to see signs of this playing out in the real economy, driven principally by the electrification of transport. Notably, there are material signs that gasoil and gasoline demand is beginning to peak in China, driven by a shift towards EVs, plug-in hybrids and LNG heavy-duty trucks.

Despite the dispersed outlook for natural gas, and demand remaining flat in the Probability-weighted scenario, we still see valuation risks flowing through to stock level – which we can see when comparing gas utilities with renewable-energy utilities (Figure 28). This is driven by additional factors beyond fossil-fuel use, such as the higher carbon costs to operate gas assets.

Figure 28: Temporal economic shocks across utilities sub-industries



Source: abrdn, September 2024. MSCI ACWI Index weighted by market capitalisation

Moreover, the role of natural gas as a transition fuel will continue to remain controversial. An increasing body of work is being dedicated to tracking and monitoring methane leaks at natural-gas facilities and across gas pipelines. It is widely understood that methane leaks are broadly unaccounted for in greenhouse-gas accounting inventories. Methane is a more potent greenhouse gas than carbon dioxide, creating significant question marks around its integrity as a genuine climate-transition fuel.

The directional trend of less carbon capture and storage (CCS) capacity in the underlying NGFS models is an important signal for investors. Our fundamental research on CCS has indicated significant engineering risks and challenges associated with geological storage and transport.[20] Economically, we believe carbon prices will need to increase significantly to see CCS as a viable scaled solution to future-proof fossil-fuel-intensive business models.

Is the energy transition becoming cheaper?

Within the underlying NGFS models, the cost of climate action has declined. This is the case for both the M-G and REMIND models but is most pronounced in the M-G model. In Table 2 we show that the projected 2050 global carbon price in real terms ($, 2020) has fallen by $241. This is principally driven by decarbonisation technologies becoming cheaper.

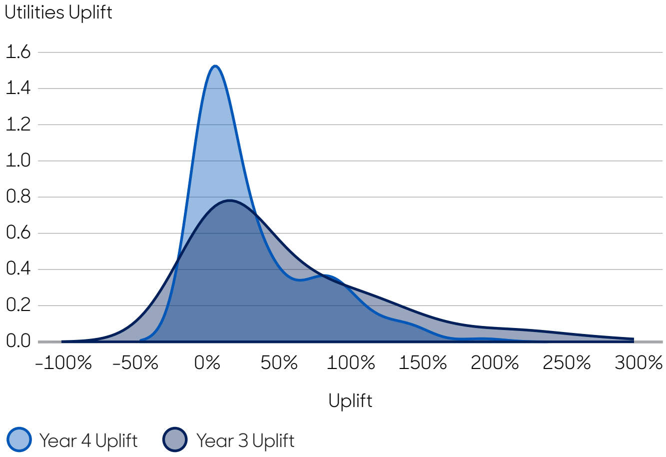
Table 2: Comparing carbon prices, Year 3 and Year 4 (probability-weighted mean)

Regional carbon prices in 2050	Y4 - Y3 difference ($)	Year 4 ($/tCO2, 2020)	Year 3 ($/tCO2, 2020)
Global	-241	102	343
US	-298	219	517
China	-112	121	233
EU	-109	321	430

This feature has impacted the valuation of emission-intensive sectors. Utilities with a high carbon intensity benefit from lower carbon prices. On the other hand, for low-emission businesses, including pure-play renewables, this reduces their advantage against more emission-intensive peers (although they remain amongst the companies benefitting the most from the energy transition). The overall effect is positive, as the largest utilities companies tend to have larger emissions intensity, but we have seen a reduction in the distribution tails for the sector (Figure 29).

[20] E&E News by POLITICO, 2024 www.eenews.net/articles/first-us-co2-injection-well-violates-permit-epa/

Figure 29: Lower carbon costs reduce the uplift when utilities companies implement their targets



Source: abrdn, 2024. Universe limited to companies included in the company-target approach only

The Materials sector contains some of the most energy-intensive industries, including Steel and Construction Materials, and is therefore also highly sensitive to carbon cost. Lower prices contribute to a reduction in carbon costs across the broad range of subsectors, but with substantial reductions of approximately 10% for Fertilisers and Speciality Chemicals in the MSCI ACWI index. The same pattern is observed for Industrials.

