Integrating Nature Within Climate Scenarios

A BSR tool to drive resilient business strategy

Updated in 2025 with
Key Nature Considerations and the NGFS Phase V Scenarios

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01 | Introduction

Executive Summary

Businesses are using scenario analysis to assess risks, build resilience, and meet disclosure requirements.

To support this, BSR has been exploring the integration of nature within its four climate scenarios, to understand the interplay between climate-nature and global socioeconomic, political, and technological developments.

At this stage, the integration of nature within these scenarios has been primarily through our narratives work, this represents our first attempt at creating nature-climate scenarios and will serve as a steppingstone for future, more integrated work.

Integrating Nature into Climate Scenarios

Current Policies

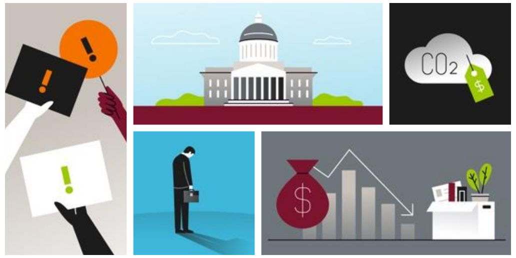
Only the policies already in force as of 2023 persist. Global temperatures rise **3°C by 2100** while biodiversity loss, deforestation and freshwater stress accelerate. Companies faced mounting supply chain and raw material risks from degraded soils, collapsing fisheries, and water scarcity.

Maps to RCP 4.5

Net Zero 2050

Early, decisive climate policy brings price shocks for companies as they transition to new supply chains, operations, and energy sources. Delayed nature protections and solutions improve biodiversity and land protection. Warming peaks near **1.6 °C in 2040** and falls to **1.4 °C by 2100**.

Maps to RCP 1.9



Delayed Transition

A decade of inaction is followed by a sudden, globally climate policy push in the 2030s. Emissions fell, but brought inflation, supply shocks, land conversion, and a scramble for land, water, and critical minerals in biodiverse regions. Warming is limited to **1.7 °C by 2100**.

Maps to RCP 2.6

Fragmented World

A breakdown of global cooperation splits nations into net-zero leaders and laggards, leaving fossil fuel extraction, land use, and resource consumption unchecked in much of the world despite aggressive action elsewhere. Physical damages increase and **by 2100**, the world sees warming **rise 2.4°C**.

Maps to RCP 3.4

These are the BSR climate scenarios which served as a foundation for layering in nature and biodiversity alongside physical and transition climate risks and opportunities. This document provides the extended scenario narratives, along with more information on sustainability reporting and how to use scenarios. Note that while each scenario features increasing physical risks from climate change over the next 15 years, those diverge significantly thereafter—with radically different outcomes over the long term.

02 | Background Information

About Scenario Analysis

The Case for Scenario Analysis

Scenario analysis can help organizations:

Identify and assess **climate and nature-related risks and opportunities** and stress-test **business strategies** against plausible futures.

Create more robust business strategies and financial planning by identifying management actions that are robust across a wide range of plausible futures.

Enhance **strategic conversations** by challenging business-as-usual assumptions and considering novel, disruptive developments.

Improve strategic agility by establishing indicators to monitor the changing business environment and rehearsing responses to disruption in advance.

Promote **collaboration among internal stakeholders** through shared discussion of key drivers reshaping the external operating environment.

Meet disclosure requirements and requests from investors and other stakeholders for information on climate and nature-related risks and opportunities, and the resilience of the business strategy.

Scenario Analysis in Financial Reporting

The Task Force on Climate-Related Financial Disclosures (TCFD) recommends that companies undertake climate scenario analysis to test and disclose the resilience of their business strategy. Many jurisdictions are developing climate-related disclosure rules and standards, often in line with the TCFD recommendations.

Recommendations

- The degree of robustness of the organization's strategy and financial plans under different plausible future states of the world
- How the organization may be positioning itself to take advantage of opportunities and plans to mitigate or adapt to climate-related risks
- How the organization is challenging itself to think strategically about longer-term climate-related risks and opportunities

Mandatory Reporting

- The EU's **Corporate Sustainability Reporting Directive** (CSRD) and **California's Climate Related Financial Risk Act** both prioritize the use of climate scenario analysis to identify and assess climate-related risks and opportunities and test the resilience of business strategies to climate change.
- The Climate-Related Disclosures Standard of the **International Sustainability Standards Board** (ISSB), which has been adopted by jurisdictions around the world, also includes climate scenario analysis as a key assessment tool.

