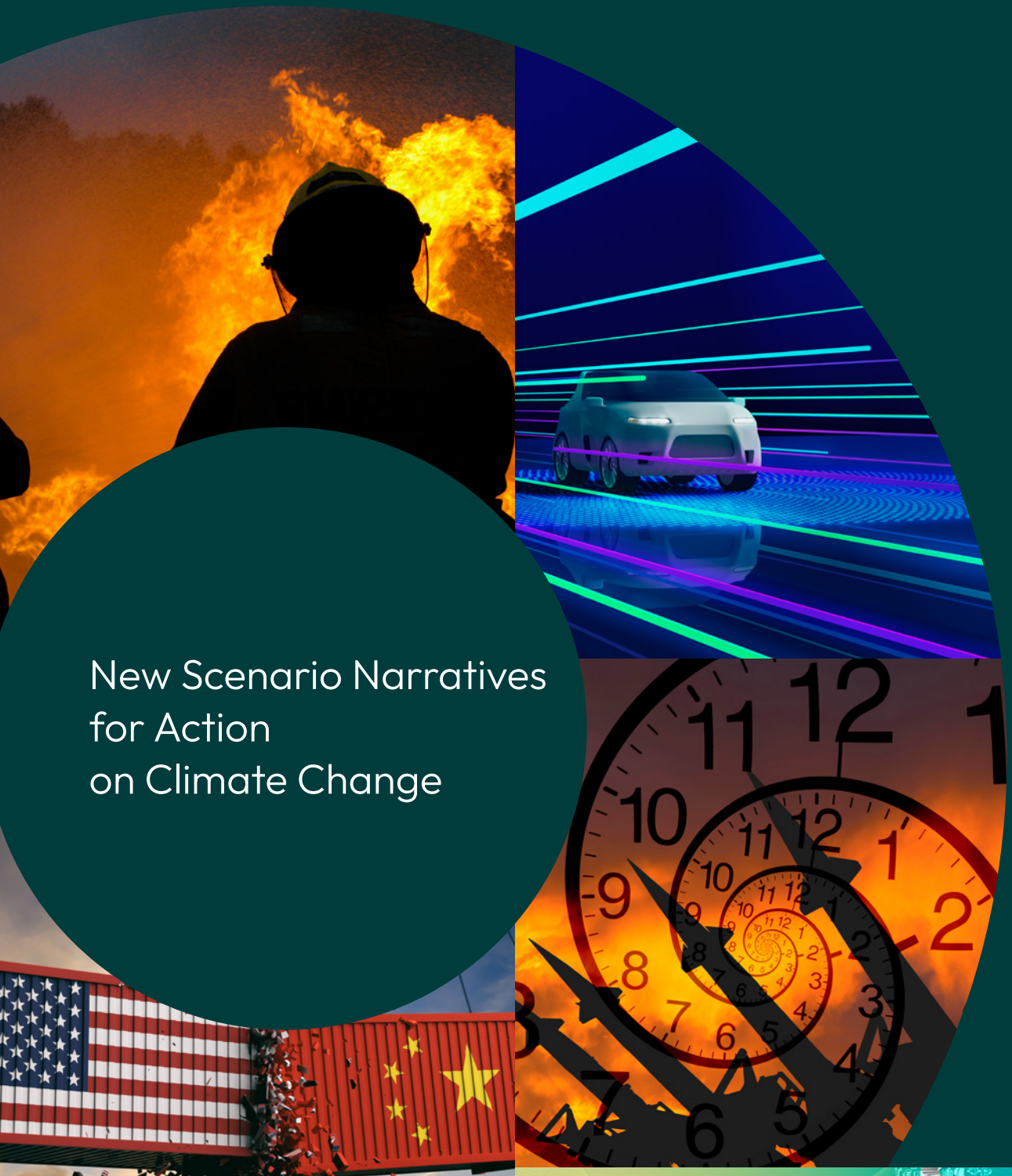
University of Exeter

USS For members, for the future.

No Time To Lose



New Scenario Narratives for Action on Climate Change

"We are already witnessing devastating physical impacts from a warming planet, which are only going to intensify over coming decades. Add transition risks to the mix, and the resulting risk landscape will be increasingly difficult to navigate. But, given the significant uncertainties, we urgently need to consider a variety of scenario narratives. As this timely and thought-provoking paper makes clear, there is no time to lose"

Jo Paisley, GARP

"Physical climate change and the technology revolutions of the energy transition pose huge potential for disruption across society and the economy. But there is no single path forward, nor will outcomes be limited to the simple and the first-order. As stewards of our clients' capital, we need to be informed and open-minded about the range of investment risks and opportunities that might evolve. Our experience suggests that quantitative scenario models struggle to reflect the complexities at play: they leave too much "out of the box". We are finding greater challenge and better insight in the creation and exploration of plausible futures in narrative form. But this is an emerging field, and USS has provided a space for collaboration that should both stretch and showcase the usefulness of the qualitative approach."

Caroline Cook, Baillie Gifford

"We've long known that integrated assessment models do a poor job at representing the wide-ranging implications of climate change and severely underestimate the risks. Yet, in the past few years, we've seen these become a mainstay in financial scenario analysis for climate change. Climate change is a significant financial risk and the systematic use of these models by financial institutions without consideration of their limitations could undermine risk management and over time be a source of systemic risk itself. Narrative approaches have emerged as a way to counter these limitations. As such, I'm delighted to see this new contribution from friends at the University of Exeter and USS that advances work on the narrative approach to scenarios, building upon the latest science and economics of climate change."

Dr. Nicola Ranger, Environmental Change Institute, University of Oxford

"Current mainstream scenarios used for financial analysis are in many respects incomplete and fail to achieve their goals, due to unintentional but critical internal contradictions: they assume a stable economic equilibrium in their attempt to help assess potential situations of economic and financial turbulence. This leaves the finance community without the tools they need to assess the real implications of climate change and policy on financial value, volatility and the state of future markets. This work is paradigm shifting in beginning to fill this knowledge gap."

Dr. Jean-Francois Mercure, World Bank

Contents

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Preface

As long-time producers and users of economic forecasts, we are well aware of their fallibility. But attempting to forecast the implications of addressing climate change takes this to a whole new level. The degree of volatility and uncertainty surrounding the dynamics of the physical climate and its interaction with the political, economic, technological and behavioural responses and drivers makes the task of looking ahead complex and fraught. And yet, heeding the increasingly strident warnings of climate scientists about climate change, governments, business and finance have no choice but to embrace this task.

Scenarios, which seek to make plausible assumptions about the key uncertainties that are driving climate action, have become the essential tool for decision-makers to assess the range of risks and opportunities involved. Sadly, it is increasingly clear that the mainstream economic models being used for climate risk scenarios are not up to this task. Policy makers and official bodies have conceded that the long-term systemic scenarios that have become the de facto standards for business and finance have serious shortcomings. They seriously understate the potential range of outcomes and fail to provide usable insights.

Over the last two years, we have been building a coalition of academic experts and practitioners to produce more realistic and 'decision-useful' scenarios in an effort to accelerate practical action in this 'decisive decade'. The Real World Climate Scenarios (RWCS) initiative has been dedicated to this task, building up a growing global community of individuals and organisations seeking constructive ways forward. Earlier this year, two of the RWCS founders, Mike Clark and I (the third being Willemijn Verdegaal), joined the world-leading climate team at the University of Exeter, headed by Professor Tim Lenton, to build on this.

The Universities Superannuation Scheme (USS), one of the largest pension schemes in the UK, sharing the RWCS concerns about the inadequacies of current reference scenarios, commissioned us earlier this year to apply a new approach to scenarios to support its investment and risk management decision-making. This report is the first fruit of this project, setting out a new set of short-term scenarios that incorporate a fuller range of outcomes, featuring increasingly disruptive shifts in the weather, politics, economics, technology and consumer behaviour.

Beyond USS, this project would not have been possible but for the generous support of a large and growing network of experts from a wide variety of backgrounds and disciplines. They shared their insights through interviews, bespoke comments and relevant references. There were healthy debates on many topics, but the beauty of the scenario technique is that it enabled many of their original ideas to feature in one or more of our scenario narratives, adding to their richness and plausibility.

In addition to the kind contributions of the experts noted in the Acknowledgements section, there were many others who chose to help without attribution. We are very grateful to all. Special thanks are due to those who gave especially extensive input, including János Hidi, Mark Carney, Nigel Topping, Simon Sharpe, Caroline Cook, Marek Piskorz, Kingsmill Bond, David Carlin, Michael Bradshaw, Jo Paisley, Gillian Tett, Peter Young, Tim Buckley, Louie Woodall, and Tim Hodgson.

Needless to say, there is ample scope to question the authors' final choices over the precise stories, but we hope that these scenarios will act as inspiration for others to refine and adapt for their own bespoke purposes.

Mark Cliffe (lead author)

Acknowledgements

Nishtha Aggarwal (Climate Energy Finance)
Scott Aguias (Z-Risk Engine)
Wayne Berman (Blackstone)
Kingsmill Bond (RMI)
Michael Bradshaw (Warwick Business School)
Tim Buckley (Climate Energy Finance)
David Carlin (UNEP FI)
Mark Carney (UN Special Envoy for Climate Action and Finance)
Alex Child (Carbon Cap)
Kamya Choudhary (Grantham Research Institute)
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Lilia Couto
Richard A. Falkenrath (Bridgewater Associates)
Richard Folland (Carbon Tracker)
Elsa Fornero (University of Turin)
Sam Geall (China Dialogue)
János Hidi (Cambridge Econometrics)
Tim Hodgson (Thinking Ahead Institute)
Derek Leatherdale (GRI Strategies)
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Rupert Way (Oxford University)
Louie Woodall (Manifest Climate)
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Peter Young

Executive Summary

It is time for a paradigm shift in climate scenario analysis. Policymakers and regulators have championed it as a key technique for addressing the uncertainties surrounding climate change. Long-term regulatory driven scenarios have successfully highlighted the global systemic challenges posed by global warming. But now that business has largely joined governments in aiming to meet these challenges by aiming for Net Zero greenhouse gas emissions, the question is how to operationalise those commitments. Since reaching Net Zero in 2050 is widely believed to need emissions to be halved by 2030, this goal calls for plans informed by shorter term scenarios. Moreover, organisations need bespoke scenarios to embed the analysis of climate risk and opportunities into all their decision-making.

This paradigm shift towards shorter horizons and business applications requires scenarios that focus less on the climate itself and more on the vicissitudes of politics, markets and extreme weather events. Global warming is not a major uncertainty over the next few years, but extreme weather events are rising rapidly, even if location and timing are uncertain.

At the same time, the limitations of current official scenarios and methodologies, notably from The Network for Greening the Financial System (NGFS), are becoming increasingly apparent. They are failing to capture key aspects of the real world, including acute physical risk, politics and policy, unemployment, finance, asset prices, volatility, tipping points, path dependency and complex feedback loops.

These omissions lead to implausible and partial narratives, which limit their practical usefulness. Crucially, these omissions mean that the resulting scenarios inadvertently understate both the economic damage of climate change and the potential benefits of action.

Recognising the urgent need to develop scenarios that fill these gaps, the **Real World Climate Scenarios (RWCS) initiative**, launched early in 2022, mobilised a multi-disciplinary network of practitioners and experts. Meanwhile, **Universities Superannuation Scheme (USS)**, one of the largest pension schemes in the UK, having undertaken scenario analysis for its Task Force on Climate-related Financial Disclosures (TCFD) report in 2022, reached similar conclusions about the "significant limitations" of current reference scenarios.

Having noted that it shared concerns raised by the RWCS initiative and the University of Exeter-led Economics of Energy Innovation and System Transition (EEIST) project, USS decided to collaborate with the University to develop a new approach, based on more realistic scenario narratives. USS has appointed Exeter's Global Systems Institute to develop 'Decision Useful Climate Scenarios' to support its efforts to incorporate climate and transition considerations in its investment and risk management processes.

This report presents a new set of four narrative global climate scenarios out to 2030 based on a framework which embraces the radical uncertainties surrounding the potential positive as well as negative tipping points. Assumptions about the key scenario drivers were developed with the help of over 40 experts in geo-politics, climate policy, economics, finance, technology and consumer behaviour (see Acknowledgements).

The resulting scenarios focus on how volatile, and often hard to model, political and economic transition drivers might interact with a realistic baseline physical narrative. This common physical narrative, woven into all four scenarios, includes representative events such as location-specific heatwaves, hurricanes and floods. Specifically, it is assumed that the current El Niño that will extend into 2024 will be associated with unprecedented temperature extremes, damaging food production and social stability, followed by disruptions from La Niña.

We present a matrix of scenarios involving four different combinations of high or low policy activism and high or low market dynamism. The most optimistic scenario, 'Roaring 20s', has both drivers working in harmony, resulting in rapid decarbonisation. In the most pessimistic scenario, 'Meltdown', a toxic political climate compounded by dysfunctional markets frustrates progress. In between are two scenarios in which either the markets ('Boom and Bust') or policy ('Green Phoenix') stymie progress. Altogether, compared with commonly used reference scenarios, this new set aims to present a richer, broader and more realistic range of possible developments on which to base decisions.

The report has been produced to inform USS decision-making. But USS's wider intention, by making this report public, is to stimulate a broad-ranging debate among practitioners, policy makers and academic experts about developing this practical approach to climate scenario analysis with a view to embedding it into transition planning and all forms of financial decision-making.

Beyond that, the aim is to draw out the investment implications, looking at strategic asset allocation and risk management, based on the scenarios' potential impact on macroeconomic variables and the behaviour of asset markets. USS intends to develop a long-term investment outlook informed by the scenarios and draw out investment implications for capital markets expectations, top down portfolio construction and country/sector preferences.

Scenario 3. Boom and Bust (BB) – policy steps up after fossil fuel surge bursts

A Ukraine peace deal and easing of global geopolitical tension triggers an initial surge in economic growth which leads to overheating in major economies and higher fossil fuel prices. Policy is tightened in response, which leads to a bust, forcing governments to step in to provide support. A just green transition is driven by pro-active policies to ease private sector frictions and support the emerging world.

Scenario 1. Roaring 20s (R20) - policy and markets align

Proactive climate policies and dynamic markets create powerful positive feedback loops. More extreme weather events focus minds and create a sense of global solidarity around a recognition of humanity's mounting debt to nature. Constructive competition between nations accelerates technological progress and deployment.

Scenario 4. Meltdown (M) - policy failures compound weak growth

Climate policy is the casualty of mounting geopolitical tension and protracted recession. A Republican victory in the US elections is followed by Ukraine being partitioned. Tension with China undermines global decarbonisation efforts and technological progress. Extreme weather events are badly handled, triggering famines, mass migration and political instability.

Scenario 2. Green Phoenix (GP) – market-driven, while policy lags

Climate action is initially upended by stagflation, the geo-political fallout of a stalemate in Ukraine and badly-handled weather shocks. Popular anger builds and civil society gradually emboldens more enlightened businesses and local governments to step up and roll out mature green technologies, but progress is patchy and erratic.

