

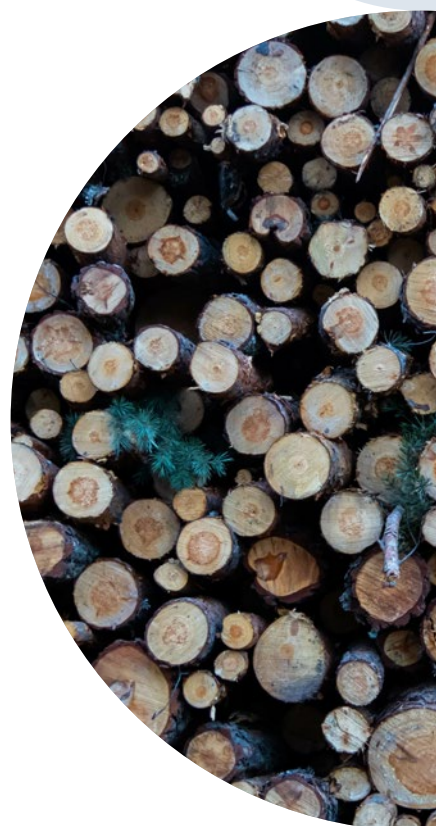
abrdn's 2021 climate scenarios: the evolution of investment risk and opportunity since the Covid crisis

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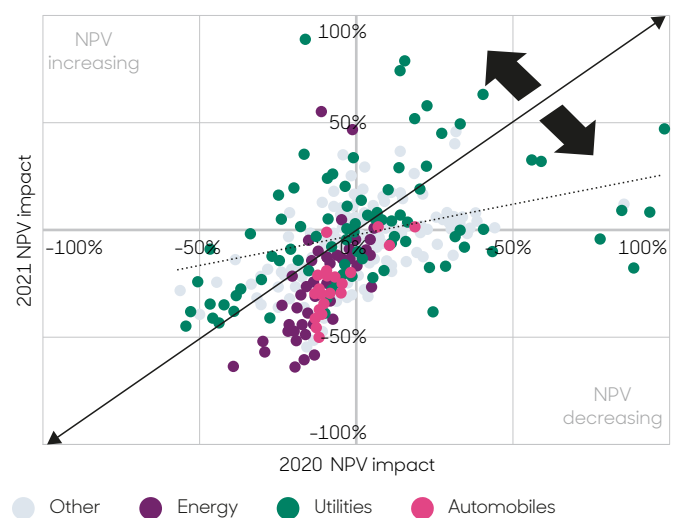


Main takeaways

- Our 2021 climate scenario analysis update took place against a very different economic and policy backdrop to **last year's exercise. The Covid pandemic has significantly altered the long-term economic growth outlook in many countries, lowering projected energy demand.** Renewable technologies have rapidly gained market share in the power and transportation sectors, with expectations for future gains better reflected in asset prices. And the ambition and credibility of commitments have improved ahead of November's COP26 meetings in Glasgow.
- This note first **outlines the modifications we have made to the design of our bespoke climate scenarios, and the probabilities we assign to them, amidst this fast-changing landscape.** We then examine their implications for the future of energy usage, before examining how they alter our impairment estimates for the listed equity and credit securities covered in our 2020 exercise.
- The core insight from our 2020 analysis remains intact – namely that there is a large dispersion of risks and opportunities within and between sectors but relatively little impact at the aggregate index level. But **downward revisions to long-term fair valuations were more common than upward revisions** (see Figure 1). This is mainly attributable to two factors: the much lower profile for energy demand; and higher expected carbon prices derived from a reduced estimated potential to deploy negative emissions technologies and increases in assumed policy ambition.
- The opportunity set has also been attenuated by the fact that **our baseline scenario now assumes markets are pricing in a faster energy transition** than was the case in early 2020. This is especially the case for firms that are pure plays on zero-carbon technology deployment. At a sector level, these drivers have the largest effect on valuation estimates in the energy, materials, auto and utility sectors. The upshot is that while there is still considerable scope to add alpha through the incorporation of climate scenarios into investment processes, even greater discrimination in stock selection is required to capture the opportunities.

- Energy remains the most impaired sector in both our equity and credit results. However, the aggregate uplift effect for equity utilities reverses for corporate credit. This results from the effect of the cap on the valuation uplifts for low-carbon utilities in a credit portfolio, as implied default rates cannot fall below zero. **The potential downside is therefore more critical for credit** as there is further to fall for e.g. a fossil-fuel intensive generator than there is for a low-carbon generator to rise.
- Follow up notes will: detail the extensions of our analysis into real estate, infrastructure and sovereign bond assets; **show how we can adapt our analysis to capture credible corporate transition plans and their implications into emissions pathways and valuations;** deepen our analysis of physical climate risks; explore how the nature of climate risk and opportunity varies across the world's major regions; and demonstrate how we incorporate the insights from climate scenario analysis into Strategic Asset Allocation.

Figure 1: Negative exposures to climate transition risk generally increased in our 2021 exercise



Source: Planetriss/abrdn, Sep 2021.

Incorporating post-pandemic energy transition drivers into our bespoke scenario design

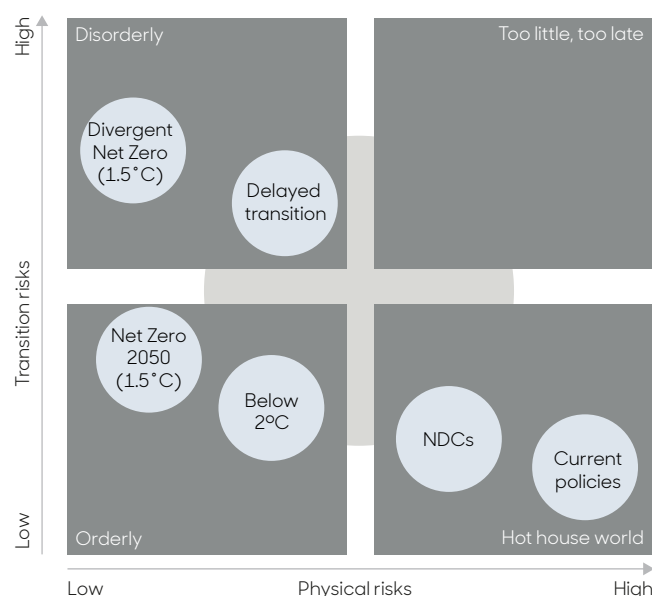
The past 18 months have witnessed significant changes in the underlying drivers of climate risk that we incorporate into our bespoke climate scenario framework:

- **The structural damage resulting from the Covid pandemic has lowered our projections for long-term global economic output**, and altered both its regional and sector composition. That in turn has reduced our expectations for future cumulative energy demand, both for fossil fuels and renewable energy.
- **Renewable energy penetration in the transportation and power sectors has taken a leap forward** since the pandemic, thanks to tightening regulations and falling relative production costs. Moreover, rigorous assessments of future technological change have generally lowered estimates for the relative price of renewable technologies.
- The **climate commitments made by the major government and corporate fossil fuel emitters have generally become more ambitious**. And though these commitments are not sufficiently ambitious to satisfy the objectives of the Paris Agreement, the expected speed of global decarbonisation has increased. Many prudential supervisors have also taken steps to require regulated banks, insurance companies and pension funds to assess their exposures to a range of physical and climate transition risks.
- Investors have responded to the changes in these drivers by also **pricing in a faster energy transition**, with valuations for pure play firms in the utility, industrial, materials and auto sectors rising especially strongly.

The durable signals from these shifts have been fully incorporated into the design of our 2021 climate scenarios, with important implications for the climate-related risks and opportunities facing investors. The main changes are as follows:

- **We switched to using the off-the-shelf scenarios built by the Network for the Greening of the Financial System (NGFS; see Figure 2)**. NGFS scenarios have become the standard used by regulators to assess climate risk exposures for regulated financial entities. Using them as the base scenarios for our bespoke framework facilitates comparability and better meets the needs of our clients. We mapped our previous scenarios onto the new NGFS scenarios to ensure continuity in the analysis.

Figure 2: NGFS scenarios capture a wide range of transition and physical climate risks



Source: NGFS, 2021.



