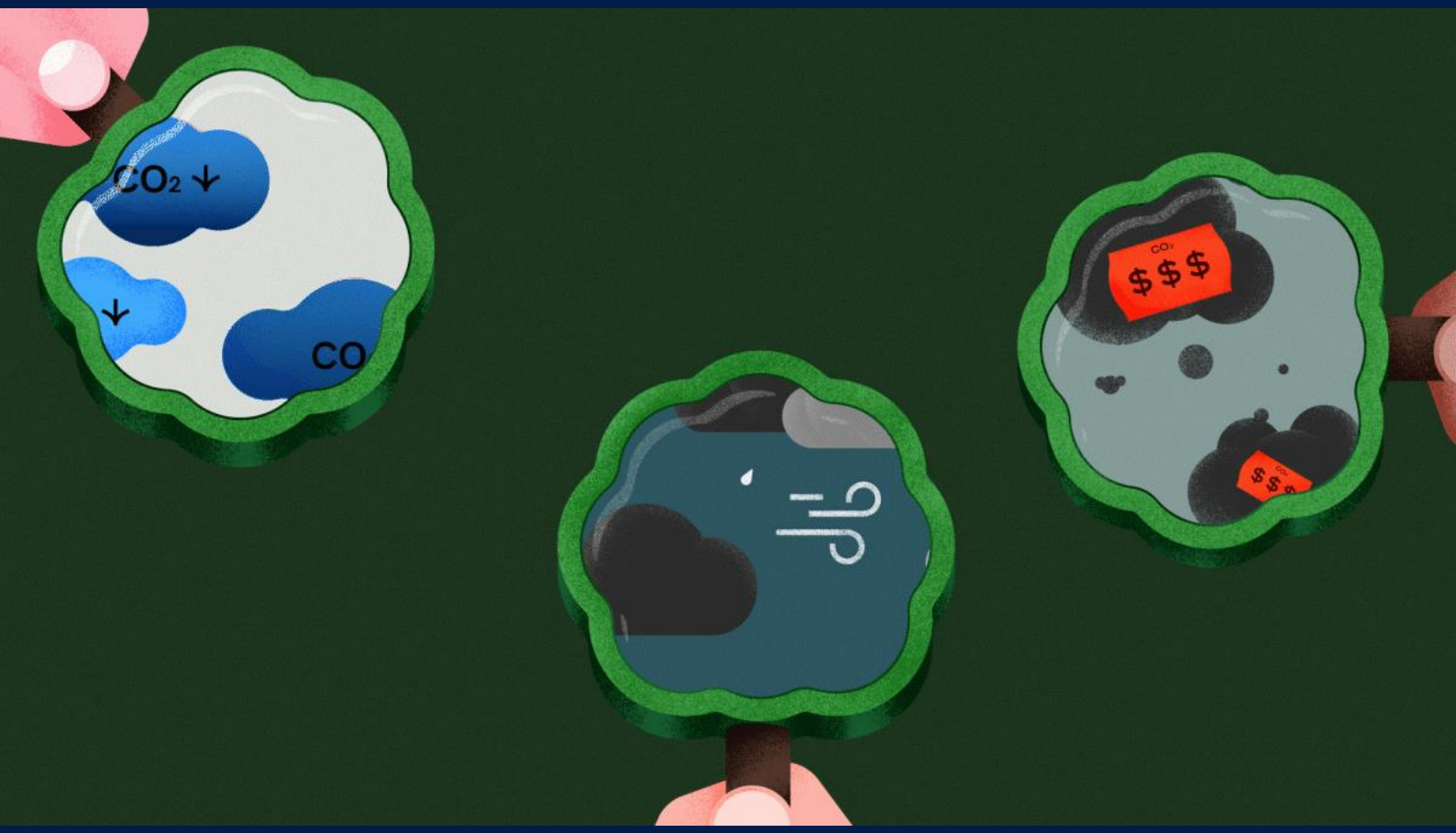
GIC × McKinsey Sustainability

ThinkSpace



From Risk to Opportunity: Bottom-Up Climate Scenario Analysis for Investors

OCTOBER 2023

Authors

WONG DE RUI
Senior Vice President, Sustainability Office, GIC

THOMAS NIELSEN
Partner, Planetrics, McKinsey Sustainability

Acknowledgements

The authors would like to thank Shang Thong Chie and Trang Chu Minh from GIC and Ethan McCormac and Ahmed Ali from Planetrics for their contributions to this work.

Executive summary

- **Investors are increasingly exposed to climate change.** According to the International Energy Agency (IEA), the goal of limiting global warming to 1.5°C will require the transformation of economies around the world[1]. Investors are likely to be affected by these changes as the transition to a low-carbon economy further shapes companies, markets, and the global economy[2].
- **However, the pace and path of future climate policy and technological change are uncertain**. Traditional risk and return models that are solely based on historical data make it challenging to explore new climate-related risks. Quantifying climate risks can be further complicated by significant uncertainty around the pace and stringency of policy and technological innovation.
- **To address these uncertainties, GIC employs both top-down and bottom-up approaches for stress-testing investment portfolios against a multitude of potential future pathways.** Top-down approaches assess risk at a macroeconomic level. In a previous report[3], GIC mapped out the climate impact on macro indicators such as gross domestic product (GDP) growth or inflation, as well as financial asset returns.
- **Climate risks, however, are concentrated across and within sectors, depending on factors such as emissions intensity and market characteristics.** Companies might be impacted differently even within the same emissions-intensive sector. A granular, bottom-up modelling approach can help investors quantify climate impacts on firms across and within sectors.

