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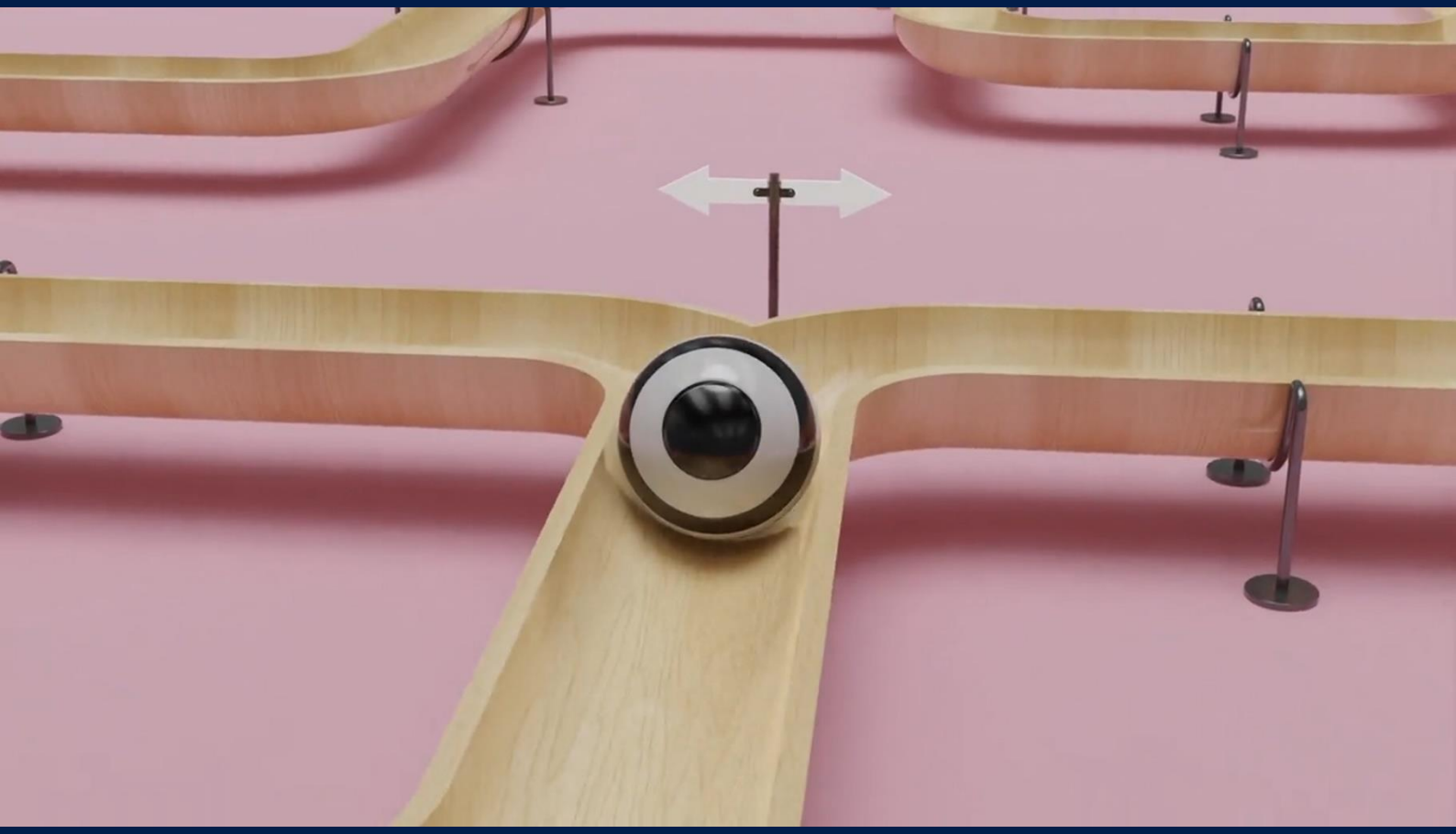

The GIC Climate Signposts:

