The Missing Middle: The Most Likely Climate Scenario the World is Tracking

The future the world is actually tracking sits between the two scenarios everyone models

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Executive Summary

Every institutional climate model starts from a choice of scenario. Overwhelmingly, that choice is one of two extremes: a 1.5°C world of rapid decarbonization, or a 4°C hot-house world of runaway emissions. These are the scenarios regulators ask for, and they are the scenarios that fill most stress tests and disclosure reports.

There is a growing and correct intuition across the climate and investment community that neither of these worlds is likely to happen. What has been missing is a defensible answer to the obvious next question: if not the tails, then what? Which future is the world actually tracking today?

> Today's data looks most like a world of patchy, partial climate policy, not the clean-energy triumph, and not the hot-house collapse.

This paper answers that question. Rather than betting on a single scenario, we let the real-world emissions record run forward many thousands of ways and measure which standard scenarios it most resembles, comparing them on cumulative carbon, the quantity that actually drives warming, rather than on any single year or temperature label. The result is a single, probability-weighted pathway we call the 'Emmi most-likely scenario'.

On this basis, annual fossil CO_2 falls from 38.1 $GtCO_2$ in 2025 to 27.5 $GtCO_2$ by 2050. That path lies above every 1.5°C- and 2°C-aligned scenario, implying a most likely warming of 2.3°C by 2100, with a likely range of 1.7°C to 2.9°C. Both the Paris target and the 4°C hot-house sit outside that range at close to zero probability.

For a risk officer meeting disclosure obligations, the tails remain the job; that is what regulation prescribes. But for anyone making an investment decision, the expected world is the one that matters, and it is knowable. This paper explains the difference and why using regulatory tail scenarios to make investment decisions leads investors to misprice climate risk in both directions.

> 2.3°C, the most likely warming by 2100. Both the 1.5°C Paris target and the 4°C hot-house sit at close to zero probability."

Contents

Everyone is modeling the two futures least likely to happen

Ask most institutions which climate scenario they use, and the honest answer is that they use the ones they were handed. Regulatory frameworks are prescriptive: they ask firms to test their exposure under a small number of fixed scenarios, almost always anchored on a Paris-aligned 1.5°C pathway at one end and a high-warming world at the other. This is entirely appropriate for its purpose, but it has quietly become the default lens for climate thinking, including decisions the framework was never designed to inform.

The problem is that these two anchors are the least likely points on the entire distribution of possible futures. The 1.5°C pathway would require cutting global emissions roughly in half within 25 years, a trajectory nothing in the observed record supports. The 4°C hot-house requires emissions to keep climbing through 2050, which runs against the structural decoupling of growth from carbon now visible across most major economies.

This leaves a gap that clients increasingly raise with us directly: they know the tails are unlikely, but they do not feel equipped to nominate a credible central case of their own. Picking a scenario off a chart feels arbitrary; building one in-house feels like it invites accusations of bias. So the tails get used by default, not because anyone believes them, but because they are the only options on the table.

> Both are real stress tests. Neither is a forecast.

> “Everyone models the two futures least likely to happen.”

A probability, not a pick

Emmi's approach is built to close that gap without asking anyone to simply trust a hunch. The principle is straightforward, even though the machinery behind it is not: instead of choosing one scenario and defending it, we estimate how probable each scenario is, given what the emissions record is actually doing, and then blend them in proportion to those probabilities.

Three design choices make the result credible rather than merely another opinion:

- We compare scenarios on cumulative carbon, the running total of emissions over 2000 to 2050, not on a single year. A single year of emissions is noisy: it swings with weather, the economic cycle, and later data revisions. The cumulative total is stable and is also the quantity that physics tells us determines warming.
- We anchor everything on the observed record. The forecast is calibrated on decades of measured emissions rather than on assumptions about future policy, technology, or population. It answers the question 'where does the current trajectory lead?' rather than 'what would we like to happen?'
- We use a broad library of standard scenarios: the main IPCC (SR1.5 and AR6) and NGFS families, alongside the widely-used IPR pathway, rather than a favorite. Each receives a probability; none in the set is discarded. The scenarios that dominate most reports simply receive very little weight.

What is cumulative carbon?