[1] International Energy Agency (IEA) (2023). *Net Zero Roadmap: A Global Pathway to Keep the 1.5°C Goal in Reach*.
[2] For a detailed overview of the potential financial risks related to climate change, see 'Bank for International Settlements (2020). *The Green Swan: Central Banking and Financial Stability in the Age of Climate Change'*; and 'International Monetary Fund (IMF) (2019).*Climate Change and Financial Risk'*.
[3] GIC and Ortec Finance (2023). *Integrating Climate Scenario Analysis into Investment Management: A 2023 Update*.

This paper, co-authored with Planetrics, part of McKinsey Sustainability, explores a bottom-up climate scenario analysis methodology to support investors in assessing the transition impacts on individual companies and their portfolios:

- Sections 1 and 2 introduce climate scenario analysis as a tool to help investors explore low-carbon transition scenarios.
- Section 3 details a bottom-up climate scenario analysis approach to assess company-level financial impacts.
- Section 4 presents results for an illustrative global equity portfolio. It highlights pockets of potential climate-related risks and opportunities across and within sectors, as well as the impact of whether companies might achieve their publicly announced climate targets.
- Section 5 concludes with a brief discussion of potential investment applications.

Introduction

While their evolution over time remains uncertain, climate-related risks are on the rise due to increasing temperatures, more frequent extreme weather events, and changing policies. Although countries have pledged to limit temperatures to 1.5 – 2.0°C by the end of the century, existing commitments fall short of these goals according to the United Nations Environment Programme[4]. In scenarios that limit temperature rise to 1.5°C, the Intergovernmental Panel on Climate Change (IPCC) estimates that greenhouse gas (GHG) emissions must fall by over 40% this decade[5].

Scenario analysis can help investors manage and quantify climate-related risks. Climate scenarios are increasingly used by financial institutions, central banks, and regulators to estimate and explore the financial impacts of climate change under different policy and technology pathways. For investors, climate scenario analysis offers a tool to test how investments may perform under different climate outcomes, weigh the balance between the potential risk and return of investments under different climate scenarios, and make informed investment decisions.

Scenarios are not forecasts, policy prescriptions, guidance, or advocacy. Rather, scenarios represent plausible futures. For example, they can serve as a tool to test the impact of inaction against climate change, or the impact of policy measures targeted at reducing global emissions.

This paper highlights how bottom-up climate scenario modelling can help investors quantify potential transition risks and opportunities. It focuses on transition risks and opportunities as they impact company costs and revenues within typical investment horizons. However, investors should also consider the likely impacts of climate change-induced physical risk on their portfolios.

[4] United Nations Environment Programme (UNEP) (2022). *Emissions Gap Report.*
[5] IPCC (2023). *AR6 Synthesis Report: Climate Change 2023.*

Climate scenario selection

Climate scenario analysis begins with scenario selection, considering investor-specific requirements and use cases. For risk management, adverse scenarios with abrupt policy and energy system changes can offer insights on likely downside risks, while capital allocation decisions may require more balanced scenarios. In addition to use cases, scenario selection should consider the investor's time horizon, scenario-specific assumptions and limitations, and regulatory guidance, among other factors.

Investors can select publicly available climate scenarios from several scenario providers, each with different narratives, modelling methodologies, and assumptions. There are several publicly available climate scenarios, including, for example, the Principles for Responsible Investment (PRI) Inevitable Policy Response[6], the International Energy Agency (IEA) Net Zero Emissions by 2050[7] and the Network for Greening the Financial System (NGFS) Divergent Net Zero[8] scenarios. Scenario providers apply different modelling methodologies based on their policy, technology, and energy system assumptions. Each scenario set and underlying modelling methodology has its own advantages and disadvantages, so there are benefits to testing a range of scenarios to explore a wider set of uncertainties and pathways. Publicly available scenarios typically assume coordinated policy (in)action across sectors and regions. These scenarios are predominantly used by investors for stress-testing high transition or high physical risk outcomes (for instance, 1.5°C or 4°C scenarios).

Investors are increasingly complementing public scenario sets with bespoke scenarios that allow them to incorporate their views on the evolution of policy and technology. Bespoke scenarios introduce further sector-

[6] United Nations Principles for Responsible Investment (UNPRI) (2021). *Inevitable Policy Response*.
[7] IEA (2023). *Net Zero Roadmap: A Global Pathway to Keep the 1.5°C Goal in Reach*.
[8] Network for Greening the Financial System (NGFS). *Scenarios Portal*. The NGFS is an international group of central banks and supervisors that established in 2017 with the aim to enhance the role of the financial system in addressing climate change. It now includes more than 100 central banks and supervisors from around the world including the Monetary Authority of Singapore.

region variation in policy, technology, and other key assumptions. These assumptions aim to closely track the evolution of policies and technologies observed to date. Bespoke scenarios are commonly used by investors for capital allocation purposes, which enable them to incorporate their perspectives on potential policy developments and technology pathways.

Regardless of use case, selecting a range of climate scenarios enables investors to assess multiple risks and opportunities. Using a wide set of scenarios allows investors to explore a broad range of potential policy and technology pathways. This can help investors assess how companies might perform under different climate transition scenarios. Investors may choose to focus on particular elements and features of the chosen scenarios — this paper, for example, addresses transition risks — to ensure insights are relevant to their own unique circumstances, use cases and views.

This paper focuses on listed assets and analyses impacts under the NGFS Divergent Net Zero scenario on a global equity portfolio. The Divergent Net Zero scenario from the NGFS phase III REMIND-MAgPIE model explores a scenario that limits global warming to 1.5°C through changes in policy and resulting impacts to the global energy system, but with divergent policies introduced across sectors. As part of the scenario narrative, the NGFS Divergent Net Zero scenario examines a potential future where carbon prices are three times higher in transport and buildings compared to power and industry. This results in relatively deeper decarbonisation in the transport and building sectors compared to other NGFS scenarios. While this paper focuses on applying a single scenario within the framework of a bottom-up modelling approach, in practice, testing multiple scenarios can yield further insights about the range of possible futures. All results are presented relative to a baseline scenario, which is a “current policies, current climate” scenario. The next section describes the methodology used to translate scenarios into bottom-up, security-level financial impacts.