The Task Force on Nature-Related Financial Disclosures (TNFD) builds on the TCFD recommendations by applying scenario analysis to nature-related risks and opportunities. TNFD recognizes the importance of integrated climate-nature scenarios for integrated planning. TNFD's framework is referenced in evolving guidance and regulations, including the ESRS, ISSB standards, and UK disclosure policy.

Recommendations

- Explore how different plausible futures could affect nature-related dependencies, impacts, risks and opportunities in the *Assess* phase of the LEAP approach
- Demonstrate that the results of the scenario analysis inform governance, strategy, capital allocation, risk management, and disclosures
- In the absence of a single global nature goal akin to 1.5C and off-the-shelf nature scenario narratives like NGFS or IEA climate scenarios, use a 'building blocks' approach to craft location-specific nature scenarios that reflect the context of nature-related issues for the organization

Mandatory Reporting

- The EU **Corporate Sustainability Reporting Directive's ESRS** incorporates all 14 recommendations of TNFD, including the use of scenario analysis in multiple ESRS environmental disclosure topics.
- The **ISSB** has begun formally discussing how TNFD guidance can sit alongside IFRS S1 and S2 guidance.
- The **UK *Green Finance Strategy* and *Nature Markets Framework*** endorse TNFD and signal an intention to consult on making nature-related disclosures mandatory

Considerations When Using These Scenarios

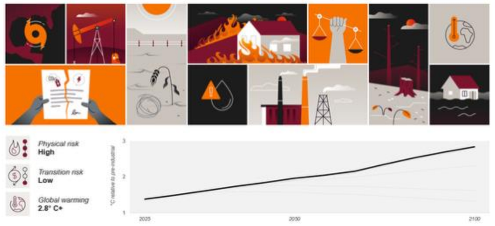
Scenarios are an important strategic tool that enable the **exploration of how multiple drivers of change may interact and converge to shape the future in different and unpredictable ways**.

When using these scenarios, it is important to remember:

1. The **scenarios are hypothetical constructs** that depict a set of different plausible climate and nature-related futures that will impact the operating context of business.
2. Although grounded in research and data, **the scenarios are not intended to predict** a single “most likely” future. Rather, they offer a complementary approach to forecasting, one that enables the exploration of highly uncertain future possibilities.
3. These scenarios use **broad descriptions to holistically describe plausible futures** based on the available climate data. **Not all topics are included in each decade** of each scenario. Instead, the scenarios highlight the defining topics and developments in each decade.

Current Policies

Minimal climate action today results in disastrous climate impacts and disruption by 2050.

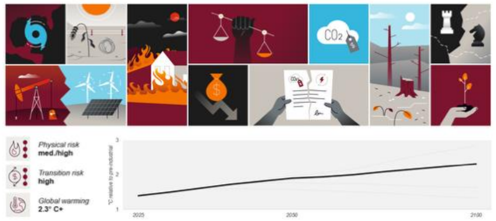


Delayed Transition

A decade of delays leads to hasty climate policies that greatly disrupt business and society.

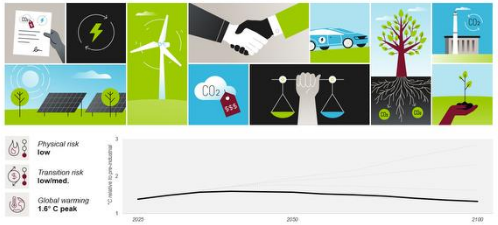
Fragmented World

A delayed and fragmented policy response leads to both high physical and transition risks.



Net Zero 2050

A cooperative global effort to act on climate change now drastically lowers climate risks by 2050.



How to Use These Scenarios

Use the scenario set to test your strategy, challenge assumptions, uncover blind spots, and identify additional actions to address climate and nature-related risks and opportunities. Resilient strategic ideas are those that work across most or all scenarios.

Taking each scenario in turn, ask:

- If this scenario were to transpire, **what would be the impacts on our business?**
- **What new challenges and opportunities would be created**, and are we prepared for these?
- **Are there any strategic moves** that we can make that would position the business to thrive across all the scenarios?