Cumulative carbon is the running total of CO_2 emitted over a period, here, 2000 to 2050, rather than the amount emitted in any single year. It matters because the physics is clear on this point: how much the world warms depends on the total quantity of carbon added to the atmosphere, not on the emissions of any one year. A single year is also noisy, swinging with weather, the economic cycle and later data revisions, while the cumulative total is stable. We therefore compare scenarios on cumulative carbon and treat annual emissions and warming as consequences of it.

We publish the full distribution below rather than just the headline. That openness is deliberate: the probabilities are the result, and they should be open to scrutiny. What stays proprietary is the method that produces them, how the forecast ensemble is constructed and how each trajectory is assigned to a scenario. That is the core of what Emmi does. The logic is transparent: run the world forward from the observed record and see which scenarios it clusters around, even though the internals are not.

The world is tracking a world of patchy policy

When we do this, the probability mass does not spread evenly, and it does not land on the tails. It concentrates overwhelmingly on the middle of the distribution, a world of partial, fragmented climate action. A single scenario, the NGFS Fragmented World, carries more than 70% of the weight on its own: more than all eighteen other scenarios in the library combined.

> “70.6% of the world’s likely emissions future sits in a single scenario, fragmented, partial climate policy, more than all eighteen others combined.

The world’s emissions future, weighted by probability

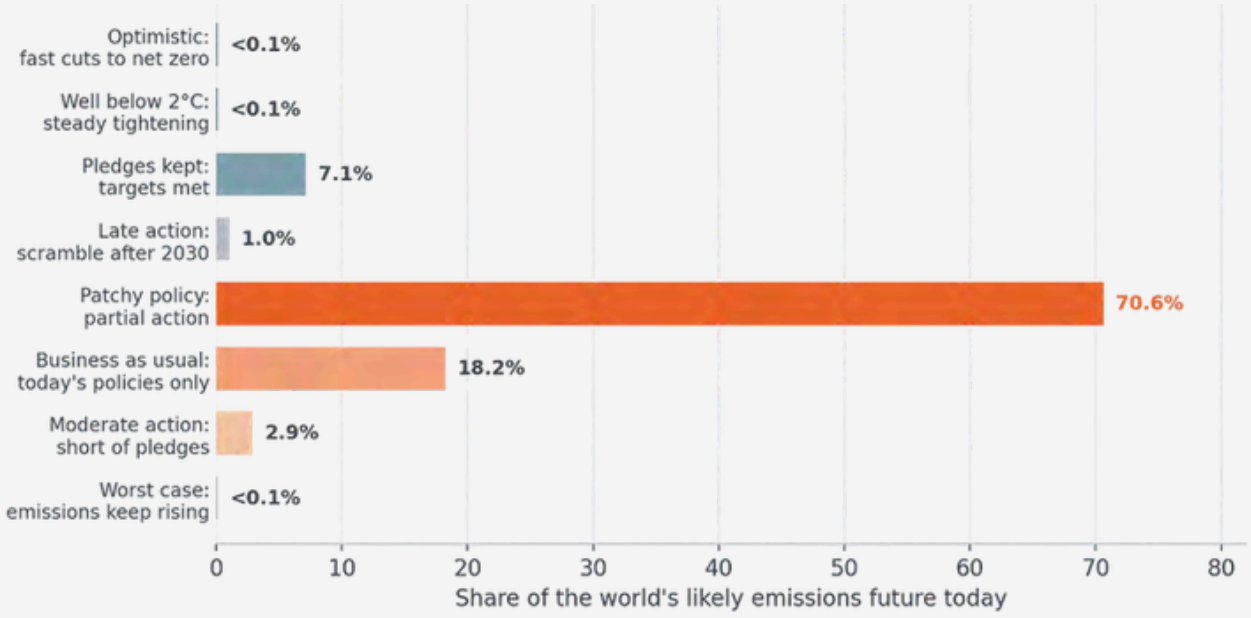


Figure 1. The standard scenario library, grouped into plain-language buckets and weighted by how much of the world's likely emissions future each captures today. Plain labels are an interpretive aid; each maps to standard IPCC / NGFS scenarios.

Read in plain language, the picture is stark. The optimistic and worst-case ends of the spectrum, the two regions where most institutional modeling actually sits, together hold a fraction of a per cent of the probability. Almost the entire distribution falls between 'pledges kept' and 'today's policies only.'

Table 1. The scenario spectrum ranges from fastest cuts to rising emissions, with the probability weight in each bucket today.

