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Global Macro Insights: Race to net zero

Tracking Net Zero Progress: Too Little, Not Too Late

Anna Stupnytska
Global Macro Economist

Salman Ahmed
Global Head of Macro and Strategic Asset Allocation

Edward Rayment
Multi Asset Investment Associate

Investment Professionals

Fidelity INTERNATIONAL

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Executive summary

- The year 2022 was unprecedented in many ways. From new temperature records, to a war-induced energy crisis and bold policy action, it brought both climate urgency and energy security into sharp relief.
- In this paper we assess the latest developments on corporate action, technology and policy - what we call 'transition enablers' - and look at the progress needed for the world to transition to net zero by 2050.
- The developments aren't enough to change our baseline view from a disorderly to an orderly net zero transition. But the policy shifts catalysed by the war-induced energy crisis do have the potential to dramatically speed up progress towards net zero goals. However, near-term uncertainty remains high.
- On corporate action, FIL's Climate Ratings show that most companies set targets and take measures to somewhat mitigate their impact on climate change but are struggling to align their activities to a net zero path.
- To get on track for the net zero transition by 2050, companies across most sectors would have to pick up transition momentum rapidly from here.
- On technology, we narrow down our focus on four key groups, including low-carbon energy, energy efficiency and storage, building efficiency and hydrogen.
- Our assessment concludes that only electric vehicles (EVs) are on track for the net zero transition by 2050 while low-carbon energy sources have the potential for either an orderly or disorderly pathway. Other technologies lag significantly, either in terms of adoption or development.
- Assessing policy action over the past year, we note some encouraging progress on a country level, with Europe and the US standing out, but international cooperation is weak.
- Carbon pricing and technological advances are among those policy factors that are most likely to move the dial towards net zero compliance in the near term. In the long term, the geopolitics of energy security - and its fundamental shifts catalysed by the Russian invasion of Ukraine - will be a key driver of the net zero transition.
- Tracking transition enablers with the aid of analyst research should help investors navigate the tremendous uncertainty associated with climate change and its impact on economies, allowing to capture shifts in probabilities of different climate scenarios in real time.
- This analysis can then be used to understand how long-term capital market assumptions (CMAs) and strategic asset allocation (SAA) might change in response to changing transition and physical risks in the future. We will examine this further in a follow-up paper.

An unprecedented year

The year 2022 was unprecedented in many ways. From new temperature records, to a war-induced energy crisis and bold policy action, it brought both climate urgency and energy security into sharp relief. It was also a year of extraordinary market turbulence which looks to continue in the years ahead.

The past eight years are set to be the warmest on record, according to the World Meteorological Organisation. Extreme weather events, including heatwaves and droughts in Europe, China, the US and East Africa, and flooding in Pakistan affected millions of people in 2022 and resulted in extensive damages, devastating loss of life and acute levels of food insecurity globally.

Meanwhile, Russia's invasion of Ukraine in February 2022 caused major dislocations in global commodity markets, sparking the worst energy crisis since the 1970s. The war in Europe pushed many countries across the world to prioritise fossil fuels throughout 2022 as a short-term solution to the problem of energy supply. As a result, last year saw a rebound in consumption of coal and an estimated 1% rise in CO_2 emissions globally, according to the Global Carbon Project.

The crisis has highlighted the medium-term trade-off between pursuing energy security and pursuing green transition. While these objectives should, in theory, be compatible in the long term, the path there is fraught with challenges. It is largely the geopolitics of energy security - and its fundamental shifts catalysed by the war - that will shape the path towards a very different world order than the one we have seen over the past few decades and influence the temperature outcomes in this century.

While there was no progress on emissions, there were breakthroughs on policy. The US passed the Inflation Reduction Act (IRA), the country's most ambitious piece of climate legislation to date. The EU reached a historic deal to set up the Carbon Border Adjustment Mechanism (CBAM). COP27 played host to a last-minute agreement to create a loss and damage fund to help developing countries impacted by climate change. The COP15 UN Biodiversity Conference also surprised by delivering a pledge to protect and restore at least 30% of the Earth's land and water by 2030.

In our recent work where we modelled the potential impact of the hot house world on asset classes, we argued that long-term macroeconomic projections must incorporate both the physical and transition risks associated with climate change for a more complete picture of expected returns from a long-term SAA perspective. Given the huge uncertainty involved and various dynamics at play, we also laid out a framework for assessing the credibility of various climate change scenarios. We concluded that the most likely scenario is that of Disorderly Transition, whereby policies required to cap the temperature increase below 2°C above pre-industrial levels are delayed or diverge across countries and sectors.

The many events of 2022 and assessments based on our framework haven't changed our view. Using a set of climate scenarios provided by the Network for Greening the Financial System (NGFS) in their latest update, we still think a Disorderly Transition scenario is, on balance, the most likely climate change pathway for now. However, near-term uncertainty is as high as ever. On one hand, there is a real risk that emergency measures taken in response to the war could undermine the efforts underway to transition energy systems to cleaner alternatives and may over time jeopardise the global climate agenda. On the other hand, the momentum behind climate legislation across the world, if coupled with effective implementation in the years ahead, may well raise the likelihood of the net zero transition by 2050.

In this paper we assess the latest developments on corporate action, technology and policy - what we call 'transition enablers' - and look at the progress needed for the world to transition to net zero by 2050. Tracking transition enablers should help investors navigate the tremendous uncertainty associated with climate change and its impact on economies, allowing to capture shifts in probabilities of different climate scenarios in real time. This analysis can then be used to understand how long-term CMAs and SAA might change in response to changing transition and physical risks in the future. Indeed, in a follow-up paper, we will show how different climate change scenarios can shape CMAs that underpin our SAA framework.

Tracking transition enablers

A smooth net zero transition is anything but a certainty, and so should not be used as a base case for strategic investment decisions. Energy shocks, policy uncertainty and behavioural changes reinforce the case for continual climate scenario analysis.

In our previous paper on the topic we developed a framework for tracking the credibility of climate transition pathways. We identified key transition enablers - corporate action, technology and policy action - which have the potential to accelerate or slow down the process of net zero transition and thus can be used to gauge the likelihood of different climate outcomes underlying the six NGFS scenarios.

In this paper, we update our trackers and define thresholds for each tracked metric to 2050 that would correspond to the three broad scenario groups in the NGFS framework - Orderly Transition, Disorderly Transition and Hot House World.[i]

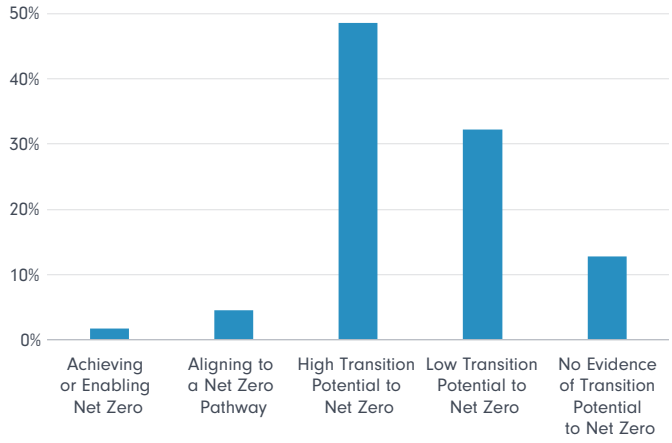
Corporate action - only a few companies are on track for net zero

Since the inaugural instalment of the FIL Climate Ratings in 2021, the coverage has been extended from 1,600 to more than 2,000 companies. The methodology is comparable to the previous set with the addition of a minimum criteria related to climate lobbying.

In the total sample, only 2% of companies in our coverage are currently achieving or enabling net zero (Chart 1), with the majority of companies in this category represented by utilities, materials and industrials, sectors accounting for around 38% of global emissions (Chart 2). 5% of companies are aligning to a net zero pathway, with a sector skew towards consumer discretionary, staples, IT and communication services, in total accounting for just under 20% of global emissions.