Introduction - The Need for a Paradigm Shift

Increasingly dramatic extreme weather events show that climate change is not just a potential long-term existential threat to humanity, but a clear and present danger to our welfare and wealth. Growing recognition of this needs to be reflected in a paradigm shift in the scenarios being used to take action to address it. Decision makers have no time to lose in acting on their commitments, even in the face of growing volatility and radical uncertainty. Simply waiting for more data or better models is no longer an option, they have to act on judgements based on more realistic and plausible scenario narratives.

Scenario analysis is designed to aid decision-making in uncertain environments. Policymakers and regulators have rightly championed it as a key technique for addressing the challenges of climate change. Following the lead of the Intergovernmental Panel on Climate Change (IPCC), financial regulators have used scenarios to examine alternative climate and climate policy pathways to highlight the need for action. For business as well as policy makers, scenarios help to identify risks and opportunities arising from climate change.

Up until now, the focus has been largely on long-term regulatory driven scenarios highlighting the global systemic challenges posed by global warming. But regulators have also been calling for financial institutions and corporations to use short- and medium-term scenarios to embed climate risk analysis into all of their decision-making.

These calls have been given added urgency by the need to execute transition plans to meet recent commitments to Net Zero greenhouse gas emissions. Moreover, recent extreme weather events have served as a stark reminder of the warnings in the latest round of IPCC reports, which highlighted the evidence that climate change is accelerating.

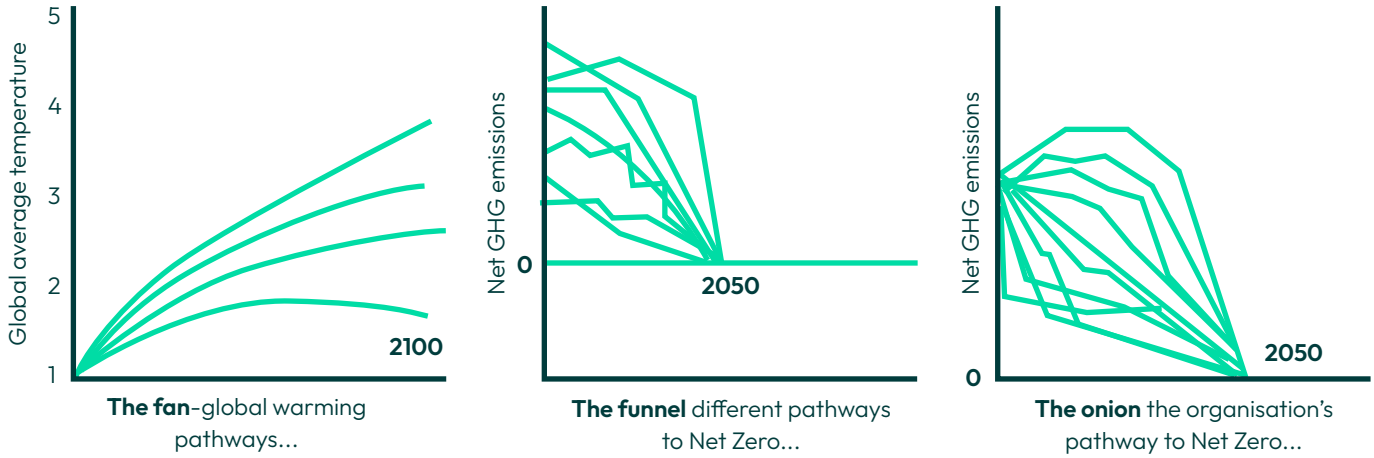
This need to address shorter horizons and business applications represents a paradigm shift in climate scenario analysis, because it switches the focus away from the climate itself to the vicissitudes of politics, markets and extreme weather events[1]. Global warming is not a major uncertainty, at least over the next few years, but extreme weather events are rising rapidly, even if location and timing are uncertain.

[1] What planet are we on? Mark Cliffe, The Actuary, May 2023 https://www.theactuary.com/2023/05/04/what-planet-are-we#:~:text=We%20need%20scenarios%20to%20embrace,%2C%20uncertainty%2C%20complexity%20and%20ambiguity.&text=VUCA%20is%20not%20just%20short,accelerates%20change%20in%20unpredictable%20ways.

This switch in focus should also be reinforced by the fact that, having taken the goal of Net Zero on board, the need is less to consider alternative emissions and climate paths, but rather the variety of routes to Net Zero (Figure 1) The need is now urgent, because with many organisations adopting transition plans with interim targets broadly consistent with halving GHG emissions by 2030, cuts of 8% p.a. are needed for the rest of the decade in order to achieve them.

Figure 1

Bespoke Scenarios, From Fan to Funnel - "Knowing your onions"



The fan-global warming pathways...

The funnel different pathways to Net Zero...

The onion the organisation's pathway to Net Zero...

At the same time, the limitations of current official scenarios and methodologies, notably from The Network for Greening the Financial System (NGFS), are becoming increasingly apparent. They are failing to capture key aspects of the real world, including acute physical risk, politics and policy, unemployment, finance, asset prices, volatility, tipping points, path dependency and complex feedback loops.

Figure 2

Integrated Assessment Models: a World without VUCA or Finance[2]

Equilibrium modelling omits key risks and processes

NGFS scenarios use IAMs combining:

1. General equilibrium models
2. Linear climate damage functions

What's missing?

Physical Risks:

- Weather (acute physical risk)
- Non-linear shifts or tipping points
- Feedback loops
- Pandemics
- Natural capital losses

Transition Risks

- Market frictions and failures (beyond carbon pricing)
- Wars and geopolitical shocks
- Policy disruptions
- Financial market volatility
- Stranded assets or labour
- Unemployment
- Disruptive technological progress or behaviour change
- Adaptation
- Loss and damage

[2] VUCA is the acronym for volatility, uncertainty, complexity and ambiguity, used originally by the US Army War College, but now in widespread use in strategic planning.

These omissions lead to implausible and partial narratives, which limit user engagement and divert modelers' attention from critical variables. In the process, they limit their practical usefulness for both policy-making and business decisions. Worryingly, these omissions mean that the resulting scenarios inadvertently understate the potential range of outcomes[3].

It is sadly ironic that the omission of crucial aspects of the real world is often excused on the basis of modelling or data limitations. The pervasive use of 'DICE'[4] general equilibrium models compounds the unreality of the scenarios in general use, since they result in implausibly smooth adjustment processes and proxy climate policy largely through carbon pricing[5], the progress on which is worryingly slow. In the process, such models typically lead to implausibly low estimates both of the economic damage of climate change[6] and of the potential benefits of action[7].

Another factor is that policy makers and businesses alike approach climate scenarios with both conservatism and 'political correctness', making them reluctant to include subjective or controversial drivers of change. In particular, there is a reluctance to make assumptions about much needed political or policy changes, or future technological progress. Current scenario narratives rarely explore the implications of plausible assumptions about hard to quantify drivers of change such as politics and social change. The Covid pandemic and Ukraine war have provided vivid illustrations of how short-term volatility can accelerate structural change.

A major part of the challenge in constructively addressing these shortcomings is that building realistic climate scenarios is not in the first instance a modelling problem. In scenario planning, "narratives eat modelling for breakfast": no amount of modelling will save you if you are not addressing the right questions. Before you ask "what kind of worlds might we be in?" you need to ask "what are we trying to achieve?".

The big question for asset owners, for example, is the outlook for asset prices. Yet asset prices are totally absent from official scenarios, the output of which somehow need to be translated into the implications for asset prices using 'expert judgement' (an inconvenient truth is that there is no reliable model for forecasting asset prices[8]).

As a result, there is an urgent need to develop scenarios that better capture critical features of the real world and assess the factors that will drive action to address climate change. The **Real World Climate Scenarios** initiative, which was launched early in 2022, has mobilised a network of practitioners and experts to work towards addressing this need.

Background to the USS Exeter Project: 'Decision Useful Scenarios'

Pension funds in the UK are mandated to conduct climate scenario analysis under the Task Force on Climate-related Financial Disclosures (TCFD) framework. Universities Superannuation Scheme (USS), one of the largest private pension schemes in the UK, undertook scenario analysis for its 2022 TCFD report, but identified "significant limitations". In its report, USS highlighted that it shared concerns raised by industry experts involved in the Real World Climate Scenarios (RWCS) initiative "on the inadequacy of climate reference scenarios which do not pay sufficient attention to tail risks, tipping points and discontinuities explored by recent research, do not focus enough on short-term horizons and prioritise highly uncertain quantification to a more qualitative "narrative-based" approach".[9]

Inspired by the RWCS work, and the University of Exeter-led Economics of Energy Innovation and System Transition (EEIST) project, USS decided to collaborate with the University to develop a new approach. They have appointed its Global Systems Institute to develop 'Decision Useful Climate Scenarios' to support its efforts to incorporate climate and transition considerations in its investment and risk management processes.

[3] See, for example, https://actuaries.org.uk/emperors-new-climate-scenarios

[4] Dynamic Integrated Climate-Economy

[5] The Economics of Immense Risk, Urgent Action and Radical Change: Towards New Approaches to the Economics of Climate Change Nicholas Stern, Joseph E. Stiglitz & Charlotte Taylor, Feb 2022 https://www.nber.org/papers/w28472

[6] Loading the Dice Against Pensions, Steve Keen, Carbon Tracker, Aug 2023 https://carbontracker.org/reports/loading-the-dice-against-pensions/

[7] See, for example, Empirically grounded technology forecasts and the energy transition, Rupert Way, Matthew Ives, Penny Mealy and J. Doyne Farmer INET Oxford Working Paper, Sep 2021 https://www.inet.ox.ac.uk/files/energy_transition_paper-INET-working-paper.pdf and The Breakthrough Effect: How to Trigger a Cascade of Tipping Points to Accelerate the Net Zero transition, Mark Meldrum, Lloyd Pinnell, Katy Brennan, Mattia Romani, Simon Sharpe and Tim Lenton, SystemIQ, University of Exeter, Jan 2023 https://www.systemiq.earth/wp-content/uploads/2023/01/The-Breakthrough-Effect.pdf

[8] For a discussion of the issues involved, see 'The Power of Dynamic Asset Allocation', M. Cardinale et al 2014

[9] See - USS TCFD 2022 report https://www.uss.co.uk/-/media/project/ussmainsite/files/how-we-invest/tcfd-2022.pdf

The project is designed to enable USS to develop a deeper understanding of physical and transition risks and how the dynamics of tipping points may affect these across different regions over short as well as long horizons. A framework has been developed to build scenarios which embrace the risks, radical uncertainties and opportunities presented by addressing climate change. This has been used to create the new set of four narrative global scenarios out to 2030 presented in this report. These assess how political and economic transition drivers might interact with a realistic baseline physical narrative, dominated by increasingly frequent extreme weather events.

Beyond USS's direct use, the intention is to stimulate a broad-ranging debate among practitioners, policy makers and academic experts about developing this practical approach to climate scenario analysis with a view to embedding it into transition planning and all forms of financial decision-making.

USS, with the support of the Exeter team, will use this approach to build a framework to draw out the investment implications, looking at strategic asset allocation and risk management, based on the scenarios' potential impact on macroeconomic variables and the behaviour of asset markets. This will enable USS to develop a long-term investment outlook informed by the scenarios and draw out investment implications for capital markets expectations, top down portfolio construction and country/sector preferences.

Outline of this Paper

In this initial summary paper, we outline:

1. The methodology and framework behind the construction of the scenarios, highlighting the importance of 'decision useful' shorter term scenarios featuring policy intervention and market dynamism as their two main driving dimensions.
2. The baseline physical climate narrative, focusing on illustrative extreme weather events, which in turn underpins -
3. The four scenario narratives to 2030, based on combinations of political and economic drivers and their interaction with finance, technology and consumer behaviours.

1. Methodology of Narrative Creation

The USS Exeter project builds on the scenario construction process pursued by the Real World Climate Scenario (RWCS) Initiative, which is summarised in Box 1. In this report, we focus on the development of the narratives (stage 5 in the Box).

Box 1: The Scenario Construction Process

1. Define the objective
What problem are you trying to solve? What action are you expecting to take? Over what time horizon?

2. Identify external drivers
Develop a comprehensive list of relevant drivers, drawn from politics and policy, the environment, economics, technology, and society.

3. Assess the drivers
Build a useable framework based on the impact, uncertainty, interlinkages and ranges of the key drivers.

4. Define the Scenarios
Identify the most important drivers, clustering other related drivers based on their interlinkages (see example below).

5. Develop the Scenario Narratives
Engaging stories for each scenario should explain how the key drivers interact and affect the organisation's context.

6. Quantify the scenarios
Where possible calibrate the scenarios with quantitative modelling or develop methods and metrics for qualitative variables.

7. Embed into decision-making
Develop a scenario thinking culture throughout the organisation's strategy, planning and operations.

Source: Mark Cliffe (RWCS)

A. Scenario Design Choices

To make scenarios 'decision useful', they need to be relevant, plausible, illuminating, provocative, and actionable for the purposes at hand. In this case, the following design choices were made:

1. Time Horizon
Initial project end date is 2030, a common interim target for Net Zero transition plans, typically with a goal of halving of GHG emissions. On this 7 year horizon global warming is not a key uncertainty: the focus is on transition risk, interacting with common acute physical risks.

Although 2030 is shorter than the horizon used by the IPCC and NGFS, it is longer than the horizons of typical economic, political and business forecasts and plans, which are often confined to no more than 3 years ahead.

Path dependency ('one thing leads to another') means initial conditions and events through to 2025 are critical: e.g. election outcomes (US, UK etc) and the outcome of the Ukraine war. Simple extrapolations or model projections of the recent past are not good enough.

2. Granularity vs. Materiality
Greater granularity, by country/region or sector, adds realism and salience to the narratives. However, granularity adds to complexity.

Materiality (based on impact and degree of uncertainty) is therefore a key discipline in limiting excessive complexity. The focus is on large countries (e.g. China, US) or blocs (e.g. EU) and critical sectors which have most impact on the outcomes.

3. Volatility vs. Stability
Volatility is embedded in the narratives, since it is a catalyst for change, including structural breaks (e.g. as policy changes triggered by shocks, as in "never waste a good crisis") and tipping points (e.g. political crises,

technological breakthroughs, energy shocks, financial crashes or 'Minsky moments' that lead to defaults and early asset stranding).

Linear trends, unless rapid, exercise a limited impact on short horizons, for example natural population growth.

4. Broad but Plausible Ranges
Scenarios are not forecasts; their value comes from examining a range of outcomes. This needs to be broad enough to develop a deeper understanding of the possible outcomes.

Climate change is characterised by unprecedented change, so scenarios should cover outcomes beyond past experience. So history should only be a partial guide in setting the range of potential outcomes described in the scenarios; judgement is required. This is particularly relevant when it comes to stress testing, where the focus is on more extreme outcomes.

Plausibility should take precedence over probability: scenarios are designed to assess uncertain futures where there is no objective way of assessing the probability of possible outcomes. The assessment of plausibility will therefore require judgement.