Scenario	What it means	Probability today
Optimistic: fast cuts to net zero	Aggressive decarbonisation, the clean-energy success story (1.5°C-aligned).	<0.1%
Well below 2°C: steady tightening	Policy ramps up steadily and holds warming comfortably under 2°C.	<0.1%
Pledges kept: targets met	The world delivers on its current stated commitments.	7.1%
Late action: scramble after 2030	Little happens now, then an abrupt, costly catch-up.	1.0%
Patchy policy: partial action	A fragmented world of half-measures, where today's data points.	70.6%
Business as usual: today's policies only	No new climate action beyond what is already in force.	18.2%
Moderate action	Some tightening, but short of stated pledges.	2.9%
Worst case: emissions keep rising	No course correction; emissions climb through 2050.	<0.1%

These are the full weights, not a selection: they sum to 100% across the entire library, and the two extremes that anchor most stress tests, fast cuts to net zero and the rising-emissions worst case, together hold under 0.2% of it.

> **<0.2%...** the combined probability of the two extremes that anchor most climate stress tests."

One pathway, weighted by probability

Blending the scenarios by their probabilities produces a single central pathway. It is deliberately not the same as simply picking the most probable scenario and stopping there. Because we retain the weight on the higher-emitting worlds rather than discarding them, the blended path sits slightly above the single modal scenario, a reminder that the residual probability on 'business as usual' pulls the expected outcome upward, exactly as accounting for risk should.

The headline figures are simple to state. Annual fossil CO_2 declines from 38.1 $GtCO_2$ in 2025 to 27.5 $GtCO_2$ by 2050. This is above every 1.5°C- and 2°C-aligned pathway. It is a world where emissions are clearly past their peak and falling, but nowhere near fast enough to meet the targets that anchor most disclosure reports.

Why the expected case sits above the single most likely scenario.

It seems intuitive that a 'most likely' pathway should just be the single most probable scenario. It isn't, and the difference matters. Because we keep some weight on the higher-emitting worlds rather than discarding them, the small chance of a worse outcome lifts the average, so the blended path sits a little above the single most probable scenario, exactly as accounting for risk should. It is the same logic as an expected value in any financial model: you weight every outcome by its probability rather than betting on the single likeliest one. The two only converge if one scenario becomes a near-certainty.

Where the world is actually heading, versus the tails everyone models

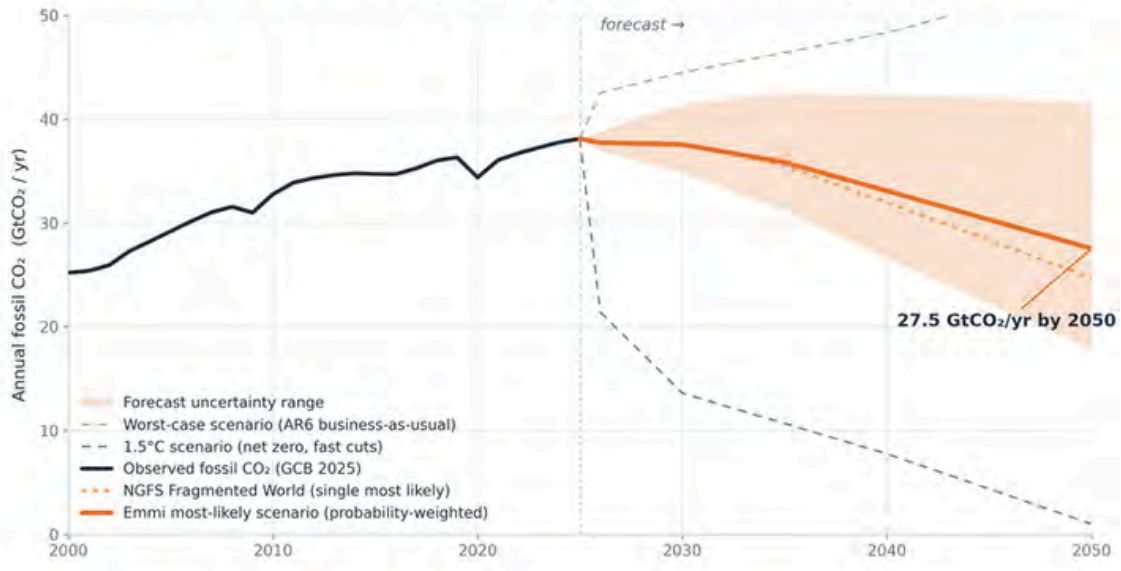


Figure 2. The Emmi most-likely scenario against the tails that dominate most climate stress tests. The probability-weighted path reaches 27.5 $GtCO_2$/yr by 2050, well inside the space the tails leave empty.