Climate scenario modelling: A bottom-up approach

Investors can use top-down and bottom-up approaches to model the potential impact of climate change on risk and return. The approaches complement each other: Top-down models are more suited for strategic asset allocation, while bottom-up frameworks help inform investment due diligence, asset selection, and stewardship activities. Investors can leverage insights from multiple modelling approaches, and the next generation of models is increasingly synthesising elements from both modelling frameworks.

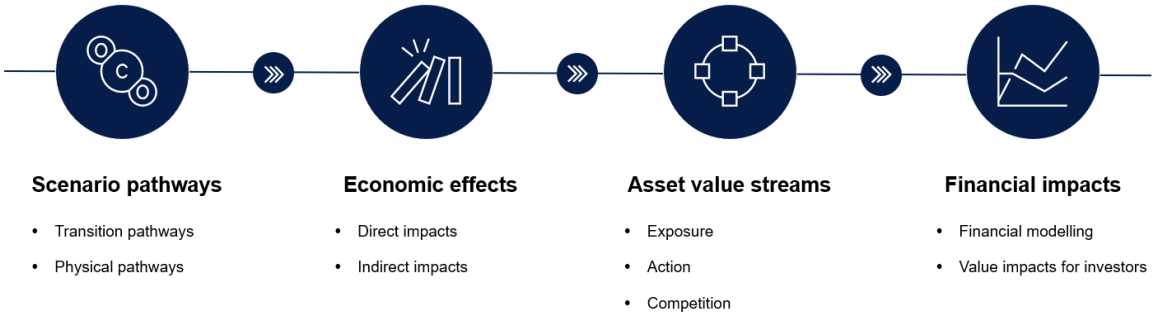
This paper applies a bottom-up scenario analysis approach, drawing on the Planetrics model architecture, to translate climate scenarios into potential financial impacts on individual securities[9]. The approach set out in this paper considers companies' responses to economic changes and market dynamics and helps quantify the potential financial impacts of companies meeting their publicly announced climate targets. The modelling approach uses a four-step framework, shown in **Figure 1**, to quantify financial impacts up to 2050:

1. **Define scenario pathways:** Scenario narratives provide the economic, energy system, and climate variables needed for the subsequent steps in the modelling process.
2. **Translate into economic effects:** Scenario pathways are translated into direct and indirect economic effects. Direct effects manifest as immediate costs to companies (for example, a tax on companies' emissions) while indirect effects change companies' costs and revenues through secondary channels (for example, an increase or decrease in the demand for a company's products).

[9] An alternative bottom-up approach that GIC has developed is the Carbon Earnings-at-risk Scenario Analysis (CESA). CESA examines carbon pricing risks across different scenarios and their impact on companies' earnings and valuations. See 'GIC (2022). *Carbon Earnings-at-risk Scenario Analysis (CESA) – A Financially Material Measure for Managing Transition Risks*' for more detail on this approach.

3. **Calculate asset value streams:** The asset modelling component quantifies the profit implications of economic changes based on a company's exposure (for example, emissions intensity determines direct carbon costs). The company's response (for example, abatement) acts as mitigating factors. Finally, competition dynamics such as reallocation of market share, firm exit, and ability to adjust prices to offset increased input costs are modelled.
4. **Quantify financial impacts:** Lastly, revenue and cost changes up to 2050 are translated into a net present value (NPV) impact[10] using a discounted cash flow approach.

Figure 1: The modelling framework

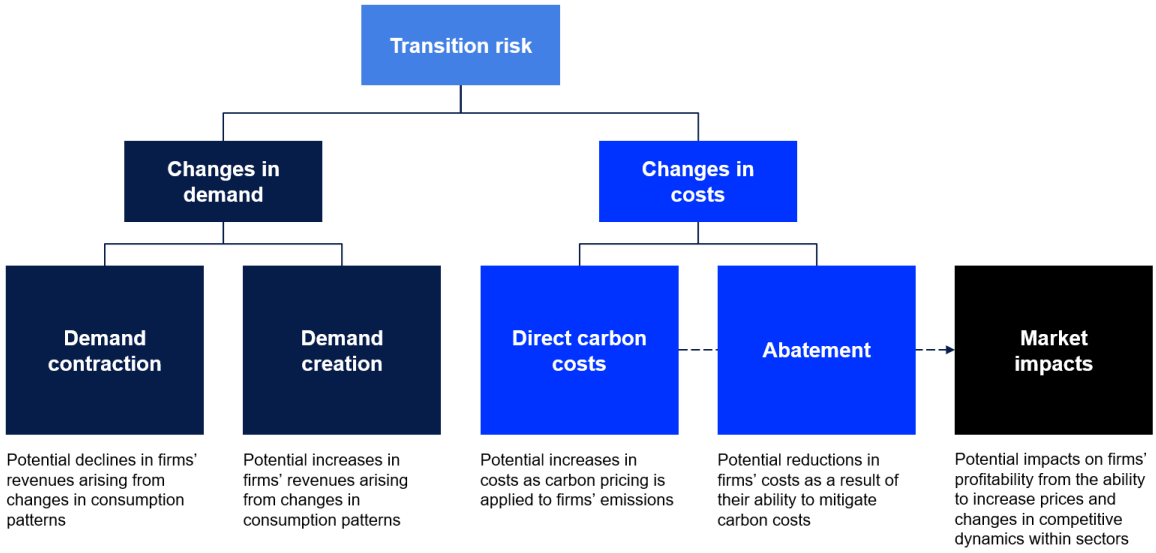


Source: Planetrics.