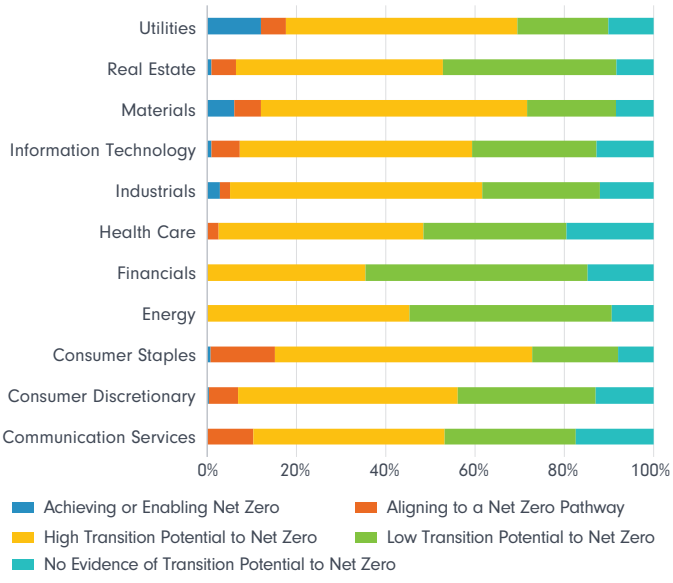
Chart 1: Just under half of all companies show either low or no evidence of transition potential

Rating distribution of 2080 companies, share of total



Source: Fidelity International, February 2023.

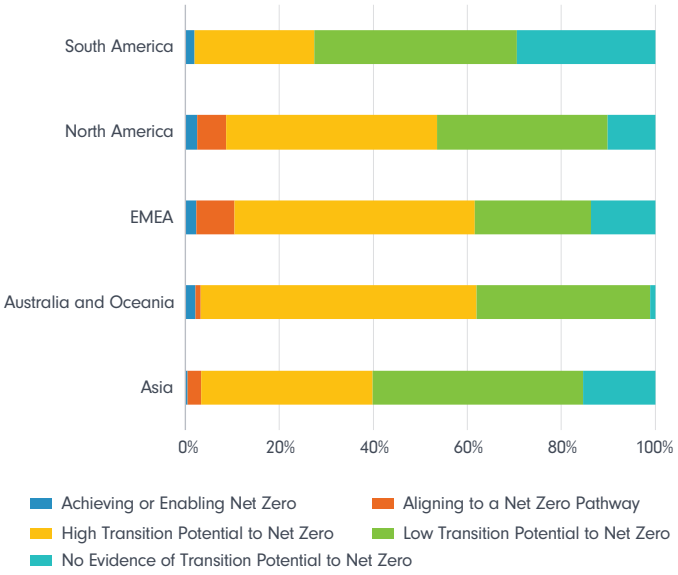
Chart 2: Utilities, materials, IT and consumer staples have the most companies in the top two categories



Source: Fidelity International, February 2023.

In terms of geographical distribution, EMEA and North American companies dominate both categories at the top - achieving or enabling net zero and aligning to net zero (Chart 3). Asia and South America perform poorly. Companies in both regions overwhelmingly show low or no evidence of transition potential. Australia and Oceania see the highest proportion of companies falling within the high or low transition categories.

Chart 3: EMEA and North American companies dominate the top two categories of FIL Climate Ratings



Source: Fidelity International, February 2023.

These takeaways are broadly consistent with the previous set of Climate Ratings, with small differences largely attributed to the difference in sample sizes and the addition of a new indicator. Most companies continue to set targets and take measures to somewhat mitigate their impact on climate change but are struggling to align their activities to a net zero path.

Technology - narrowing focus

For this paper we worked with our research analysts to narrow the list of technologies to track within the context of the net zero transition. The four technologies that passed our selection criteria are **low-carbon energy (including renewables), energy efficiency and storage (including EVs and batteries), building efficiency and hydrogen.**

To reach net zero by 2050, over 90% of global electricity generation in 2050 will have to come from **low-carbon energy sources** such as renewables, nuclear and biomass. Specific renewables of interest for our tracker are solar photovoltaic (PV) and wind, as together these account for over 75% of global electricity generation in the NGFS Net Zero 2050 scenario.

Within the area of **energy efficiency and storage**, the necessity of **EVs and batteries** for net zero transition is readily apparent considering that road transport accounts for over 18% of total CO_2 emissions globally, with transportation sectors being the largest greenhouse gas (GHG) emitters in the US, UK and EU. Currently, the benefits of EVs are diminished by the coal-intensive electricity they use, both during manufacturing and exploitation. According to EDF, over a third of the lifetime CO_2 emissions from an EV car comes from the energy used in production. Low-carbon electricity, alongside improving battery efficiency, will help cut both manufacturing emissions as well as day-to-day emissions.

Building efficiency includes technologies such as insulation, heat pumps, and on-site renewables. In 2021 the operation of buildings accounted for 30% of global final energy consumption and 27% of total energy sector emissions, according to the IEA. Building insulation reduces the heating required for buildings. Most of the energy used in both EU and UK homes, at just over 60%, is for space heating, demonstrating how large the savings from insulation can be. Unlike many other technologies key to the transition, those technologies needed to achieve building sector decarbonisation are mature and widely available, such as energy efficient building envelopes, heat pumps, and on-site renewables. However, their adoption is hampered by multiple cost and non-cost barriers.

Hydrogen's abundance and energy density make it the most useful molecular store of energy, and while its importance in the net zero transition varies widely across different models and scenarios, at the very minimum it will be needed to fill the gaps where electricity cannot easily replace fossil fuels, including in steelmaking and chemical industries, heating, the heavy transport sector, and peak power generation. While currently hydrogen is primarily produced from fossil fuels, hydrogen produced from renewable energy (green hydrogen) could play a huge part in any net zero pathway. Blue hydrogen, where the resulting CO_2 emissions are captured and stored, could also have a role in the transition.

We are not including CCUS in our quantitative tracker for now, as the technology is not expected to be functional and scalable until after 2030. Moreover, placing too much emphasis on CCUS early on in transition can actually disincentivise progress in other key technologies, which are expected to deliver most of the decarbonisation over the next decade, thus potentially jeopardising the net zero transition scenarios. Over time, however, CCUS should become an important part of the technology tracker.

Policy action - Europe keeps up momentum, US moves up a notch

Assessing policy action across the four pillars - carbon pricing, political environment, policy incentives and international cooperation - over the past year, we note some encouraging progress on a country level, with Europe and the US standing out, but a disappointing lack of momentum on international cooperation. The relatively weak outcomes from COP27, and lack of specificity over the new loss and damage fund for countries most vulnerable to climate change, have shown that global agreement is difficult to reach. We make only one change by upgrading the overall US rating from 'Low to Medium' to 'Medium,' on positive developments related to increased policy incentives in the IRA and some progress on regional carbon pricing. Other changes to the tracker include adding the UK, one of the global leaders on climate policies, and dropping Russia. Table 1 summarises our latest assessment.

Table 1: US rating has been upgraded to 'Medium' in our climate policy action tracker

	EU	UK	US	China	India
Carbon pricing	High	High	Low to medium	Medium	Low to medium
Political environment	High	Medium	Medium	High	Low
Policy incentives	High	Medium to high	Medium to high	Medium	Low
International cooperation	Medium to high	Medium	Low to medium	Low to medium	Low
Overall rating	High	Medium to high	Medium	Medium	Low

Source: Fidelity International, February 2023.

Carbon pricing

The EU remains the leader in carbon pricing, strengthened by recent announcements of a more ambitious reduction target for Emissions Trading Scheme (ETS) sectors of 62% by 2030, aided by the introduction of a new ETS covering buildings and road transport. Notably the scheme includes GHGs, not just carbon, currently covering over 40% of the jurisdiction's emissions, although this will soon be much higher.

In December 2022, the EU also announced the CBAM, a historic policy breakthrough which targets imports of products in carbon-intensive industries and seeks to prevent carbon leakage. Despite backlash from trading partners, we see the CBAM as further incentive for these countries to adopt their own carbon pricing systems, inching the world towards a global carbon price. **We keep EU's 'High' rating unchanged**, supported by carbon policy ambition and momentum.

We add the **UK** to our policy tracker with a **'High' rating** as it has been a leader in a number of transition-related policies and initiatives which can serve as templates for other countries. The UK's carbon trading scheme has only existed since January 2021, but as the UK previously participated in the EU's scheme, it shares many characteristics. The scheme is likely to go even further than the EU's in realigning the emissions cap to meet net zero by 2050, rather than setting emissions goals only by 2030.