Be sure to **give equal consideration** to all scenarios rather than trying to choose “the most likely” scenario. History is full of unlikely scenarios causing great disruption. Scenario analysis provides an important opportunity to ask “what if” questions.

Discuss the scenarios among a diverse group of internal stakeholders because no individual expert has a complete view of the emerging future.

Consider drawing from the NGFS datasets to add additional data and further contextualize and tailor the scenario narratives to your organization and industry.

Stay up-to-date with nature specific datasets and projections and consider **targeted commodities and materials and near-term projections** as a following step.

Given that the scenarios take a global view, **consider the specific policy changes in your region** that may impact your operating context, and explore the regional data available in the NGFS or WWF, as well as industry-specific datasets such as ENCORE.

BSR can help your organization use these scenarios in a variety of ways, including informing strategy processes; conducting a TCFD-aligned scenario analysis; stress-testing plans, assessments, and targets; and designing more transformative and foresightful industry collaborations. For more information, please contact Ameer Azim (aazim@bsr.org).

Climate Methodology

Benefits of the NGFS Scenario Framework

A range of third-party climate scenarios are publicly available. Most of these are narrowly focused, explore only transition or physical risks, and are based on assumptions not always relevant for the business community. BSR chose the Network for Greening the Financial System (NGFS) scenarios as the foundation for this set of climate scenarios for several reasons:

NGFS
Central Banks and Supervisors
Network for Greening the Financial System

The scenarios were derived from multiple **reputable climate models** by the Potsdam Institute for Climate Impact Research, the University of Maryland, and the International Institute for Applied System Analysis, among others.

They were developed with reference to the TCFD recommendations and are suitable for all sectors, not just finance, to undertake climate scenario analysis in line with the recommendations.

They integrate **both physical *and* transition risks into the same set**, with shared assumptions and parameters.

They are accompanied by **substantial supporting documentation** and are regularly updated.

The NGFS approach allows for **the exploration of a broad range of temperature pathways as well as different assumptions** that better reflect the uncertainty of future conditions, and guards against model bias.

Scenario analysis results using the NGFS framework represent **aggregate sectors and markets** and can be a guide to assess individual company risks.

Building BSR's Climate Scenario Narratives

BSR's extended scenario narratives are holistic, qualitative depictions of plausible futures that explore socioeconomic, technological, and policy considerations. Grounded in the NGFS scenario framework and accompanying data, they were designed to provide companies with a broader view of business-relevant transition and physical risks. BSR developed them using the process below:

In consultation with an interdisciplinary group of internal and external experts, **identified key topics** that would broaden the scope and increase the business relevance of the original NGFS scenarios.

Researched trends that would drive the evolution of these business-relevant topics and brainstormed plausible pathways for each topic under each scenario, aligned with the parameters established by NGFS data.

Wrote an expanded narrative for each scenario, supplementing it with content that was drawn from NGFS supplemental documents.

Extracted data from the NGFS IIASA Scenario Explorer (Phase V) and **NGFS Climate Analytics Climate Impact Explorer**, with a particular focus on the most relevant variables for each scenario (e.g., include information on risk from high carbon pricing in scenarios where carbon price is expected to be higher).

Note: All qualitative content in this scenario set was added by BSR, while all quantitative content is derived from the NGFS datasets. Qualitative content is BSR's interpretation of how key topics might plausibly evolve across each scenario, grounded in the NGFS data and assumptions.