5. Tonality and the Narrative Arc
Each scenario narrative has its own tonality which should be reflected consistently across the underlying topics, e.g. positive political dynamics vs. dysfunctional markets.

Equally, since the scenarios are non-linear, and build in 'path dependency', each has a distinctive narrative arc that may feature disruptions, including tipping or even turning points. For example, the election of a climate denying government part way through the scenario horizon may trigger sudden shifts in policy, markets and technology choices.

6. Objectivity and Diversity
Given the powerful, sometimes polarised, perspectives evoked by climate change, and the critical role of politics, it is crucial that the scenarios are constructed and communicated in an objective fashion. The goal is to make them as useful as possible to all stakeholders.

Since the exercise involves producing a range of scenarios, it enables diverse perspectives to be embraced, enhancing the richness and robustness of the narratives.

B. Scenario Drivers and Topics

Now that the focus is on delivering Net Zero, transition planning is a priority. Transition plans focus on how to reach Net Zero, so the NGFS's long-term scenarios on alternative emissions and global warming outcomes are less relevant. Instead, we need scenarios that consider the different ways and speeds of reaching net zero – especially given that different countries and companies will pursue different pathways.

Moreover, as mentioned earlier, global warming is baked in for the next decade. Even if net emissions fall rapidly during the next few years, the existing stock of emissions means further increases in the global average temperature are almost inevitable. And while there is considerable and growing uncertainty over how high temperatures will get from the late 2030s onwards, the likely range of outcomes for the 2020s is comparatively modest. In the language of scenario planning, global warming is a 'pre-determined'.

The implication is that global warming and other 'chronic' physical risks are not key drivers for short-term climate scenarios. Instead, the key drivers are transition risks that involve climate-related shifts in policy, the economy, finance, technology, and consumer behaviour, and how they interact with extreme weather events and other acute physical risks, (see Figure 3 and Appendix). These are often hard to quantify and model, but scenario narratives can make explicit assumptions about them, including how they might interact. By contrast, NGFS scenarios rely on models that gloss over acute physical risks, which scientists fear are now rising rapidly, as well as many material transition risks.

Regarding physical risks, the project has developed a baseline narrative, discussed in detail later, to cover all four scenarios. This baseline, involving global warming of nearly 0.2C over the rest of the decade, focuses on acute physical risks, with representative events such as location-specific heatwaves, hurricanes and floods. Although there is some uncertainty over the specific timing and location of such extreme weather events, scientists are confident that such acute risks will rise in a non-linear fashion, i.e. with both rising frequency and intensity. Specifically, it is assumed that the current El Niño, which will extend into 2024, will be associated with unprecedented temperature extremes[10], damaging food production and social stability, followed by disruptions from La Niña.

[10] The record-breaking temperatures experienced since this project began bear this out.

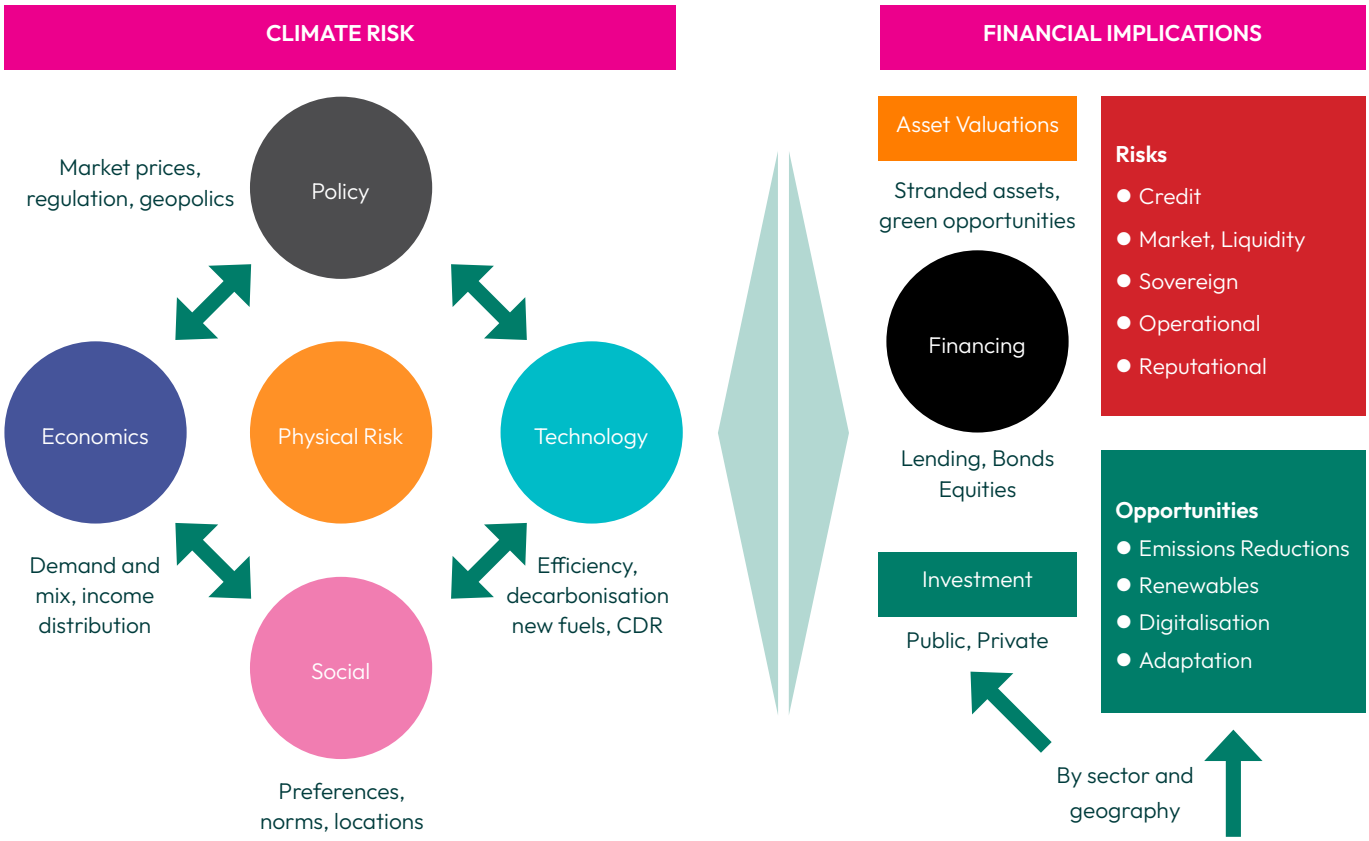
That said, later we discuss an important caveat regarding the possibility of a chronic physical risk tipping point occurring or appearing imminent by 2030. One example, namely the collapse of deep convection in the Labrador-Irminger Seas and the associated shift in the North Atlantic Subpolar Gyre (SPG, would have dramatic consequences for weather patterns in the Northern hemisphere (see section 2 for more details).

When looking to 2030 rather than the NGFS's preferred 2050 horizon, climate risk scenarios therefore entail quite different drivers and narratives. With global warming largely a given, our scenarios focus instead on uncertainties over human action and how it interacts with frequent extreme weather events. What matters most are transition drivers, which fall into two key groups: (1) politics and policy (2) economics and markets.

Figure 3

Scenario Drivers and Implications

Systemic and dynamic interactions drive financial risk

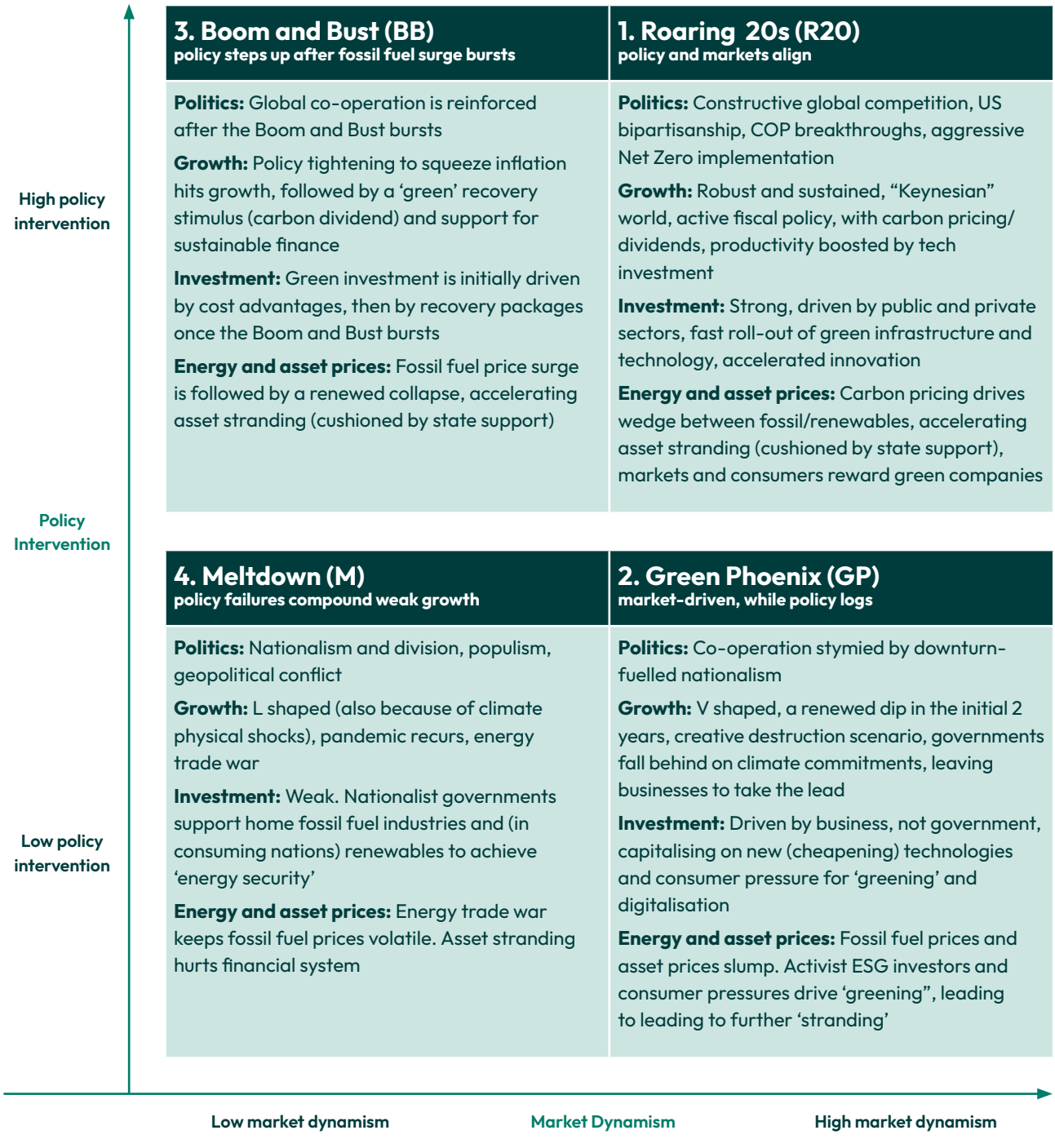


Source: Mark Cliffe, RWCS

Figure 4 shows a 2x2 matrix of our set of scenarios based on these key drivers. On the vertical axis, the first driver is the degree of policy activism. Aggressive action through fiscal policy or government regulation will probably be the biggest factor in determining how quickly the world transitions. This will depend heavily on political will at national and international levels, throwing the spotlight on the electoral cycle in the US and other key democracies, as well as geopolitical relationships with China, Russia, and other major players. It should be noted that the sensitivities around such political questions may make it harder for official bodies to address them.

Figure 4

Real World Climate Scenarios (to 2030) - 2x2 Matrix



Source: Mark Cliffe, RWCS

On the horizontal axis, the second key driver is business and consumer dynamism. A dramatic shift in capital and spending will be needed to reach Net Zero, including the development and rollout of renewable energy and carbon removal technologies. This is unlikely to be the smooth process portrayed by Integrated Assessment Models (IAMs): market booms and busts[11] and policy interventions are likely to lead to volatility in prices and investment flows, and thus in attendant financial risks and returns.

The matrix scenarios involve four different combinations of high or low policy activism and high or low market dynamism. The most optimistic scenario, 'Roaring 20s', has both drivers working in harmony, resulting in rapid decarbonisation. In the most pessimistic scenario, 'Meltdown', a toxic political climate compounded by dysfunctional markets frustrates progress. In between are two scenarios in which either the markets ('Boom and Bust') or policy ('Green Phoenix') stymie progress. In all scenarios, extreme weather events are woven into the narratives to accelerate or reverse the behavioural impetus driving the transition at local or global levels.

C. The Narrative Creation Process

In order to craft the scenarios a group of over 40 leading experts were invited to contribute on the six main "topics" for each of the four scenarios, namely:

1. Physical risk (the baseline narrative only)
2. Geo-politics/climate policy
3. Economic
4. Finance
5. Technology and Sectoral trends
6. Consumer and Civil Society

The list of experts who generously offered their insights, whether in verbal or written form, is shown in the Acknowledgements. The The University of Exeter team drew on the insights from the topic experts on each of the six topics to develop an overarching narrative for each of the four scenarios described later in this report. Although there was a surprising degree of unanimity on some issues, the manifold uncertainties surrounding all of these topics led to a variety of opinions and hypotheses being expressed by the contributing experts, which meant that the University of Exeter team had to make some editorial judgements about what to include. The final responsibility for the narratives featured in section 3, and any attendant errors, therefore rests with the University of Exeter team.

Mark Cliffe

[11] The NGFS currently bases all of its scenarios on a single smooth pathway of GDP growth, namely the 'SSP2' socio-economic pathway of the IPCC. Although it says 'the sensitivity of the scenarios to alternative socio-economic assumptions could be explored in future work, depending on needs' it has not done so yet. See https://www.ngfs.net/ngfs-scenarios-portal/faq/

2. Physical Climate Narrative to 2030

Disclaimer

The events described in this narrative scenario are fictional and intended for illustrative purposes. While they are based on the potential impacts of climate change and weather patterns, their specific occurrence, timing, and severity are subject to uncertainties. It is crucial to consult scientific research and authoritative sources for accurate and up-to-date information on climate change and its potential consequences.

The alarming predictions of climate scientists are becoming a growing reality. This narrative scenario explores a decade filled with climate changes and weather events between 2023 and 2030, based on scientific research, state-of-the-art modeling, and assessments of likelihood. The events described here showcase a wide range of climate-related disasters that are increasingly likely as the planet continues to warm, underscoring the diverse impacts of climate change on different regions.

2023 marked the emergence of El Niño, a phenomenon characterized by wide-ranging changes to normal weather patterns. The Eastern equatorial Pacific Ocean's warming has already led to extreme weather events such as heatwaves, wildfires, torrential downpours, and overflowing rivers, causing widespread and significant damage across the globe. Unprecedented extremes in sea surface temperatures, Antarctic sea-ice loss, and Canadian wildfire extent all signal destabilization of the climate.

In **2024**, the world confronts the challenges of a "Super El Niño" event, exacerbated by human-induced climate change, resulting in powerful and prolonged weather phenomena.