Modelled climate value impacts are disaggregated into five transition risk impact channels. Impact channels, shown in **Figure 2**, quantify the change in NPV from specific risk, opportunity, and mitigating factors relative to the baseline scenario.

[10] The net present value (NPV) impact is defined as the percentage change in the net present value of the company's future dividends under the climate scenario relative to the chosen baseline scenario.

Figure 2: Climate impacts can be disaggregated into five transition risk impact channels



Source: Planetrics.

Bottom-up scenario analysis, including impact channel assessment, can support investors across the investment life cycle. To demonstrate the approach, the model is applied to a global equity portfolio in the next section. However, it is important to recognise that impacts may vary across asset classes. For example, in illiquid investments, such as real estate and infrastructure, asset-specific considerations should also be considered.

However, limitations remain to climate scenario modelling. This includes potential gaps in the availability, quality, and scope of climate data for certain regions, sectors, and asset classes. Such gaps make it necessary to draw on sectoral and regional proxies for some assets, limiting the granularity of the analysis. A further limitation is the modelling of low-carbon technologies with relatively low levels of technological readiness currently. These technologies often show considerable differences in deployment levels across publicly available scenarios. Climate scenario analysis results are also sensitive to the choice of baseline scenario. This paper assumes a baseline scenario of "current policies, current climate", but this assumption does not account for the

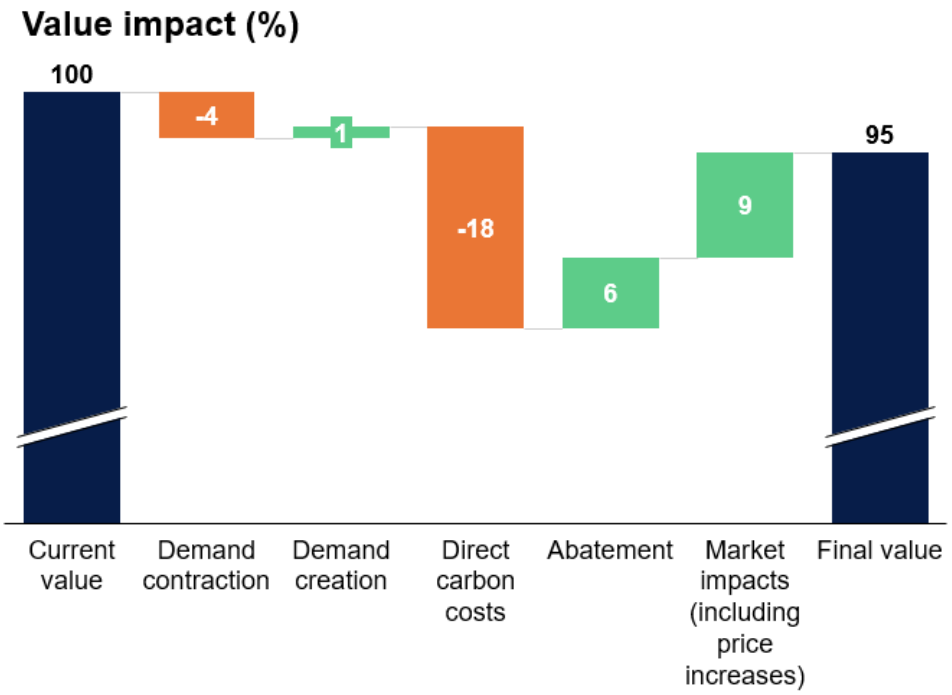
potential of the market to price in a different scenario for specific securities. For example, markets might price a growth company that is a low-carbon technology pure play based on the assumption of a net-zero emissions by 2050 pathway.

Climate scenario results

The estimated NPV impact on an illustrative global equity portfolio from climate-related transition risk is 5%, which is disaggregated by impact channel in **Figure 3**. Under this scenario, the majority of modelled impacts are driven by carbon costs, as higher carbon prices increase operating costs and lead to a -18% impact on value. However, the scenario modelling indicates that some of these direct carbon costs can be abated, generating an offsetting +6% value uplift[11]. Market impacts contribute a further +9% value uplift, arising mostly from the increase of prices by companies due to rising production costs from higher carbon costs. Finally, demand contraction and demand creation impacts, which capture changes in demand for high- and low-carbon goods respectively, lead to a combined -3% impact on portfolio value.

[11] An increase in the NPV of future cash flows.

Figure 3: NPV impacts by channel



Source: Planetrics.

However, bottom-up modelling finds that transition impacts are likely to be unevenly distributed across sectors, with the energy sector potentially experiencing material value impairment[12] while utilities may see value uplifts. The energy[13] sector is the most exposed as demand for fossil fuels falls sharply in the Divergent Net Zero scenario. The non-energy materials[14] sector faces high direct carbon costs because of its high emissions intensity associated with, for example, mining, smelting and the production of cement, chemicals, and fertilizer. However, companies are likely to increase prices in response, mitigating the impact on profitability. Utilities[15] may benefit as demand creation from the electrification of the economy and

[12] A decrease in the NPV of future cash flows.
[13] The energy sector includes companies primarily engaged in upstream, midstream, or downstream activities related to oil and gas production. The sector also covers the production of thermal coal.
[14] The non-energy materials sector includes companies primarily involved in basic and intermediate material production. It contains companies involved in activities related to mining, smelting and fertilizer, cement, chemicals, and steel production.
[15] The utilities sector includes companies primarily involved in the delivery of gas, electricity, and water directly to residential and commercial users. It comprises companies involved in the generation, transmission, and distribution of electricity.

the ability to increase prices may more than offset negative impacts from carbon pricing and lower demand.