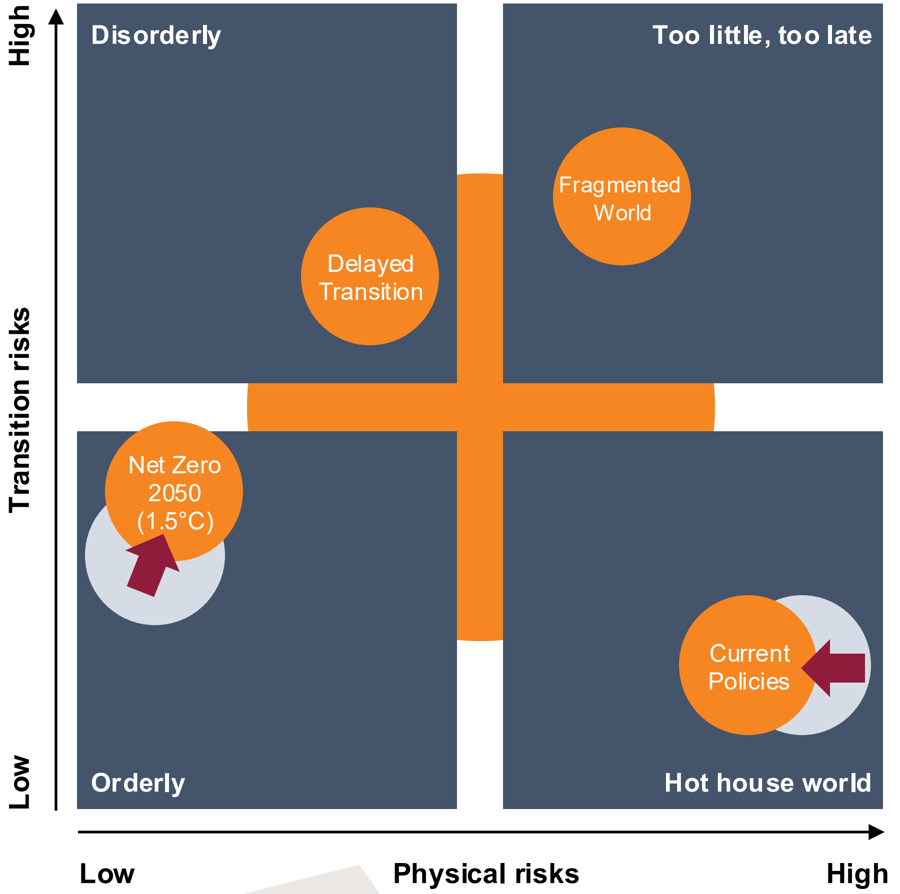
NGFS Scenario Framework Overview

The NGFS scenarios were developed to provide a common starting point for analyzing climate risks to the economy and financial system. They represent a global, harmonized set of transition pathways, physical climate impacts, and economic indicators. The framework describes four types of climate scenarios:

- **Disorderly** scenarios explore higher transition risk due to policies being delayed or divergent across countries and sectors. Carbon prices are typically higher for a given temperature outcome.
- **Too little, too late** scenarios assume that a late and uncoordinated transition fails to limit physical risks.
- **Orderly** scenarios assume climate policies are introduced early and become gradually more stringent. Both physical and transition risks are relatively subdued.
- **Hot house world** scenarios assume that some climate policies are implemented in some jurisdictions, but global efforts are insufficient to halt significant global warming. Critical temperature thresholds are exceeded leading to severe physical risks and irreversible impacts like sea-level rise.

BSR has created narratives for each type of scenario: **Net Zero 2050**, **Delayed Transition**, **Current Policies**, and **Fragmented World.** It has also highlighted **business-relevant data points** from the NGFS datasets that help quantify the physical and transition risks in each scenario.

NGFS Scenarios Framework Phase V



In Phase V, NGFS updated the scenarios to account for the latest data and policy commitments up to March 2024. The arrows show how the scenarios have shifted to reflect these updates.

Source: NGFS Climate Scenarios Database Technical Documentation V5 (2024)

Nature Integration Methodology

Methodology | Background & Context

Context:

In April 2025, BSR published its third iteration of its four climate scenarios, **Current Policies**, **Net Zero 2050**, **Delayed Transition**, and **Fragmented World**, following the NGFS Phase V data update. Each scenario uses a different global warming trajectory that leads to economic, physical, and social developments. For more details on the climate methodology, see the previous section.

Scope:

The following is BSR's first step toward integrating nature within its climate scenarios. Due to the limited availability of robust, open-source climate-nature scenario models and of access to biodiversity specific compatible data across horizons within our scenario models, the integration of nature within these scenarios has been primarily through narratives based on reputable third-party sources. As such, whilst nature considerations have been layered across all previously climate-focused narratives, **we do not yet consider these nature-climate scenarios, but rather a first step towards the integration of nature within our climate scenarios**.