Those sectors are amongst the largest beneficiaries if companies fully implement their published targets. Because of lower carbon prices, the uplift is slightly lower than we saw in last year's analysis, but it remains significant and highlights that setting (and meeting) emission-reduction targets will greatly matter.

In Table 2 we can see a large difference in prices across regions. The 2050 global price of $102/tCO2 is significantly lower than in the large economies of the US, China and the EU. This reflects the lower climate-policy ambitions of emerging market economies. However, a key policy development that may change this is the introduction of the EU Emissions Trading Scheme Carbon Border Adjustment Mechanism (CBAM). The impact of CBAM would be, in effect, an import tax reflecting the EU carbon price. Currently, CBAM is in its initial phase, targeting effective implementation from 1 January 2026. CBAM has the effect of bringing global economies closer to a single global carbon price and creates more incentive for economies outside of the EU to begin implementing carbon-price schemes.

It is important to note that the prices we show in Table 2 are real prices; in nominal terms the carbon prices are much higher. Table 3 outlines both the real ($, 2020) and nominal global carbon prices under the probability-weighted scenario and the more ambitious Paris-weighted scenario.

Table 3: Comparison of real and nominal carbon prices

Carbon prices in 2050	Year 4 ($/tCO2, nominal)	Year 4 ($/tCO2, 2020)
Global Probability-weighted mean	185	102
Global Paris-weighted mean	344	190

We do expect decarbonisation costs to fall for technologies that fit the typical characteristics of 'Wrights Law', which states that, for every doubling of cumulative production of a technology, its costs typically decrease by a consistent percentage, reflecting the benefits of learning and efficiency gained through increased production.

These characteristics include:

- Consistency in manufacturing, enabling 'learning by doing'
- Scale in dissemination of the technology
- Predictability in input costs.

Nuclear energy is an example of a technology which has struggled to reduce costs, as the construction of nuclear reactors often involves idiosyncratic challenges. There appears to be a similar challenge for CCS projects. These are the technological dynamics we track when considering our bespoke scenario construction and assessing the efficacy of carbon-price projections within the underlying climate models.

Portfolio emissions – a forward-looking view

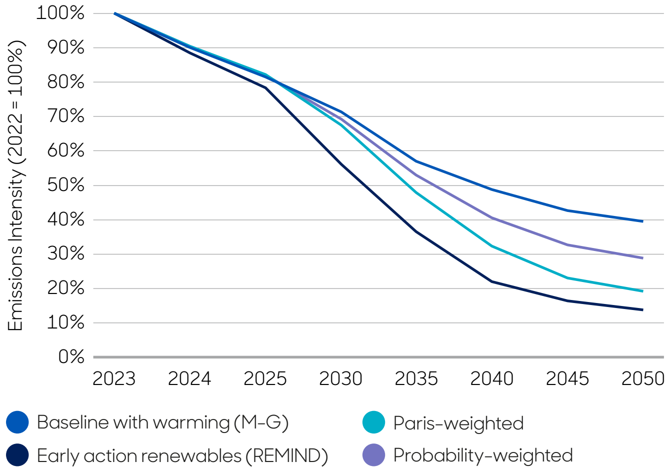
In addition to needing a forward-looking view of the financial impacts of climate change on investments, many financial institutions want to understand how their portfolio emissions are likely to evolve over the coming years. This is particularly true when they are setting out and monitoring forward-looking carbon commitments. We leverage our approach to project emissions pathways at company, portfolio and scenario levels.

This year's baseline is less optimistic than the NDC emissions pathways (Figure 30). This is driven by a core belief and observation that, while policy ambitions are increasing, the implementation of climate policy has proven challenging. Given that climate change is predominantly an energy-system infrastructure challenge, there is a considerable time lag before climate policy and investments in low-carbon assets have a material impact on real-world emissions.

The gap between NDCs and current policies similarly identifies a persistent credibility gap between the climate objectives of countries and their actual policies.

In our Probability-weighted mean scenario, emissions remain flat until at least 2025. There is a possibility of a slight decarbonisation by 2030. For this to happen, we would need to see a continued decarbonisation of developed economies, alongside a decarbonisation of the Chinese economy. There are signs that this will begin to happen before the end of the decade.