What it means for warming: 2.3°C

Cumulative carbon maps directly onto temperature. Based on the IPCC's own calibrated climate sensitivity, the most likely pathway implies a warming of 2.3°C above pre-industrial by 2100, with a likely range of 1.7 to 2.9°C.

The warming the data actually points to

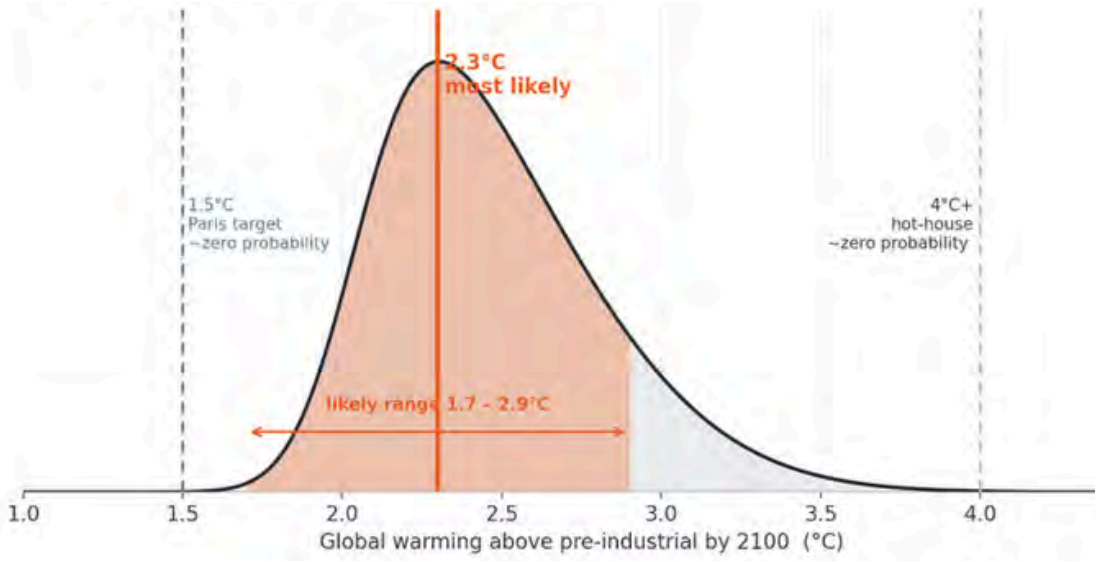


Figure 3. The warming distribution implied by the observed-and-forecast record. The 1.5°C Paris target and the 4°C+ hot-house both sit outside the likely range, at close to zero probability.

This deserves to be read carefully in both directions. 2.3°C is not a benign outcome. It implies serious and costly climate disruption, and on current evidence, it puts the 1.5°C target already out of reach. But it is also a long way from the 4-to-6°C existential trajectories that looked plausible two decades ago. Using a 4°C central case when the evidence points to 2.3°C miscalibrates physical and transition risk alike; it simply overstates in the opposite direction to a 1.5°C assumption.

The tails aren't wrong; they're just not the whole picture

It would be easy to read all this as an argument against the scenarios regulators prescribe. It is not. The distinction that matters, and the one most often blurred, is between reporting and investing.

Mandatory climate disclosure is, at its heart, a stress test. It asks a deliberately prescriptive question: 'What are the material risks to this business under these specified scenarios, including ones we do not expect to occur?' That is a feature, not a flaw. The point of stress-testing a portfolio against a 4°C world is precisely to understand exposure at the boundary, whether or not that boundary is likely. For this purpose, you do not need, and arguably should not use, a most-likely scenario. You take the prescribed pathways, apply them, and report. Introducing your own view of what is probable only invites the perception of bias into what should be a clean piece of compliance.

> Materially managing a risk and materially reporting a risk are two different jobs. The tails answer the second. The expected world answers the first.