- **The NGFS scenarios themselves have been updated to incorporate new post-Covid IMF projections** for long-term global economic growth and its regional composition (see Figure 3). These make significant downward revisions to cumulative economic growth over the next three decades, with some of the largest revisions occurring in emerging markets. Given the positive correlation between growth and energy consumption, this has the effect of reducing the forecast size of the energy market compared with last year’s exercise.
- One of the two integrated assessment models (IAMs) we use to map carbon emissions and climate policy scenarios to technology pathways and the composition of energy demand (Message-Globiom), **has become more optimistic about solar PV usage and more pessimistic about natural gas and nuclear usage** in the baseline scenario (see Figure 4). This reflects faster than expected increases in solar’s market penetration, the expectation these trends will continue, and a less favourable outlook for carbon capture and storage (CCS) technologies.
- Then, as climate action is scaled up in the 2021 Message-Globiom scenarios, natural gas is squeezed out by more than in 2020, mostly in favour of renewables, and to a lesser extent nuclear. Critically, **the nuclear share now increases modestly in most scenarios relative to the baseline**, rather than declining as it did in the 2020 scenarios. This has the effect of boosting estimated valuation uplifts for utilities with nuclear portfolios.
- **Our baseline scenario now incorporates a moderately faster transition towards low-carbon technologies.** This reflects the way that both energy system modellers, and markets themselves, have re-appraised the outlook for renewable technologies. Because all security valuation estimates are expressed relative to that baseline, this has the effect of reducing the transition opportunities for many companies in our scenarios. For those companies that act as an option value for investors betting on an even more rapid zero carbon energy transition we have made further adjustments to our standard baseline to prevent their fair valuations from being overestimated.
- **Our bespoke scenarios have also been adjusted to incorporate the more ambitious policy environment** in some countries, as well as the faster decline in the relative price of renewable technologies, particularly in the transportation sector (see Figure 5). Thus while the ranking of sectors in terms of their likelihood of completing the zero-carbon energy transition has not changed, the outlook for the transportation sector is now much closer to the power sector than the industrial and buildings sectors.
- From a regional perspective, we still think that Europe has the highest chance of completing the net zero transition by 2050 and emerging markets (ex-China) the least. However, thanks to Biden’s victory in November’s elections, as well as the Democrat majority in both houses, which is facilitating more ambitious federal climate policies, we no longer think that the US will lag behind the other developed economies. Meanwhile, **China’s expanded policy commitments imply that it is likely to decarbonise more quickly than the average across the rest of the emerging markets complex.**
- The upshot is that our mean scenario now sees greater emissions reductions than in our 2020 exercise. And though we do not yet think that the outlook for global climate policies and technology pathways are consistent with the objectives of the Paris Agreement, **we have increased the probability attached to stronger action and Paris aligned scenarios.**

Figure 3: Less long-term economic growth and energy demand

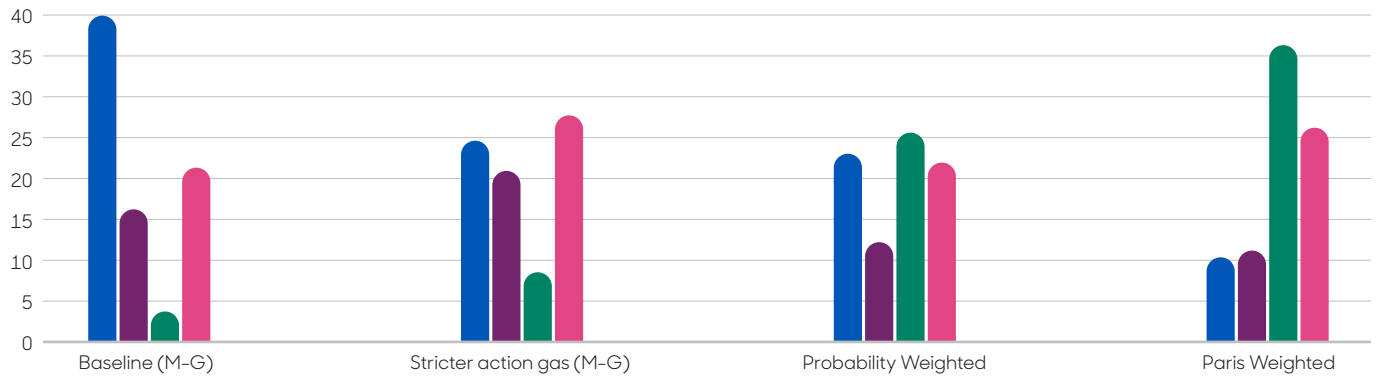
Changes in TFC/GDP for NGFS 2021 Current Policy relative to NGFS 2020 Current Policy (%)							
Region	2020	2025	2030	2035	2040	2045	2050
China	0	-3	-4	-9	-14	-17	-21
Europe	-13	-14	-14	-16	-20	-25	-29
India	-20	-16	-11	-10	-13	-17	-21
Latin America & Caribbean	-6	-2	-4	-7	-10	-13	-17
Middle East & Africa	-7	-2	1	4	4	5	4
USA	4	6	3	0	-5	-9	-13
World	-5	-4	-4	-5	-9	-12	-15

TFC stands for total final consumption.
Source: Planetricss/NGFS (2020, 2021).

Figure 4: A brighter future for solar in the Message-Globiom model

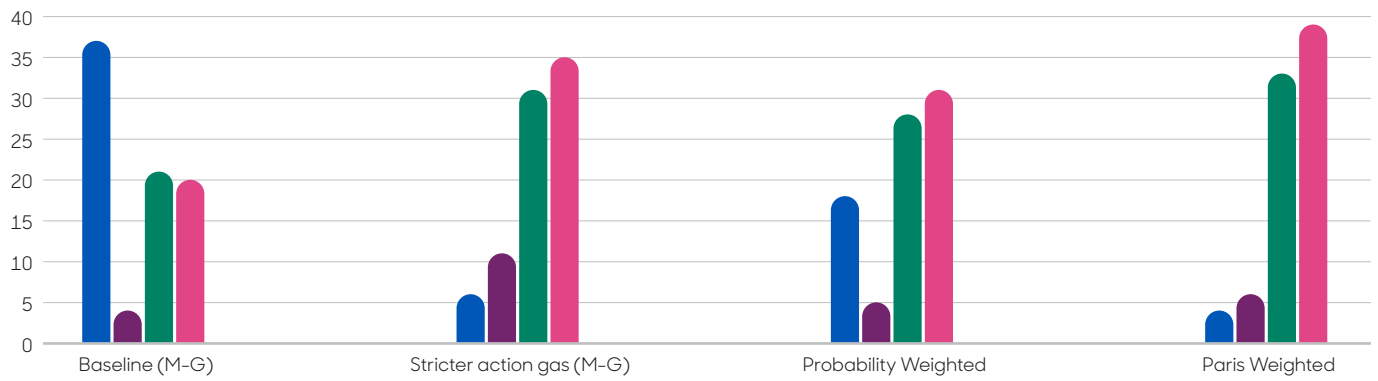
2020

Power generation mix 2050 (%)



2021

Power generation mix 2050 (%)