Figure 30: Carbon-intensity trajectory of the MSCI ACWI index across selected scenarios



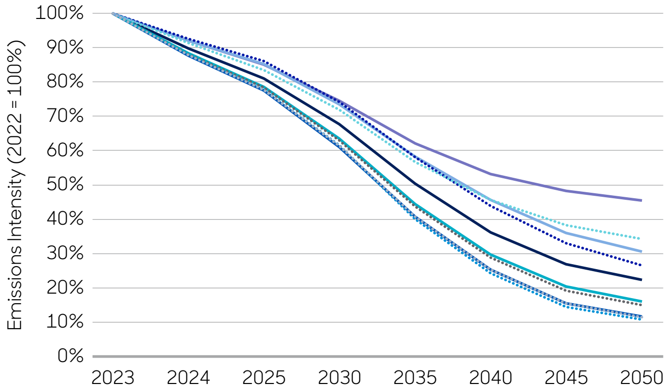
Source: abrdn, 2024. MSCI ACWI Index weighted by market capitalisation

Sector carbon-intensity pathways

Our clients are often interested in understanding decarbonisation within their portfolios from a carbon-intensity perspective. In Figure 31 we show the probability-weighted pathways across sectors, at a global level. We see utilities leading the way, driven by a rapid reduction in solar, wind and battery costs, supported by long-established policy mechanisms (such as contracts for difference and – to a lesser extent but still materially impactful – carbon-price mechanisms).

In contrast, due to a lower technology readiness level, the energy sector struggles to keep pace, although it does still decarbonise on an intensity basis – as do all other sectors.

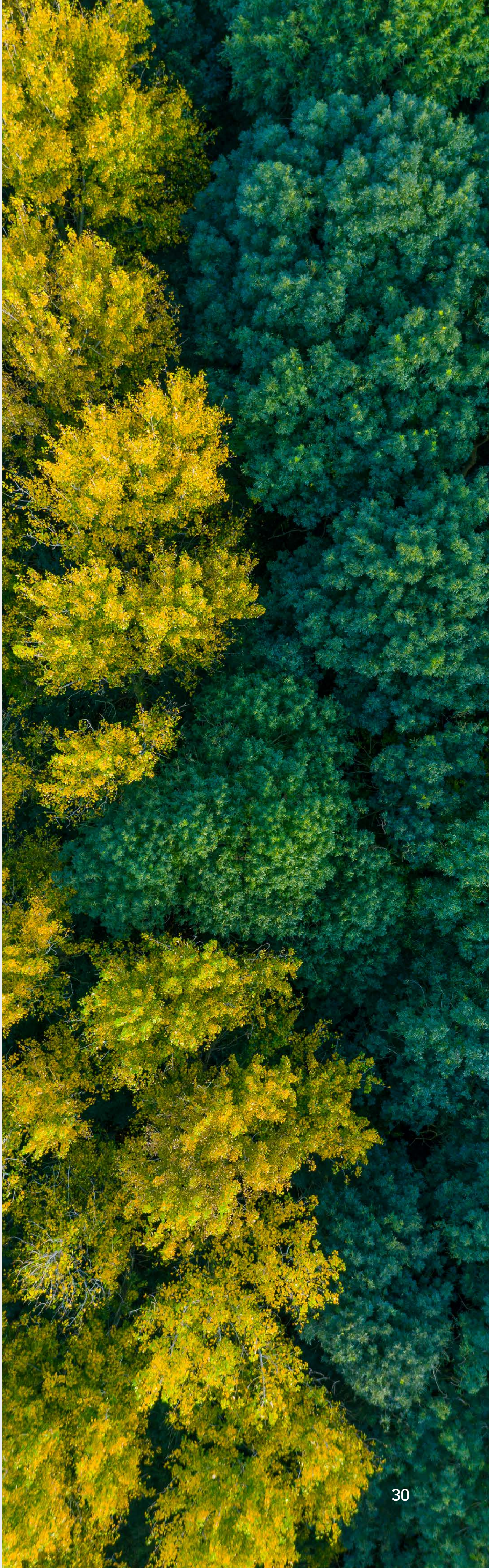
Figure 31: Carbon intensity



Source: abrdn, 2024.