Previously, we noted China's encouraging path on the way to carbon pricing, as it launched its ETS, with plans to expand to seven further sectors beyond the power sector. Even without further expansion, the scheme is already the world's largest, covering 40% of national emissions, according to ICAP. **We keep China's 'Medium' rating in this category unchanged**.

The US has not seen much change on carbon pricing over the past year, but the Regional Greenhouse Gas Initiative (RGGI) timeline for potential joiners has been in flux, with Pennsylvania and North Carolina possibly joining soon. According to BloombergNEF (BNEF) Pennsylvania alone joining could expand the size of the US carbon market by 80%. Additionally, three other states have separate cap-and-trade programs planned for 2023. Moreover, in 2023 the US is expected to raise its official estimate of the Social Cost of Carbon, a measure of the economic damages caused by each tonne of carbon pollution produced today, prompted by a recent estimate of USD190

by the Environmental Protection Agency (EPA). Given that the government's estimate is used in policy making, and alongside the various ETS expansions planned for 2023, **we notch up the US rating on carbon pricing to 'Low to Medium'**, on grounds of encouraging policy momentum.

India keeps its 'Low to Medium' rating for now. Last year the trade of Energy Saving Certificates (ESCerts) under the existing Perform, Achieve and Trade (PAT) Mechanism, which does not explicitly target emissions reduction but does lay out a framework for carbon pricing, was halted due to poor demand. Since then, the Indian Bureau of Energy Efficiency presented a draft blueprint for the phased introduction of a national cap-and-trade scheme. In December 2022, an amendment to the 2001 Energy Conservation Act, establishing the legal basis for a voluntary carbon credit trading scheme, was passed through the Upper House of parliament, and therefore the provisions of the act have been in force since 1st January 2023. The focus now is on implementation.

Political environment

For the political environment pillar, we **keep EU's 'High' rating** due to accelerating momentum on climate action, catalysed by Russia's war in Ukraine. The REPowerEU plan, put forward by the European Commission in May 2022, constitutes a step in the right direction. The plan includes a proposal to increase the share of renewables in final energy in 2030 from 40% to 45%. Within the EU, Germany and Spain stand out with their 2030 renewable electricity generation targets raised to 80% and 70%, respectively.

In China the central government published the 14th Five Year Plan for the energy sector, laying out a general direction – as well as specific tasks and goals – for the energy system for 2021-2025. At the 20th Party Congress, President Xi affirmed China's net zero commitment, but emphasised a cautious approach to balancing its transition ambitions against the need for energy security. We **maintain China's 'High' rating** on political environment but will be monitoring its policy direction, particularly with respect to coal.

In the **US**, the IRA was the most notable piece of climate-related legislation to date which supports its **'Medium' rating for policy environment**. Box 1 provides more detail on the IRA.

We assign a **'Medium' rating to the UK in this category**, but we do note that the tumultuous 2022 in UK politics, including policy U-turns on fracking and wind, raises uncertainty on further prospects on climate policy in general and on the delivery of the Ten Point Plan in particular. Among notable 2022 developments, the Transition Plan Taskforce (TPT), set up by the UK government in April 2022, published its guidance on what a gold standard transition plan should look like. The consultation process is expected to lead to the first corporate transition plans being issued by the end of 2023, building on the disclosures made under the Task Force on Climate-Related Financial Disclosures (TCFD) framework but taking a more forward-looking and granular approach.

India maintains its 'Low' rating as its coal capacity is likely to continue rising, aided by subsidies for both fossil fuels and renewable energy, including direct subsidies, fiscal incentives, price regulation and other government support. While coal subsidies in absolute terms have remained unchanged since 2017, they are still approximately 35% higher than subsidies for renewables.

Box 1: The Inflation Reduction Act

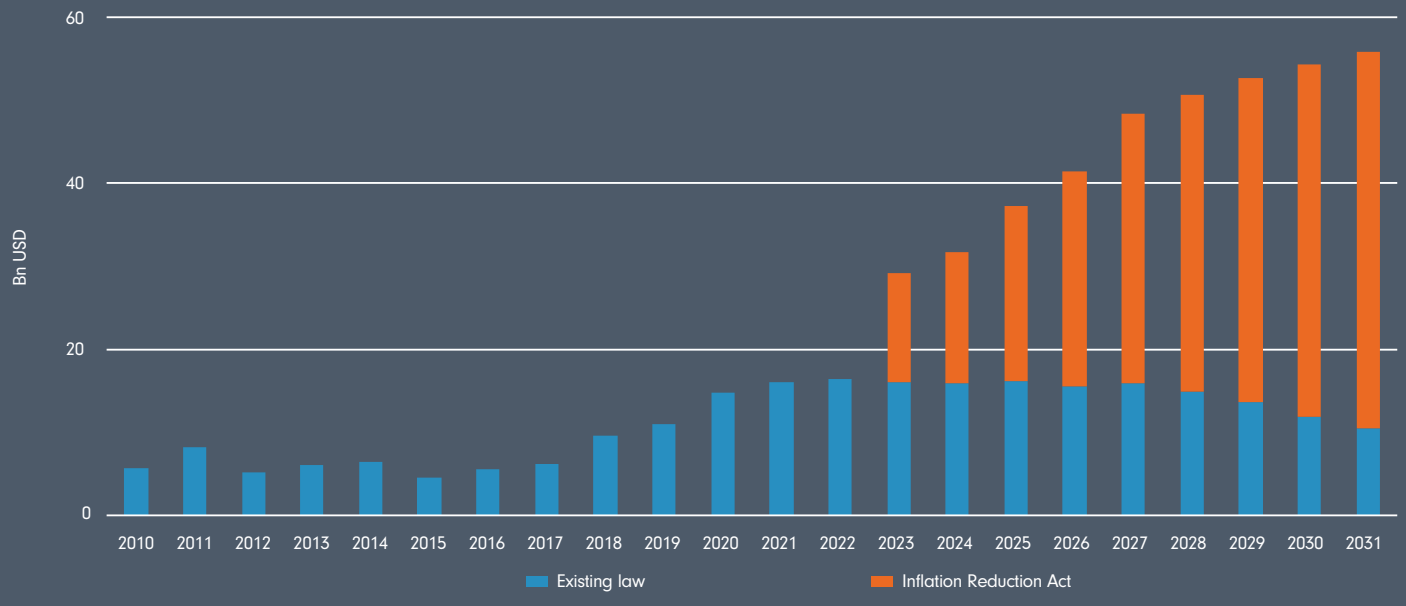
US President Biden signed the US Inflation Reduction Act (IRA) into law in August 2022. It directed nearly USD400 billion at climate change mitigation and decarbonisation. The IRA is significantly additive to existing federal support for sustainability efforts in the US illustrated in Chart 4.

The IRA's expansion and extension of tax credits for renewables development are one of its notable improvements on existing policy. Our sector specialists estimate that utilities could increase their solar and wind capex under the new incentives between 20% and 100% over the next decade, depending on geographic and other regional differences. This could significantly increase the percentage of renewables in the US electricity generation mix (currently 20% of total).

In terms of technology advancement, the IRA provides funding for breakthrough technologies including battery storage, green hydrogen and carbon capture and storage. While mass market adoption and commercial viability is further off for these sectors compared with wind and solar, the incentives could accelerate development and lead to lower cost curves over the coming decades. Our sector specialists view green hydrogen as a potentially scalable fuel source for transport by the 2030s, and carbon capture as potentially scalable by the 2040s.

Finally, it is worth noting that the IRA is focused on US domestic manufacturing and production along the decarbonization industrial value chain. The legislation contains domestic labour requirements, including minimum wage and apprenticeship requirements, and domestic content requirements, such as battery component manufacturing. How trade agreements and as a result decarbonisation supply chains will ultimately be structured with other large global manufacturing centres (e.g. Europe, China) is yet to be resolved.

Chart 4: The IRA is significantly additive to existing federal support for sustainability efforts
Total budgetary effect of US Federal energy tax incentives



Source: Fidelity International, US Treasury, Congressional Budget Office, February 2023.