An Investor Tool for Navigating an Uncertain Future

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Executive summary

- The GIC Climate Signposts (GCS) were developed to enable a holistic and balanced appraisal of the relative likelihoods of key climate scenarios.
- "Too Little Too Late" is the marginally predominant scenario currently. However, the GCS also points to high climate scenario uncertainty, elevated transition and physical risks, and disruptive change on the horizon. We have made progress over the last three years, but the current level of climate action is insufficient to achieve a 1.5ºC outcome.
- Investors must manage their portfolios nimbly and optimise for a range of climate outcomes. They should address both transition and physical risks in their investment due diligence and prepare to navigate heightened market volatility as more policy actions trail burgeoning policy commitments.

Introduction

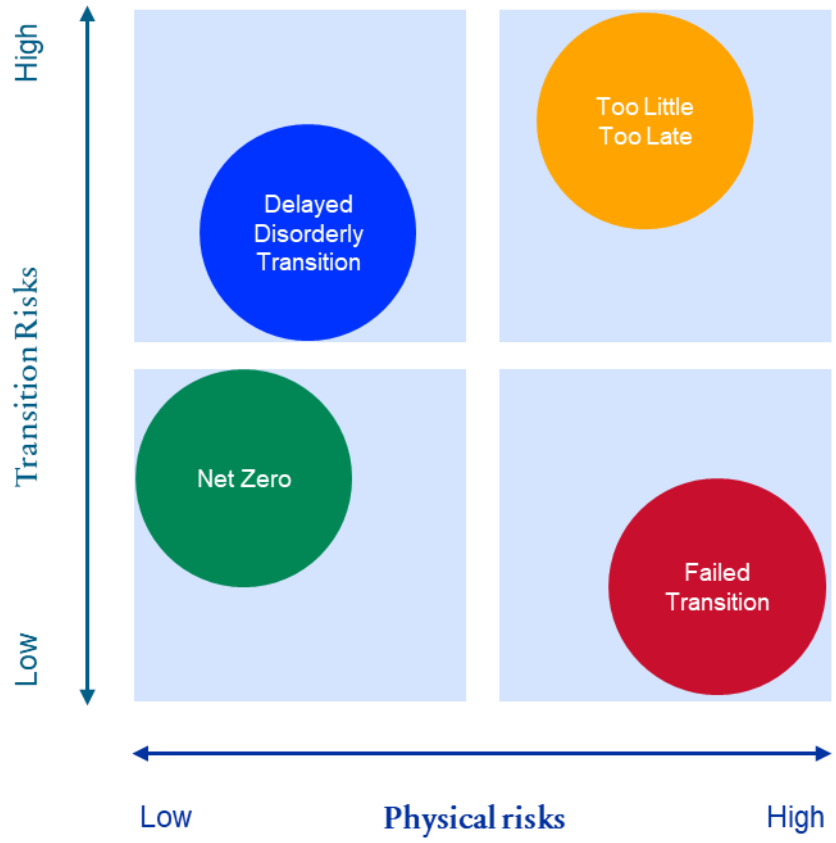
Climate issues are complex, multi-faceted and fast-evolving. GIC has established that climate change affects asset returns through three channels: physical risks, transition risks, and market risks. Significant uncertainty surrounds these risk drivers, and climate scenario analysis helps us understand their possible pathways.[1] We used a combination of approaches, both top-down and bottom-up, to examine the range of impacts on investment portfolios and to identify critical pockets of risk.

Alongside climate scenario analysis, forming a view on the relative likelihoods of the climate scenarios is important for nimbly managing our investment portfolio and bolstering its resilience across different future plausible states of the world. This task, however, is complicated by dissenting views among experts in different domains.

[1] See top-down analysis from GIC and Ortec Finance's climate scenarios. GIC (2023). *Integrating Climate Scenario Analysis into Investment Management: A 2023 Update*.