Limitations

- Results are sensitive to the assumption that the market is currently pricing based on the selected baseline. For some companies (for example, pure-play low-carbon technology startups), this assumption may be complicated by the market pricing in a scenario different from the baseline for these companies.
- With the exception of the company-target analysis, the results do not consider companies' commitments to transform business models and abate emissions.
- The results are sensitive to current company revenues. Companies without revenues and/or negative net income (startups) are particularly sensitive to even modest carbon-cost shocks, which reduce profitability to zero.
- Demand creation analysis captures growth in demand for mature and high-growth clean-tech products which are already in commercial production or proven at scale. The analysis does not capture demand growth for more nascent technologies.
- The physical risk modelling accounts for expected average annual damages and impacts from temperature rise on economies. The changing tail risks of extreme events, supply-chain interruptions, and indirect societal impacts on health, migration and conflict are not captured.
- The modelling approach focuses on the demand side, assuming that the supply-side structure by 2050 remains similar to that of today.
- The company-target approach currently assumes that companies can achieve their stated transition targets at no additional cost or loss of efficiency. Targets are also analysed in isolation, and thus do not account for the way that one company's transition can affect another's, or the effect on overall sector/region emissions profiles. As a consequence, this represents an upper bound on the benefits companies can derive from transitioning.



Appendix 1

Scenario descriptions

The following table provides a summary of the bespoke and off-the-shelf scenarios used in the project. We assign probabilities to all our bespoke and off-the-shelf scenarios, which are then used to calculate our Probability-weighted mean and Paris-aligned mean scenarios.

Table A1: Year 4 scenario descriptions

Scenario	Description
Probability-weighted mean	Mean scenario based on probabilities assigned to all bespoke and off-the-shelf scenarios
Paris-aligned mean	Weighted average across all Paris-aligned scenarios where warming is limited to below 2°C by 2100
Baseline (M-G)	Bespoke scenario reflecting what the market is currently pricing in (December 2023, the base date for impairment). The assumption is that markets are pricing in a continuation of current policy except in circumstances where any future policy changes were already signalled, highly credible and already explicitly factored into analysts' discounted earnings expectations. Probability weighting: 10%
Limited Action (REMIND)	Bespoke scenario. Limited new policy action, with a renewables tilt. Probability weighting: 23%
Limited Action (M-G)	Bespoke scenario. Limited new policy action, with a gas tilt. Probability weighting: 13%
Stricter Action (REMIND)	Bespoke scenario. Strict, but delayed new policy action, with a renewables tilt. Probability weighting: 13%
Stricter Action (M-G)	Bespoke scenario. Strict, but delayed new policy action, with a gas tilt. Probability weighting: 8%
Early Action (REMIND)	Bespoke scenario. Strict, immediate policy action, with a renewables tilt. Probability weighting: 3%
EM-DM Divergence (M-G)	Bespoke scenario. Larger divergence between developed and emerging market policy action. Probability weighting: 9%
NDC (REMIND)	Off-the-shelf scenario. Current commitments for policy implementation – NDCs (Nationally Determined Contributions), with a renewables tilt. Probability weighting: 4%
NDC (M-G)	Off-the-shelf scenario. Current commitments for policy implementation – NDCs (Nationally Determined Contributions), with a gas tilt. Probability weighting: 3%
Below 2°C (REMIND)	Off-the-shelf scenario. Gradual increase in policy stringency keeping temperature increase below 2°C, with a renewables tilt. Probability weighting: 2%
Delayed Transition (M-G)	Off-the-shelf scenario. Delayed implementation of Paris-aligned policy, with a gas tilt. Probability weighting: 2%
Fragmented World (REMIND)	Off-the-shelf scenario. A 'too little, too late' scenario with both high physical and high transition risk, with a renewables tilt. Probability weighting: 5%
Fragmented World (M-G)	Off-the-shelf scenario. A 'too little, too late' scenario with both high physical and high transition risk, with a gas tilt. Probability weighting: 1%
Net Zero 2050 (REMIND)	Off-the-shelf scenario. Immediate Paris alignment, with a renewables tilt. Probability weighting: 0.5%
Current Policy p90 (REMIND)[21]	Off-the-shelf scenario. Current policy action only, with a renewables tilt. 90th percentile warming impact. Probability weighting: 0.5%
Forecast Policy Scenario (IPR)	Off-the-shelf scenario. A fully integrated climate scenario modelling the impact of the forecasted policies on the real economy up to 2050. Probability weighting: 3%

[21] In our Year 3 analysis we utilised both p50 and p90 Current Policy scenarios (equally weighted at 0.25%), but this year the p50 has been dropped so that the Current Policy scenario provides a more accentuated tail risk, to better emphasise the potential impact of physical risks.