Policy incentives

The **EU continues scoring 'High'** in this category. The European Central Bank (ECB) remains at the forefront in mitigating climate risk, with its climate action plan covering corporate bond purchases, collateral framework, disclosure requirements and risk management. In 2022 the ECB carried out the climate stress testing exercise, assessing how prepared banks are for dealing with financial and economic shocks stemming from climate risk, and published a thematic review on a risk-based supervisory approach to climate change and environmental degradation.

In the US, we believe the green tax incentives within the IRA represent enough of a shift in policy to warrant an upgrade in **US's rating to 'Medium to High'**.

The **UK gets a 'Medium' rating** on policy incentives. In 2022, the government announced over GBP5 billion to support a green recovery. On the monetary policy front, the Bank of England (BOE) had environmental sustainability and transition to net zero inserted into its core mandate, introduced 'climate criteria' into its corporate asset purchases and published its own climate-related financial disclosure in 2022.

China keeps its 'Medium' rating, with its '1+N' climate policy framework storing the potential for transformation, though more clarity and detail is required to understand its implementation scope and timeline. On the monetary policy front, the People's Bank of China (PBoC) also continues making progress by exploring the role of monetary policy in encouraging financial institutions to support carbon emission reduction. We stick to **India's 'Low' rating** under the policy incentives pillar. The country has not announced any dedicated fund, though a plan to issue Sovereign Green Bonds is a part of the Union Budget 2022-23 announcement.

International cooperation

Whilst COP27 was by no means expected to be ground-breaking, the creation of the historic loss and damage fund was a notable breakthrough and work to mobilise capital into cross-border climate projects continues, including via direct financing and the voluntary carbon markets. However, with no detail on actual funding and uncertain prospects from here, we do not believe the COP process has moved the needle on political international cooperation for now. The biggest surprise was to the downside through the failure to agree on the phase-down of all fossil fuels, instead only including the need for "low-emission" energy and dropping the resolution to cause emissions to peak by 2025.

On a more positive note, global momentum on corporate disclosure regulation, including the work of the International Sustainability Standards Board (ISBB) and transition plans, is gathering pace. The impact of transition plans could be positive by forcing companies to think about their climate risks, business models and products in a much more granular way than TCFD. At the same time, 2022 showed there are also risks from regulation being made at speed and having to be revised due to unintended consequences, potentially delaying capital investment in the transition.

The **EU keeps its 'Medium to High' rating**. In addition to the ECB's contribution to the NGFS framework, EU's foreign policy agenda is increasingly integrating climate action into the assistance programme. The EU's contribution for climate finance to developing economies amounts to EUR23.4 billion to date.

The **UK receives a 'Medium' rating**. The BoE actively promotes collaboration on climate-related risks and the government's Climate Finance Accelerator will support promising low-carbon projects in nine middle-income countries and connect them with investors. UK's TPT is working with other countries and international frameworks which are preparing guidance on transition plan disclosures.

Both **China and US keep their 'Low to Medium' rating**. Climate talks between the two countries resumed in late 2022, after being suspended for months amid tensions over trade, Taiwan and other security issues. While this is clearly a step in the right direction, uncertainty over the future path for negotiation and implementation remains high.

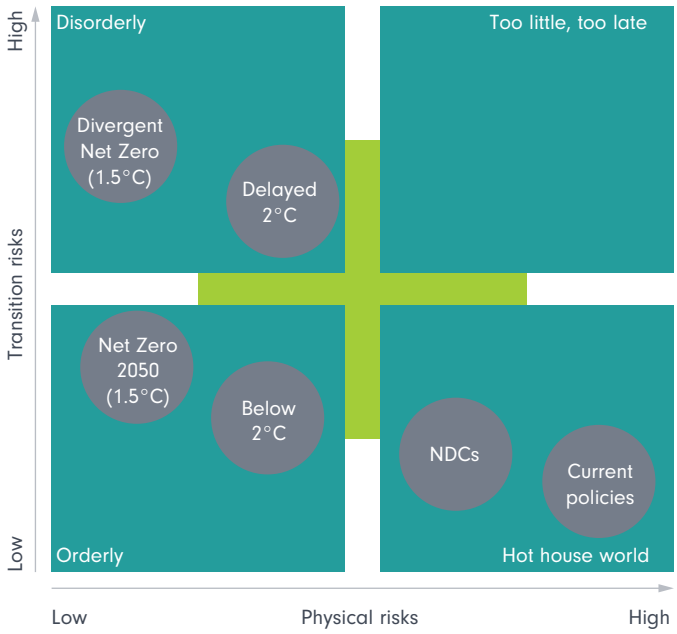
Finally, **India keeps its 'Low' rating**. In the run-up to COP27, India updated its 2030 Nationally Determined Contributions (NDC) targets and approved the plans to cut emissions intensity of its GDP by 45% by 2030. For its rating to rise, India has to show more ambitious policy action and evidence of implementation in coming years.

Looking ahead: Mapping climate scenarios

Assessing the likelihood of different climate scenarios is undeniably highly complex, with many moving parts and much uncertainty inherent in the macroeconomic modelling of climate outcomes. With that in mind, we created a simplified framework for mapping the trajectories of our transition enablers (corporate action, technology and policy) onto climate scenarios. For some enablers, such as renewables, corresponding trajectories are already part of the NGFS climate scenarios we rely on, so we can compare actual outcomes against those assumptions over time. Others, such as international cooperation, are only implicit in the climate scenarios. In those cases we pick proxies from other sources, such as the IEA, or use our own judgement in assessing what path for those enablers would correspond to each of the climate scenarios.[ii]

To simplify the mapping further, we focus on the three key quadrants in the NGFS scenario matrix, each representing two sets of climate scenarios (Chart 5). Those are; Orderly Transition (low physical and transition risks), Disorderly Transition (low physical and high transition risks) and Hot House World (high physical and low transition risks). As time progresses, the range of outcomes will narrow. But, for now at least, we assume it is still possible for the world to end up pretty much anywhere on this matrix.

Chart 5: Our mapping focuses on the three quadrants within the NGFS scenario framework

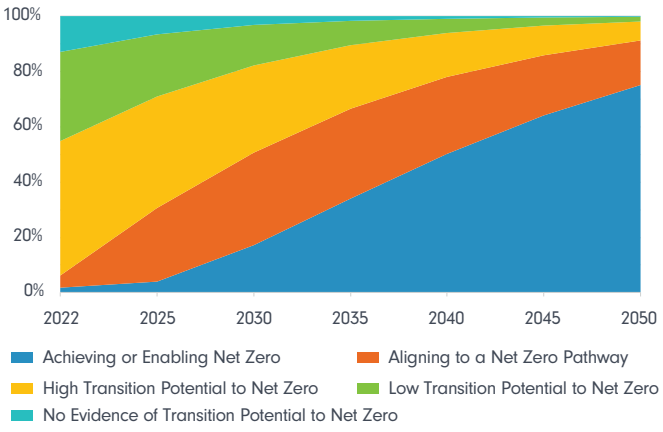


Source: Fidelity International, NGFS, September 2022.

Defining scenario thresholds for corporate action

To achieve net zero, at least 90% of companies in our coverage should be either achieving or enabling net zero or aligning to a net zero pathway by 2050. This means that around half of all companies in each category should be moving up the rating every five years. While this transition is unlikely to be linear, modelling it in this simple framework gives us a sense of the required speed and magnitude of change between now and 2050 (Chart 6). Given the low starting base, this pace may well be achievable in the next decade, but it will become increasingly ambitious over time and highly contingent on the progress in other areas we are tracking - technology and policy.

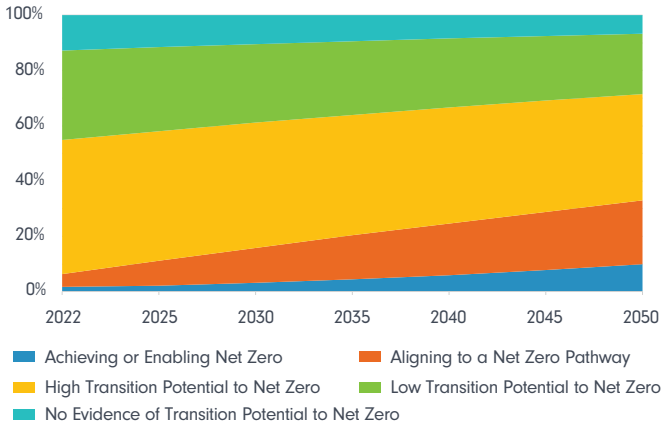
Chart 6: Companies face an ambitious net zero transition trajectory in coming years



Source: Fidelity International, February 2023.