Southern Africa and **India** experience prolonged droughts exacerbating water scarcity and food insecurity, as changing rainfall patterns disrupt crop yields and livestock production. Record temperatures and prolonged droughts lead to 'heatflation' due to smaller harvests and higher prices.

South America experiences extreme floods (**Brazil and Paraguay**) resulting in damage to crops such as soybeans, corn, wheat, rice, sugarcane, and coffee. The damage to agriculture in these three regions leads to increased price volatility in the global commodity markets, food price inflation and creates financial burdens for vulnerable populations.

The world continues to suffer from more frequent and intense heatwaves, leaving vulnerable populations at risk. Regions previously unaccustomed to extreme heat, such as parts of Europe and Canada, suffer from soaring temperatures. During the summer of 2024, **France**, and **Japan**, experience record-breaking heatwaves and wildfires, posing health risks and straining infrastructure. Hospitalizations for heat-related illnesses compounded by impact on tourism become an economic burden for **France**.

During Summer as El Niño conditions transition towards more neutral conditions a powerful superstorm forms and intensifies rapidly before making landfall along the **Gulf Coast of the United States**, influencing the presidential election. El Niño usually suppresses hurricanes that affect the Caribbean and US. However, these storms are powered by ocean heat, and record-high sea temperatures in the Atlantic have led the UK Met Office to forecast an above-average number of tropical storms in the North Atlantic. The warmer ocean temperatures in the Gulf of Mexico contribute to the storm's intensity and the resulting destructive storm surges and heavy rainfall.

The storm results in massive property damage across the **Gulf Coast states, including Texas, Louisiana, Mississippi, Alabama, and Florida**. Countless homes, businesses, and public buildings are destroyed or severely damaged. Critical infrastructure also suffers extensively due to the superstorm. Roads, bridges, and highways are washed away or rendered impassable, severely hampering transportation and logistics in the affected regions. The power grid experiences widespread blackouts, leaving millions without electricity for days or even weeks. Water treatment facilities and sewage systems are damaged, exacerbating public health and sanitation concerns in the aftermath of the storm.

The Gulf Coast region is a vital hub for industries such as oil and gas production, tourism, agriculture, and shipping. Oil refineries and drilling platforms in the Gulf of Mexico are severely damaged, resulting in disruptions to energy production and supply. Tourism, a major source of revenue for coastal communities, suffers as popular vacation destinations are ravaged by the storm, leading to a decline in tourism revenues. The agriculture sector faces extensive losses due to crop damage and livestock losses, further straining the economy and global food supply.

As a result of the widespread damage to property, infrastructure, and industries, the United States experiences a decline in overall output and GDP growth. The Gulf Coast region, a significant contributor to the nation's economy, faces an economic downturn that ripples through various sectors. While reconstruction efforts help GDP to rebound, this comes at the cost of required substantial resources and time, diverting funds from other areas of economic growth.

Amidst these challenges, El Niño brings some relief to the drought-stricken **Horn of Africa** with increased rainfall.

In **2025**, the world experiences a transition from the El Niño to the La Niña phase, bringing significant climate and weather impacts. As the equatorial Pacific Ocean cools, La Niña emerges, altering global weather patterns.

The **Southwest United States** faces a severe drought, impacting water resources, agriculture, and causing economic hardships. Rivers dry up, reservoirs reach critically low levels, and agricultural productivity plummets. Water restrictions and rationing measures are implemented, causing economic hardships and exacerbating tensions between water-dependent sectors. The drought in **California** is recorded as one of the worst droughts in history.

South America and Central America also suffer from a prolonged drought, coinciding with important global events like COP30 and intensifying discussions on climate action. Many regions in South America and Central America rely on hydropower for electricity generation. Reduced water levels in reservoirs lead to energy shortages and increased reliance on fossil fuels.

Australia and Siberia face devastating wildfires. destroying vast forested areas, leading to loss of biodiversity and habitat for various species.

The **United Kingdom** experiences extensive flooding, disrupting infrastructure and economic activities. The flooding impacts critical infrastructure, transportation networks, and residential areas, resulting in the displacement of residents and significant damage to property. The floodwaters inundate streets, submerge underground tunnels, and overwhelm drainage systems, leading to severe disruptions in daily life and economic activities.

On a positive note, **India** benefits from La Niña, as it strengthens the summer monsoon and brings high rainfall, benefiting the economy reliant on agriculture and industry.

Continuing La Niña conditions in **2026** leads to a series of extreme weather events and coastal erosion. Rising sea levels, combined with the alternating phases of El Niño and La Niña, lead to increased flooding, erosion, and threats to coastal communities worldwide. **Low-lying small island nations** face existential threats, while the erosion of coastal cliffs and beaches in the UK poses risks to infrastructure.

European countries face heatwaves and widespread wildfires during La Niña. The disruptive effects of these events lead to destruction of crops, dramatic decrease in tourism throughout Europe due to transportation disruption, health and safety concerns, and shifts in travel preferences.

Southeast Asia experiences extensive flooding, **East Africa** suffers from severe drought, and the Andean region sees devastating landslides, while the **Bay of Bengal** witnesses a powerful storm. This could result in a complex humanitarian crisis with food insecurity, displacement, and migration challenges in multiple regions.

Despite the challenges, there are positive impacts, such as increased rice production in **Vietnam** and opportunities for renewable energy and fishing industries in certain regions.

In **2027**, the world experiences a dual assault of especially extreme climate events linked to ongoing global warming. In the **Amazon** rainforest, unprecedented drought and deforestation contribute to catastrophic mega wildfires, resulting in irreversible ecological damage, loss of biodiversity, and the release of massive amounts of carbon dioxide. Due to the loss of large swathes of forest, the carbon offset market is sent into a tailspin. The voices promoting the implementation of carbon capture and storage (CCS) technologies, as well as solar radiation management (SRM), become louder.

Meanwhile, **Southeast Asia** is hit by a super typhoon of unprecedented intensity, fueled by warm sea surface temperatures and atmospheric instability. The typhoon brings destructive winds, torrential rainfall, and widespread flooding, causing immense destruction to infrastructure and displacing communities, particularly in **The Philippines**. The Philippines heavily relies on agriculture, and this disruption hits production, affecting food supply and prices. Manufacturing facilities are temporarily closed, leading to reduced output, supply chain dislocations and price spikes. Tourism is badly disrupted. This fuels record inflation in the region.

In other parts of the world, the **Middle East** endures a severe heatwave, **Moscow** faces an unprecedented heatwave, and ongoing rapid glacier retreat in the **Alps** impacts water availability, tourism, and ecosystems.

In **2028**, scientists' warnings about the intensification of tropical storms become a reality as catastrophic events unfold worldwide. In the Atlantic, a superstorm fueled by warm ocean waters rapidly strengthens into a Category 5 hurricane, causing devastating damage and loss of life along the coasts of **Florida, North Carolina, and Caribbean nations like Barbados.**

Simultaneously, frequent tornado outbreaks occur globally resulting in destruction across various regions, particularly in the **Midwest of the United States**. These severe weather events collide with the presidential election campaigns in the United States, elevating climate change and disaster management as key issues.

Southeast Asia is struck again by a powerful cyclone, affecting **Bangladesh and Myanmar** with destructive storm surges and heavy rainfall. Additionally, **China** experiences increased tornado activity, leading to property damage and disruptions. Tornado damage to transportation networks and warehouses can lead to supply chain disruptions, affecting the movement of goods and services within and outside the affected regions. This leads to global supply chain issues due to China's importance in manufacturing. **India's** presidential election emphasizes climate change and sustainable development in the candidates' agendas.

A silver lining is that in **South Asia** the increased monsoon rainfall and improved water management systems help recharge groundwater reserves, reducing water scarcity and supporting agriculture during the dry season.

2029 is characterized by unprecedented global wildfires that ravage the **Western United States, Australia, the Amazon** rainforest, and **Siberia** due to dry conditions and prolonged heatwaves. These infernos surpass previous records, causing a devastating impact on air quality and respiratory health while straining firefighting resources. In **Australia**, the unprecedented wildfire season engulfs vast areas, displacing communities and prompting renewed discussions on climate action. The fires in the **Amazon** lead to scientists declaring an ecological catastrophe. The massive wildfires in these regions release vast amounts of greenhouse gases into the atmosphere exacerbating climate change and its associated impacts. Additionally, the land's ability to absorb and store carbon is reduced. This is detrimental to (re)forestation efforts and the carbon offset market.

India experiences an extraordinary heatwave with unprecedented wet bulb temperatures (T_W)[12]. TW reaches over 32 degrees for multiple consecutive days with peak TW reaching over 35 degrees. This results in many fatalities and an absolute stop on all labour activities (farming, manufacturing, etc…) for 2 weeks.

Positively, in **Europe** warmer weather leads to longer growing seasons and milder winters facilitate the expansion of agriculture and enable the cultivation of new crops, contributing to local food self-sufficiency.

In **2030**, various regions of the world experience the consequences of environmental challenges. Indonesia witnesses the detrimental effects of rising sea levels and increased rainfall as Jakarta suffers from severe coastal flooding, displacing millions of people and causing significant infrastructure damage.

Similarly, **Bangladesh** faces widespread flooding due to severe monsoon rains and rising sea levels, resulting in the displacement of millions of people and significant damage to infrastructure and agriculture. The impacts of severe monsoons in Bangladesh and South Asia lead to an economic crisis and increasing political instability.

Western Africa, particularly **Nigeria and Ghana**, endure prolonged drought and heatwaves that exacerbate water scarcity issues, leading to crop failures, food insecurity, and conflicts over limited water resources.

Entering the new decade, the **Arctic** experiences another record-low sea ice extent, heightening concerns about the effects of global warming on polar ecosystems and ramping up discussion about whether we have passed tipping points in the cryosphere. The loss of Arctic ice is a clear indication of rising temperatures and the amplification of climate change due to sea ice – climate feedbacks. The loss of reflective ice surfaces in the Arctic amplifies the absorption of solar radiation by the dark ocean water, leading to further warming and additional ice melt. This positive feedback loop accelerates climate change, especially in the Arctic.

[12] Wet bulb temperature (TW) is a metric that considers the combined result of the heat and humidity. More technically, TW is a meteorological parameter that represents the lowest temperature that can be reached by evaporating water into the air, while simultaneously maintaining constant air pressure and humidity. TW has a significant impact on human health and comfort, primarily because it directly influences the body's ability to cool itself through the process of sweating and evaporation. When the wet bulb temperature is high, the air is already saturated with moisture, making it more difficult for sweat to evaporate from the skin. This reduces the body's natural cooling mechanism and can lead to overheating, heat stress, and potentially life-threatening conditions like heatstroke. High wet bulb temperatures can indicate dangerous heat conditions that can strain the body's ability to regulate its temperature, leading to various heat-related illnesses."

Warming of the permafrost region and the Greenland ice sheet are amplified, the latter of material concern in its implication for rising sea levels. The melting of land ice contributes to rising sea levels globally. This poses a significant threat to coastal communities, low-lying islands, and vulnerable coastal ecosystems. The loss of sea-ice cover also removes protection for Arctic coastal communities from storms, and the thawing of permafrost makes movement across the Arctic land surfaces harder. Even in the face of the ongoing climate catastrophe the increased accessibility of oil and gas reserves in the Arctic attracts some companies to invest in energy exploration and extraction.

The Arctic Sea ice low is an indication of things to come. As the world enters the new decade, the fragility of our planet's climate systems becomes increasingly evident. Looking beyond 2030, the landscape of climate and extreme weather events becomes even more intricate and uncertain. As global temperatures rise due to human activities, the impacts of extreme weather events become more pronounced and frequent, leading to devastating consequences for ecosystems and societies. The asymmetry of risk is evident in the disproportionate effects of these extremes, where the negative outcomes far outweigh any potential positive outcomes.

The scenarios described here illustrate the complex and multifaceted impacts of climate change on across the planet. While the events depicted are fictional, they draw upon real scientific understanding of how climate change can amplify extreme weather events, disrupt ecosystems, and threaten the very fabric of societies.

Looking forward, one of the most pressing concerns is the potential crossing of climate tipping points. These critical thresholds, beyond which irreversible and abrupt changes occur, cast a shadow over our ability to predict and manage the impacts of climate change. The melting of major ice sheets, the disruption of ocean currents, and the release of vast amounts of methane from thawing permafrost are just a few examples of tipping points that could have cascading effects on global climate patterns and ecosystems (See Figure 5).

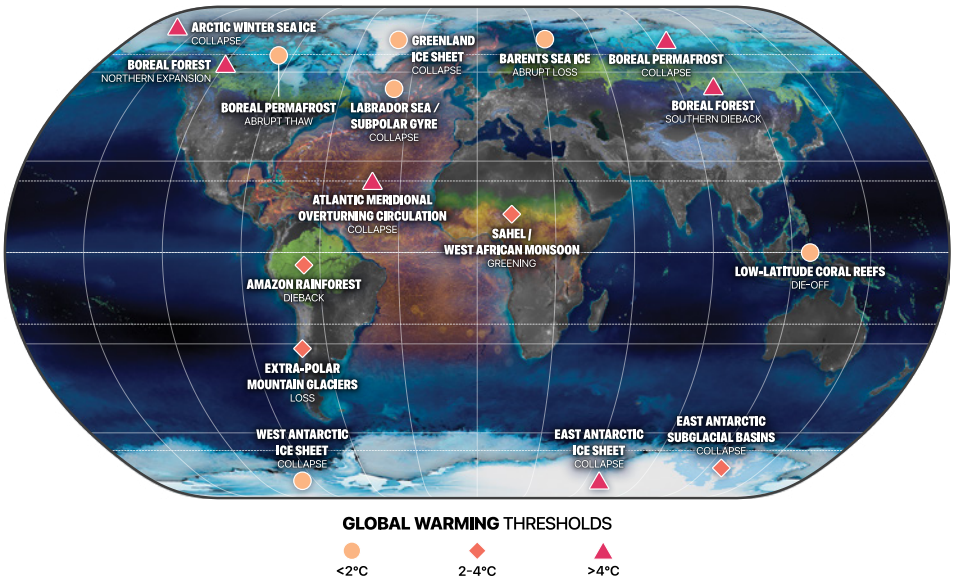
One example of a tipping point that may be triggered in the coming decade is the collapse of the deep convection in the Labrador-Irminger Seas and the associated shift in the North Atlantic Subpolar Gyre (SPG). Armstrong McKay et al. (2022) estimated the temperature threshold for SPG tipping to be about 1.8°C. This means that SPG collapse may occur as early as the 2030s with the latest CMIP6 models supporting this. These models suggest that the collapse of the SPG would have dramatic consequences on weather patterns in the Northern hemisphere, especially on Europe (Swingedouw et al., 2021[13]). In these models, we observe a localised North Atlantic regional surface air temperature drop of ~2- 3°C.

Additionally, the anticipated northward shift of the atmospheric jet stream would lead to heightened weather extremes across Europe. This shift may be connected to the atypical cooling events and instances of heatwaves that have occurred in recent years. The intertropical convergence zone is expected to move southward, which is expected to have significant effects on fisheries and biodiversity, carrying broad implications for society as a whole.