Appendix 2

Changes to the NGFS model and the impact on our Year 4 update

The following table outlines the key changes to the NGFS scenario suite and the underlying energy-system models, their implication, and how these are broadly manifested in our Year 4 update.

Table A2: Summary of NGFS changes and impacts on our Year 4 update

Two scenarios for the price of one	
NGFS/model change	**abrdn Year 4 update**
A Low Demand scenario has been added to the bottom-left 'orderly' quadrant in Figure 3. This assumes significant behavioural changes will reduce energy demand, resulting in low transition and low physical risk.	We believe this to be an implausible scenario so have not included it.
A Fragmented World scenario has been added to the top-right 'too little, too late' quadrant in Figure 3, in which climate policy is implemented over time but stringency and timing is fragmented across geographies, limiting the speed of transition.	We believe this is a valuable inclusion and have allocated a 6% weight to Fragmented World.
The Divergent Net Zero scenario has been discontinued; this scenario achieved net-zero with limited policy coordination.	Last year we allocated little probability to this, and we have now removed it.

Scenario narrative shifts	
NGFS/model change	**abrdn Year 4 update**
The Nationally Determined Contribution (NDC)[22] and Current Policy scenarios have slightly reduced transition risks. This reflects the integration of the latest country NDC and net-zero targets (up until March 2023), along with increased climate policy, such as the particularly impactful US Inflation Reduction Act[23] and EU Fit for 55.[24]	Overall, our Baseline is now more ambitious, aligning with the increased ambition of the NDC scenario. This scenario is prevalent in our regional and sector selections, as we believe it is widely factored in across the market. In our Baseline, we shift the European power sector to NDC from Below 2°C to reflect a fall in power-utility valuations and a more ambitious underlying NDC model with the EU Fit for 55 consideration. The Baseline now reflects the NDC scenario for the Buildings sector across all developed markets. It was determined that the Current Policy scenario assignment in Year 3 now assumes a higher oil demand that does not match market assumptions.
Orderly transition scenarios in the bottom-left quadrant of Figure 3 see an increased transition risk due to policy implementation delays – orderly scenarios have become inherently more disorderly.	Within our probability assignment of transitional scenarios (Paris-aligned), we have also increased the proportion of probability that is assigned to 'disorderly' delayed scenarios. This reflects our view that, whilst policy ambition is gradually increasing, the majority of action required will not be implemented until at least 2030.

22 Nationally Determined Contributions (NDCs) includes all pledged policies, even if not yet implemented.

23 This is the most substantial US climate policy seen to date. It sets out approximately $400 billion aimed at substantially reducing carbon emissions by the end of the decade. Funds are delivered through tax incentives, grants and loan guarantees, and mainly target clean electricity generation and transmission, and clean transportation (including electric-vehicle incentives).

24 This policy package aims to ensure EU legislation is in line with the target to reduce EU emissions by at least 55% by 2030. This includes reforms to the EU emissions-trading system (ETS) and the introduction of a Carbon Border Adjustment Mechanism (CBAM) to apply a carbon price to imports of products in carbon-intensive industries.