To reconcile competing expert opinions, various investment organisations[2,3,4] have developed tools to track the progress of the climate transition and navigate uncertainties surrounding it. At GIC, we have developed the GIC Climate Signposts (GCS) to provide a holistic and balanced appraisal of the likelihood of GIC's four main climate scenarios: Net Zero (NZ), Delayed Disorderly Transition (DDT), Too Little Too Late (TLTL), and Failed Transition (FT). Figure 1 illustrates where these climate scenarios reside on the spectra of physical risks and transition risks.

Figure 1: Physical vs transition risk impacts in GIC's climate scenario set



Source: GIC, Ortec Finance

[2] A 3.3ºC aggregate implied temperature rise as of Mar 2023, according to Schroder's tool which compares projections made by international organisations to estimate the temperature change. Schroders (2023). *Climate Progress Dashboard*.
[3] A disorderly transition is still the most likely scenario according to Fidelity. Fidelity (2023). *Tracking Net Zero Progress: Too Little, Not Too Late*.
[4] There was significant acceleration in the transition in its latest reading as of end-2021, from a year prior. However, this remains insufficient to achieve a below 2ºC warming outcome. ABP (2022). *Inseplen op kimaatrisico's en - kansen*.

The GCS uses a range of indicators covering four dimensions: countries, businesses, technology, and the physical environment. They include indicators of the future and present, of words and deeds, and across key stakeholders and drivers of decarbonisation. Figure 2 provides an overview of the indicators used in the climate signposts. See Appendix A for more details on the methodology.

Figure 2: Overview of the GIC Climate Signpost indicators across four dimensions

Source: GIC

Findings

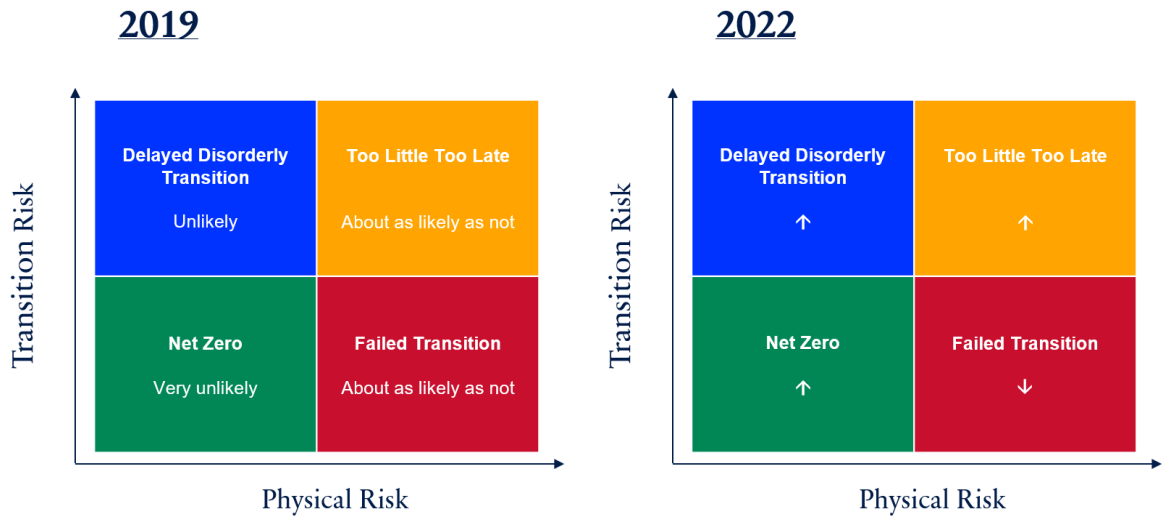
The present scenario probabilities in descending order are: Too Little Too Late,[5] Failed Transition, Delayed Disorderly Transition, and Net Zero.