Approach:

BSR devised a **data and research-driven methodology** for integrating nature considerations. Our approach, outlined in the following slides, has so far enabled us to make a first integration (primarily qualitative, though with some quantitative proof points) of nature within our climate scenarios. These narratives are flexible to future developments as the nature modeling and scenarios space evolves. **Accessible, nature-climate scenarios will be critical for organizations to understand how they drive and are at risk from nature degradation and biodiversity loss.**

Integrating nature within climate scenarios can serve as an essential foundation to embed ecosystem dynamics alongside climate projections, offering businesses a holistic lens that challenges outdated assumptions, helps avert maladaptive or myopic actions, and strengthens systemic and corporate resilience

Methodology | Process Overview

Using BSR's climate scenarios as a foundation, the following steps were taken to layer in additional nature impacts and dependencies.

1 Reflected on Climate Data Selection

- Isolated variables from the NGFS dataset that describe or lead to nature loss, such as expanded agricultural areas, fossil fuel extraction, or wildfires.
- Incorporated data points into our narratives with new quantitative information such as deforestation, habitat fragmentation or pollution.

To answer the questions: Could we leverage relevant nature-related variables from our climate dataset? Should we rethink the pool of data driving our narratives?

2 Layered Scenario-Specific Data

Leveraged data sources within scenarios where they matched our scenario assumptions and data:

- Current Policies: Nature Finance's *Degraded World*; Planetary Boundary Business as Usual (BAU)
- Net Zero 2050: IPBES' Climate First; Global Critical Minerals Outlook 2024
- Delayed Transition: Nature Finance's *Degraded World*
- Fragmented World: Nature Finance's *Degraded World*

To answer the question: For missing biodiversity-specific data in our dataset, is there external data compatible with our scenarios that we could include?

3 Linked to ENCORE Data

- Mapped the economic activities specific to each scenario to their corresponding ISIC code (International Standard Industrial Classification), e.g., extraction of crude petroleum.
- Linked ISIC codes to ENCORE's data to grasp:

✓ How business **depends** on natural systems (e.g., water, pollination, fertile soil), called "dependencies"

✓ How business **impacts** natural systems (e.g., through pollution, land-use change), called "pressures" or "impacts"

To answer the questions: How would the climate world in each scenario impact nature? How would the projected risks and climate measures interact with nature? How would that affect specific industries?

4 Recognized IPBES Drivers

Looked at how economic and climate trends affect nature via the IPBES framework and Thematic Assessment Report:

- Indirect drivers' impacts on direct drivers (i.e., GDP growth drives intensification of use change)
- Indirect drivers' impacts on nexus elements (i.e., GDP growth drives high negative impacts for biodiversity)
- Interactions among nexus elements (i.e., increasing food production drives negative impacts on biodiversity)

To answer the questions: What logical causal effects are seen between climate and nature? Could climate projections impact nature's contribution to people?

5 Considered Additional Impacts

Consulted additional data as relevant based on the underlying climate data and scenario developments:

- The Biodiversity Indicators Partnership
- WWF Risk Filter Suite
- TNFD
- IPCC Shared Socioeconomic Pathways
- Nature Finance Scenarios
- Planetary Boundaries Scenarios
- Network for Greening the Financial System

To answer the questions: What are other potential feedback loops we might have missed? Would they generate cascading, compound or cumulative impacts?

Methodology | Future Developments

At present, the availability of robust, open-source climate-nature scenario models is limited, reflecting a field that is still maturing. Within this context, BSR has prioritized laying the groundwork for future integration of nature within climate scenarios, as data and tools become more widely available.

Nature Modeling

The quantitative modeling of nature parameters would facilitate a more comprehensive analysis of climate and nature impacts, potentially enabling the estimation of cascading and compound effects as well as of potential feedback loops across climate and nature.

Layering in nature scenarios data will allow business users to better understand how nature impacts and dependencies interact and connect to their climate projections. However, this data will need to be amenable to their preexisting climate scenarios data.

The development of climate-nature scenarios is not without its challenges, but BSR sees this as an ever-evolving space critical for business resilience and effective transition planning.

Sector-Specific Narratives

BSR has started to apply its work to the sectors we support our members on. The first sector outlook we have piloted is the FBA (food, beverage, and agriculture) sector. In future work, BSR aims to expand its library of materials for additional sectors.