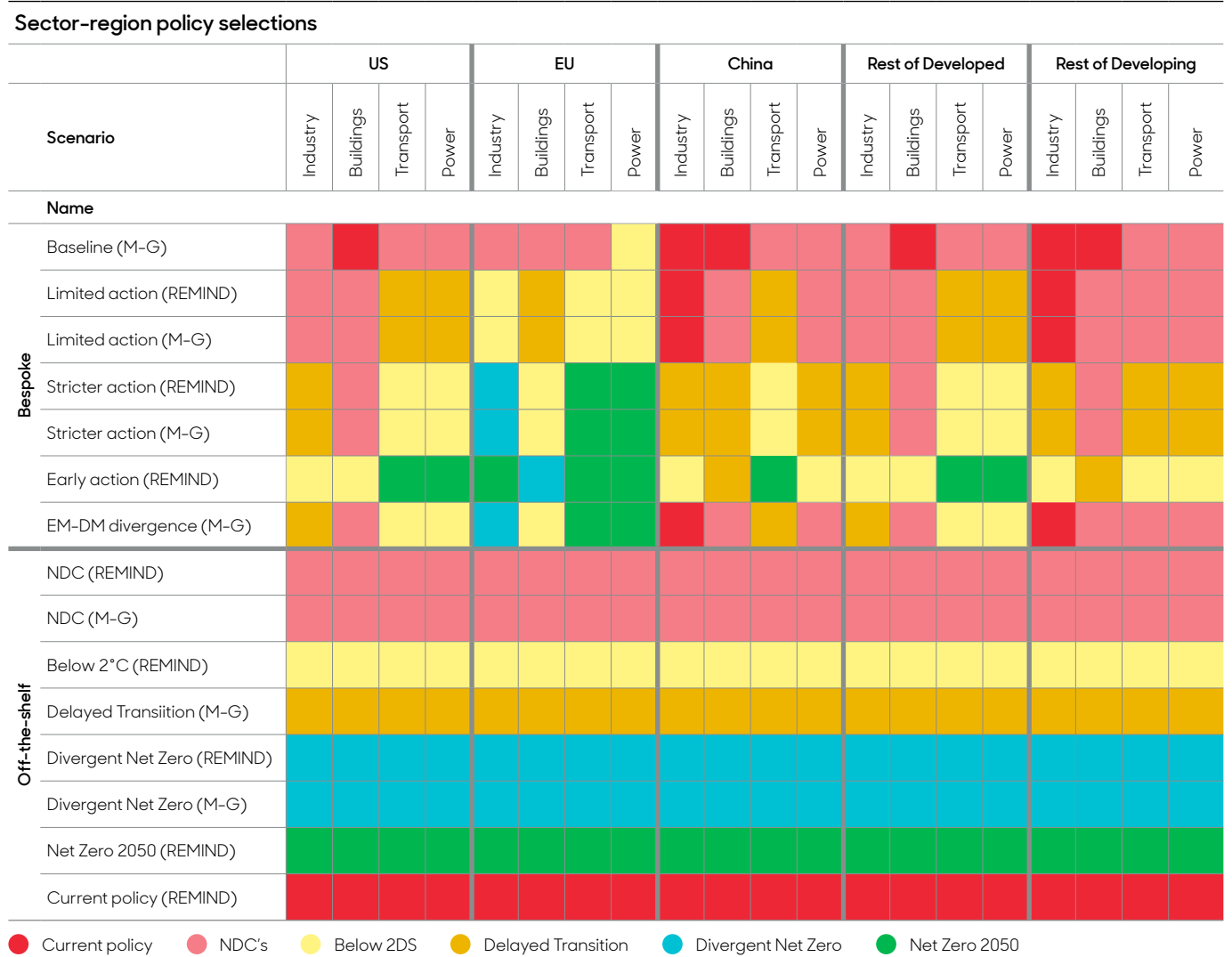


● Gas ● Nuclear ● Solar ● Wind

Source: abrdn/Planetrics Sept 2021.

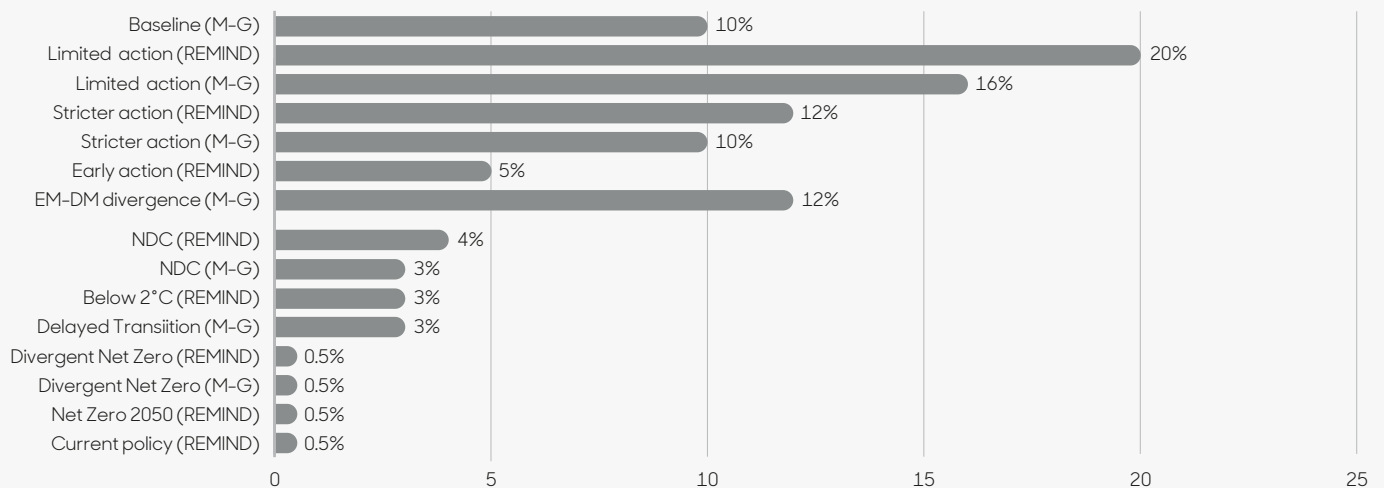


Figure 5: Greater policy ambition is factored into our baseline and bespoke scenarios, and the probabilities we assign to them



Likelihood

Scenario weightings (%)



Source: Planetics/abrdn Sept 2021.

Scenario changes alter the expected scale, speed and composition of the energy transition

Estimated impacts on the fair valuation of securities relative to their current price depend on a number of key outputs from the climate scenarios:

1. The temperature pathways derived from the individual off-the-shelf and bespoke scenarios, including their probability-weighted and Paris Aligned means.

Our 2021 scenarios span temperature increases relative to pre-industrial levels of 1.4 degrees (Net Zero 2050) to 3.1 degrees (Current Policy), with a mean rise of 2.2 degrees (see Figure 6). **This mean is 0.2 degrees lower than in our 2020 exercise**, reflecting the greater ambition factored into the design of the baseline scenario and individual bespoke scenarios, as well as the higher probabilities attached to stronger action scenarios.

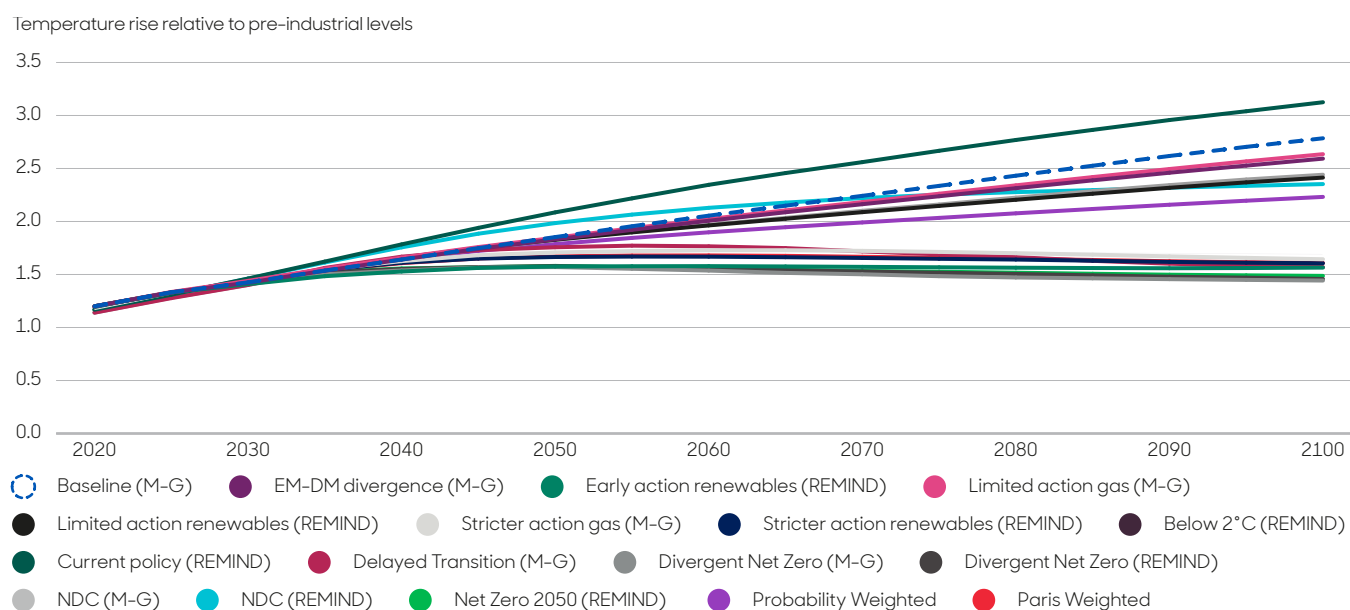
2. The trajectory of explicit and implicit carbon prices that is required to constrain the budget for cumulative carbon emissions in line with a scenario's policy objectives and the model's assumptions about future technology pathways and economic growth.