The GCS indicates progress towards a successful transition, defined as keeping global warming below 2ºC by 2100, being

[5] Current policies in place are projected to result in global warming of 2.8ºC over the twenty-first century, which is consistent with GCS showing the predominant scenario as being TLTL, where the temperature outcome is between 2-3ºC. UNEP (2022). *Emissions Gap Report 2022: The Closing Window*.

made over the last three years. The best (Net Zero) and worst (Failed Transition) outcome improved and declined in likelihood, respectively[6] (See Figure 3). This is because of a rise in net-zero pledges by governments and businesses,[7] improved public awareness of the urgency of climate action[8] and increased investments in the solutions required to accelerate the green transition.[9]

Figure 3: Climate scenario probabilities in 2019 vs 2022



Source: GIC calculations based on data from BloombergNEF, Cambridge Econometrics, Climate Action Tracker, the Climate Change Performance Index Report, the Global CSS Institute, Google Trends, the IEA, McKinsey, MSCI, NGFS, Ortec Finance, S&P Trucost, etc.

Three key insights from the GCS and their investor implications:

- **High degree of climate scenario uncertainty**[10,11]: No climate scenario has more than 50% probability. However, none can be completely ruled out either.

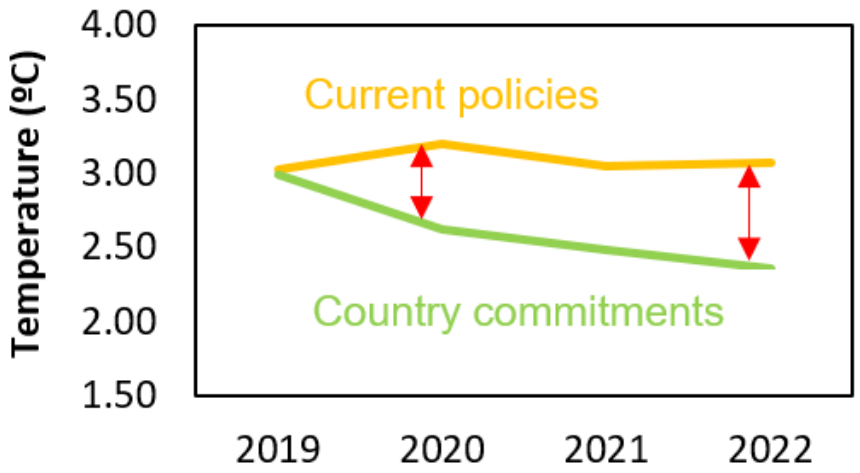
[6] The likelihood description follows the United Nations Intergovernmental Panel for Climate Change's (UN IPCC) language guidance on describing uncertainty. See Appendix B for more details.
[7] Long-term low-emission development strategies by countries currently cover 83% of global GDP, 68% of greenhouse gas emissions and 69% of total energy consumption. UNFCC (2022). *Long-term low-emission development strategies*.
[8] Public sentiment is measured using the five-year popularity trend of search terms that reflect climate consciousness or climate advocacy.
[9] EV sales doubled between 2020 and 2021, while the number of electric cars on the road tripled between 2018 and 2021, aided by extensive policy incentives to electrify transport as well as the proliferation of EV brands in the market. Investments in energy efficiency and other end uses grew by approximately one-quarter between 2020 and 2022. IEA (2022). *Global EV Outlook 2022*.; IEA (2022). *World Energy Investment 2022*.
[10]The view that the Net Zero scenario has the lowest probability is shared by the scientific community. 16 out of 24 Dutch scientists surveyed opined that limiting global warming to well below 2ºC was not possible. NOS (2022). *Klimaatwetenschappers: beperken opwarming aarde gaat mislukken.*
[11]The IPCC AR6 WG III Summary for Policymakers notes that "Global GHG emissions in 2030 associated with the implementation of nationally determined contributions (NDCs) announced prior to COP26 would make it **likely** that warming will exceed 1.5°C during the 21st century". Based on IPCC's guidance on language regarding uncertainty (see Annex B), this implies that a 1.5ºC outcome has a 0% to 34% chance of occurring. IPCC (2022). *Climate Change 2022: Mitigation of Climate Change: Summary for Policymakers*.

Investors who optimise their portfolio for a single scenario risk getting blindsided.

- **Elevated transition and physical risks**: Scenarios with high physical risks are "Likely" and those with high transition risks are "As Likely As Not".[12] Investors cannot only focus on managing transition risks – addressing physical risks is equally important.
- **Climate progress disguises disruptive change on the horizon**: The fall in probability of the worst-case scenario, a Failed Transition, over the last three years is driven in part by strengthening country commitments, which can be a leading indicator of future action.