For the sector narratives, BSR prioritized layering in additional dependencies that are relevant to the sector at hand, provided by ENCORE, explaining how physical climate hazards impacted ecosystem services relevant for that sector. Sector impacts were also considered in each narrative, to understand drivers of nature loss and key considerations for business.

03 | Integrating Nature into Climate Scenario Narratives

Scenario Narratives Overview

NGFS Scenario Assumptions & Characteristics

Overall NGFS Assumptions: The four NGFS Scenarios have a 2050 horizon year and are differentiated by key design choices relating to long-term policy, short-term policy, and technology availability.

Individual Scenario Assumptions

SCENARIO	CURRENT POLICIES Only currently (2023) implemented policies are preserved, leading to high physical risks.	NET ZERO 2050 Stringent climate policies enable net zero GHG emissions around 2050, with delayed nature protections.	DELAYED TRANSITION Climate policies are delayed, which forces a very aggressive policy response starting in 2030.	FRAGMENTED WORLD Climate policies are delayed and globally fragmented, leading to high physical and transition risks.
Physical risks	**High physical risks**	**Low physical risks**	**Low–med. physical risks**	**Med.–high physical risks**
Impact of transition	**Low transition risks**	**Low–med. transition risks**	**Med.–high transition risks**	**High transition risks**
Global temperature rise*	3.0°C+ by 2100 (RCP 4.5)***	1.4°C, peak: 1.6°C (RCP 1.9)***	1.7°C, peak: 1.8°C (RCP 2.6)***	2.4°C+ by 2100 (RCP 3.4)***
Policy reaction	No additional**	Immediate and smooth**	Delayed**	Delayed and fragmented**
Technology change	Slow	Fast	Slow then fast	Slow then fragmented
Carbon dioxide removal use	Low	Medium/high	Low/medium	Low/medium
Regional policy reaction	Low regional variation	Medium regional variation	High regional variation	High regional variation

** above pre-industrial levels by 2100*
*** because NGFS's phase 5 data set was developed in 2024, this does not include any recent policy developments which may have strengthened or weakened ambition.*
**** IPCC's Representation Concentration Pathways*
Scenario descriptions based on the NGFS Phase V Documentation as well as data from NGFS Climate Impact Explorer and NGFS IIASA Scenario Explorer.

Overview of the Four Scenario Narratives

Current Policies

2020s

- Climate policy, along with efforts to protect nature, stalled
- Limited investment was directed to the energy transition while land-use change and resource exploitation expanded
- Physical climate and nature impacts accelerated and brought disruption

2030s

- Low carbon prices failed to reduce emissions, incentives to exploit natural resources continued
- Climate and nature impacts continued to accelerate
- Assets became uninsurable, lack of natural resource buffers intensified risk

2040s

- Short-term adaptation measures left nature behind
- Inequality was exacerbated
- Climate impacts caused exponential economic losses, biodiversity loss caused ecosystem collapse
- Multiple planetary boundaries are surpassed by 2050

Overview of the Four Scenario Narratives

Net Zero 2050

2020s

- Swift and forceful action was taken to reduce emissions, but rapid renewable adoption threatened habitats and natural resources
- Economies adapted, but not without struggle
- Climate and nature impacts continued to accelerate, warranting increased continuity planning

2030s

- Emissions reduction efforts brought unintended consequences for nature
- Efforts to tackle harder-to-abate sectors reduced emissions but intensified competition for natural resources
- Economies began to recover, with businesses starting to integrate people and nature considerations into their product and service strategies

2040s

- The world successfully reached net zero as nature protections gained momentum
- Climate and nature impacts stabilized
- Climate reparations facilitated increased equity, and continued biodiversity restoration efforts scaled

Overview of the Four Scenario Narratives

Delayed Transition

2020s

- Policymakers added minimal climate measures and largely disregarded existing nature provisions
- Reliance on fossil fuels continued
- Physical impacts became more apparent

2030s

- An abrupt climate crisis response began, and governments across the world set ambitious, yet often haphazard net-zero commitments
- Countries at highest risk of physical impacts scaled adaptation measures
- Businesses and citizens faced high compliance costs during the transition
- Decarbonization was ultimately successful, yet nature pressures persisted