The increased policy ambition embedded in our mean scenario, as well the models' more pessimistic assessment of the potential for the deployment of carbon capture and storage policies, **forces carbon prices significantly higher than in our 2020 scenarios** (see Figure 7). This is especially the case after 2030 when policy action ramps up more significantly and abatement costs for the remaining emissions are considerably higher.

As we will show in the next section, this has the effect of increasing the average negative contribution from carbon costs in our security valuation attribution. It is also important to note that our bespoke policy framework generates different mean carbon price trajectories for each major emitting sector and region of the global economy.

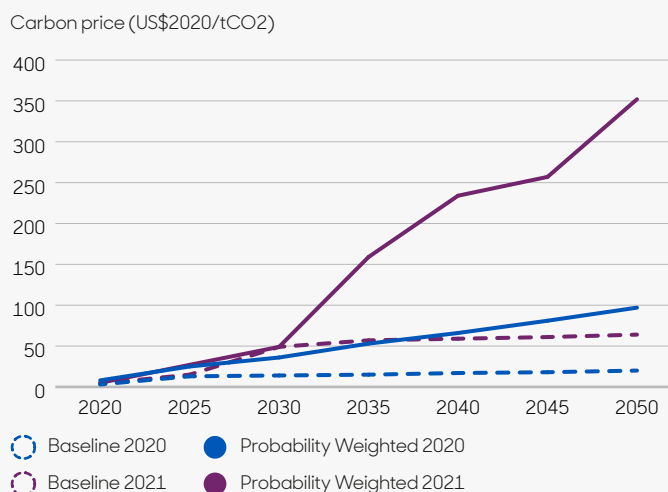
3. The composition of energy usage and prices resulting from the intersection of our pathways for emissions, carbon prices, economic growth, and relative technology costs.

Figure 6: Temperature rise to 2100 relative to pre-industrial levels



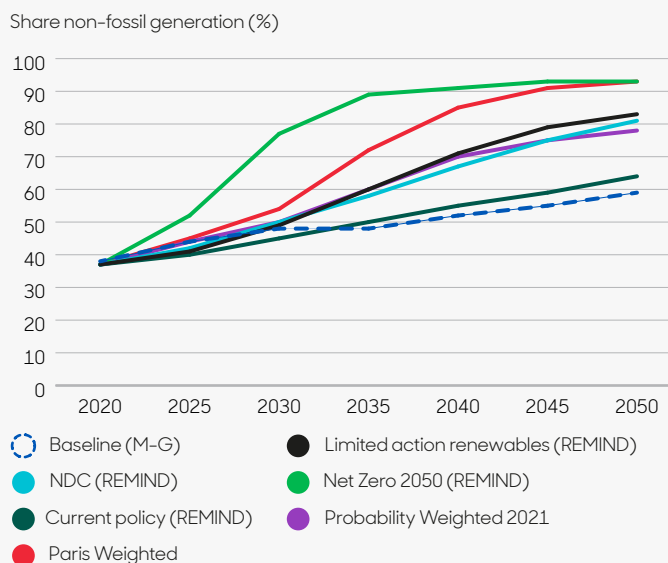
Source: Planetrics/abrdn Sept 2021.

Figure 7: Carbon prices are much higher than in our 2020 scenarios exercise



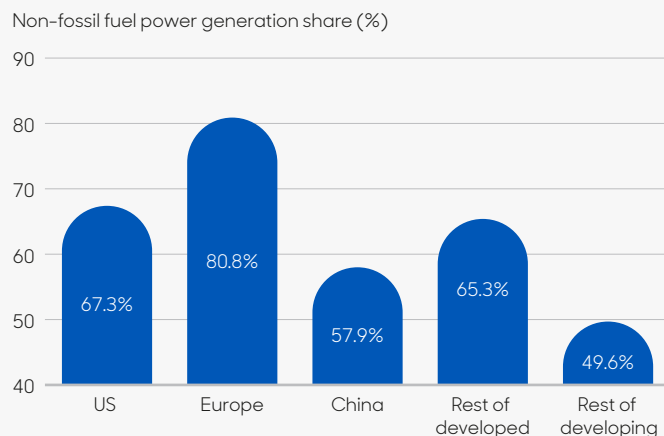
Source: Planetrics/abrdn Sept 2021.

Figure 8: Zero-carbon generation set to dominate the power sector



Source: Planetrics/abrdn Sept 2021.

Figure 9: Power sector decarbonisation is likely to be highest in the developed markets



Annual average non-fossil fuel power generation share (2020-2050) in the Probability-weighted mean scenario.
 Source: abrdn/Planetrics Sept 2021.

The combination of greater policy ambition and more optimistic assumptions about the relative cost of renewable technologies **leads to the global share of non-fossil fuel power sector generation increasing to 78% by 2050 in our mean scenario**, 5 percentage points (ppts) higher than in our 2020 exercise (see Figure 8). In moderate action scenarios, the Remind model still generates a higher non-fossil fuel share than the Message-Globiom model. But in rapid, Paris-Aligned transition scenarios both generate non-fossil fuel shares above 90% because natural gas can only play a limited role in rapid transition unless CCS technologies become commercially viable at scale.

These non-fossil fuel energy shares in power generation vary significantly across regions, particularly in our bespoke scenarios and those that fall short of achieving net zero emissions by 2050. In our mean scenario, for example, the European non-fossil fuel energy share in the power sector mix averages 81% between now and 2050, 67% in the US, 58% in China, and only 50% in the rest of the emerging markets (see Figure 9). This is the natural consequence of our assumptions about likely policy variation across the major emitting regions.

Within the renewable energy sector, **there is now less dispersion in the projected shares of solar and wind generation** than in the 2020 exercise. For example, in the 2020 Limited Action scenario drawing on the Message-Globiom model, solar only reached a 4% market share by 2050. That is now 23%, thanks to the revisions in the model developer's assumptions about future technology costs. These changes generate more plausible results in our view. Note though that these same modelling changes now generate a much higher solar share in our baseline scenario, such that the change in solar usage in the mean scenario relative to the baseline is smaller than in our 2020 exercise. This has important implications for our security valuation estimates presented in the next section.

Our 2021 scenarios produce equally significant changes in the transportation sector. **In our mean 2021 scenario, electric vehicle (EV) penetration reaches 90% by 2050, 24ppts higher than in 2020** (see Figure 10). This is attributable to our assumption that decarbonisation policies aimed at the sector ramp up more quickly, as well as our more optimistic assessment of how quickly the cost of EVs will fall below that of internal combustion engine (ICE)-powered vehicles.

Our updated scenarios also have important implications for fossil fuel demand and usage. **For oil, faster and increased EV penetration is a weight on demand. But it is the downward revisions to global growth expectations that have the largest effect.** This shifts the entire profile of oil consumption down in both the baseline and mean scenarios (see Figure 11). And then after 2030, when peak oil demand is projected to occur, oil consumption declines much more rapidly than in 2020, with a larger gap between the baseline and the mean scenarios.