We assume that under current policies this transition would happen at a slower speed, which leads to only a third of companies positioned in the top two categories by 2050 (Chart 7). In terms of pace, this means around 10% of companies in each category should be transitioning to a higher rating every five years - not such a tall order overall, but without support from other transition enablers even this pace could become increasingly challenging in the latter part of the horizon.

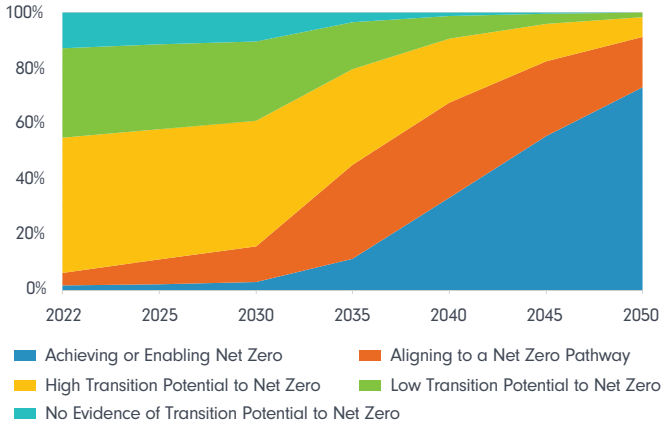
Chart 7: Under current policies only a third of companies would be positioned in the top two categories by 2050



Source: Fidelity International, February 2023.

Under the NGFS Disorderly Transition scenario, we assume corporate transition to higher climate ratings evolves slowly before 2030. After that, companies must move fast to catch up, meaning about two-thirds of companies in each category should be improving their rating every five years, ending up with over 90% of companies rated in the top two categories by 2050 (Chart 8). This is certainly a challenging pace which only seems achievable with significant breakthroughs in technology and game-changing policy at national and international levels. With that in mind, within the Disorderly Transition quadrant in Chart 5, a more feasible scenario would be a Delayed Transition where the temperature increase is capped only at 2°C.

Chart 8: Disorderly transition requires rapid acceleration of net zero efforts after 2030



Source: Fidelity International, February 2023.

Given our company sample is not equally distributed across sectors, with a third in financials and industrials, we also look at corporate action projections on an emission-adjusted basis. This shifts sector weights significantly away from financials, IT and healthcare towards industrials, consumer discretionary and consumer staples. Financials and healthcare tend to be over-represented in lower climate ratings (low or no evidence of transition potential), so reducing their weights lowers the bar for the overall net zero transition. For instance, if the pace of transition within these two sectors is halved, while that for other sectors remains the same, we could still get 90% of companies on an emission-weighted basis rated in the top two categories by 2050.

In other words, as long as companies in high emission sectors achieve or align to a net zero pathway at the appropriate pace, provided other transition enablers are supportive, the Net Zero 2050 scenario can be within reach. While of course we want to see companies across all sectors moving up the climate ratings - and those who fall behind would likely be penalised by investors - for the purposes of tracking corporate action and mapping it onto climate scenarios, focusing on high emitters may well be sufficient for gauging the base case pathway.

Defining scenario thresholds for technology

To track the evolution of technology we identify a number of indicators within the four categories we outlined, which are relatively timely and sensible for using in scenario mapping. Table 2 shows these indicators and our scenario alignment assessment for each technology, reflecting which quadrant in the climate scenario matrix each indicator is on track for. The key criteria we use to determine this are:

- S-curve progress - is this technology in development or deployment?
- Does necessary infrastructure exist and which stage is it at?
- Is there enough policy momentum to support this technology at different stages of development and deployment, both on a national level and globally?

This is of course a highly subjective exercise, due to enormous uncertainty and various other caveats, which we think is nevertheless useful in simplifying the complex system and gauging the likelihood of a net zero transition.

Table 2: Our assessment of climate scenario alignment for each technology

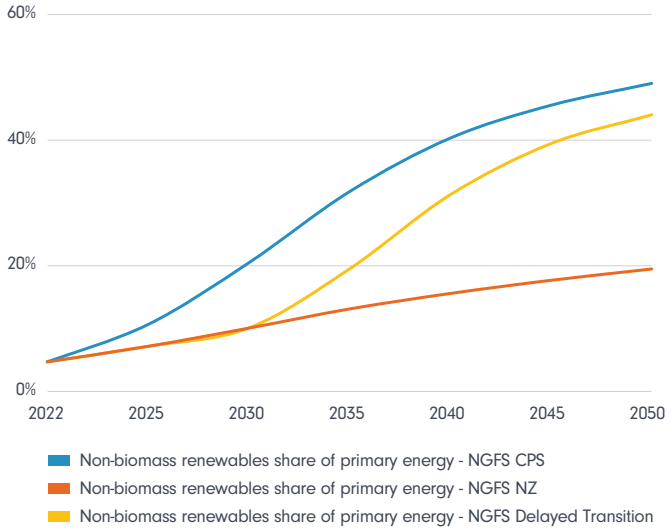
Technology		Currently on track for
Low-carbon energy		Net Zero 2050/Divergent Net Zero
Energy efficiency and storage	Battery storage	Hot House World/Disorderly Transition
	Electric vehicles	Net Zero 2050
Building efficiency		Hot House World/Disorderly Transition
Hydrogen		Hot House World/Disorderly Transition

Sources: Fidelity International, IEA, NGFS, BNEF, February 2023.

Low-carbon energy

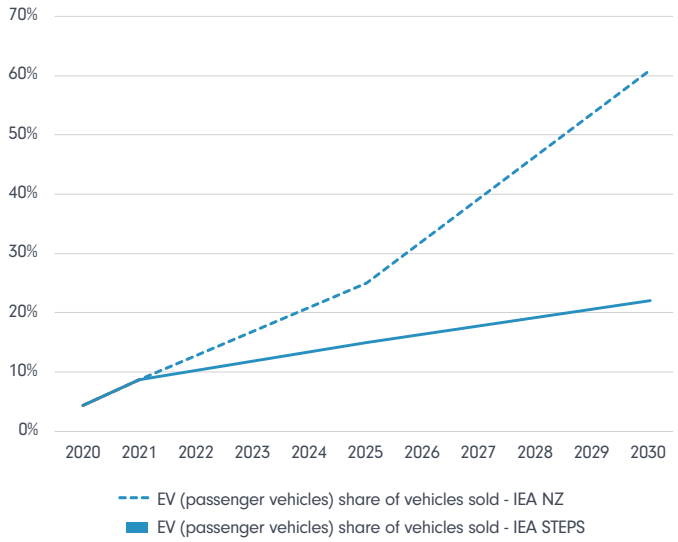
Changes in the energy mix are key to all climate change scenarios. We thus rely on NGFS projections for setting scenario thresholds for key sources of renewable energy - solar and wind. In 2020, the starting point for the latest NGFS scenarios, all non-biomass renewables overall accounted for around 5% of primary energy and 28% of total electricity generation[iii]. Under the Net Zero 2050 scenario, the share of renewables in primary energy should roughly double by 2025, quadruple by 2030 and increase 10-fold by 2050. The share of renewables in total electricity generation should rise 2.5-fold by 2030 and get to around 90% by 2050 for the net zero transition to occur. As Chart 9 illustrates, this trajectory is much shallower in the Current Policies scenario (Hot House World), with the share of renewables in primary energy only rising to 20% and the share in total electricity generation rising to 70% by 2050.

Chart 9: The share of renewables in primary energy is projected to quadruple by 2030 and increase 10-fold by 2050 under the Net Zero 2050 scenario



Note: CPS stands for Current Policies Scenario, NZ stands for Net Zero 2050 Scenario.
Source: NGFS Phase 3 Scenario Explorer, September 2022.

Chart 10: The share of EVs in total vehicles sold reaches 60% by 2050 under the Net Zero 2050 scenario



Note: NZ stands for Net Zero 2050 Scenario, STEPS stands for Stated Policies Scenario which is roughly equivalent to the NGFS Hot House World quadrant.
Source: IEA Global EV Outlook 2022.