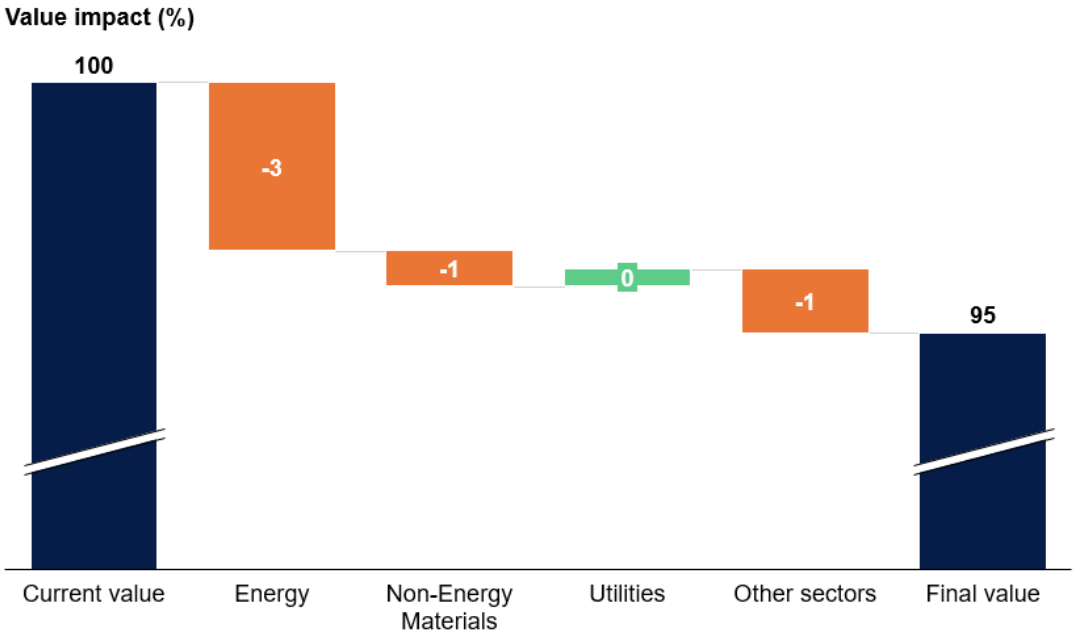
Material within-sector variation is also likely as some firms see value impairment while others may experience growth from low-carbon goods and services. The within-sector spread between the top- and bottom-decile performers can be substantial for the most transition-sensitive sectors. This dispersion is driven by companies' emissions intensity relative to peers and revenue mix (share of revenues from low-carbon versus high-carbon goods and services). The ability to quantify the potential impact of climate-related risks and opportunities on companies and assets is critical for investors' research, due diligence, and asset selection. Section 4.2 discusses these findings in more detail.

Climate targets also impact company value, with modelled value uplifts of ~30% on average from firms achieving climate targets in the example scenario. Companies are dynamic and can respond to the low-carbon transition by setting climate targets which change their product mix, reduce their carbon intensity, or both. The analysis finds that results are sensitive to whether firms meet their publicly announced climate targets and that achieving targets can mitigate risks and generate material upside. There is a likewise wide dispersion in impact, depending on the industry and the company's position within it. Section 4.3 addresses these findings in greater detail.

4.1: Across-sector impacts

Energy, non-energy materials, and utilities are the biggest contributors to overall results, collectively accounting for three-quarters of the total portfolio NPV impact. These are the most transition-sensitive sectors because they are engaged in emissions-intensive activities, generate a material proportion of their revenue from emissions-intensive products, or both. While these sectors make up less than 10% of the portfolio by value, they drive most of the modelled portfolio impact in the scenario as shown in **Figure 4**.

Figure 4: Sector contribution to portfolio NPV impact under the NGFS Divergent Net Zero scenario



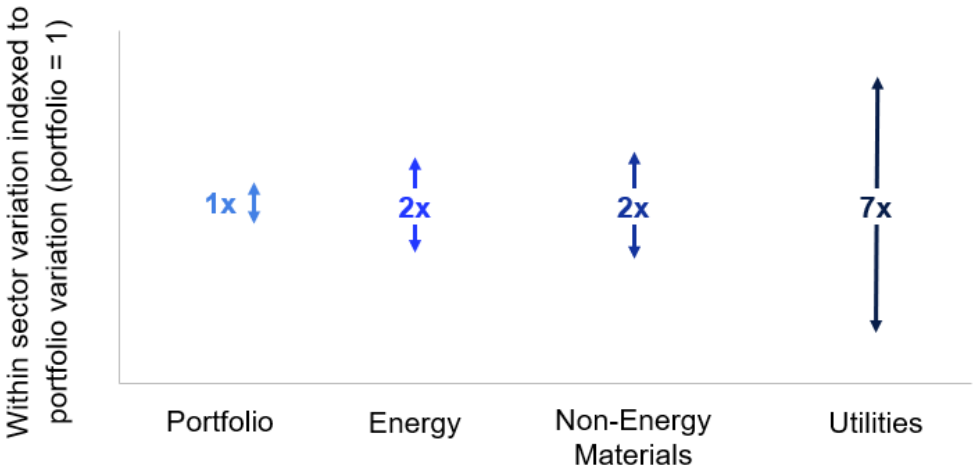
Source: Planetrics.