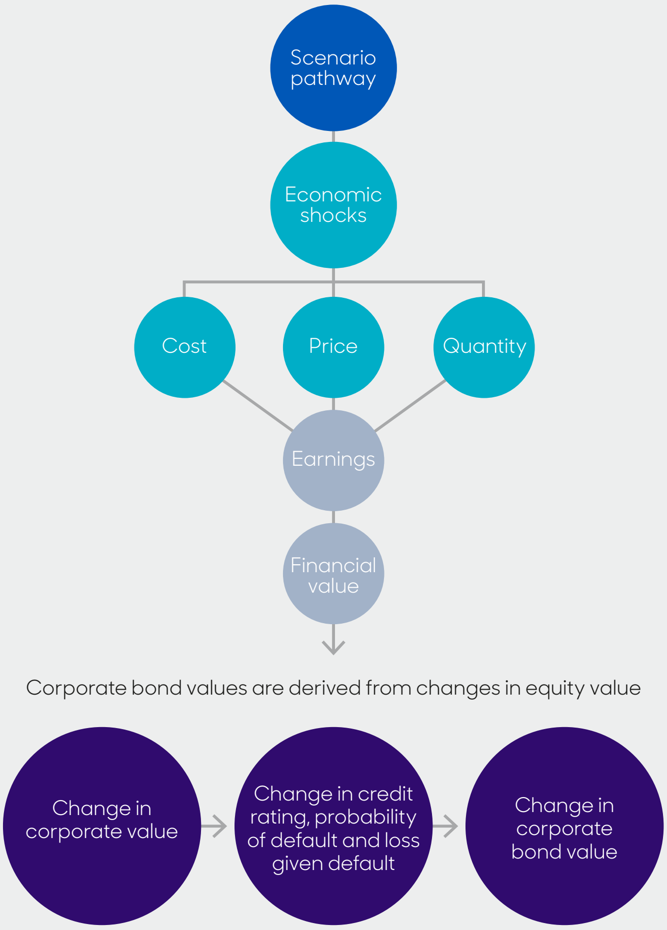
Technological pathways	
NGFS/model change	**abrdn Year 4 update**
Within the models, carbon prices are more effective at reducing emissions. This change is most apparent in the M-G model, with significant reductions in carbon pricing post-2030.	The smaller difference between the Baseline and the Probability-weighted mean scenario results in lower average direct carbon costs for assets after 2035 than in last year's analysis. Therefore, in general, the carbon cost burden on companies has been reduced, despite the increase in policy ambition.
REMIND scenarios see an increase in electrification: reduction in decarbonisation-technology capital costs (particularly solar) continue to accelerate, resulting in greater electrification in the industry, transport and buildings sectors. However, M-G represents a less electrified transition than in the previous iteration – higher demand for energy from industry in Asia increases oil and gas consumption and reduces the share of electricity in total final energy consumption.	This has been a significant contributor to greater demand creation in our scenario analysis results. Our research indicates that electrification tends to be the lowest-cost method of decarbonisation in most sectors (for example, road transport and steelmaking) but not necessarily in all. We continue to take a diversified approach in our suite of scenarios but have increased our weighting towards REMIND.
As in previous years, M-G continues to see a significant role for gas in the transition but REMIND has reduced even further the role of gas..	This change aligns with our fundamental view of CCS. While on one hand there is increased policy support for CCS, we do not believe the technology will follow the same cost-reduction curve as other climate technologies, such as solar, wind and batteries.
There is a reduction in the use of carbon capture and storage (CCS) in general, to reflect lower capital costs for renewable technologies such as solar. The use of direct air CCS, in particular, has been removed.	This change aligns with our fundamental view of CCS. While on one hand there is increased policy support for CCS, we do not believe the technology will follow the same cost-reduction curve as other climate technologies, such as solar, wind and batteries.

Appendix 3 – Methodology overview

Translating scenario pathways into financial impacts on securities

The core structure of our approach has remained unchanged from our previous analysis, and is summarised by Figure A1.

Figure A1: Methodology steps



Source: abrdn/Planetrics, 2024

Our climate scenarios set out the potential pathways for policy and technology developments which determine the physical and transition trajectories for the analysis. From these scenarios, economic shocks are simulated which consider both direct and indirect impacts on individual companies.

The scenarios determine different pathways for carbon pricing, primary energy demand, transition-technology development, sectoral emission trajectories, and resulting global temperature. These, in turn, create direct and indirect impacts on companies (transition and physical economic shocks), which then drive changes in company earnings and value.