There is a **widening gap between countries' words and deeds** as countries appear to accelerate their commitments even as actual policymaking lags behind (Figure 4). Any rapid closing of the widening gap could precipitate disruptive change. Investors must prepare to navigate **heightened volatility** when stronger climate actions materialise.

Figure 4: Gap between current policies and commitments of countries



Source: GIC calculations based on data from Climate Action Tracker and the Climate Change Performance Index Report.

[12] Scenarios representing high physical risks refer to TLTL and FT as the global temperature outcomes by 2100 are above 2ºC. Scenarios representing high transition risks include DDT and TLTL as there are significant climate-related transition policies implemented in these scenarios to achieve global temperature outcomes below 2ºC by 2100.

Conclusion

The GCS enables GIC and our peers to think beyond binary outcomes of whether the world is on track to meet the climate goals set by the Paris Agreement, by allowing for a more nuanced probability assessment. This provides a useful reference point as we work towards strengthening the integration of climate risks in our portfolios, whether through more in-depth due diligence on physical risks or by accounting for transition risks through carbon price stress tests and/or climate value-at-risk analyses.[13]

The GCS probabilities provide an outlook based on the state of the world today. Too Little Too Late is the marginally predominant scenario at this time, although encouragingly the Failed Transition probability has declined considerably thanks to country and industry commitments and policies. We anticipate further changes ahead, although the future is uncertain. Given the non-zero probabilities of all four climate scenarios and the fact that they will continue to change, investors should manage their portfolios nimbly and optimise for a range of climate outcomes.

Importantly, climate risk integration must be carried out at both the top-down and bottom-up levels to gain a holistic and nuanced view of a portfolio's climate risks and investee companies' climate resilience plans. Bottom-up strategies must also prepare for the economic volatility that might result from a potential disruptive transition that is increasingly more likely to unfold.

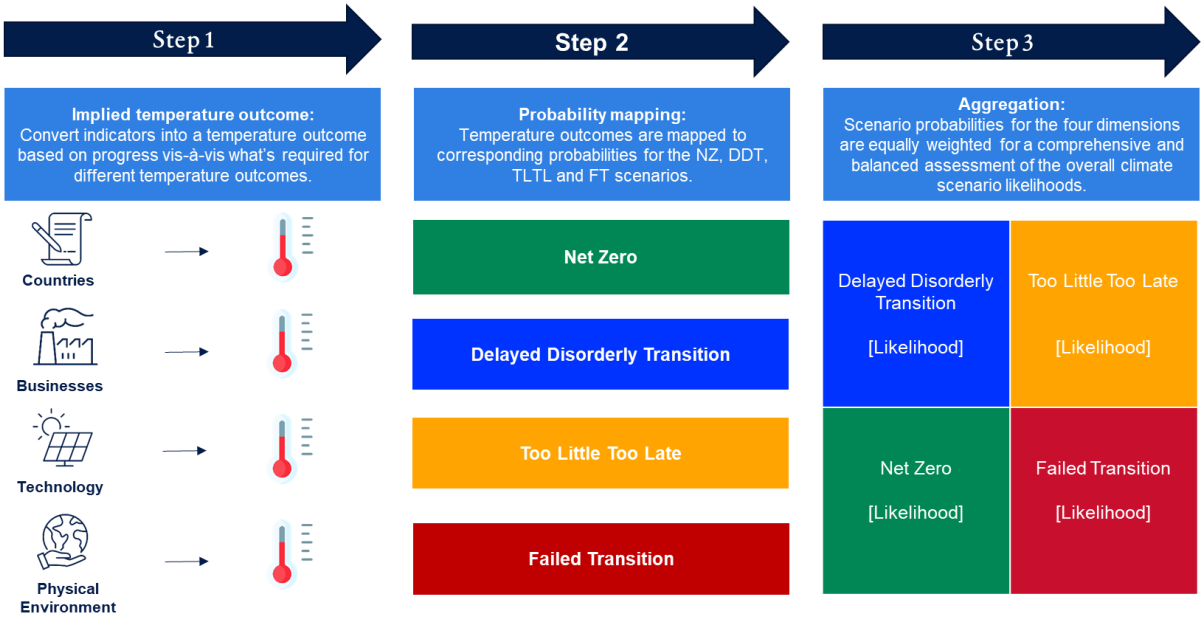
As with other climate-related analytics, the GCS is an evolving tool, and we welcome feedback from the investment community on improving it.[14]