4.2: Within-sector impacts

Applying a bottom-up modelling approach finds material within-sector variation in the most transition-sensitive sectors in the example scenario. A company's relative emissions intensity and product mix shape its performance relative to its competitors. Higher carbon prices can amplify competitive pressures within a market as emissions-intensive firms see their costs increase faster than emissions-efficient competitors. Higher cost producers face the greatest potential cost pressures, while lower cost producers may gain market share and increase prices. Some firms might become unprofitable and exit the market, with benefits accruing to remaining firms. A company's product mix also matters. Companies with exposure to products and revenue streams that are expected to see greater demand in the net-zero transition (for instance, green minerals) may benefit, while those that generate revenues from emissions-intensive products and services are likely to experience declining

demand. As a result, within-sector variation is greatest in the climate-sensitive sectors as shown in **Figure 5**.

Figure 5: Within-sector variation is likely highest for the most transition-intensive sectors



Source: Planetrics.

In the modelled scenario, low-carbon utilities benefit more from direct carbon costs relative to high-carbon utilities. High- and low-carbon utilities[16] experience comparable levels of demand creation from the electrification of transport and heat in buildings. Differences in outcome between the two are driven by differences in emissions intensity: Utilities that generate electricity from renewables may experience minimal direct carbon cost increases, while utilities that produce power from gas and coal (370 and 760 gCO2e/kWh respectively[17]) could see higher direct carbon costs. In this scenario, the former may gain market share and benefit from higher profits due to rising electricity prices.

The energy and non-energy materials sectors also see greater within-sector variation in impacts than the

[16] High- and low-carbon utilities are defined as the top quartile most and least emissions intensive power utilities respectively.
[17] IPCC (2014). *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the IPCC.*

broader investment universe. Within the energy sector, the variation is caused by different stranding and margin impacts on upstream producers, which arise from declining demand for oil and gas in the NGFS Divergent Net Zero scenario. The company-specific combination of stranding and margin impacts reflects where a producer is positioned on the production cost curve. Higher cost producers are likely to be stranded first. The variation among downstream energy firms is influenced by the relative emissions intensity of refinery operations, with emissions-efficient refiners less exposed to rising carbon costs than the more emissions-intensive refiners in the scenario.

The non-energy materials sector is highly heterogenous and the variation in impacts is driven by the specific type of activity that companies are engaged in. For example, some companies, such as lithium and cobalt producers, experience increasing demand for their products (demand for lithium increases in line with demand for electric vehicles (EVs) and battery storage) in the scenario, while the most emissions-intensive steel, chemicals, and fertilizer manufactures may see an increase in their costs as carbon prices rise.

Companies that change their product mix or emissions intensity may be able to mitigate downside impacts and potentially benefit from the low-carbon transition. The results presented above are based on companies' current operations (such as emissions intensity) and revenues. However, many companies have set climate targets to change their emissions intensity or transform their businesses to benefit from anticipated growth in new low-carbon markets. The next section explores the financial impacts of companies that achieve their publicly announced climate targets.

4.3: Company targets

An increasing number of companies have publicly announced climate targets to reduce their environmental impact. This trend reflects increasing corporate awareness, shareholder, consumer, and employee pressure, as well as

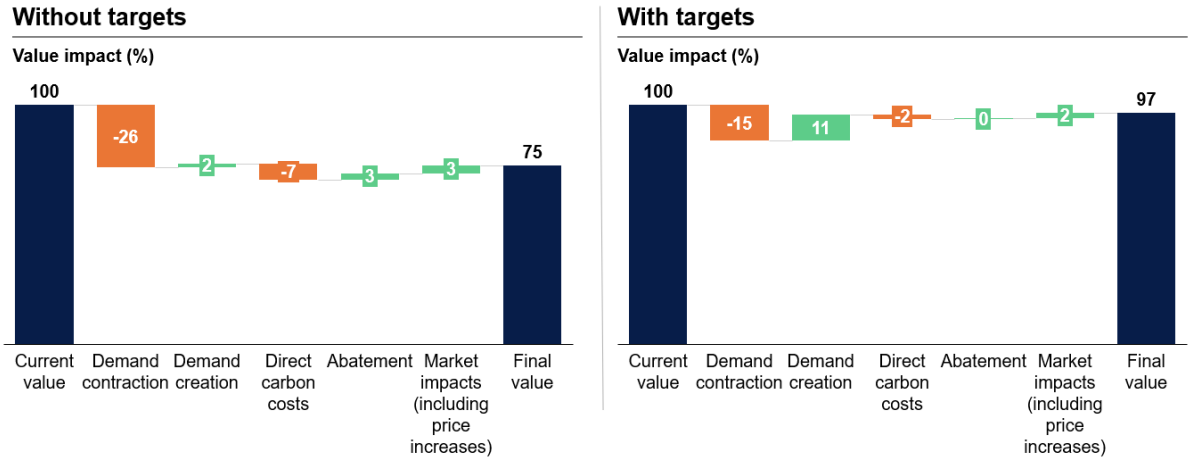
changes in government policy. The most common climate targets are emissions reduction targets, including, for instance, net-zero emissions by 2050 targets. However, it is becoming increasingly common for companies to also set revenue and product mix targets. Revenue targets could include, for example, a target to derive 50% of revenues from the sale of EVs by 2030. Both types of targets can materially change a company's exposure to transition-related risks and opportunities.

Bottom-up modelling can help assess the potential impacts of companies meeting their climate targets. Drawing on publicly announced company climate targets[18], it is possible to quantify the NPV impacts of companies meeting their targets. These results support investors in their assessment of whether the company's target covers its key climate risks and opportunities[19].