Our sector analysts view the renewables trajectory under the Net Zero 2050 scenario as realistic, but the assumption for nuclear energy is disputable. Not regarded as a renewable source of energy by NGFS, the nuclear share in total energy generation is assumed to fall by 2030. However, our analysts believe that this metric will stay flat, as on a net basis, more capacity is set to be added by the likes of China, than be decommissioned by other countries up to 2030.

Notably, as Chart 9 illustrates, Delayed Transition (which is one of the NGFS scenarios within the Disorderly Transition quadrant) is largely indistinguishable from the Current Policies scenario until 2030, after which the share of renewables rises steeply but does not converge to the Net Zero 2050 path. Such nonlinear regime shifts would complicate the tracking. This is an important general point to bear in mind for mapping transition enablers to climate scenarios in the next few years.

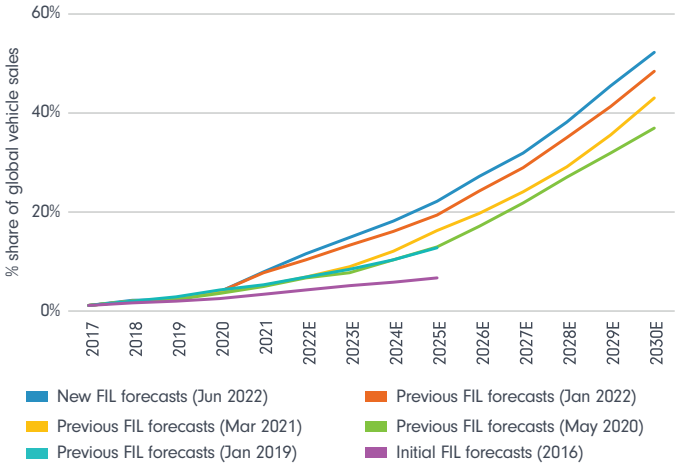
Energy storage and efficiency

EV sales data is timely and easily available from a number of sources so we can use it as a key indicator in this category. NGFS scenarios, however, do not provide EV series as inputs so we use the corresponding IEA scenarios for setting the thresholds (Chart 10).

Our sector analysts believe that the Net Zero 2050 trajectory for EVs, where the share of vehicles sold reaches 60% over the next decade, is realistic (Chart 11). The recent upward shift in projections has been driven by China, and its phasing out of internal combustion engine vehicles. Furthermore, the June 2022 forecast was made before the US's IRA, which should boost the global EV penetration further over the next decade. Taking into account both the IEA's assessment of EVs being on track for Net Zero 2050, and our analysts' projections, we currently view the EV trajectory as net-zero compatible.

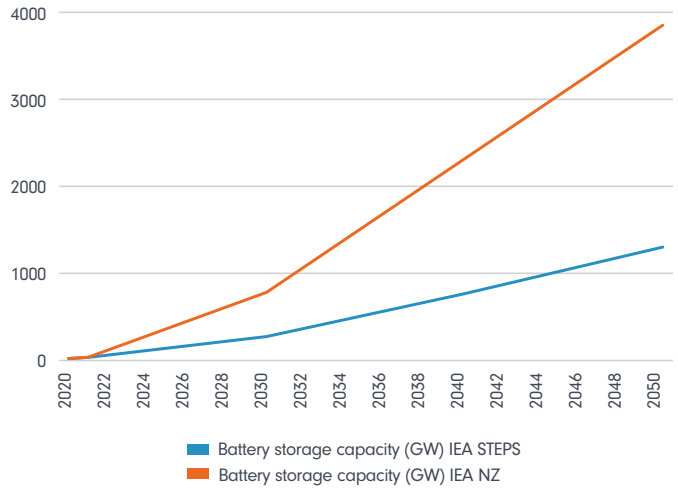
As EV battery capacity projections are inevitably intertwined with EV sales projections, we use the this as the main indicator to track in this category. But battery storage capacity, important for uses beyond vehicles such as in housing and industry, is also useful to track as this is a key component of transition. Technological advances here will have to be quick to keep pace with the demands of the transition. The IEA Net Zero 2050 scenario, for example, assumes a multiple hundred-fold increase in this metric, as Chart 12 shows.

Chart 11: FIL global EV forecasts have improved with each iteration



Source: Fidelity International, February 2023.

Chart 12: Global battery storage capacity is assumed to rise non-linearly under the Net Zero 2050 scenario



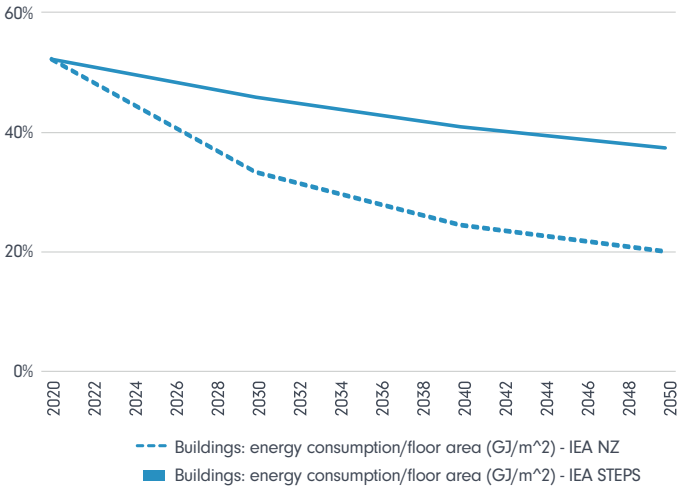
Source: IEA World Energy Outlook 2022.

Building efficiency

For building efficiency the IEA provides projections of both energy consumption from buildings and floor area under the corresponding Net Zero 2050 and Current Policies scenarios (Chart 13). This allows us to calculate energy consumption per unit of floor area. Under the Net Zero 2050 scenario, building energy efficiency is assumed to improve by 36% by 2030 and 62% by 2050 which is very ambitious given the current building energy efficiency requirements. The EU, for example, which is the leader in energy efficiency targets, only sets the goal of increasing energy efficiency for the overall economy by 32.5% by 2030. While this is close enough to the Net Zero 2050 scenario, such ambitious targets are not common among other big emitters, meaning a step-change in related policies is required to put the world on track for large efficiency improvements in both residential and non-residential sectors.

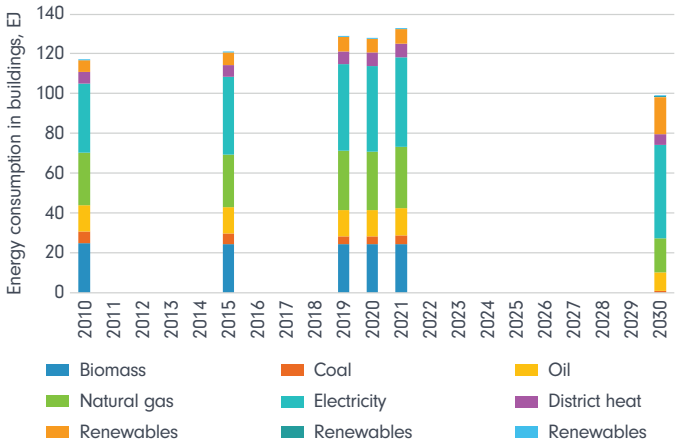
Tracking the energy consumption mix in buildings, including heat pumps for example, would be another useful way for gauging progress on this front. As Chart 14 shows, we need to see a huge shift towards electricity and renewables as the main sources of building energy consumption by 2030. At this point, we are likely heading for a Disorderly Transition scenario on this metric.

Chart 13: Under the Net Zero 2050 scenario, building energy efficiency is assumed to improve by 62% by 2050



Source: IEA World Energy Outlook 2022, IEA Global building energy use and floor area growth in the Net Zero Scenario, 2010-2030.