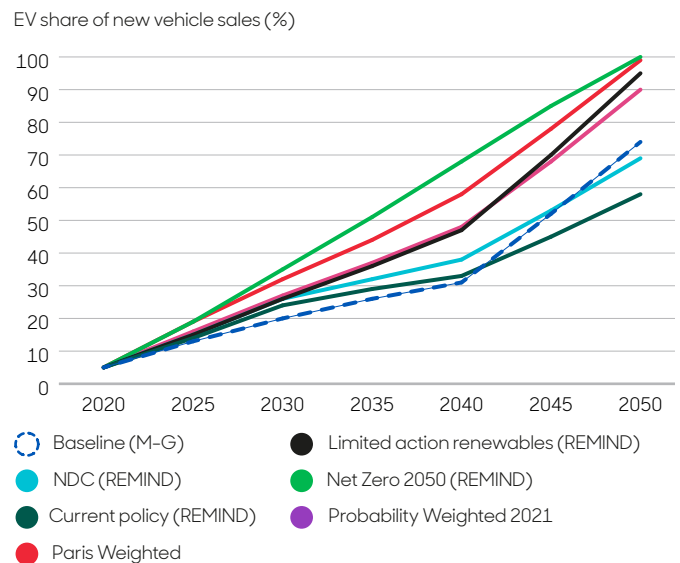
Much weaker oil demand translates into higher negative impairments for most energy companies. The large decline in cumulative expected economic activity also has the effect of **reducing the scale of the increase in future electricity demand.** That reduces the average contribution from demand creation, particularly for firms in the utility sector. We discuss this in more depth in the next section

Meanwhile, **the outlooks for both coal and natural gas demand have also become more dire** in the 2021 scenarios. Coal usage is projected to decline by 60% in our mean scenario from today's levels, up from a 25% decline in our 2020 exercise. And in Paris Aligned pathways, coal usage is more or less completely wiped out.

Natural gas usage does not fall outright in our mean 2021 scenario, but the previously projected increases have been revised away. It remains a transition fuel in moderate action scenarios; however, in the Paris Aligned scenarios, natural gas usage falls by 50% compared with the flattish demand in the 2020 exercise. This is largely a result of the **model designers becoming more pessimistic about the potential for negative emissions technologies like CCS to be deployed at scale.**

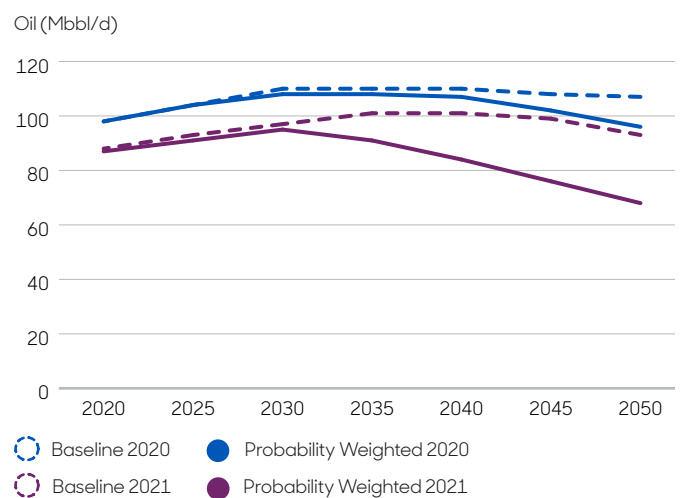
The changes to the long-term outlook outlined above, which have significant implications for security valuations, may seem very large in just an 18-month period. But this has been a period of unusually higher economic and policy flux. Thus, while we would not be expecting to make similarly large changes in future exercises – at least not over such a short time frame – **this adaptability to new information is a feature of our climate scenario framework** that is much harder to incorporate into non-probabilistic exercises drawing only on off-the-shelf scenarios.

Figure 10: EVs set to take the majority of passenger vehicle sales by about 2040 in our mean scenario



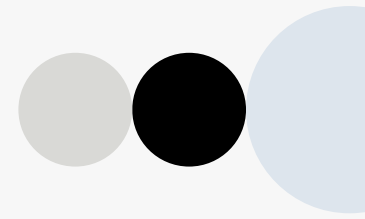
Source: Planetrics/abrdn Sept 2021.

Figure 11: A much weaker outlook for oil demand



Source: Planetrics/abrdn Sept 2021.

Updating our equity and fixed income results: what has changed since 2020?



In our climate scenario framework estimated security valuation uplifts and impairments relative to the baseline are decomposed into seven main categories that drive the future revenue and earnings of companies:

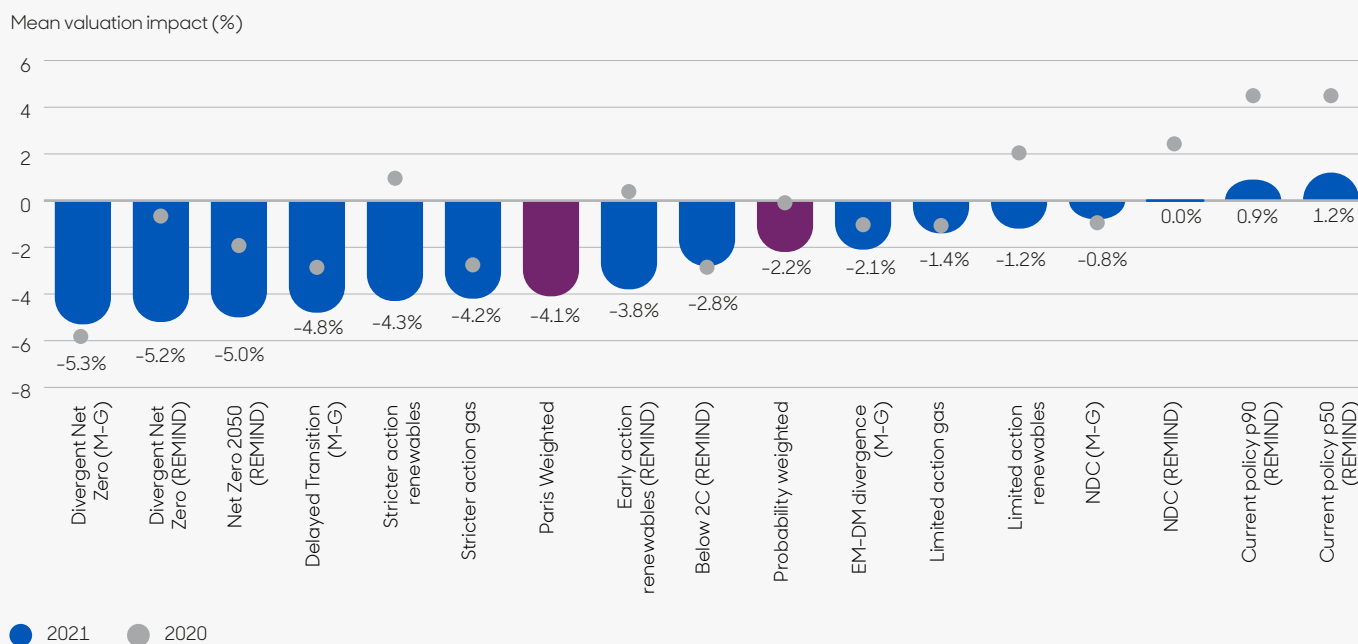
- The **physical effects** of climate change on the value of assets held by companies and their ability to **adapt** to these physical effects;
- The amount of new **demand created**, or old sources of **demand destroyed** as a result of climate driven changes to the global economy and energy system; and
- The explicit and shadow **costs of carbon** faced by companies resulting from mitigation policies, their ability to **abate** those costs by reducing or eliminating emissions, and the way that competition dynamics affect companies' abilities to **pass these on** to end users.

As foreshadowed in the previous sections, the shifting macroeconomic, technology, policy and market landscape have combined to significantly alter the outlook for demand creation, demand destruction and carbon costs. As we will show, these lead to significant changes in impairment and uplift estimates for listed equity and credit valuations,

particularly in the sectors most exposed to transition risk – energy, consumer cyclicals, non-energy materials, industrials, and utilities.