The example of an automotive original equipment manufacturer (OEM) helps to illustrate how bottom-up modelling can account for the impact of a company achieving publicly announced climate targets. The company presented in **Figure 6** is primarily exposed to declining demand for internal combustion engine (ICE) vehicles, and to a lesser extent, carbon pricing on its direct emissions. Its target covers both its product mix (EV/ICE sales split) and scope 1 and scope 2 emissions. Reducing revenues from ICE vehicles results in less demand contraction (-26% without targets to -15% with targets), while increasing EV sales leads to more demand creation (+2% without targets to +11% with targets). At the same time, meeting its decarbonisation target lowers direct carbon costs net of abatement (-4% without targets to -2% with targets). Market impacts are marginal with or without targets. The total impact of the OEM achieving its announced climate targets is a 22% value uplift in the NGFS Divergent Net Zero scenario.

[18] The analysis presented in this section draws on the Planetrics climate targets database.
[19] The company climate targets modelling approach does not make a judgment on target credibility; instead, the modelling assumes that the company achieves its stated climate targets at no additional cost. Targets apply to each company only and assumes that competitors do not transition; upside for companies from meeting targets will fall as rivals achieve their own targets. These results should be seen as upper bounds on the value uplifts from meeting climate targets.

Figure 6: Potential value impacts on an automotive OEM by channel, with or without climate targets



Source: Planetrics.

The modelling of company climate targets identifies four archetypes:

- **Additional upside:** Companies that may see positive NPV impacts from the transition, with or without climate targets. By already decarbonising their operations and products, this archetype could see material improvements in climate value impacts. For example, a low-carbon electric utility, which already benefits in the Divergent Net Zero scenario, may experience an additional value uplift in a scenario where it achieves its publicly announced climate target of generating 100% of electricity from renewable sources by 2030[20].
- **In transition:** These companies successfully reduce their emissions intensity or revenues from emissions-intensive products (or both), and in doing so, have the potential to transform their business to benefit from the net-zero transition. Such companies could see the largest value uplifts from meeting climate targets. NPV impacts for these companies are most sensitive to whether investors expect the company to achieve

[20] The examples included under each archetype are provided for illustrative purposes only and do not refer to actual companies.

its publicly announced climate target. For example, an integrated steel manufacturer, which experiences material direct carbon costs and associated downside value impacts under the Divergent Net Zero scenario, may receive a value uplift if it achieves its net-zero by 2050 target. Meeting the target supports the steel manufacturer in its efforts to reduce its carbon costs, improve its ability to increase prices, and gain market share from more emissions-intensive competitors.

- **Insufficient targets:** For these companies, targets may not be sufficient to fully offset transition impacts on their business. As a result, they may see a low to moderate amount of value uplift, even if they achieve their target. This archetype presents an engagement opportunity for investors: Once these companies have been identified, active stewardship becomes an important lever for investors to encourage these firms to consider setting or strengthening targets to mitigate their transition-related risks and capture upside value. For example, a multinational auto OEM with a 2030 EV sales target of 25% may be able to partially mitigate demand contraction impacts on their ICE business from rising EV sales. However, the EV sales target is insufficient in the NGFS Divergent Net Zero scenario to fully offset these impacts.
- **Demand contraction dominates:** Some companies are reducing their scope 1 and scope 2 emissions but continue to focus operations on producing emissions-intensive products. While these firms may see a value uplift from meeting their publicly announced operational emissions reduction targets, these cost savings might not offset stranding and margin impacts on their emissions-intensive goods and services. For example, in the NGFS Divergent Net Zero scenario, an oil and gas exploration and production (E&P) company with a target to reduce its scope 1 and scope 2 emissions intensity by 20% by 2025 reduces some of its carbon costs by meeting this target. However, the target does not reduce the primary risk to the E&P company, which is rising value impacts from demand contraction on oil and gas revenues.

Accounting for company targets can offer an informed view of the potential financial impacts of companies' plans to transform their operations and businesses. The ability to account for and quantify forward-looking changes in company emissions and revenue profiles is a key feature of the next generation of climate scenario models. These insights support investors in managing risks, performing due diligence, and conducting engagement activities, as detailed in the next section.

Future of climate scenario analysis

Future climate scenario analysis will likely increase model flexibility to support bespoke scenarios, enhance company target analysis, and leverage improved data. Bespoke scenarios and enhanced company target modelling enable investors to embed their own forward-looking views and research into climate scenario modelling, while improved data can increase the comprehensiveness of results and broaden the use of scenario analysis to more asset classes.

Investors are increasingly demanding bespoke scenarios. The most widely used scenarios today are publicly available scenarios that typically assume globally consistent climate policy across regions. Publicly available scenarios support stress-testing and risk functions, but do not typically explore conditions such as diverging climate policy across geographies. In response, investors are increasingly creating customised scenarios to embed their own forward-looking perspectives on policy and technology developments into scenario narratives and design. As a result, this approach can produce further actionable insights for investment teams.

As discussed in Section 4.3, it is becoming increasingly important to consider the impact of company climate targets, and their achievement or lack thereof, in scenario modelling. Many models rely on observed, present-day financial and environmental data to model future performance. However, as part of their transition strategies, many companies have announced a range of climate-related targets. Climate-related targets can fundamentally change how businesses operate and transform the risk-reward profile of an investment under future climate scenarios. The current generation of models supports this functionality, but the next generation is expected to enhance the methodologies used to assess the impact of these climate targets, including consideration of the costs and feasibility of targets.

Climate data continues to improve, and financial institutions are converging on a common set of metrics and emissions estimation methodologies.

Investors are working together to establish common frameworks for the reporting of financed emissions through, for example, the Partnership for Carbon Accounting Financials (PCAF). Investor engagement extends to unlisted assets, with industry initiatives such as the ESG Data Convergence Initiative developing a common approach to environmental, social and governance (ESG) data in private markets. More granular, higher-quality data, coupled with higher coverage, will likely lead to more comprehensive scenario analysis and modelling.