Chart 14: Improved building efficiency, shift to more efficient appliances and clean technologies are crucial for getting on track with the Net Zero 2050 scenario

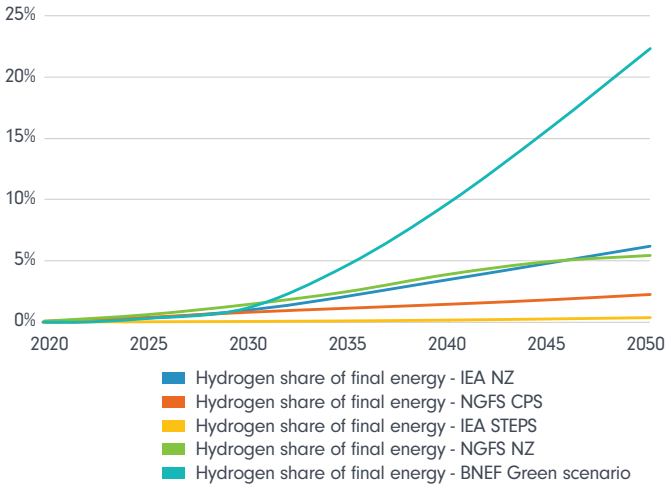


Source: IEA Energy consumption in buildings by fuel in the Net Zero Scenario, 2010-2030.

Hydrogen

Out of all the technologies we propose to track, hydrogen tends to cause the most debate. The two main points of contention are around the different measures that climate scenario providers use to project hydrogen usage and around the hydrogen share projections themselves and whether hydrogen is essential to the transition. BNEF, for example, assumes the hydrogen share in final energy consumption rises to over 20% by 2050 under its Green scenario, while NGFS and IEA assume a less ambitious path where the share rises to around 6%, as Chart 15 shows.

Chart 15: The assumption for hydrogen's share of final energy to 2050 differs widely across scenarios and sources



Source: NGFS Phase 3 Scenario Explorer, IEA World Energy Outlook 2022, BNEF New Energy Outlook 2021.

Rather than looking at the share of hydrogen in total energy supply, consumption or generation, our sector analysts build forecasts for demand from individual sources in industry and transport. In their baseline scenario they assume a tripling of hydrogen demand by 2050, a less ambitious trajectory compared to the one required for the net zero transition by NGFS and other sources as above. While our analysts agree that hydrogen will play a role in hard-to-decarbonise sectors such as steel and long-distance transport, they believe that many of the most touted uses of hydrogen - such as short-distance transport and space heating - are unlikely to take off, due to their price and inefficiency. For now at least, hydrogen remains very inefficient, with final output below 30% of the initial electricity input according to the IEA.

While hydrogen does not seem essential for a successful transition of the whole economy, it should play an important role in decarbonising heavy-emitting sectors. But it also has the potential for upside surprises if progress is made on efficiency and thus should be part of the technology tracker.

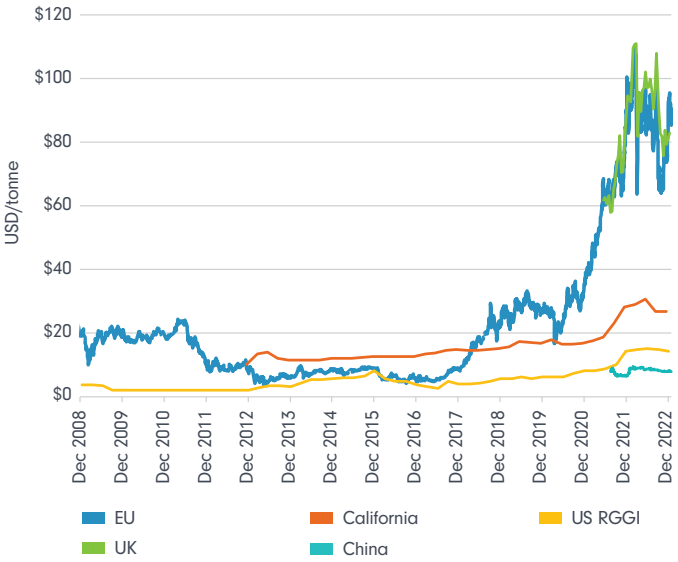
Defining scenario thresholds for policy action

Policy action is the most challenging of the three enablers to map onto climate scenarios as it is mostly qualitative in nature and involves a high degree of subjective judgement on policy importance and scope, its implementation prospects, risks and potential unintended consequences. Our attempt to rank countries on the four key pillars of policy action illustrates this challenge. In addition to continuing this ranking assessment over time, we also propose two metrics to add a quantitative dimension to the tracker - these include carbon prices and NDCs.

Tracking carbon prices

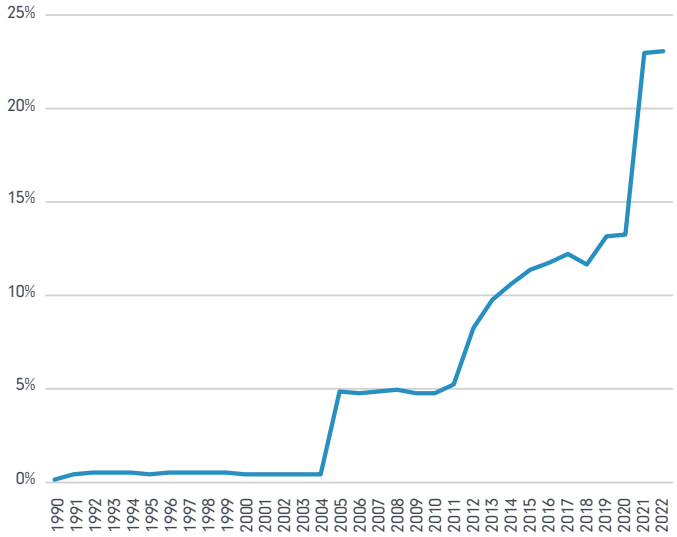
Tracking carbon prices available across existing schemes is one obvious way to map policy action onto NGFS scenarios which provide carbon price trajectories for different geographies and pathways. As Chart 16 shows, carbon prices in Europe and the UK have diverged significantly from other schemes, which in itself is an encouraging development. If this momentum continues, European and UK carbon prices may well converge to the NGFS Net Zero 2050 trajectory in the next decade at least.

Chart 16: ETS contract prices for carbon in Europe and the UK have diverged significantly from other schemes



Source: International Carbon Action Partnership (ICAP) Allowance Price Explorer, February 2023.

Chart 17: Only around 23% of emissions globally are covered by ETS and carbon taxes



Source: World Bank Carbon Pricing Dashboard, February 2023.

However, if we account for the share of emissions covered by these schemes, results are less positive. The global average price is between USD5-6 per tonne, as only around 23% of emissions globally are covered by ETS and carbon taxes (Chart 17). In June 2022, the Global Emission Reduction (GER) contract, which aims to become the global reference price for voluntary carbon markets, debuted with a bid/ask of USD7.65-7.70, according to Net Zero Markets. As Table 3 shows, actual weighted average prices per tonne are much lower, even though the EU and UK still stand out relative to others. In China, while the current price of Carbon Emissions Allowances (CEAs) is at around USD8, the emission-weighted price is just over USD3 per tonne of CO_2.

Table 3: Current ETS prices are far below levels required for countries to get on track for Net Zero 2050, especially on an emission-weighted basis

				NGFS NZ scenario price assumption (USD2010/t CO_2)					
Country	ETS emisisons coverage 2022	Price (USD/ tonne) December 2022 Average	Weighted price per tonne	2025	2030	2035	2040	2045	2050
Global	23%	24.3	5.6	85.0	114.6	180.7	255.2	345.1	451.2
US (RGGI and California)	6%	24.4	1.6	122.0	162.7	245.4	328.2	410.9	493.7
EU 28	40%	91.0	36.4	122.0	162.7	369.0	575.4	781.7	988.1
India	N/A	N/A	N/A	25.2	42.2	74.3	127.9	209.4	325.4
China	40%	8.1	3.2	79.7	110.0	174.5	262.2	375.9	518.4
UK	33%	83.0	27.4	122.0	162.7	369.0	575.4	781.7	988.1

Note: The global emission-weighted carbon price is calculated using all existing schemes and their latest respective weights and pricing. The global unweighted price is backed out from the weighted price and the global emissions coverage share. No current data is available for India due to suspension of ESCerts trading in the PAT.

Source: Fidelity International calculations, ICAP, World Bank Carbon Pricing Dashboard, NGFS Phase 3 Scenario Explorer, February 2023.