Figure 5

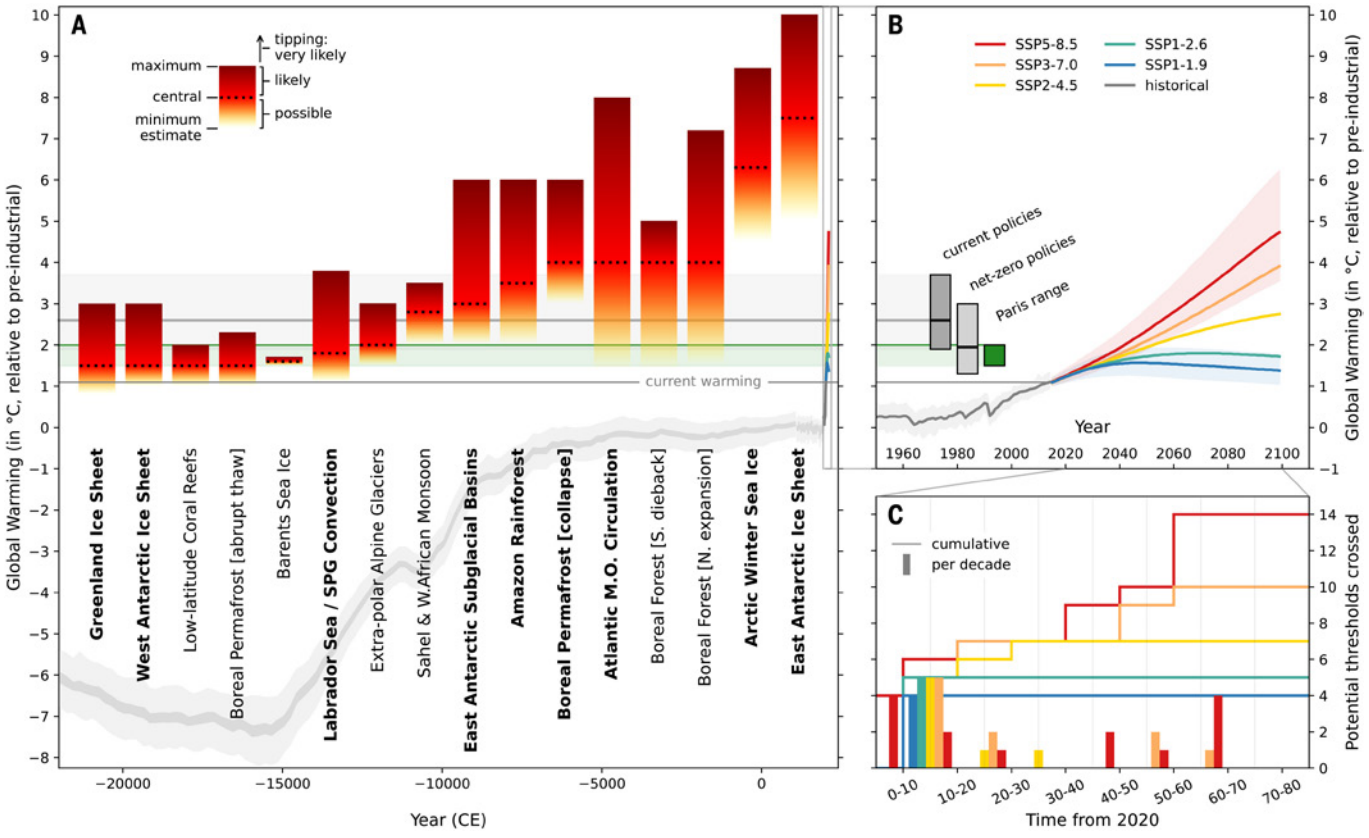
16 Climate Tipping Points

The top panel shows the locations of climate tipping points in the cryosphere (blue), biosphere (green), and ocean/atmosphere (orange). The pins are color-coded to represent the projected global warming thresholds for triggering these tipping points. The bottom panel shows the central temperature estimate (black dashed line) and the estimated temperature range (yellow to red gradient bars) for each tipping points global warming threshold. Images are reproduced from Armstrong-McKay et al (2022)[14].



[13] https://nyaspubs.onlinelibrary.wiley.com/doi/10.1111/nyas.14659

[14] Armstrong McKay, D. I., Staal, A., Abrams, J. F., Winkelmann, R., Sakschewski, B., Loriani, S., ... & Lenton, T. M. (2022). Exceeding 1.5 C global warming could trigger multiple climate tipping points. Science, 377(6611), eabn7950.



This narrative underscores the profound vulnerability of communities, economies, and ecosystems to the evolving climate reality. The tales of droughts, floods, superstorms, wildfires, and other catastrophes emphasize the need for immediate and sustained efforts to mitigate and adapt to these challenges. However, whether these efforts will be forthcoming or sufficient will depend on the political and economic context. In the next section we set out four scenarios which could result in quite different responses to the mounting physical risks of climate change. The narrative serves as a reminder that we are all stakeholders in this global story, and our actions will shape the trajectory of the world we leave for future generations.

Dr. Jesse F. Abrams and Professor Timothy M. Lenton

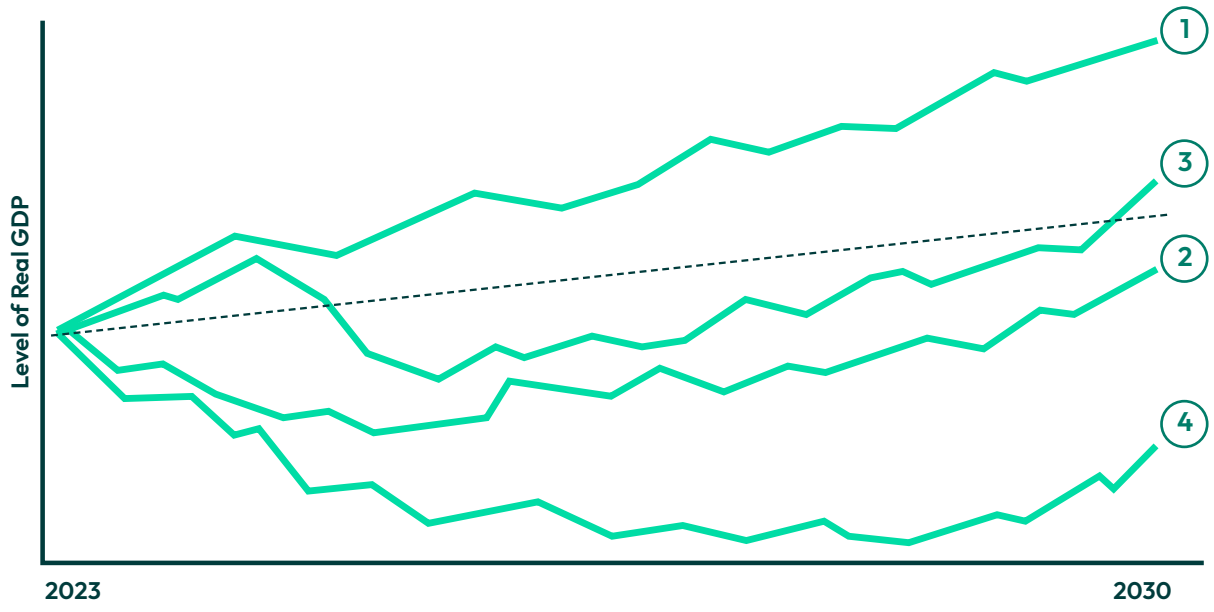
3. Four Scenario Narratives to 2030

The illustrative physical climate narrative underlines the fact that over the rest of the decade, even in the absence of crossing key climate tipping points, the increasing volatility of weather sets a striking context for all four of our scenario narratives. Moreover, even if the world succeeds in reducing its GHG emissions over this period, it will have no material impact on the physical risks that it faces. As a result, our narratives focus is on the political and economic drivers of transition risk, and their interaction with extreme weather.

In section 1, we noted that volatility is embedded in our narratives. This is in stark contrast with the smooth pathways mapped out by the long-term reference scenarios used thus far; even the 'disorderly' scenarios produced by the NGFS are characterised by a single one-off shock, often after 2030. To highlight the point, rather than a trend GDP growth rate, our scenarios have distinctively different pathways for GDP through the rest of decade, with profound consequences for politics, markets, technological progress and consumer behaviour, not to mention GHG emissions. The figure below shows illustrative 'stylised paths'[15] for global GDP in each case.

Figure 6

Stylised Paths for Global GDP, 2023-30



1 Roaring 20s 2 Green Phoenix 3 Boom & Bust 4 Meltdown

[15] In this report, we describe the scenarios in qualitative terms only. We intend to examine the pathways in more quantitative terms at a later stage in the project.

On the political front too, there is ample scope for further volatility over the remainder of the decade. The aftermath of Covid-19 and the ongoing war in Ukraine are but two of the obvious drivers of this. As we have seen, it is possible for political shocks not just to accelerate policy action, but even reverse it, a possibility that is noticeably absent from current reference scenarios. In our narratives, we consider the potential upsets that could flow from the political calendar shown in the figure below.

Scheduled General Election (or equivalent)

US 2024 and 2028

EU 2024 and 2029

Japan 2025 and 2029

Germany 2025 and 2030

India 2024 and 2029

United Kingdom 2024 and 2029

France 2027

Canada 2025

Australia 2025 and 2028

Russia 2024 and 2030

Brazil 2026 and 2030

Scheduled Convention of the Parties (COP)

Dubai 2023

E Europe (tbc) 2024

Brazil 2025

Scenario 1. Roaring 20s - policy and markets align

Proactive climate policies and dynamic markets create powerful positive feedback loops. More extreme weather events focus minds and create a sense of global solidarity around a recognition of humanity's mounting debt to nature. Constructive competition between nations accelerates technological progress and deployment.

Geo-politics & Climate Policy

An easing in geo-political tension allows global policymakers to accelerate in the Race to Net Zero. Russia is forced into a peace deal in 2024 by Ukrainian battlefield successes, paying reparations in return for a phased but partial unwinding of Western sanctions. This triggers a substantial economic rebound and a relief rally in the financial markets as commodity prices, inflation and interest rates drop in response.

Economic recovery reinforces confidence in the green transition, and political parties supporting strong climate action benefit in the wave of elections in 2024. Successes in the EU and UK are followed by a landslide victory for US President Biden. Although the Democrats fail to win the Senate, popular support for the Inflation Reduction Act (IRA) allows Biden to join other leaders in strengthening commitments to decarbonise, as more countries write them into law.

Earlier, the COP28 conference in December 2023, had made surprisingly good progress despite the fact that the Ukrainian war was still ongoing at the time. The UAE host succeeded in gaining a toughening in the language around the phase out of fossil fuels and securing agreement to create a "Clean Energy OPEC" to mobilise with global targets for wind and solar by 2030. Discipline in OPEC+ begins to fray, major oil consuming nations enter constructive negotiations to manage fossil fuel prices in a broad corridor in return for an agreement from richer OPEC members to fund renewables in emerging economies.

Competition with China for leadership in renewables becomes a 'race to the top' rather than a destructive trade war. Although China continues to lead, even stepping up its targets for renewables, and ramping up on storage, hydrogen and nuclear, this is a spur to redoubled efforts elsewhere to catch up. Public investment and subsidies catalyse the growth in green technologies. The US, EU, the UK, Japan and other developed markets reach agreement on domestic subsidies and sourcing requirements, co-ordinating investments and co-operating on critical materials.

Political support for the COP process gains further momentum as the Bridgetown Initiative on global climate finance is embraced and the Multi-Lateral Development Banks take a larger more assertive approach. Brazil hosts COP30 in 2026, following the re-election of President Lula, securing a dramatic breakthrough in financial support for the Global South. Growing funding for mitigation, adaptation and loss and damage is warmly welcomed in the emerging world.

India pragmatically reduces its import tax on solar photovoltaics (PV), largely from China, while stepping up investment in domestic PV manufacturing with the help of a targeted GST (Goods and Services Tax) reduction. It succeeds in reaching a peak in its greenhouse gas emissions by 2030. After devastating wildfires in the Amazon in 2027, Brazil secures international financial support to get its goal of ending deforestation by 2030 back on track.

Strong economic growth provides the funding to accelerate the deployment of green technologies, with the emphasis being placed on the most promising and material sectors and technologies. Public policy is directed towards clearing away constraints from permitting and planning, infrastructure, energy distribution and storage, and critical metal and mineral supplies.

A World Trade Organisation system is developed to co-ordinate carbon pricing, and carbon border adjustments are structured in such a way as to limit domestic protectionism. Revenues are redistributed by national governments to drive just transitions locally and globally to support those displaced by the decline of carbon-intensive sectors, and help those hurt by the effects of extreme weather

Consumption taxes and subsidies on energy and resource use are transformed radically to shift the burden away from the poor towards the rich, as well as create smart incentives to help manage demand and peak-load pressures. The concepts of double materiality and natural capital are increasingly adopted by regulators later in the decade. AI and digitalisation facilitate transparency for climate and nature-based reporting and transitioning.

Economics

Growth is robust and sustained, accelerating through the rest of the decade as public policy catalyses private innovation and investment. The green transition is increasingly perceived more in terms of opportunities than risks, and AI is leveraged to great effect to power a positive productivity shock.

The strong downward trend in the cost of green technologies reasserts itself as scale economies and learning effects kick in. Potential supply constraints on the energy transition are addressed by the 'whole systems perspective' that becomes the norm among policy makers. While supply is stimulated, demand is managed, ensuring affordable access while penalising excessive resource consumption. With productivity rising, inflation is held in check despite robust growth. Strong returns on investment are reflected in real interest rates, which edge higher.

Major fossil fuel importing nations in Europe and Asia enjoy a green growth bonus relative to high cost energy producing nations, notably North America and Russia. The Middle East, Australia and parts of Africa and Latin America emerge as major exporters of solar-based fuels and relocating energy-intensive industries. Although China continues to benefit from its lead in green technology, strong public policy support in the US, the EU and the rest of the developed world helps to accelerate technological progress, production and deployment.

Carbon pricing systems become more pervasive, notably in Asia. Revenues from progressive green taxation are ploughed back into green investment and infrastructure, as well as transitional support to cushion the stranding of assets and labour in carbon-intensive industries.

Taxes and pricing systems to curb the use of other resources and environmental degradation spread out from the developed world, incentivising recycling and circular business models, with the revenues also being redistributed to aid just green transitions. The emerging world draws the benefit from the developing nature asset class and the need for climate friendly agriculture and land use.

Finance

Robust growth and rapid technological progress spark the required acceleration of financial support for the green transition. Public policy plays a catalytic and supportive role with price and regulatory incentives, leveraging public funding with 'first loss' capital to de-risk private flows.

Annual funding for the global energy transition doubles to over USD 2tn by 2025, and doubles again by 2028 as climate policy gains momentum from popular support. The newly re-elected Biden Administration agrees to align its subsidy regime with the EU and other developed nations, which gives further impetus and clarity to private financing.