Beginning with our aggregate index level results, **there has been a marked downward shift in the valuation estimates for the MSCI global index** (and regional indices) in almost every scenario, including the mean (see Figure 12). Moreover, the combination of greater demand destruction, less demand creation and higher carbon costs mean that, in aggregate, only the current policy scenarios result in an uplift, and even those are lower than in the 2020 exercise. The biggest downward revisions were to the scenarios drawing on the Remind model. This is because the Message-Globiom model used in our baseline now generates more renewable usage in the future, reducing the scale of demand creation in the Remind scenarios. (Year 1)

Figure 12: A more negative outlook for global equity valuations in our 2021 exercise

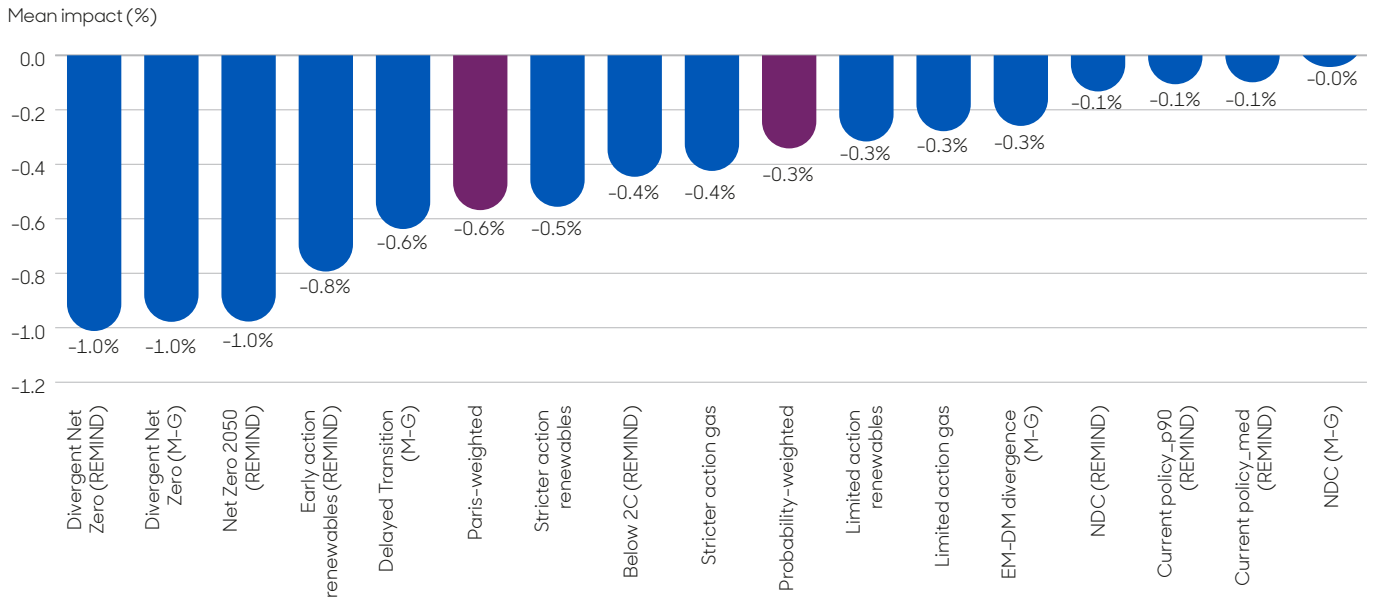


Source: Planetrics/abrdn Sept 2021.

In general, listed corporate **credit valuation impacts mirror those for listed equities**, albeit on a smaller scale. The more ambitious scenarios generate larger portfolio impacts and, as with equity, the aggregate impact in the Paris-weighted mean is twice that of the probability-weighted mean (see Figure 13). Credit impacts are generally in the same direction as equity impacts, because credit impairment

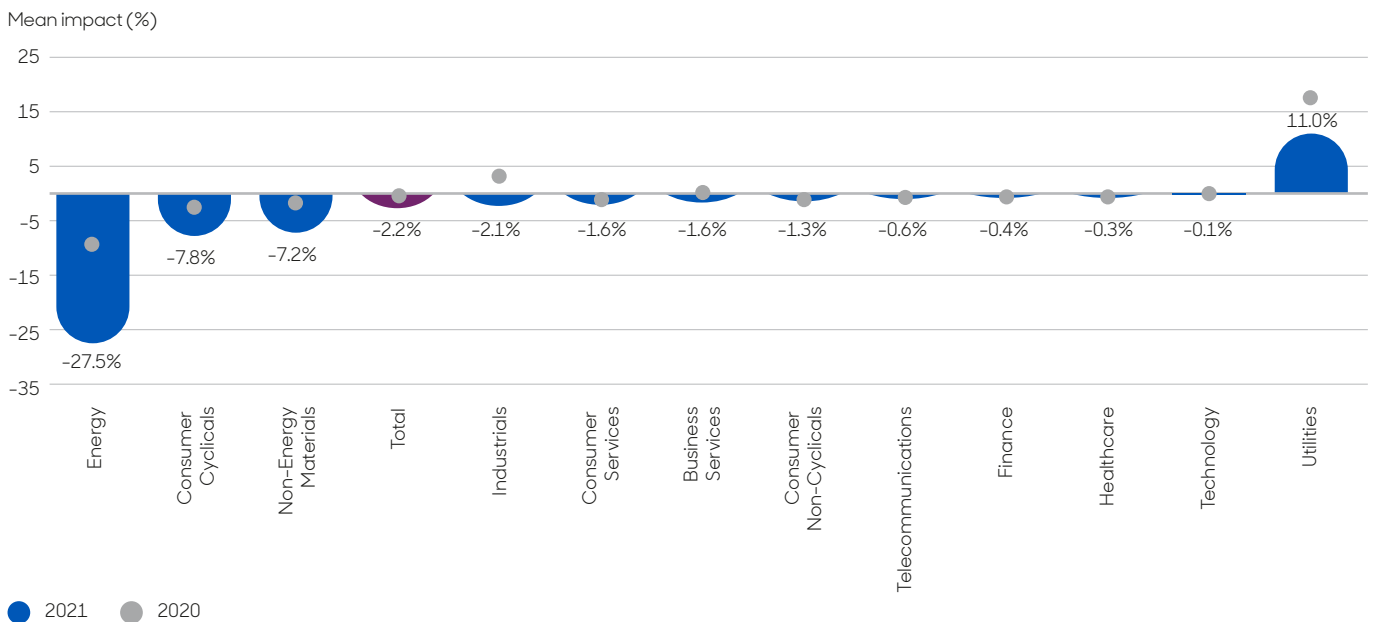
estimates are also derived from changes to future earnings pathways relative to the baseline. Effects are generally smaller because debt is higher in the capital structure than equity and credit securities have time-limited duration, reducing the effect of climate effects in the later years of our modelling horizon.

Figure 13: A negative outlook in all scenarios for credit valuations



Fixed Income Portfolio NPV impacts by scenario. Portfolio impacts are shown for model-able listed issuer bonds in the iShares Global Corp Bond UCITS ETF. Source: Planetrics/abrdn Oct2021.

Figure 14: Probability-weighted NPV impacts by sector - equity



Source: Planetrics/abrdn Sept 2021.

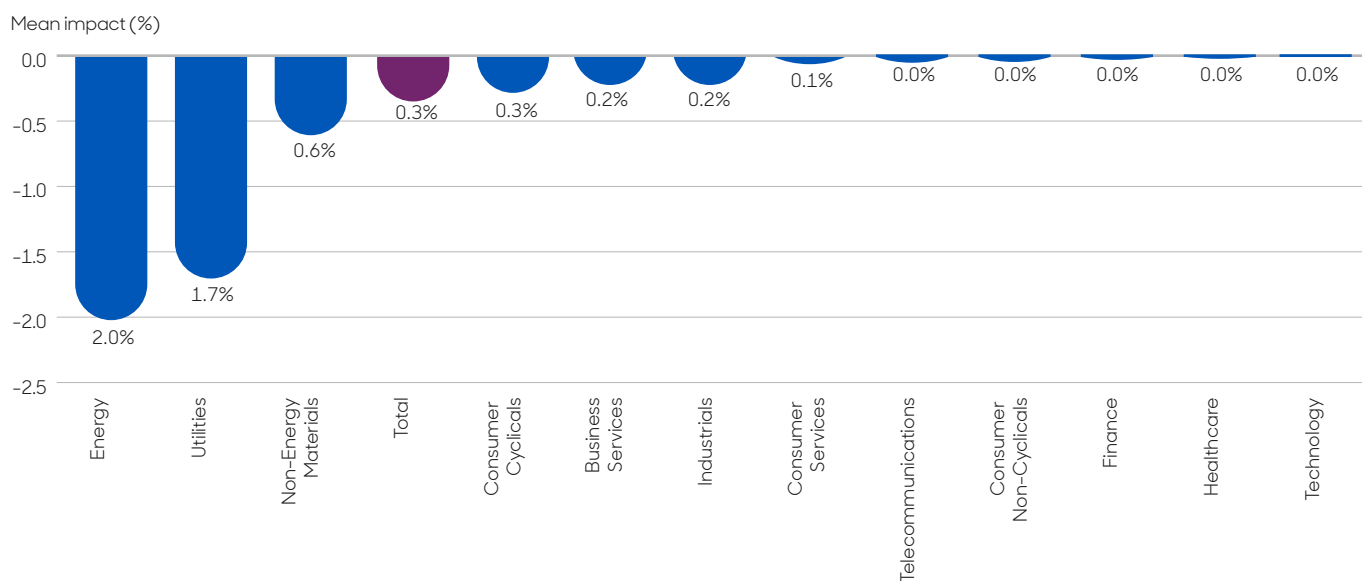
At the equity sector level, global utilities still experience the largest estimated valuation uplift in our mean scenario, and the energy sector the largest estimated impairment. **However, the size of the utility uplift is smaller because of the reduced amount of demand creation** compared with the baseline (see Figure 14). The utility sector also displays the greatest variation between winners and losers.