[13] See "GIC (2022). *Carbon Earnings-at-risk Scenario Analysis*." and our upcoming publication, "Climate Value at Risk Analysis" for more details on the bottom-up analysis.
[14] Potential improvements for the future include complementing the technology indicators with more nascent solutions such as direct air capture or nuclear fusion, and expanding the physical risk measures with metrics such as the level of Arctic ice melt, permafrost thaw or sea level rise when data sets for benchmarking them will become available.

Appendix A

We employ a three-step process to convert a range of indicators across the four dimensions of countries, businesses, technology, and the physical environment into useful climate signposts:

Figure A1: Overview of the 3-step methodology



Source: GIC, Ortec Finance

Step 1: Implied temperature outcome

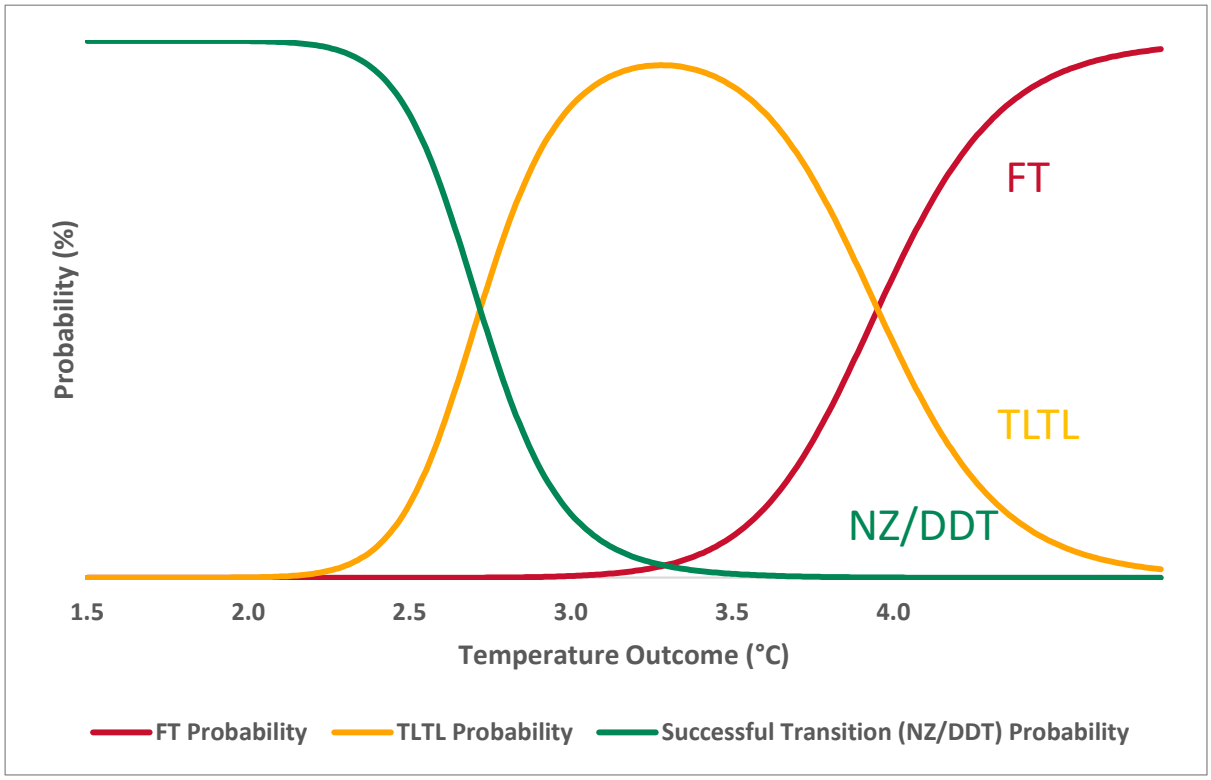
- For each indicator, we derive a temperature outcome that's calculated with reference to the emission scenarios and temperature pathways laid out by the Intergovernmental Panel on Climate Change (IPCC),[15] and data sets from the Network for Greening the Financial System (NGFS), and Ortec Finance.
- For example, if our indicators demonstrate that the levelised cost of electricity (LCOE)[16] for wind has reached sufficiently low levels for a successful net-zero pathway, the temperature outcome attributed to that indicator would be 1.5°C.