Transparency is progressively increased by mandatory disclosures, which are quickly followed by the implementation of transition plans, including by asset owners. From 2026, annual reporting of climate transition targets, under new ISSB standards, creates a positive feedback loop through regulatory, investor and civil society scrutiny. By the end of the decade most major jurisdictions implement International Sustainability Standards Board (ISSB) reporting. Natural capital reporting also follows quickly, triggering a particular focus on land use and agriculture.

The shift towards global co-operation over fossil fuel prices and carbon markets gives clarity to mainstream finance over the pace of transitioning away from fossil fuels and towards renewables. Although the rapid transition inevitably creates dramatic sectoral realignments, this clarity helps to limit asset price volatility and asset stranding of fossil fuel and mistaken green investments, limiting the disruption of the required recycling of capital.

State support and the continued availability of insurance, backstopped by the public sector where necessary, further eases transitional losses. The unpredictably of returns is reduced by a de facto global agreement on the phased wind-down of fossil fuel production, which rules out the need for competitive greenfield investments. Fears of the bankruptcy of fossil fuel majors are allayed, and they avoid the threat of tobacco industry-style class action lawsuits. As a result, asset price growth is generally strong throughout the period.

There is an explosion of money inflows into global ESG mutual funds, ETFs, derivatives instruments based on underlying sustainable indices, and sustainability bonds, creating deeper and more liquid markets. New capital market instruments are facilitated by predictable and clear policy and regulation, supporting the funding of aligned services including infrastructure (such as grid and storage) and nature-based solutions (including decarbonisation, biodiversity, water). Pension funds build on risk mitigations offered by governments and development banks to increase long duration investments in the transition, sustainability and regeneration.

In the retail finance domain banks and other financial institutions develop new financing models with energy providers, manufacturers and installers. These include 'temperature as a service[16]', 'mobility as a service'[17] models to accelerate consumer adoption of green solutions by relieving them of the burden of funding the upfront investment to replace or retrofit transport fleets and real estate. Circular business models are given a lift by environmental taxation, which incentivises vehicle and other asset sharing, as well as extended ownership models with high recycling-based end-of-life valuations.

Carbon markets grow rapidly in maturity and size, crucially in China and the rest of Asia. Agreement is reached in 2026 for the World Trade Organisation to co-ordinate the markets globally, albeit initially in 'carbon clubs' of like-minded nations in specific carbon-intensive sectors. Genuine verifiable carbon removal certifications, severe penalty mechanisms and supply limitations are established, enabling them to become integrated with traditional markets, and derivatives markets grow, enabling risk management activities.

Funds flows to emerging markets are unleashed by breakthroughs in COP negotiations over climate finance funding and the decision by China to join the West in granting debt relief. Multi-lateral Development Banks (MDBs) embrace a new role in de-risking private investment following the Bridgetown reforms. This lowers the effective cost of capital for emerging markets. External finance rises to USD 1tn per year by 2030 as private funds flows are 'crowded in'. Tropical nations including Brazil, Congo and Indonesia fund restoration of rainforests and grasslands by selling natural capital credits to polluters in China and the developed world.

Technology

The public and private sectors work in harmony to accelerate innovation and the deployment of the technologies required for the transition. Phase-out and mandates create market incentives for scaling production, which drives efficiency gains, while pricing subsidies further accelerate achievement of price parity with fossil-fuel based technologies. Policy plays an enabling role in deployment, helping to accelerate the roll out of needed infrastructure, including grids, storage, charging networks, easing barriers from planning, permitting and skilled labour availability.

In the current decade the focus is on solar, wind, batteries and electric vehicles, which soar through the take-off stages of their S-curves of adoption as capabilities scale and prices fall. More green technologies such as residential heat-pumps, green ammonia, green hydrogen and alternative proteins surpass price parity and reach take-off before the end of the decade. Hard to abate sectors such as steel, cement, shipping and aviation take longer, but public policy helps to accelerate progress through regulations (phasing out fossil fuels in favour of renewables), subsidies and seed investment.

[16] 'Temperature as a service' involves the providers supplying consumers with heating and air conditioning services while retaining ownership of the onsite systems. Consumers commit to pay for the temperature services without having to pay for the necessary equipment or maintenance.

[17] Consumers purchase access to vehicles or other mobility services without having to purchase or maintain the vehicles or transport systems.

Although the US and Europe start at a cost disadvantage to China, massive public investment, rapid innovation and pragmatism on trade allow green deflation to be the predominant theme of the decade. Emerging markets leapfrog coal to renewables, with Africa exploiting its solar potential.

Policy and regulation reward efficiency by incentivising energy and materials saving, sharing and circular business models. In transport, tax advantages and subsidies are granted for small EVs, bikes, car sharing, rental services and public transport. This reduces the burden of fleet replacement, electricity demand and charging infrastructure.

Digital technologies and AI supercharge the drive to sustainability, managing and lowering resource demand and facilitating an ongoing move away from physical to digital activities. E-commerce platforms such as Amazon prioritise circularity over consumption. Demand management and new materials innovation help to alleviate the pressures from the rapid investment in materials to support the transition, including lithium, nickel, cobalt, uranium, copper and rare earths.

Agritech innovations enable agricultural productivity to soar despite the adverse effects of climate change. This aids the pursuit of nature as well as climate targets. Calorific conversion in agriculture changes radically, as GHG pricing changes the production mix away from animals, fossil-fuel based fertilizers and wastage. Soil sequestration is recognised and scaled rapidly without loss of yields.

Consumer and Civil Society

The human toll exacted by extreme weather adds to civil society pressure for action. This is expressed not just through people's social, spending and saving behaviour, but in their political activism and voting. Governments respond as the decade progresses as they recognize the changing public mood. Supportive policies and green deflation mean consumption tipping points spread across sectors and markets.

Social norms shift against materialism, reinforced by progressive consumption taxation and sustainability education. Tax revenues on carbon and resource intensive consumption are used to support and subsidise greener alternatives. Public policy and commercial marketing embrace and cultivate surprisingly rapid moves away from big cars, big homes, long distance travel, red meat, and fast fashion in favour of sharing and circularity, localism and community, social interaction and services.

Consumers reward green companies for being 'cool' as well as cheaper. Public labelling of green products such as electric vehicles, heat pumps and recycled products creates consumer momentum. The growing middle classes in the emerging world leapfrog carbon-intensive lifestyles to cheaper and less polluting alternatives.

Governments and businesses embrace the 'just transition' and increasingly focus on helping disadvantaged communities and societies, which widens the popular support for climate action. This is particularly important in countries where the 'cost of Net Zero' continues to form the basis of a populist backlash against climate action. Rapid and responsible development of AI transforms education across society to support more sustainable and fulfilling work and lifestyles.

Savers, assisted by the transparent and consistent sustainability reporting, increasingly see their savings, investments and pensions as powerful transmission channels. This trend begins in Europe, but quickly becomes global.

The emerging world, which is especially vulnerable to increasingly extreme weather events, enjoys growing support from the developed world as civil society increasingly rewards governments' efforts to transfer financial and technological support. Philanthropies and mass campaigns support not just recovery and adaptation fundraising efforts, but also flows of government and investor funds for rapid mitigation efforts in agriculture, power, real estate and mobility.

Scenario 2. Green Phoenix (GP) – market-driven, while policy lags

Climate action is initially upended by stagflation, the geo-political fallout of a stalemate in Ukraine and badly-handled weather shocks. Popular anger builds and civil society gradually emboldens more enlightened businesses and local governments to step up and roll out mature green technologies, but progress is patchy and erratic.

Geo-politics & Climate Policy

Geo-politics remains fractious, with fragmentation between East and West, and North and South. Co-operation over climate change is stymied and competition over technology and resources constrains more than stimulates progress. Although some countries persevere with their Net Zero goals others backtrack in the name of energy security or cost savings.

The Ukraine war turns into a frozen conflict. Russia repels Ukrainian counteroffensives, enjoying some success with counterattacks, and the frontlines shift only modestly as both sides dig in. Rising defence budgets continue to stretch finances on all sides. Budgetary restraint and continued security worries play into the hands of populists and nationalists in Europe, undermining the appetite for climate action.

Divisions between China and the West deepen as China continues to chafe against US-led protectionism on technology and draws on the resources of an increasingly-dependent Russia. The West struggles to operationalise the 'derisking' of its supply chains, which continue to rely heavily on Chinese goods. Tensions over Taiwanese independence flare up sporadically, but China does not take military action. India's state fails to grasp opportunities for rapid progress, and falls short of its climate goals.

In the US, the lingering stagflationary environment, Ukrainian stalemate, and Biden's stumbling reaction to the weather shocks of 2024 lead to a narrow Republican victory in the elections. Although Congress is divided, support for Ukraine is nevertheless lukewarm which frustrates its attempts to defeat Russia. Given the benefits of the Inflation Reduction Act in the Red states, fiscal support for climate action is left largely intact, despite mounting budgetary pressures. However, Republican supporters in the oil states resist any acceleration in the wind-down of fossil fuel production or any moves to make oil and gas more expensive. The new Administration also shows markedly less enthusiasm for international co-operation on climate policy.

Domestic politics generally become increasing volatile and shortsighted in the face of global tensions and weather disasters. Food prices intensify frictions, and climate-sceptic politicians and parties make gains in the 2024-25 election cycle. Germany is a notable example as the SPD/Green coalition falls in the midst of a swing to the right in 2025. Although in the UK Labour win the 2024 election with a greener agenda, the narrowness of their victory constrains their ability to deliver on it. Many, but not all, countries soft-pedal or reverse on their climate commitments. The COP process struggles as nationalism prevails and protectionism persists. This leads to a further weakening in support for extra funding to emerging economies, which struggle in the face of economic, political and weather shocks.

Climate action depends heavily on bottom up but patchy initiatives from state and local governments, business and civil society. Mounting popular anger over lacklustre growth and the mounting toll from weather shocks begins to wear down support for political incumbents later in the decade, leading to a partial comeback of politicians more supportive of climate action. Previously hidebound governments increasingly respond to the clamour from business to rapidly deliver policy to mitigate systemic climate risk and support opportunity.

Democrats make a comeback in the US elections in 2028 in a hotly contested election. The narrowness of their victory in the Presidential election and the split result in the House and Senate elections means that renewed progress on climate policy in 2029-30 is slow.

Economics

Global economic growth suffers a renewed dip in 2024-25, as the Ukraine war rumbles on. Ongoing supply-side problems and higher food prices delay the hoped-for falls in inflation and interest rates.

The ongoing war between Russia and Ukraine leads to recurrent problems in the supply of food and fertilisers. Meanwhile, 'Super El Niño' related weather shocks disrupt supplies of a range of foodstuffs elsewhere, pushing up prices, depressing growth and heightening political problems. Emerging economies are particularly exposed, and fail to secure much needed international funding.

The subsequent recovery in 2025-26 is moderate, relying on a gradual easing in inflation and interest rates as well as business initiative. Businesses take 'bottom-up' action in the face of dysfunctional government policies, including counterproductive tariffs and widespread failure to address planning and infrastructure constraints.

Business initially engages in a costly shift to 'near-shoring' and 'friend-shoring' of supply chains. Under consumer and investor pressure, companies in the developed world start to take the lead on climate action by stepping up investment in already cost-competitive green technologies. The relative attraction of renewables grows, benefiting from lower material and labour costs.

Businesses become increasingly adept at "jurisdiction shopping" by switching from business-hostile to business-friendly markets. Some governments feel compelled to support national champions and attract foreign capital. But European businesses in particular pragmatically, if quietly, build their relationships with Chinese suppliers. In the emerging world, some commodity producers successfully exploit the continued rivalry between China and the West over scarce materials.

Growth is moderate but erratic at the end of the decade, as interest rates begin to turn up again, sparking periodic financial upsets and recurrent volatility.

Finance

The flow of investment struggles in 2024-25 in the face of the economic downturn, political tension, policy errors and financial market setbacks. Cross-border investment suffers as geo-political tensions and nationalism prevail.

In the US, the Republicans' electoral successes embolden some Republican States to persevere with partisan ESG polarisation and attacks on financial institutions' commitments to Net Zero. Pushback from business and mainstream Republican voter opinions mean that this legislative push ultimately largely fails, but not before some financial institutions take flight from some Red States and industry Net Zero alliances.

Indeed, as the decade wears on, consumer and investor pressure to act on climate mobilises the financial sector, albeit in an erratic and patchy fashion. This shift spreads from Europe to North America and beyond. Despite being made mandatory in only a handful of jurisdictions, ISSB-style disclosures take root and are gradually extended and refined, helped by tech-enabled measurement. Most US companies with operations overseas embrace ISSB-style disclosures when the US SEC fails to implement its climate risk disclosure rule.

Advanced technology also aids the development of global surveillance needed for insurance, but coverage begins to suffer from the reluctance of governments to provide support.

Pro-climate action governments exert what nudges they can to encourage ESG-led finance, but efforts are uncoordinated and lack of consensus on carbon pricing bedevils progress. Despite patchy political support, shareholders maintain the pressure on quoted corporates to lean into the transition and legal challenges continue to mount.

The mid-decade pullback in interest rates helps to spark an upturn in lending and investment, with an emphasis on proven technology opportunities. This plays into a tech-led revival in equity market fortunes. Companies generally look to deliver on their transition plans, which depresses fossil fuel investment and leads to disorderly stranding of carbon-intensive assets.

The financial damage from asset stranding becomes a recurrent political as well as economic problem. Heavily exposed investors in the US and UK suffer substantial hits, leading to periodic market volatility. Downturns are triggered in fossil-fuel producing areas in the US, Canada, Australia, and Indonesia, prompting political backlashes against green energy suppliers to the affected regions. Stranding also hits Russia, leaving it increasingly financially isolated and dependent on China, and the low-cost Gulf oil producers capitalise on their market dominance and plough their profits into downstream industries and renewables.

Although multi-national businesses get creative in navigating the dysfunctional geo-political environment, bottlenecks re-emerge as short-termism collides with systemic and material shortages. As a result, the decade ends with a renewed upturn in interest rates and further financial markets volatility.

Ultimately, political headwinds mean that overall funding volumes fall short of what is needed for the energy transition. Poorer emerging markets, where much of the investment is needed, suffer particularly with limited and costly flows of international capital.

Technology

Dysfunctional government policies slow progress on new technologies and infrastructure development, but more mature green technologies, such as solar energy and electric vehicles, continue to be rolled out. Technological innovation is directed to finding workarounds to constraints such as grid development and critical minerals, but progress in hard-to-abate sectors is harder in the absence of government support.

Geo-political tensions lead to continued frictions in trade between China and the West, but competition to build out capacity keeps prices falling, even if deployment of green technologies moves more slowly up their adoption S-curves than in scenario 1. In the US, while the Republican incumbency in 2025-28 reinforces the dysfunctional relationship with China, doubling down on protectionism, it leans towards supporting green tech. While there is no scaling up of the support from the IRA, Red states take full advantage.