Meanwhile, **the size of the energy sector's estimated impairment is now considerably larger than in the 2020 exercise, thanks mostly to the greater amount of demand destruction** related to lower economic growth and

hence energy usage, but also the reduced role for CCS technologies and the stronger outlook for EVs.

Though energy is the most impaired sector in both our equity and credit results, **the sign of the aggregate effect for utilities reverses for corporate credit**. That is because there is a much larger effective cap on the valuation uplifts for low-carbon utilities in a credit portfolio as implied default rates cannot fall below zero (see Figure 15). Effectively there is further for a fossil-fuel intensive generator to fall, than there is for a low-carbon generator to rise.

Figure 15: Probability-weighted NPV impacts by sector – fixed income



Fixed Income Portfolio NPV impacts by sector. Probability weighted iShares Global Corp Bond UCITS ETF. Source: Planetrics/abrdn Oct 2021.



For consumer cyclicals, the negative impairment is mostly driven by auto companies. Although EV penetration is now expected to be greater than in the 2020 exercise, lower economic growth results in less demand creation. **And the increased policy ambition factored into our bespoke scenario design also results in higher carbon costs for companies with significant legacy ICE businesses.** For non-energy materials, much of the negative impairment is driven by the direct carbon costs for steel and cement companies. And there has been a reduction in the degree of uplift for green mineral companies as a result of lower demand creation relative to the baseline.

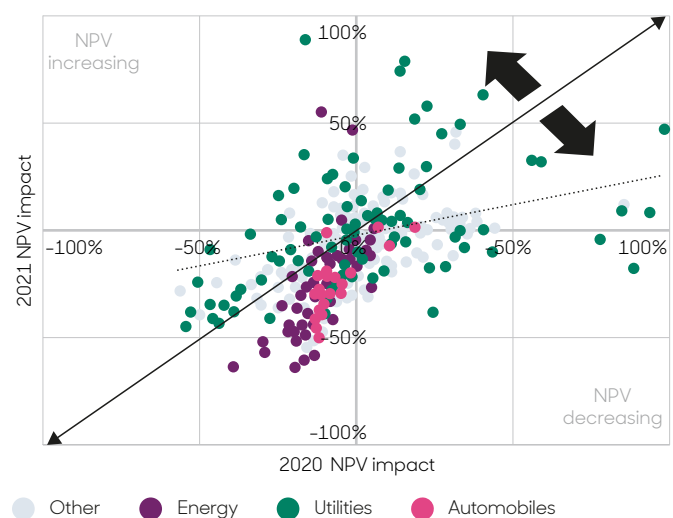
At the sub-sector level, we still see a similar pattern of resilient winners and consistent losers. However, the magnitude of the average uplifts for sub-sectors like green minerals, renewable utilities and renewable equipment manufacturers is now estimated to be smaller. This mostly reflects the fact that **the current market valuation of these companies now better reflects the positive outlook for such firms than was the case in 2020**, even as our expectations for policy ambition have also increased.

Drilling down yet further into the company-specific results, our 2021 exercise affirms our original conclusions that **climate risk and opportunity is mostly a micro, or security-level phenomenon.** That is because there is much greater dispersion across securities within a sector or a region, than there is across the sectors or aggregate regional indices themselves (see Figure 16).

However, the same drivers changing our aggregate global and sector specific results, have also altered the nature of the dispersion within sectors. For example, because renewable utilities now experience a smaller estimated valuation uplift, **the right hand tail of the utility sector distribution has become smaller.** Conversely, changes to the business models of some carbon intensive utilities imply smaller valuation impairments than in the 2020 exercise, shrinking the size of the left hand tail.

This hints at **the importance of being able to take corporate transition strategies into account in the original analysis,** rather than waiting to apply a screen after it is completed. We will detail how we incorporate transition plans and their effects on valuation estimates in a follow-up paper later in the year.

Figure 16: Year 1 vs, Year 2 NPV impacts in the probability-weighted mean scenario



Source: Planetrics/abrdn Sept 2021.

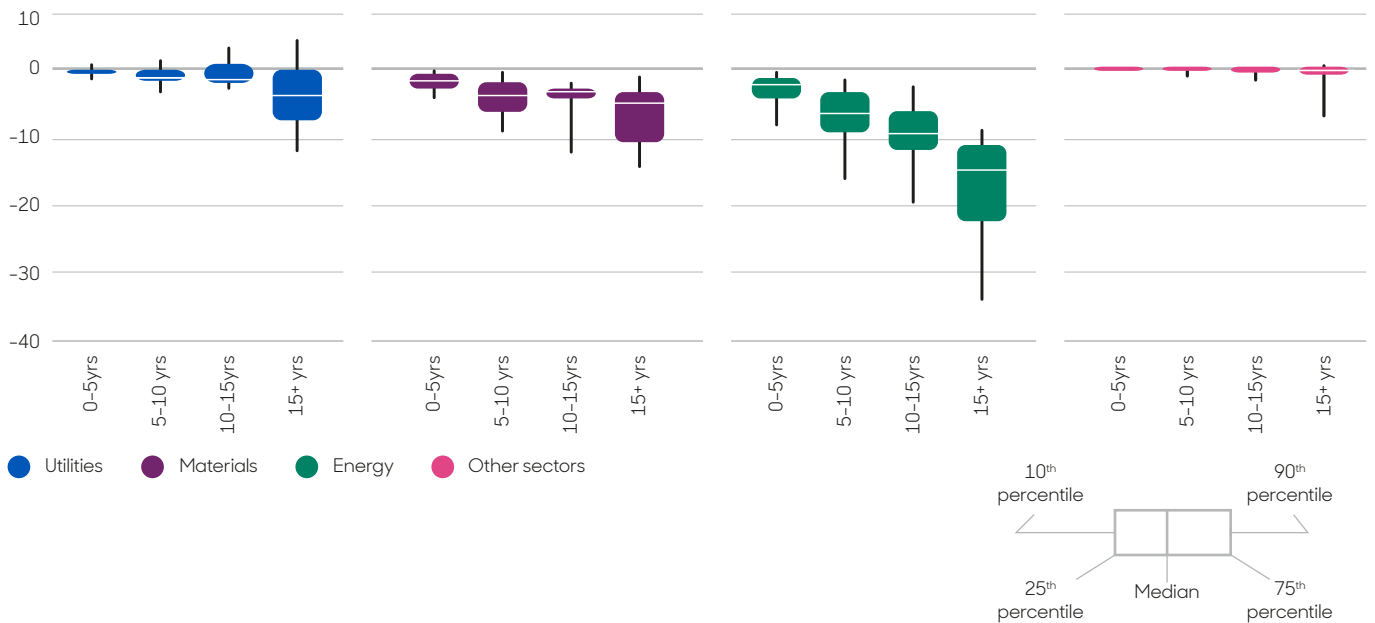


At fixed income security level we see that longer duration bonds experience larger impacts as climate shocks become more severe as the scenarios progress towards 2050 (see Figure 17). However, companies with higher quality starting credit rating are better able to absorb those shocks.