Table 4: Quantifying the gap between NDC targets and NGFS Net Zero 2050 assumptions

Country	NDC	NGFS equivalent of NDC	Relative gap
China	CO_2 emissions peak before 2030	Peaked in 2020	-10 years
	Carbon neutrality by 2060	2045	-15 years
	Lower CO_2 emissions per unit of GDP by over 65% from the 2005 level	88%	-26.1%
	Increase the share of nonfossil fuels in primary energy consumption to around 25%	40%	-37%
	Increase the forest stock volume by 6 billion cubic meters from the 2005 level	N/A	N/A
	Bring its total installed capacity of wind and solar power to over 1.2 billion kilowatts by 2030	3.46	-65%
US	Economy-wide target of reducing its net greenhouse gas emissions by 50-52 percent below 2005 levels in 2030	64%	-20.9%
India	Reduce the emissions intensity of GDP by 45% by 2030 below 2005 levels	51%	-12.2%
	Achieve about 50 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030	N/A	N/A
EU (joint NDC)	Net domestic reduction of at least 55% in greenhouse gas emissions by 2030 compared to 1990	67%	-17.3%
UK	Reduce economy-wide greenhouse gas emissions by at least 68% by 2030, compared to 1990 levels	N/A	N/A

Note: only those NDCs which are quantifiable are shown in the table.
Source: Fidelity International calculations, NGFS Phase 3 Scenario Explorer, UNFCCC NDC Registry, February 2023.

With the global emission-weighted carbon price around USD5-6 per tonne, huge changes in global scheme coverage and pricing incentives - and potentially the global carbon price - are needed in the next few years to reach price levels required to achieve the net zero transition. For now, given the divergent state of the carbon market across countries, we believe a Disorderly Transition scenario (where it is Delayed or Divergent) is still the most likely outcome.

Tracking the NDC gap

In order to assess and compare countries' ambitions more quantitatively, we compare their stated 2030 NDCs to the relevant metric in the NGFS Net Zero 2050 scenario, where comparable NGFS data exists. We then calculate the relative gap between NDC ambitions and corresponding NGFS net zero requirements (Table 4).

As per our analysis, the US's NDC is 21% below the NGFS Net Zero 2050 scenario, while the EU's NDC is 17% below and China's NDCs are on average 43% too low compared to the NGFS Net Zero 2050 scenario. While it has not been possible to directly quantify the sufficiency of the UK's NDC via NGFS data, as the UK is included within their EU28 data, the Climate Action Tracker (CAT) rates it as "compatible" with Net Zero 2050, the only such country, alongside Norway.

NDCs have to become more ambitious across the world, particularly in China, and only moderate improvements would be required in the EU and US to get on track with the NGFS Net Zero 2050 trajectory. But divergences on policy and implementation in other areas represent the main obstacles faced by the world on the path to net zero. Closing the NDC gap in each country on paper would unlikely guarantee the net zero transition by 2050, but it would certainly get us closer to it.

Disorderly transition, new world order

2022 was a year in which geopolitical conflicts translated in to increased climate scenario uncertainty. The range of possible outcomes is now wider than before, and the influence of policymakers over the direction and speed of transition to net zero is more acute.

Carbon pricing and technological advances are among those policy factors that are most likely to move the dial towards net zero compliance in the near term. As the pressure from high energy prices has subsided, at least for now, so have concerns about coal and oil replacing natural gas as a potential transition fuel. But high volatility in energy prices seen throughout 2022 presents an opportunity to push through carbon price increases and adjust ETS structures by adding explicit price floors and price ceiling to rule out extreme price spikes in the future.

In the long term, the geopolitics of energy security - and its fundamental shifts catalysed by the Russian invasion of Ukraine - will be a key driver of the net zero transition. For more than eight decades the geopolitics of energy have been dominated by geopolitics of gas and oil. The rise of China as a dominant energy consumer in recent years has dramatically shifted energy consumption patterns which were previously dominated by the West. Even with the China-US decoupling firmly in place, the US strategy towards China includes cooperation on climate change.

As decarbonisation changes the energy demand mix, new cartels will form around the minerals and materials needed for renewable technology deployment. The transfer of technology from the developed to developing world may become a source of tension with consequences for capital deployment and technological progress. On the production side, the reallocation of terms of trade towards producers of renewable energy may come into play as the resource curse shifts away from oil and gas producers, countries which will need to diversify their economies or suffer political instability as petroleum revenues drop on permanent demand switching.

On technology enablers, there has been notable acceleration in renewables investment and green hydrogen expansion across the world in 2022. Key policy initiatives undertaken in 2022 in the US and Europe in particular should keep this momentum going. The technology and supply chains of renewables, and their differences to those of fossil fuels, are in themselves important global economic and geopolitical considerations. In this context, the role of a superpower protecting international energy supply chains across sea and land, one which the US has played since WW2, takes on a completely new dimension. Once the critical material supply chain is secured, the production of end usable green energy near consumption points is much easier compared to fossil fuels, thus making the technologies more amenable to self-reliance and reshoring paradigms. These dynamics are likely to accelerate further on the back of the war and the pandemic shock. The very nature of renewable production, which reduces the need for expansive international networks and cooperation will shape a completely different world order compared to the one we have seen over the past few decades.

These interconnected dimensions of the necessary switch from fossil to renewables are critical geopolitical landscape drivers and will also need close analysis and assessment as different climate change scenarios come into shape in coming years. So far, the recent developments aren't enough to change our baseline view from a disorderly to an orderly net zero transition. But the policy shifts catalysed by the war-induced energy crisis do have the potential to dramatically speed up progress towards net zero goals. This crisis can be turned into a game-changing opportunity. More policy support and coordination across countries is essential to achieving a sustainable, secure, and affordable energy system, which would in turn pave the way to a more orderly net zero transition and a temperature increase below 2°C.

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Carbon needs to cost at least $100/tonne now to reach net zero by 2050: Reuters poll | Reuters

Environmental Finance – 'Single, reference carbon price' trades at $7.23 22 June 2022 - Net Zero Markets

NGFS publishes a paper exploring the effects of the current energy crisis and the links with the NGFS climate scenarios | Banque de France

Nationally Determined Contributions (NDCs) | UNFCCC

[i] We use the NGFS scenario set as our baseline in order to ensure consistency with an internationally recognised and developed platform, to transparently and consistently model the impact of various climate change scenarios on key variables of interest to investors. Below is a brief explanation of the six scenarios.

Orderly quadrant:

- Net Zero 2050 Scenario limits global warming to 1.5°C through stringent climate policies and innovation, reaching global net zero CO_2 emissions around 2050.
- Below 2°C Scenario gradually increases the stringency of climate policies, giving a 67% chance of limiting global warming to below 2°C.

Disorderly quadrant:

- Divergent Net Zero Scenario reaches net zero around 2050 but with higher costs due to divergent policies introduced across sectors leading to a quicker phase out of oil use.
- Delayed Transition Scenario assumes annual emissions do not decrease until 2030. Strong policies are needed to limit warming to below 2°C.

Hot House World quadrant:

- Nationally Determined Contributions (NDC) Scenario includes all pledged targets even if not yet backed up by implemented effective policies.
- Current Policies Scenario assumes that only currently implemented policies are preserved, leading to high physical risks.

[ii] We aim to use NGFS scenarios for mapping trajectories of our technological transition enablers as much as possible. Where metrics are not available from NGFS, we use IEA projections for corresponding scenarios. According to NGFS, the IEA Stated Policies Scenario (STEPS) roughly maps onto the NGFS NDC scenario, while both Net Zero models intuitively correspond. From our comparisons, STEPS seems to be a slightly more conservative scenario, and it comes between the NGFS Current Policies and NDC scenarios (both in the Hot House World quadrant). For this reason, we use both Net Zero scenarios as best-case scenarios and the NGFS Current Policies and the IEA STEPS scenarios as worst-case scenarios (corresponding to the Hot House World).

[iii] NGFS's definition of primary energy from non-biomass renewables includes the non-biomass renewable primary energy consumption, reported in direct equivalent (i.e. the electricity or heat generated by these technologies) and includes subcategories for hydroelectricity, wind electricity, geothermal electricity and heat, solar electricity, heat and hydrogen, ocean energy.

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