[15] IPCC (2021). *Climate Change 2021: The Physical Science Basis*.
[16] LCOE refers to the total lifetime costs divided by the electricity produced for a particular generation technology and hence provides a measure to compare the economics of different energy sources such as wind, solar, oil and gas, amongst others.

Step 2: Probability mapping of climate scenarios

- We then map each indicator's temperature outcome to a probability score for each of the climate scenarios. The probability scores are based on scenario probability distributions adapted from the IPCC AR6 database. For example, if an indicator's temperature outcome is approximately 3.9°C, the probability for a successful transition (either a Net Zero (NZ) or Delayed Disorderly Transition (DDT)) is close to 0%, a Too Little Too Late (TLTL) scenario is around ~10%, and ~90% for a Failed Transition (FT) (Figure A2).

Figure A2: Relative probability distribution function climate scenarios mapped to implied temperature outcome



Source: GIC calculations based on data from BloombergNEF, Cambridge Econometrics, Climate Action Tracker, the Climate Change Performance Index Report, the Global CSS Institute, Google Trends, the IEA, McKinsey, MSCI, NGFS, Ortec Finance, S&P Trucost, etc.

- We then use an additional set of transition gap indicators to assess the degree of disruption caused by the transition to allocate the probabilities of a successful transition between NZ and DDT. The transition gap indicators distinguish between a NZ and a DDT scenario based on the likely timing of climate policies, the subsequent level of physical and transition risks, and their impact on markets. Both these scenarios involve a

successful transition and global warming is kept below the Paris temperature goal of 2°C. However, in the NZ scenario, markets price in the transition smoothly, while DDT sees a sharp and abrupt pricing-in of elevated transition risks, resulting in a sentiment shock.

- The transition gap indicators include:
    - The gap between country or business commitments and actual policies or actions introduced to implement these targets;
    - The proportion of countries and companies who have set emission targets;
    - The gap between country versus business commitments;
    - The pace of technological deployment and level of investments in energy efficiency.

Step 3: Aggregation

- Once we have created probability scores for all the indicators, we first aggregate them by dimension, attributing an equal weight to each indicator. Finally, using equal weightage, we aggregate all four dimensions to produce the overall climate scenario probabilities.

Appendix B

The table below is the UN IPCC's guidance on the language used in describing uncertainty bands, which we apply in describing the relative likelihoods of the climate scenarios in the GCS.

Figure B1: Likelihood scale

Term	Likelihood of the Outcome
Virtually certain	99-100% probability
Very likely	90-100% probability
Likely	66-100% probability
About as likely as not	33-66% probability
Unlikely	0-33% probability
Very unlikely	0-10% probability
Exceptionally unlikely	0-1% probability