As discussed, the passenger vehicle sector sits at the intersection of many of the changing drivers of our scenario analysis and results. At present most passenger

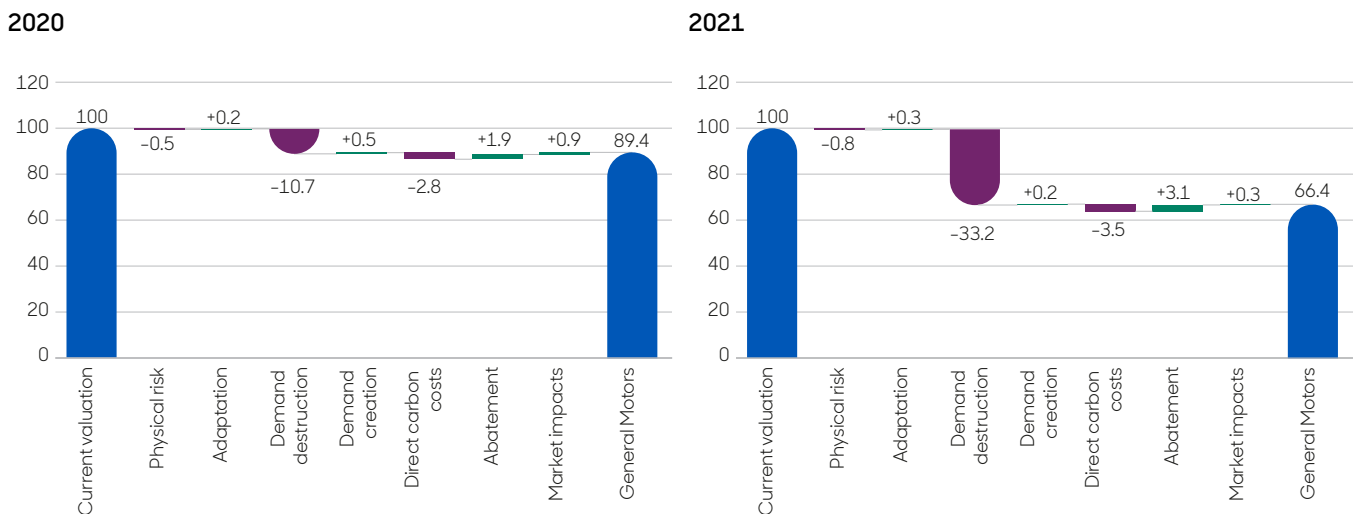
vehicles sold by auto companies have ICE engines, with only a very small number, like Tesla, selling mostly electric vehicles. In our latest analysis, ICE reliant firms are hit harder in our mean scenario because total auto demand falls (demand destruction increases) with lower economic growth in emerging economies, and the increased growth of the EV market. They also face higher carbon costs, because of the increases in average policy ambition we are factoring in for the transportation sector.

Figure 17: Longer duration bonds experience larger impacts



Change in valuation under Delayed 2°C scenario relative to current policy baseline. Impacts are based on corporate bonds in Barclays Global Aggregate. Source: Planetrics/abrdn Oct 2021.

Figure 18: Comparison of NPV impacts on General Motors Year 1 vs. Year 2



Source: Planetrics/abrdn Sept 2021.

General Motors (GM) provides a useful lens through which to view these results. In the 2020 exercise we estimated a negative impairment valuation of 10.6%, with most of the drag coming from demand destruction. **In the 2021 exercise, demand destruction is even larger, leaving the new impairment for GM at negative 33.6%** (see Figure 18).

However, this GM example, also illustrates an important caveat to the analysis. Our climate scenario framework assumes that as the EV market grows, the current market shares of the auto companies in that market remains stable. While this is a necessary starting assumption, the reality is that **some companies will be prove much better at exploiting these opportunities than others**. This is why our scenario valuation estimates are starting points for our stock pickers, not end points. And again, it is also why the incorporation of credible transition plans is so vital. GM's estimated impairment may go up or down as a result of that forthcoming analysis, but it is unlikely to remain the same.

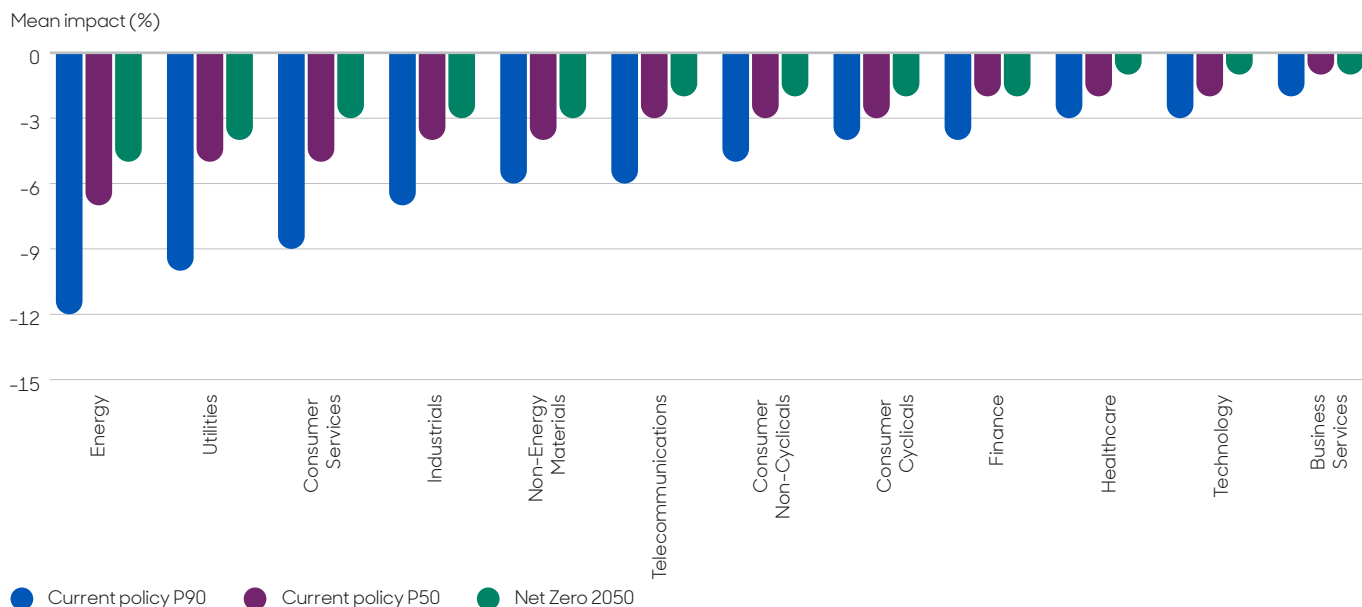
Finally, we have deepened our analysis of the implications of physical climate change in our 2021 exercise. While transition analysis often dominates the industry's focus, **significant further negative physical effects of climate change are guaranteed**, even if Net Zero 2050 ambitions are achieved. And in our mean scenario, these effects are even larger.

Our main way of confronting this challenge was to add an additional scenario where security valuation estimates are dominated by physical effects. In particular, **we added another current policy scenario, but instead of physical effects being taken from the mean of the potential distribution, we took them from the 90th percentile**. This generates larger negative valuation effects through the physical channel under that scenario, and increases the range of assets exposed to physical damages.

As was the case in 2020, capital-intensive sectors such as energy, utilities and consumer services are the most exposed to rising physical damages. But we now see that **when allowing for tipping points to occur at lower levels of aggregate temperature increase, with 90th percentile effects generating twice as much negative impairment through this channel than 50th percentile effects** (see Figure 19).

Later in the year we will explore these physical effects in much more depth, outlining not just which assets are most affected, but also where they are located and the nature of the underlying physical drivers. **We will also show how assumptions about the discount rate applied to future income streams can significantly alter perceptions of how large future physical effects are likely to be.**

Figure 19: Physical risk NPV impacts by sector (before adaptation and cost pass through)



Source: Planetris/abrdn Sept 2021.

Important information

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