Past lobbying by some business sectors in support of the fossil fuel economy is slowly overwhelmed by lobbying by businesses who clearly see the Net Zero economy will be in their business interests. Large multinational companies, including some of the oil and gas super majors, use their institutional, operational and technical heft to transition away from high emissions activities. AI and digital technology play an increasingly important role in the transition, helping to improve productivity, manage demand and lower costs.

Technology choices and energy mixes vary widely across countries and regions, notably with fossil fuel lobbies pushing harder for carbon capture and storage (CCS) and hydrogen in North America, Australia, the Middle East and the UK. By the end of the decade, the increasing severity of extreme weather events leads some countries to step up investment in geo-engineering, even in the absence of global agreement on its deployment.

Nevertheless, markets keep up the pressure to adopt the most cost-effective approaches. This leads to some stranding of high cost assets and abortive efforts by nationalist governments to protect their domestic producers with trade barriers. Emerging markets, facing severe weather and financing constraints, become increasingly reliant on finding and rolling out cheap solutions to their power, mobility and food production needs.

Consumer and Civil Society

The economic downturn and inflation of 2024-25 keeps the popular focus on living standards and energy security rather than the pursuit of Net Zero. Populist politicians and media channels reinforce this mood, making climate change an increasingly polarised issue.

Extreme weather events, badly handled by dysfunctional and cash-constrained governments, lead to social tensions and migration pressures. However, their growing frequency and intensity gradually push climate back up the agenda, helped by the economic recovery that takes hold through 2025-26.

Pressure from consumers, civil society and investors helps to galvanise action from business and finance on adaptation as well as mitigation. Price competitive green technologies are readily embraced by consumers, but adoption of earlier stage technologies struggle for want of policy support.

Fortunately, continued innovation makes green options the best option for many consumers, even without fiscal support. Thus electric vehicles (EVs) become not only cheaper to run, but cheaper to buy than internal combustion engine vehicles (ICEVs) and scale economies lead the price of heat pumps to drop below the cost of natural gas boilers.

Citizens, increasingly supportive of businesses that are clearly on a Net Zero path and accepting that everything cannot always be done for the consumer "for free", become a powerful political voice in countries where climate policy progress is ambivalent, or worse. Civil society, helped by enlightened businesses, states and cities, starts to campaign for foreign best practices to be adopted at home. Developed markets' multinational businesses and philanthropies respond to the changing popular mood by supporting emerging economies suffering from increasingly wild weather with emergency aid and funding for adaptation efforts and the deployment of cost effective green technologies. However, progress is often constrained by dysfunctional and unstable home and host governments.

The counterattack against climate denialism and delay gradually shifts the political balance later in the decade. The new Democratic administration in the US in 2029 follows earlier moves in Europe towards smart, fiscally-neutral, climate policies. They reinforce the greening of social norms by tilting the balance of taxes to favour green and circular products and services, and step up education and information efforts.

Progress is slower in many emerging markets, where weather shocks and crop failures lead to increasing economic and political instability. Nevertheless, the economic infeasibility of adopting resource-intensive Western lifestyles is seized upon by populists to reinforce 'green' national cultural norms.

Scenario 3. Boom and Bust (BB) – policy steps up after fossil fuel surge bursts

A Ukraine peace deal and easing of global geopolitical tension triggers an initial surge in economic growth which leads to overheating in major economies and higher fossil fuel prices. Policy is tightened in response, which leads to a bust, forcing governments to step in to provide support. A just green transition is driven by pro-active policies to ease private sector frictions and support the emerging world.

Geo-politics & Climate Policy

Geo-politics calms down and governments step up to lead the fight against climate change. Economic and market volatility is both the cause and result of more pro-active policy action.

The easing in international tension begins with a Chinese-brokered peace deal being struck in Ukraine in 2024, albeit a messy one that leaves Russia with part of its territorial gains and still subject to much of the Western sanctions. President Putin steps down in favour of another autocrat, but one who is more pragmatic and seeks some degree of reconciliation with the West as well nurturing Russia's relationships with China, India and OPEC.

The post war relief rally in financial markets helps political incumbents. President Biden is re-elected and doubles down on his green industrial strategy, while nurturing a more constructive mix of competition and co-operation with China on climate. The fiscal arms race over support for the transition intensifies. The UK Conservative government, unexpectedly but narrowly re-elected in 2024, falls prey to right-wing climate scepticism and falls behind in this race.

The rally in financial markets and fossil fuel prices turns into a bust in 2025, forcing governments to step in to support economic activity and lead the green transition. Distress is particularly acute in the shale belt in the US and Canada, which sees mass bankruptcies. LNG projects in Australia also succumb in a crowded market. Smart policies to incentivise the green transition and curb energy demand make the transition more affordable and just.

Meanwhile, extreme weather events, with especially shocking effects in emerging markets, boost political support for the COP process. That said, the urgency to respond to the carbon bust means that increasing reliance is placed on the major players to lead the way.

Governments in the West and the Gulf step up their financial support for the Global South. G20 Just Energy Transition Partnerships stimulate the necessary green investment that ties ex-coal exporting developing nations tighter to the West. This is welcomed by Indonesia and other Southeast Asian energy exporters whose regional heft has been damaged by the rapid collapse in global coal demand and prices.

The more pro-active policy approach catches some market players unprepared, as government choices of technologies are sometimes surprising and mistaken. Later in the decade, new international institutional bodies, structures and regulations are developed to deal with the bust fall-out and seek a more managed transition. Saudi Arabia and the Gulf States agree to an accommodation in the energy markets with China and other major consumers in return for cooperation on technology and downstream industrial development.

The theme of de-risking of supply chains is seen as less threatening by China as state-led scaling of decarbonisation gains momentum through the decade. The EU and India, as a big energy importers focused on depending on developing renewables, emerge as big beneficiaries of the carbon bust, thawing of relations with China and the partial rehabilitation of Russia. Emerging markets benefit from cross-border support for their agricultural and raw materials sectors.

Economics

An initial dip in global inflation and surge in economic growth in 2024-25 is followed by a renewed pick up in inflation, exacerbated by a weather-related spike in food prices and rising fossil fuel prices. The surge in fossil fuel prices, reflecting surging demand and post war dysfunction in Russia, gives further impetus to public and private investment in renewable energy, as the US and Europe step up their efforts to compete with China.

The burst of growth and rising inflation prompt central banks to raise interest rates, which culminates in a crash in the financial and energy markets later in 2025. Amid renewed talk of 'Peak Oil', cost-competitive Gulf oil producers become more reluctant to curb supplies, exacerbating the downturn in prices and expensive production in North America. Oil consumers, such as China, India and Europe see their growth benefit from lower prices. Consumers also benefit from the surge in investment in liquefied natural gas (LNG) precipitated by the Ukraine war, which results in substantial over supply later in the decade.

Bursting of the boom forces policy makers to step in with a renewed monetary and fiscal stimulus to support economic activity and cushion the blow of stranded assets and labour. This drives a recovery from 2026 through to the end of the decade. By the end of the decade interest rates are on the rise again as the earlier emergency easing is unwound.

The drop in wholesale energy prices gives governments the opportunity to raise carbon taxes. This helps to fund the stimulus and a just transition, as the proceeds are recycled into green investment and support to lower income groups. The pressure on fossil fuel producers is relieved somewhat by the global agreement with consumers to limit volatility by managing prices within a broad corridor, with Brent crude oil prices kept in a USD40-80/bbl range, making the transition less unpredictable.

The shocking damage to the emerging markets from volatility in the commodity markets and the weather prompts a belated step-shift in resource transfers from the developed world from 2026 onwards. These address adaptation and loss and damage as well as mitigation needs. For the poorest, debt relief provides a lifeline.

Finance

Relief at the ending of the Ukraine war, a dip in inflation and interest rates, and expectations of green-led recoveries produce an across the board rally in financial markets through 2024 and into 2025. Strong growth and rising fossil fuel prices then trigger a renewed upturn in inflation and interest rates, culminating in a bust in late 2025. This creates financial stress which disrupts investment.

Losses on fossil fuel investments, combined with the expectations of a government-led green transition, turn the prospect of asset stranding into a reality. North American banks that have overextended on loans to shale oil and gas, and investors in Australian LNG are among the casualties. Government support softens the blow, with public bailouts of some stranded assets, but governments struggle to fund this activity, faced with the prospect of nationalising some private sector financial institutions. Voluntary carbon markets are a further casualty of the carbon bust, amid scandal and acrimony.

Financial institutions are again chastened, and the governments' determination to pursue the green transition prompts a tipping point in the financial sector's thinking. Tougher regulation and capital adequacy rules on carbon-intensive assets underline the rethink. Volatility is heightened as investors seek to discern – and position themselves for – the unavoidable repricing of risk and opportunity.

In response, regulators, led by the US and Europe, devise new regimes to incentivise longer term investments, with pension funds aggregated into transition superfunds. The debt asset class grows relative to equities. Private green finance follows behind public, focusing on fixed assets and infrastructure projects. Unproven technologies struggle for public market funding, relying on private equity and venture capital.

With banks and other financial institutions licking their wounds after the carbon bust, big public investment is required to overcome lack of private finance for household transitioning. In developed markets, governments are forced to take the lead in retrofitting homes with clean heat and cooling systems, and the infrastructure for the electrification of transport systems.

The Bridgetown Initiative to mobilise global official finance is agreed at a successful "Bretton Woods +80" conference (COFP1) - albeit held in 2025 - as the UNFCCC realises that the COP process needs bolstering with COFP, the Conference of the Financial Parties. Multi-lateral Development Banks (MDBs) come to realise that these economies need a significant intervention and so make a step change in their active support for G20's Just Energy Transition Partnership (JETP) initiative. This combines national policy acceleration, private capital mobilisation, and a range of blended finance tools.

Acute physical risk shocks are mitigated by extension of public insurance schemes, and official finance flows to help afflicted emerging markets with funds for loss and damage and adaptation. The developed world succeeds in persuading China and the Gulf states to join in providing much needed financial support to the emerging markets. Sovereign wealth funds and MDB-backed blended-finance follow on by investing in emerging markets, for example in renewables in Africa and the Middle East with interconnectors to Europe. Natural capital backed financing begins to take off from 2027.

Technology

An initial surge in green investment, fuelled by strong government support and surging markets, is derailed by the sudden bursting of the boom in late 2025, which leads to economic and financial distress. Government support steps in to give renewed impetus in the late 2020s and the easing of geo-political tensions facilitates cross-border flows of state-of-the-art technology. Pragmatism prevails in relations with China, and AI plays an increasingly important role in the transition. The earlier hiatus, however, means that progress over the whole period lags behind the Roaring 20s scenario 1.

Governments make concerted efforts to support the deployment of technology by addressing barriers such as permitting and planning, regulation and supplies of critical metals and minerals. Although public funding is damaged by the downturn in 2025-26, government support for key infrastructure development, R&D and fiscally-neutral tax incentives are central to the subsequent recovery. The unemployment resulting from the carbon bust reinforces the imperative to retrain the labour force.

The growing cost advantages of the renewable energy and electric vehicles mean that they are deployed at speed, helped by some softening in protectionism around technology transfer. Official funding flows to support the accelerated rollout of renewable power in Africa, South Asia and Latin America.

However, the mid-decade financial crash inevitably delays private innovation and investment in new technologies at earlier stages in their S-curves of adoption. Governmental efforts to back winners with fiscal support and regulation also creates some lock-ins to some weak technology choices. This undermines entrepreneurial dynamism and enables some regulatory capture by large and powerful incumbents, notably on emissions removal technologies such as carbon capture and storage and, later, geoengineering.

Governments exert growing influence over global agriculture and land use at an early stage as the focus on natural capital and biodiversity grows. Amid mounting threats from extreme weather, emerging markets attract increasing global support for their food systems and there are efforts to curb the growth in the demand for meat.

Consumer and Civil Society

High fossil fuel prices in 2024-25 renew demands from consumers for government aid and prompt some push-back against Net Zero policies, but politicians successfully turn this into support for a more rapid green transition. Activism against fossil fuel companies resisting this intensifies, but the fall-out from the subsequent bursting of the boom temporarily creates stranded labour as well as assets which forces governments to step in again.

Consumers are initially blindsided by the sudden shift in resources in response to the policy turning point, but an emerging consensus develops as they are persuaded that the private sector has failed to deliver human welfare. Bailouts of failed fossil-fuel companies lead to popular anger, but civil activity dissipates as citizens fall in with the pro-active approach of those in power.

Although price tipping points for green products are reached more slowly than in the Roaring 20s scenario (1), government regulations and incentives help to change consumption habits. Strong policy drives the agenda, dragging consumers along, with stronger messaging and nudging towards greener choices, backed up by tougher regulations. The carbon bust makes households reluctant to make the capital outlays to 'green' their homes and vehicles, prompting governments to step in with national programmes of education, investment, subsidies and regulation.

The increasing frequency and severity of extreme weather events leads to local divisions and popular anger. This is calmed by increasingly proactive government responses, particularly focused on lower income and disadvantaged households. Developed economy governments respond vigorously with funding and investment to pre-empt climate-related migration flows within and out of emerging economies, notably to shore up ailing food systems. Africa and South Asia, at the forefront of the climate shocks, receive strong support. China, which suffers traumatic damage from tornadoes in 2028, ploughs scarce public resources in to rebuild and restore social stability.

Scenario 4 Meltdown (M) - policy failures compound weak growth

Climate policy is the casualty of mounting geopolitical tension and protracted recession. A Republican victory in the US elections is followed by Ukraine being partitioned and tension with China undermines global decarbonisation efforts and technological progress. Extreme weather events are badly handled, triggering famines, mass migration and political instability.

Geo-politics & Climate Policy

Geo-political tension intensifies as nationalism and division feeds off weak economic growth. Ukrainian setbacks in their war with Russia lead to President Biden's defeat. The election of a populist Republican President weakens support for Ukraine, which is subsequently partitioned as Russia claims victory. Recriminations destabilise US-Europe relations and relations within Europe, and defence and security become greater priorities. Fossil fuel interests world-wide successfully lobby for the maintenance of subsidies, and governments take advantage of the falling price of renewables to tax them. Friction with China complicates trade in renewable energy and tech equipment.

A formal China-Russia defence alliance following the partition of Ukraine leads to heightened tensions in the Taiwan Strait, East Asia and Africa. Given the new US Administration, realization that US support will not be forthcoming in a conflict with China, leads Taiwan to gradually move closer into China's political orbit. This reduces the flow to the West of the cutting-edge technologies needed for the green transition. The US reacts with more counterproductive tariffs against China.

In the US, the President, recognising that the IRA benefits his voter base, leaves its subsidies for renewables largely intact. However, he succumbs to lobbying for more support for US fossil fuel interests and again steps away from international cooperation on climate change. He reinforces the domestic sourcing requirements with higher tariffs, rebuffing EU efforts at compromise, and as a result walled markets for green technologies through trade barriers become the norm.

China backslides on its Net Zero goals in the midst of geopolitical competition, regional tension, the availability of cheap Russian oil and gas, and the dirty energy vested interests of coal-dependent provinces and state owned enterprises.