Investment decisions run on the opposite logic. An investment view is built on expected outcomes, the range of things that might happen, each weighted by how likely it is. Judging a company solely against a 1.5°C world can make a perfectly sound business look uninvestable, throwing up risk signals that would trigger divestment. Run that same company against the world we are actually tracking, and the picture often changes: real risk, yes, but manageable risk, the kind investors are paid to hold and manage rather than avoid.

> A most-likely scenario is what lets an investor tell those two situations apart.

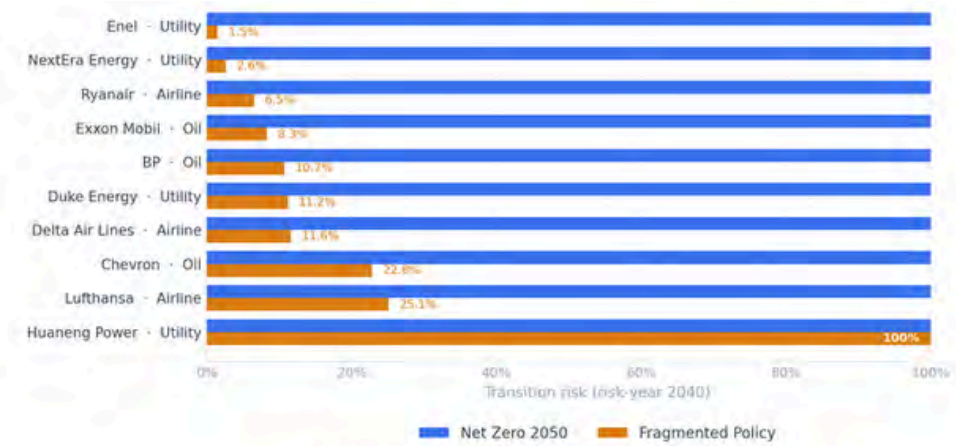
This is why the two exercises belong in separate boxes. A firm can, and in our view should, continue to report against the prescribed tail scenarios for compliance, while running an expected-scenario analysis internally to inform how it actually allocates capital and manages risk. The tail tells you where the danger lives; the expected case tells you whether, and how, to act on it. The most-likely scenario is not a replacement for the tails. It is the piece the tails were never meant to provide.

From claim to number: what changes when you swap the scenario

The argument so far has been qualitative: a sound company can look uninvestable under a 1.5°C screen yet manageable under the world we are actually tracking. It is worth seeing that in numbers, because the size of the effect may be unexpected. To make the contrast concrete, we compare transition risk under a 1.5°C-aligned pathway (NGFS Net Zero 2050) against a fragmented-policy world (NGFS Fragmented World).

Transition risk by segment - NGFS Net Zero 2050 vs Fragmented World

Source: Emmi - FY2024 model, risk year 2040, transition risk 0-100%



Transition risk by risk-year (%) — Net Zero (NZ) vs Fragmented (FR)