Taken together, these enhancements can create more robust, transparent, and flexible scenario modelling. The next generation of models could allow investors to have greater confidence in modelling results and generating more tangible and actionable insights. The ability to incorporate investors' views on how climate policy will develop and whether companies may meet their publicly announced climate targets can expand use cases as the analysis moves beyond reporting into risk management, investment decision-making, and engagement.

Investors can combine the next generation of transition risk modelling with enhanced physical risk and macroeconomic modelling for a holistic assessment of climate risks and opportunities. Physical risk modelling supports investors in their assessment of potential regional, sector-, company-, and asset-level impacts of increasing damages from extreme weather and productivity impacts on land, labour, and capital from rising temperatures. Macroeconomic modelling assesses how climate shocks ripple through the economy to help investors assess potential supply chain dynamics, sectoral linkages, and climate impacts on headline economic indicators, including GDP, inflation, and employment.

Potential investment applications and concluding remarks

Bottom-up climate scenario analysis supports investors in integrating climate change into their existing processes across multiple dimensions. Three key areas include:

- **Risk management:** The analysis enables investors to identify pockets of risks in the investment portfolio, where companies face material impacts under climate scenarios with a rapid and/or disorderly transition. Further due diligence can then be conducted on individual securities to understand the risk drivers of

potential value impairment and assess whether they can be mitigated by the company's transition strategy.

- **Identifying archetypes:** The analysis can help identify companies across sectors with a potential positive value uplift in transition scenarios. But even *within* sectors, where there is value impairment, the analysis helps to determine which companies might be less emissions-intensive or better positioned to thrive in a low-carbon economy, compared to their peers.
- **Engagement with portfolio companies:** Qualitative discussions with management on their climate targets and transition strategies can become more targeted, by drawing on the quantitative scenario analysis outputs to focus on the key drivers of potential value impairment.

Bottom-up scenario analysis offers a consistent framework for security-level analysis to support investors in managing climate risks and opportunities. Nevertheless, climate-related financial analysis is a nascent and evolving field, and GIC welcomes feedback from the investment community on how this analysis can be extended and improved.

Standard disclaimer

All information is provided for information purposes only. All information and data contained in this document is obtained by GIC, from sources believed by it to be accurate and reliable. Because of the possibility of human and mechanical error as well as other factors, however, such information and data is provided "as is" without warranty of any kind. No member of GIC nor their respective directors, officers, employees, partners or licensors make any claim, prediction, warranty or representation whatsoever, expressly or impliedly, either as to the accuracy, timeliness, completeness, merchantability of any information or of results to be obtained from the use of this document, including but not limited to the opinions, analysis, indexes, data and analytics, or the fitness or suitability of this document for any particular purpose to which it might be put. Any representation of historical data made available in this document is provided for information purposes only and is not a reliable indicator of future performance.

No responsibility or liability can be accepted by any member of GIC nor their respective directors, officers, employees, partners or licensors for (a) any loss or damage in whole or in part caused by, resulting from, or relating to any error (negligent or otherwise) or other circumstance involved in procuring, collecting, compiling, interpreting, analysing, editing, transcribing, transmitting, communicating or delivering any such information or data or from use of this document or links to this document or (b) any direct, indirect, special, consequential or incidental damages whatsoever, even if any member of the GIC is advised in advance of the possibility of such damages, resulting from the use of, or inability to use, such information.

No member of the GIC nor their respective directors, officers, employees, partners or licensors provide investment advice and nothing in this document should be taken as constituting financial or investment advice. No member of the GIC nor their respective directors, officers, employees, partners or licensors make any representation regarding the advisability of investing in any asset or whether such investment creates any legal or compliance risks for the investor. A decision to invest in any such asset should not be made in reliance on any information herein. Indexes cannot be invested in directly. Inclusion of an asset in an index is not a recommendation to buy, sell or hold that asset nor confirmation that any particular investor may lawfully buy, sell or hold the asset or an index containing the asset. The general information contained in this publication should not be acted upon without obtaining specific legal, tax, and investment advice from a licensed professional.

The information contained in this report should not be considered "research" as defined in recital 28 of the Commission Delegated Directive (EU) 2017/593 of 7 April 2016 supplementing Directive 2014/65/EU of the European Parliament and of the Council ("MiFID II") and is provided for no fee.

This document may contain forward-looking assessments. These are based upon a number of assumptions concerning future conditions that ultimately may prove to be inaccurate. Such forward-looking assessments are subject to risks and uncertainties and may be affected by various factors that may cause actual results to differ materially. No member of GIC nor their licensors assume any duty to and do not undertake to update forward-looking assessments.

No part of this information may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without prior written permission of GIC. Use and distribution of the GIC data requires a licence from GIC and/or their respective licensors.

Planetrics, a McKinsey solution, is not an investment adviser and makes no representation regarding the advisability of investing in any particular company, investment fund or other vehicle. A decision to invest in any such investment fund or other entity should not be made in reliance on any of the statements set forth in this document. Planetrics shall not be liable for any claims or losses of any nature in connection with information contained in this document, including but not limited to, lost profits or punitive or consequential damages.

This document provides general information only, based on hypothetical future scenarios. The information used to compile this report has been collected from a number of sources, and some of its content may be proprietary. The information is not intended as financial advice. The opinions presented herein constitute a judgment as at the date indicated and are subject to change without notice. The information may not be accurate or up-to-date.

This work is independent, reflects the views of the authors, and has not been influenced by any business, government, or other institution.

@gicsg

@gic

www.gic.com.sg

ThinkSpace

We explore topics of long-term importance that shape our perspectives.

Get our latest insights in your inbox monthly. To subscribe, visit www.gic.com.sg/thinkspace