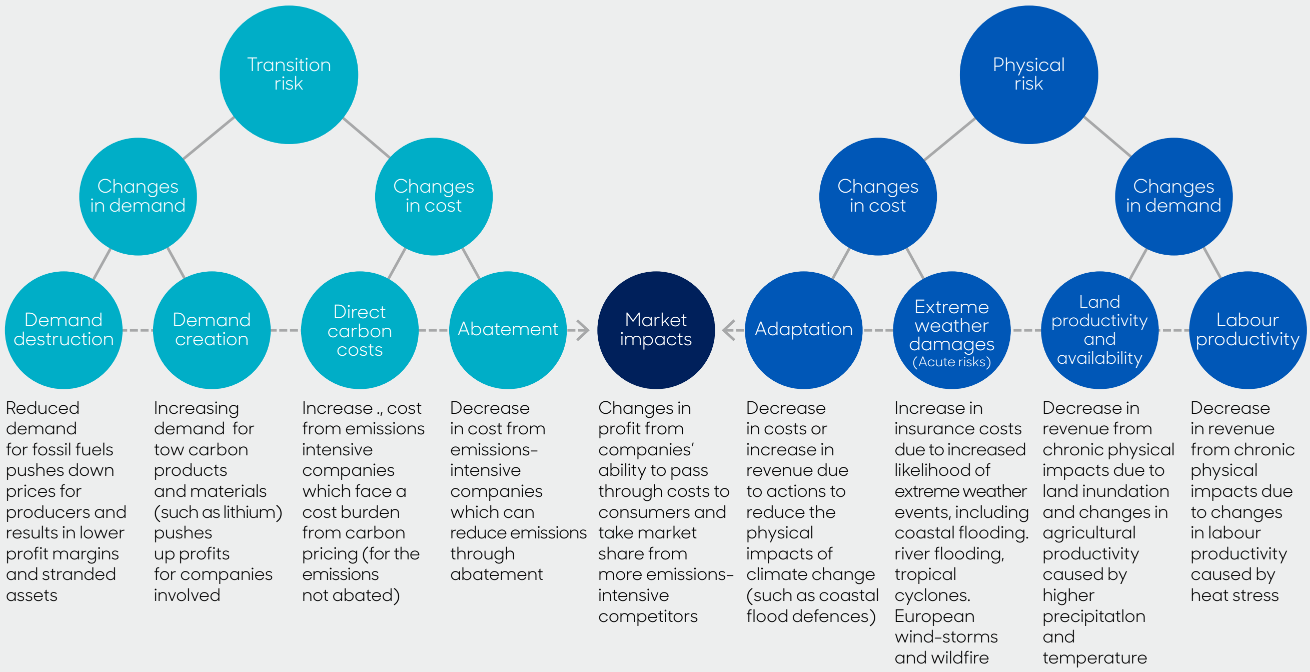
The impacts are summed at company level and discounted to estimate the impact on net present value (NPV) relative to our baseline scenario.

Corporate bond impacts are in turn derived from these changes in equity value.

Insight from disaggregated impact channels

Figure A2 shows how these climate impacts can be disaggregated into the different transition and physical impact channels to enable us to better understand what is driving climate risk at company level.

Figure A2: Scenario impact channels



Source: Planetrics, 2024

Company-target analysis

Our standard approach assesses climate risk from current company emissions and revenue shares, and does not incorporate future company targets, plans and strategies. We therefore add to our standard analysis a company-target approach that utilises the targets set out in company climate strategies. This analysis, which covers a subset of the modelled universe, takes into account two key parameters in the modelling:

- Company commitments to reduce emissions
- Company commitments to increase sales of low-carbon products.

In our Year 4 analysis we have increased the coverage of this analysis to approximately 2200 companies. Whilst this is only around 10% of the full universe, it represents around 65% of the equity universe by market cap. At least 50% of market cap is now covered in all sectors, with the largest increase in sectors which previously had the lowest coverage. The energy sector remains the sector with the highest coverage, at 81% of market cap.

Changes to the methodology

As in all annual updates, there has been a refresh of the key inputs into the model, including scenario variables (NGFS v4) and company-level financials and emissions, which have been updated to the latest available data. But there have also been some significant changes to the methodology:

- Changes have been made to the growth model, which we believe more closely mirrors the observed growth trajectories of companies and provides additional granularity. The key impacts of this change are:
  - A higher growth rate for company earnings in the short term and a lower growth rate in the long term.
  - Whilst this does not alter the results for company value, because of the higher growth rate in early years, there is a greater emphasis on early-year earnings. Therefore, potential future climate shocks have a reduced impact on a company's NPV.
  - This reduces the negative impacts (from physical climate shocks) of less ambitious scenarios (Current Policy and NDCs), but there is also a reduced upside for long-term climate 'winners' in transition scenarios, due to the greater emphasis on near-term cash flows.
- Sector-region Marginal Abatement Cost Curves have been updated to reflect the increased availability of abatement technology at a lower cost in future years. Overall, this has resulted in higher abatement in the results, with abatement potential increasing the most for the electricity-generation, steel and construction sectors. However, it should be noted that this is partially offset by a reduction in cost pass-through, given the lower costs incurred.

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