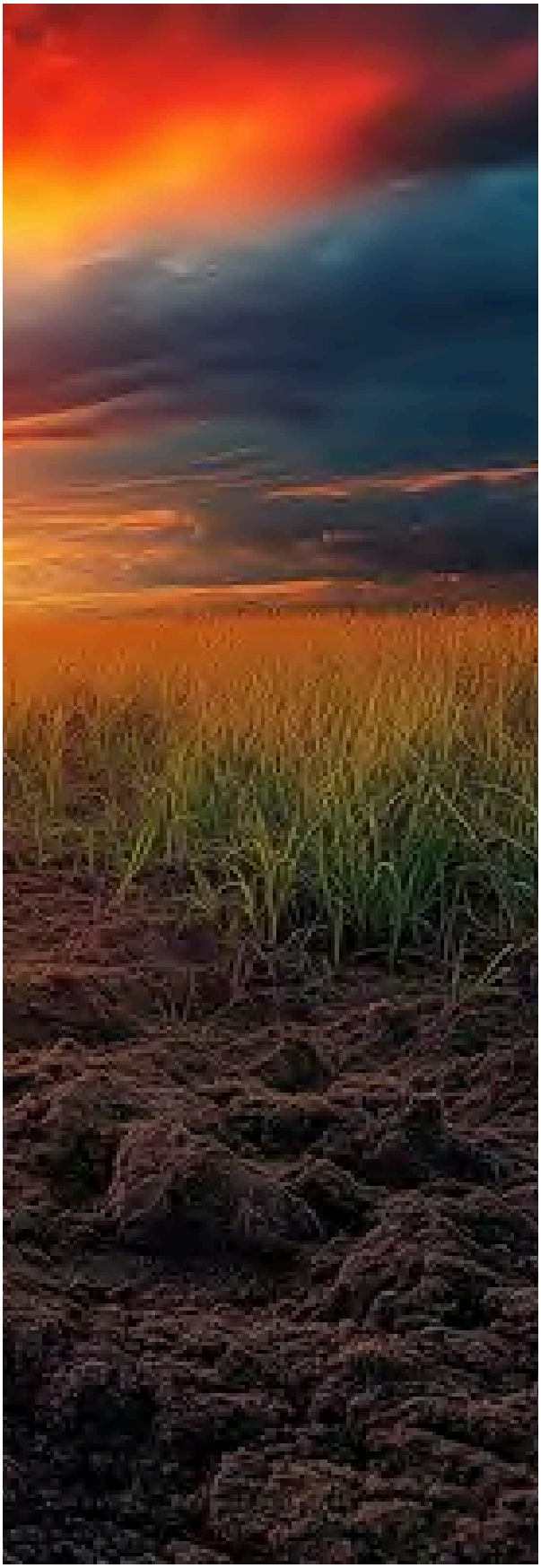
Company	Sector	NZ 2040	NZ 2050	FR 2040	FR 2050	Gap 2040
Enel	Utility	100	100	1.5	4.9	98.5
NextEra Energy	Utility	100	100	2.6	8.7	97.4
Ryanair	Airline	100	100	6.5	12.9	93.5
Exxon Mobil	Oil	100	100	8.3	23.4	91.7
BP	Oil	100	100	10.7	24.3	89.3
Duke Energy	Utility	100	100	11.2	25.6	88.8
Delta Air Lines	Airline	100	100	11.6	22.8	88.4
Chevron	Oil	100	100	22.8	53.3	77.2
Lufthansa	Airline	100	100	25.1	47	74.9
Huaneng Power	Utility	100	100	100	100	0

Figure 4. Transition risk for a sample of major listed companies under a 1.5°C-aligned pathway (NGFS Net Zero 2050) versus a fragmented-policy world (NGFS Fragmented World), at risk-year 2040.

Why NGFS Fragmented World?

Transition-risk models, ours and everyone else's, normally run against fully specified published scenarios, each of which comes with the detailed sector pathways, carbon prices, and energy-mix inputs the modeling needs. The Emmi most-likely scenario is a probability-weighted blend of those scenarios, so it doesn't come with its own native set of those granular inputs; modeling a company directly against it means constructing them first. In the meantime, the closest published stand-in for the expected case is NGFS Fragmented World, no accident, since it carries most of the weight in the Emmi blend.

The pattern is stark and consistent. Under the 1.5°C screen, every company in the sample carries maximum transition risk, a uniform 100%, the signal that would flag each as effectively uninvestable. Move to the world actually being tracked, and the picture separates into something an investor can act on: risk for the utilities and airlines falls to the low single digits or low tens of per cent, and even the oil majors land well short of the maximum. The scores stop saying ‘avoid everything’ and start discriminating between businesses.



The exception proves the point. The coal-heavy Chinese utility in the sample stays at 100% under both scenarios. Where genuine, structural transition risk exists, the expected case does not wave it away; it still reads as maximal. That is exactly what a credible measure should do: distinguish the companies whose risk is an artifact of an implausibly severe scenario from the companies whose risk is real under any plausible future.

This is the practical cost of using the wrong scenario. Screen a portfolio against 1.5°C, and everything looks like it must be sold; the signal is saturated and tells you nothing about relative risk. Screen it against the expected world, and the same portfolio resolves into holdings you can price, hold and manage, and a genuine minority you may not want to. The Emmi most-likely scenario would refine these numbers further rather than overturn them: because it retains some weight on higher-emitting outcomes, it sits slightly above Fragmented World alone, nudging the expected-case risk up a little, but the shape of the result, saturation under the tail versus real discrimination under the expected case, is the same.

What is transition risk?