Europe finds itself torn between an increasingly isolationist US and a troublesome Chinese-Russian alliance. EU unity is threatened by the temptations of cheap Russian fossil fuels and the need to secure Chinese renewable technology and materials. Talk emerges of a "Carbon Curtain" dividing Europe where once the "Iron Curtain" stood. Green policies are watered down, which is given further momentum by the election of a far right candidate as President of France in 2027. This decisively tips the balance in favour of populists in the EU. In the UK, a weak Labour-led coalition government is defeated by a more populist Conservative party attacking 'costly' climate policies.

Many countries fail to meet or even backtrack on their Net Zero commitments, although some fossil-fuel importing nations persevere with their Net Zero policies, albeit in the name of 'energy security'. Polluting industries, notably in Asia and the US, are protected with tariffs, growing subsidies and lax and relaxed environmental regulation in a desperate effort to protect jobs from technological change. Emerging markets struggle to compete in the subsidy arms race.

As Western relations with China cool further the COP process stalls, increasing tensions with the Global South, which is deprived of financial support. Deforestation and desertification continue at pace for want of firm government and funding.

Extreme weather events are badly handled, which adds to political and social instability. Heat stress, hitting wet bulb temperatures, leads to hundreds of thousands of deaths, notably in India and across Africa. Famines, food riots and mass migration spill-over into cross-border conflicts and fragmentation.

Economics

A prolonged recession ensues from political, economic and financial turmoil. Protectionism compounds the problem by disrupting trade flows and supply chains, thereby raising inflation and interest rates. The global race for securing supplies of critical minerals feeds into the politics of friend-shoring and the roll out of renewables is constrained. The resulting shortages and inefficiencies curb innovation and cost reductions.

Recession eventually leads to lower inflation and interest rates, but not back to the levels of the 2010s. Energy prices also fall back later in the decade as OPEC discipline splinters, but underinvestment and trade disruptions limit the fall. Energy security continues to take priority over Net Zero commitments, which depresses productivity and raises inflation. Companies also back away from climate commitments as their finances are squeezed.

With unemployment high, central banks increasingly find their anti-inflation mandates under political assault. The populist Republican administration leads an attack on the Federal Reserve, whose mandate is altered to prioritise employment and raise its inflation target. Populist governments elsewhere follow suit, causing fresh bouts of financial market distress, as bond yields move chaotically higher.

Energy importing developed markets such as Europe and Japan face particularly strong growth headwinds as protectionism hurts their exports and raises their import costs. Although the roll out of renewable energy becomes a security issue, high inflation, interest rates and public debts constrain the pace of investment. Efforts by some major corporations to shift investments to the US lead to intensified political frictions and damaging financial volatility.

Although China benefits from its dominance in renewables and access to materials, not least from Russia, its growth is hit by the damage to its exports from weak global growth and protectionism, and to its domestic growth by a plunge in land prices in 2025. It seeks to address its mounting debt problems by leveraging its renewables dominance to increase its access to markets in Asia, Africa and Europe. Russia enjoys a post-war recovery, helped by its Chinese alliance and increased export revenues, but of its efforts to rebuild its market in Europe enjoy only mixed success and later in the decade it is hit by competition from lower cost OPEC producers which leads to stranding of some its fossil fuel assets.

Some low income countries, notably in Africa, struggle under the weight of their debts as China continues to resist co-operating with other international creditors. Reshoring and AI compound the economic woes of the emerging world, stunting their industrial development. Growth is also hit by extreme weather events, high inflation and interest rates, underinvestment in agriculture and power, and outward migration of labour. This is a perfect storm for India's economy, which is one of the major casualties of this scenario.

Finance

Financial markets are depressed and increasingly volatile throughout in the face of the recession and political instability. Financial institutions are hit by huge losses on corporate and sovereign failures, and fall back on state support. Finance for the transition slows to a trickle, while funding for still-subsidised fossil fuels is maintained as short-term national interests prevail. Scarce public funding is diverted to financing adaptation as global commitment to mitigation weakens.

Despite the ongoing reliance on fossil fuels, price volatility and trade barriers mean that some high-cost fossil fuel assets, notably in North America and Russia, are stranded, along with some overambitious renewable investments. Support from governments is patchy, compounding the losses for heavily exposed investors, notably in the US and UK.

The backlash against Net Zero policies, ESG investments and carbon markets is keenly felt in Europe as well as North America, and legal action over greenwashing explodes. Investment horizons remain short and product innovations are noticeable for their absence. Plans to roll out mandatory climate and nature reporting collapse. The biggest winners in finance are some hedge funds who revel in this financial chaos. Industry alliances on climate action stall, the Glasgow Financial Alliance for Net Zero (GFANZ) dissolves and even the Net Zero Asset Owner Alliance (NZAOA) struggles to retain its members.

China, already struggling with its export markets, struggles to contain ballooning bad debts in its real estate market as land prices tumble in 2025. Although it remains reluctant to participate in debt structuring by emerging markets, it uses 'climate finance' as a tool of influence to gain supplies and market access.

Emerging markets suffer amid weak economic activity and the failure of developed markets to provide support, except for access to critical materials.

Development banks remain on the sidelines, underfunded by weak and distracted governments. There are recurrent defaults as creditors back away as extreme weather events and environmental degradation exact a growing toll. Island nations and struggling countries such as Bangladesh become unfinanceable, and sovereign defaults damage Western creditors amid a lack of co-operation from China.

As the decade wears on, commercial property insurance is also pulled from areas of high acute physical risk in developed markets including coastal areas in the US and Japan, Northern Canada, US mid-west, the North European Rhineland watershed, southern Spain, Italy and Greece.

Technology

Green technology innovation and investment suffers from the political, economic and financial turmoil. Less mature green technologies struggle to reach the tipping point of adoption due to pervasive infrastructure, planning, and trade barriers. However, fossil fuel importers persevere with the roll out of already cost-competitive renewable technologies, albeit under the banner of energy security rather than Net Zero.

Protectionism, political tension and badly-managed weather shocks create supply chain difficulties, limiting the scope for further green deflation, which slows adoption and deployment. Shortages of critical materials and walled markets create incentives for materials saving innovations, but while some governments prioritise this via regulation and funding, private finance remains scarce amid recurrent market volatility.

The movement of Taiwan into China's orbit disrupts the flow from Taiwan to the West of the cutting-edge technologies needed for the green transition. Global co-operation to prevent the malign use of AI is frequently flouted, leading to repeated economic and financial disruptions. Cybersecurity businesses thrive on the chaos, which is fuelled by toxic state-led co-operation between Russia and China.

The green retrofitting of commercial and residential real estate struggles to gain momentum, and power networks fail to grow at the required pace. Infrastructure problems constrain the roll out of EVs, but with public transport also suffering lack of investment, cash-strapped consumers turn to e-bikes and car sharing.

The solar and wind potential of emerging markets is constrained by the lack of affordable finance. Agricultural innovation and productivity falls victim of underinvestment, trade protectionism and repeated failure to adapt to increasingly frequent heatwaves, droughts, storms and flooding.

By 2030, some states, and even large companies, turn in desperation to geoengineering projects to maintain their own climates. Although this leads to political and legal battles, amid the deteriorating climate, it becomes a more popular option as the next decade begins.

Consumer and Civil Society

Extreme weather events compound political and economic problems and foment social instability. Food and energy security take precedence, and climate policy shifts to local adaptation from the global pursuit of Net Zero. This slows the roll-out even of price-competitive green technologies, particularly in the emerging world.

A volatile mix of low growth, high inflation and unemployment creates a sour mood across societies, and short-term economic and political priorities predominate. The diminishing trust – between and within nations - generates multiple fractious tribes at all levels of society, leading to a global blame game which undercuts collaboration. Malign use of AI compounds this as climate change is absorbed into the 'culture wars' through largely unregulated social media channels. Negative narratives abound in the mainstream media. The combination of toxic politics, massive losses and volatility, and corporate greenwashing scandals, fractures investors' action on climate change.

Growing inequality results in despair haunting wide swathes of the global population. Drug and gambling addictions rocket, while public health and law and order frequently break down in increasingly deprived neighbourhoods. In the developed markets, the masses struggle with household bills and switch from cheap fast fashion, which is undone by failing supply chains, seeking escape in online gaming and social media. Narcissism rules, and the rich ensure that luxury, financial and personal security services prosper as they migrate to neighbourhoods protected from extreme weather and crime.

Inequality is compounded by the growing number of physical disasters. These destroy homes and lead to food, water and energy shortages and price spikes.

Blows to agriculture and tourism hit poorer households and nations especially hard. Mental health and climate grief problems mount. Food riots become increasingly common in Africa, the Middle East, Latin America and South Asia as extreme droughts, fires and floods become more frequent. Such events undermine tourism in previously coastal, island and ski areas, hurting economies in the Sub tropics, Southern Mediterranean and Southern US. This is only partially offset by diversion of tourism to more northerly 'staycation' destinations.

As the decade wears on, waves of economic and climate-related migration from the Global South become an increasing problem, adding to social and political tensions. Anti-immigration parties gain strength, notably in Europe, and the US Republican Administration doubles-down on a nativist agenda.

Generally weak political leadership, fearing popular backlash, stymies coherent rhetoric and collaboration on climate change. Climate denialism continues to persist despite the abundant evidence of the damage from global warming, further undermining the political mandate for bold action and the business case for private sector leadership on the green agenda.

The political atmosphere is particularly bad in the emerging markets, where democratic governments are repeatedly overthrown, and tension grows in China, India and Brazil as extreme weather events undermine the incumbent regimes. Scarce fiscal resources are switched to adaptation as mitigation efforts falter, and by the end of the decade countries pursue quick fixes in the shape of carbon capture and storage projects and even geoengineering.

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With special thanks to Mike Clark and our network of experts (please see Acknowledgements)

Conclusion – No Time To Lose

Increasingly dramatic extreme weather events show that climate change is not just a potential long-term existential threat to humanity, but a clear and present danger to our welfare and wealth. Growing recognition of this needs to be reflected in a paradigm shift in the scenarios being used to take action to address it. Decision makers have no time to lose in acting on their commitments, even in the face of growing volatility and radical uncertainty. Simply waiting for more data or better models is no longer an option, they have to act on judgements based on more realistic and plausible scenario narratives.

The four scenario narratives set out in this initial report aspire to be 'decision useful', recognising that the short-term dynamics and implications of climate action will be dictated by the volatility of politics, economics, markets, technology and consumer behaviour. Global warming is not an uncertainty over the remainder of the decade, it is literally 'baked in'. What matters is how governments, businesses and society react in the face of the increasingly pervasive weather shocks illustrated in this report. Many organisations, not least in the investment community, are committed to playing their part in halving global greenhouse emissions by the end of the decade. It is disturbing that only in the most optimistic of our four scenarios does this look to be plausible. We have no time to lose.

Appendix: Scenario Drivers and Topics

The scenario narratives blend together developments in the key topics driving climate risks and opportunities. While **global** in nature, they need to embed material changes that will occur, and interact, within different geographies and sectors. Within the latter, some developments may reinforce or even run counter to the global narrative.

As a result, for each topic below **geographic and sector** expertise will also be required.

Topic Categories

1. Physical Risk

Acute (short-term) -> immediate, increasing non-linearly, location specific, driving transition risks

Chronic (long-term) -> (global) temperature pathways (NOT uncertain on horizons of less than 10 years, and therefore not a driver of 2030 scenarios)

Natural capital risks -> interaction with broader environmental and bio-diversity harms

2a. Geo-politics

Climate and Energy Policy, co-operation, conflict and protectionism, especially US vs China

Energy security – of supply (for consumers), of demand (for producers): quantity and price - Onshoring/ friendshoring/diversification Resource transfers (incl. The Bridgetown Initiative)

Key questions:

- Evolution of relations between China/Russia and US/West (including potential attack on Taiwan, tech competition)
- Outcome of Ukraine war and implications for relations with Russia
- Willingness of developed world to step up to support the emerging world

2b. Climate Policy

Policy commitments Nationally Determined Commitments (NDCs), targets and mandates and phase-outs (e.g. ICEs) – sector and technology specific

Regulation (Financial and Real Economy): Products, Governance, Reporting and Disclosure

Fiscal: Public investment (mitigation, adaptation, official aid), (Carbon) Taxes/Subsidies/Tariffs,

Transfers (Domestic and International – including loss and damage)

Institutional framework, market design and governance

Key questions:

- Degree of co-operation and constructive competition ('Race to the Top') and v.v.
- Willingness of major players to accelerate NDCs, e.g. through more radical tax and investment policies

3. Economic

Growth, its level, volatility, composition and distribution – > energy demand, emissions, investment

(contrast with smooth, linear pathways of general equilibrium models)

Prices – especially energy -> transition incentives

Resource availability (natural, human) -> scarcity or surplus

Key questions:

- Implications of departing from NGFS assumption of trend growth (SSP2)
- Implications of cyclical swings in activity and inflation on markets, politics and policy
- Implications of green investment (capex) on inflation, interest rates and growth

4. Finance

Scale and interaction of different forms of finance:

- Private: Banking, Insurance, Investment (asset owners and managers, Hedge funds etc), plus
- Public (national, state owned enterprises, sovereign wealth funds and international)
- Philanthropy

-> lending and investment portfolio allocation and volumes, risk management (credit, market, liquidity, operational, legal and reputational)

Public policy as catalyst for private investment -> derisk through first loss, capital requirements and reliefs (green, 'brown'), mandatory disclosures, transition plans, market design

Market pricing, asset prices and loans -> prospective returns and risks, defaults, stranded assets

Volumes, public, private and official flows (aid, blended finance cf The Bridgetown Initiative) and distribution -> investment and transformation of capacity

Key questions:

- Will the political and policy climate facilitate the required scale up of private finance?
- Consequences of potential price crashes 'Minsky moments' for energy and asset prices
- How far will regulation and stakeholder scrutiny depress public market financial flows and divert activity to private markets, unregulated channels and state owned enterprises?

5. Technology and Sectoral Trends

Renewables, storage and distribution -> pricing and diffusion (investment volumes)

Energy and power: Fossil fuel transition, hydrogen and Carbon capture, utilisation and storage

Transitioning transport, agriculture, buildings, hard-to-abate sectors

Whole economy transformation – consumption mix and efficiency

Role of policy in promoting R&D through funding, mandates, regulation, subsidy -> price and non-price tipping points

Key questions:

- How far will current or expected technological progress trigger financial asset price inflation and accelerated deployment?
- How far will deployment be constrained by resources, finance, protectionism or planning?
- How far will geographically differentiated tech capabilities and preferences trigger positive or negative spill-overs?

6. Consumer and Civil Society

Consumption patterns and social norms -> marketing, media and public education

Societal pressures, inequality (including 'stranded labour') -> political pressures and voting

Population and migration (long term)

Key questions:

- How far are green tipping points in consumption dependent on price and non-price factors?
- How far will civil society shift towards green policies or succumb to populist denialism?
- How far will extreme weather and climate grief create mental health and social problems?

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For members, for the future.

2023IIB077