Source: UN IPCC

Appendix C: Overview of implied temperature outcomes by

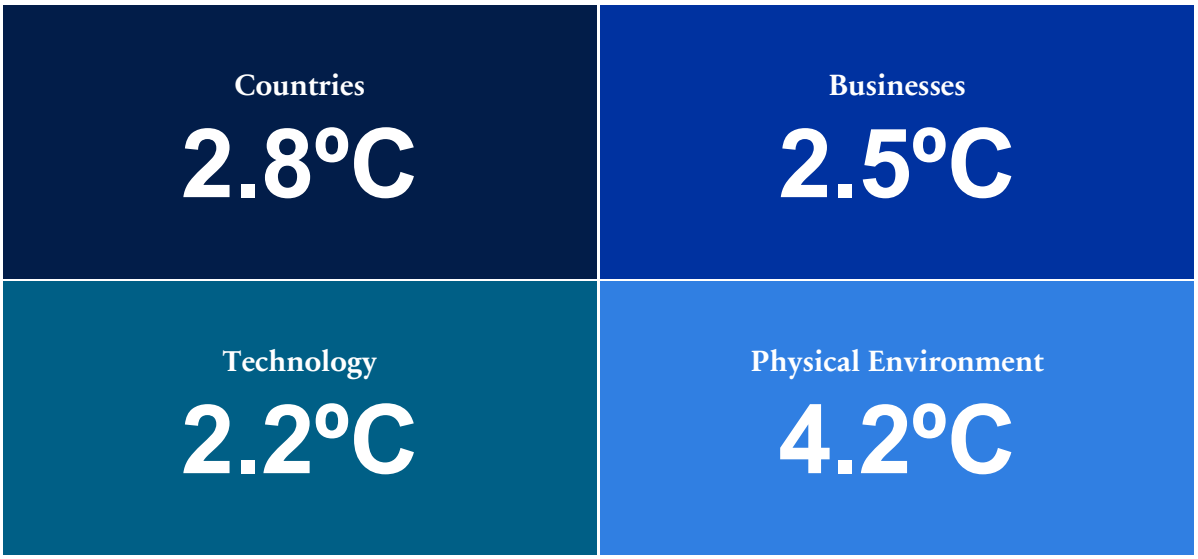
Beyond the headline scenario probabilities, Figure C1 outlines the implied temperature outcomes of the four GCS dimensions. Technology is progressing the fastest. Actual deployment of low-carbon technology is gathering pace, driven in part by more competitive costs relative to fossil fuels.

Businesses are making significant progress as companies announce stronger climate commitments. It remains to be seen if they can follow through with actual actions. Risks of implementation delays and backtracking are non-trivial.

Countries are lagging businesses in their decarbonisation commitments and actions, but they have the largest influence on effecting change. Climate ambition has increased globally, and policies are gradually catching up. Significant changes have occurred in the last two years, and it is likely that more are on the horizon, as public pressure ratchets up.

The key challenge though is that physical emissions have not fallen, and our carbon budget is running out. This raises physical risks and increases pressure for stronger climate actions that could be disruptive for the economy and markets.

Figure C1: Implied temperature outcomes by dimension in 2022



Source: GIC

Appendix D

Figure D1: Overview of GIC's climate scenarios

Drivers	Net Zero (NZ)	Delayed Disorderly Transition (DDT)	Too Little Too Late (TLTL)	Failed Transition (FT)
Global warming outcome	1.5ºC	Below 2ºC	2-3ºC	~4ºC
Net-zero emissions year	2050	2070	Not reached within 2100	Not reached within 2100
Extreme weather shock	No sudden surges in extreme weather events (EWEs)	Surge in EWEs in 2030	A series of EWEs shocks in the 2030s with each shock having a larger impact than the previous shock	EWEs rise in frequency and severity over time as temperatures rise
Policy and technology	Early policy action and adoption of low-carbon technologies	Delayed and sudden policy action to push adoption of low-carbon technologies	Delayed and cascading policy intensity with escalating impacts resulting in multiple abrupt policy changes to decarbonise the economy in the 2030s	Only current policy measures and technologies are implemented
Market pricing-in risk	Transition and physical risks priced in smoothly between 2022-25	Sharp pricing in of physical and transition impacts within a short period of time	Successively sharper pricing in of physical and transition risks over 2030s	Only physical risks are priced in and are more severe than in other scenarios
Sentiment shock	None	Large sentiment shock triggered by sudden policy action	Sentiment shocks corresponding with policy actions	None

Source: GIC, Ortec Finance

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