Transition risk is the financial risk a company faces from the shift to a lower-carbon economy, from policy and carbon pricing, changing technology, and shifting market and consumer demand, as opposed to physical risk, which is the risk from the physical effects of climate change such as storms, floods and heat. A carbon-intensive business carries high transition risk because tightening policy and changing markets threaten its model; the same business may carry little physical risk, and vice versa. The scores in Figure 4 measure transition risk only.

Conclusion

The climate conversation has been dominated by its endpoints. That made sense when the tails were genuinely in play, and the middle was anyone's guess. For regulatory reporting, the tails still make sense, but as a basis for an investment decision, leaning on them makes less sense now, when the observed record points clearly and consistently to an expected scenario: a world of patchy policy, 27.5 $GtCO_2$ a year by 2050, and around 2.3°C of warming by 2100.

Keep the tails for the stress tests that require them. But for the decisions that turn on what is likely rather than what is possible, where to allocate, what to hold, how to price transition risk, the expected world is the one that should be on the table. That world has been the hardest to pin down and the easiest to avoid naming. Pinning it down, defensibly, is the point of this work.

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Context and clarification

Is the most-likely scenario just the single most probable scenario?
No. The single most probable scenario is one input. The Emmi most-likely scenario is a probability-weighted blend of the whole library, which assigns weight to the higher- and lower-emitting worlds rather than discarding them. That residual weight lifts the expected path above the single-modal scenario; the two only converge if one scenario approaches certainty.

Are these the true probabilities of the world's emissions?
They are conditional, not absolute. A scenario that is not in the standard library cannot receive weight, and the probabilities are built on cumulative carbon rather than on the timing of emissions within that total. They are best read as the weight the observed-and-forecast record places on each standard scenario, not as a forecast of politics or policy.

Why cumulative carbon rather than this year's emissions?
Because cumulative carbon is both more stable and more physically meaningful. A single year can be revised or distorted by a one-off shock; the running total over decades cannot. And it is the cumulative total, not any single year, that determines how much the world warms. We therefore compare the cumulative carbon and report annual emissions and warming as consequences of it.

Should we use this scenario for our regulatory disclosure?
Our strong suggestion is no. For compliance, use the prescribed, standard scenarios exactly as specified; that is what keeps a disclosure clean and defensible. The most-likely scenario is built for the other job: informing investment and risk decisions, where an expected view is what you actually need.

Isn't 2.3°C reason to relax?
No. 2.3°C still implies large, costly climate disruption and it places the 1.5°C target out of reach on current evidence. The argument here is about calibration, not complacency: anchoring decisions to a 4°C central case overstates risk in one direction, just as a 1.5°C assumption understates where the world is heading in the other

Technical notes

Data.
Historical emissions are fossil CO_2 from the Global Carbon Budget (Friedlingstein et al.), with the latest year at 38.1 $GtCO_2$. Forward pathways are the standard IPCC (SR1.5 and AR6) and NGFS scenario families, together with the Inevitable Policy Response Forecast Policy Scenario, placed on a common cumulative window from 2000.

Method, in brief.
Emissions are forecast to 2050 using an observationally-anchored ensemble, each trajectory reduced to a cumulative-carbon total and matched to the nearest standard scenario. The share of trajectories landing on each scenario is its probability; the most-likely pathway is the probability-weighted blend of all scenarios. COVID years (2020–2021) are excluded from fitting. The specific forecasting techniques, weighting, and ensemble construction are proprietary to Emmi.

Scope.
Figures are fossil CO_2 only and exclude land-use emissions and non-CO_2 greenhouse gases. Warming is derived from cumulative carbon via the IPCC AR6-assessed climate-sensitivity range. Estimates are conditioned on data through 2025 and are refreshed as each annual Global Carbon Budget updates the observational anchor.

Transition-risk illustration (Figure 4).
Emmi transition-risk model (FY2024), risk-year 2040, NGFS Net Zero 2050 versus NGFS Fragmented World. Company names are shown for illustration and are not investment recommendations.

Powering the market's climate products

Emmi provides a comprehensive climate risk data solution for investors and companies.

We provide emissions, transition, and physical risk data for every company and investment – including market-impact physical risk analysis, physical risk hazard modeling, and emissions targets and forecasts. Covering both private and public markets across all major asset classes. Our data and methodologies support 100% portfolio coverage.

Emmi delivers the data transparency and customisation needed to power investment decisions, meet climate reporting obligations, and align with investor mandates.

Emmi is backed by a team of climate and finance experts.

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