2040s

- A low-carbon economy emerged, and attention shifted partially to nature
- Companies and governments began to focus on conservation and biodiversity restoration
- Habitats faced different pressures as heavy industry decarbonized
- Temperatures and physical impacts stabilized

Overview of the Four Scenario Narratives

Fragmented World

2020s

- Climate policy, along with nature action, stalled
- Energy systems remained reliant on fossil fuels, and impacts on nature became evident
- Physical impacts became more severe and apparent

2030s

- The global policy response diverged
- Fragmented global policies led to geopolitical tension and economic turbulence, but net-zero countries with greater nature protections were better at preserving natural capital
- Increasing climate and nature risks amplified inequality

2040s

- Complex trade systems intensified nature loss
- Progress from Net Zero-aligned countries alone was too-little, too-late
- Physical impacts from climate change continued to increase

Scenarios Full Narratives

Current Policies

Minimal climate and nature action today results in disastrous climate and nature impacts and disruption by 2050.

Key Scenario Characteristics

- A lack of climate and nature policies allow resource overexploitation and greenhouse gas emissions to continue business-as-usual
- Anti-globalism inhibits global supply chains, increasing biodiversity loss and natural habitat fragmentation, including habitat fragmentation, pollution, and introduction of invasive species
- Europe and Asia experience the greatest economic damages from heatwaves, while Africa, Latin America, the Middle East, and North America are most exposed to drought
- By 2050, fossil fuels still account for over 70% of the world's total energy needs

Key Scenario Assumptions

- 3.0°C+ warming by 2100
- No policy changes—continuation of policies as of 2023
- Slow technology change
- Low use of CO_2 removal
- Low regional policy variation

Current Policies

The 2020s

CLIMATE POLICY AND EFFORTS TO REVERT NATURE LOSS STALLED

Climate and nature policy stalled in the latter half of the decade due to **political gridlock** and **economic turmoil**. Supply chains suffered from declining ecosystem services.

ENERGY TRANSITION INVESTMENT LAGGED, LAND-USE CHANGE EXPANDED

Governments prioritized energy security, relying on fossil fuels, with extraction expanding into untouched landscapes, heightening **resource conflicts**, **ecosystem degradation and water stress.**

PHYSICAL IMPACTS BROUGHT DISRUPTION

Physical impacts like droughts affected a growing share of global communities and ecosystems, significantly disrupting agricultural yields, manufacturing, and transportation and causing some **industries to abandon export-dependent communities**.

The 2030s

EMISSIONS AND NATURAL RESOURCE EXPLOITATION ESCALATED

Fossil fuel extraction and infrastructure disrupted ecosystem services in aquatic and terrestrial habitats, **disrupting provisioning for nearby businesses** relying on inputs from these areas.

CLIMATE AND NATURE IMPACTS CONTINUED TO ACCELERATE

Chronic and acute weather events became more severe and frequent eroding ecosystem resilience, prompting forest and wetland conversion to cropland and redirecting corporate investments toward **reactive adaptation**.

ASSETS BECAME UNINSURABLE

With worsening weather patterns, **assets in high-risk locations** experienced rising premiums or were **deemed uninsurable**. Physical impacts and unsustainable exploitation further **degraded remaining "natural insurance"** such as mangroves and wetlands. Businesses onshored production in lower risk regions.

The 2040s

SHORT-TERM ADAPTATION MEASURES LEFT NATURE BEHIND

High-income countries invested in adaptation, leaving the middle- and low-income countries exposed, especially those working in nature-dependent livelihoods. **Poorly planned adaptation further threatened natural capital**.

INEQUALITY WAS EXACERBATED

Vulnerable populations felt the growing pressure of **food insecurity** paired with increasingly destructive **natural disasters**, feeding a burgeoning refugee crisis in Southeast Asia and Africa. **Companies received increasing blame** for driving up high prices and exploiting natural resources.

ECOLOGICAL TIPPING POINTS WERE CROSSED

Businesses were faced **with increasing costs of goods** had to **invest heavily in resilience** to withstand the exponential impacts of economic disarray, diminished ecosystem services, and physical climate impacts.

View from 2050

Policies implemented as of 2024 were preserved and **limited climate and nature policy action** were introduced into law.

↓

Without government or business action, **emissions failed to decline, allowing biodiversity loss to escalate.**

↓

Physical climate impacts increased in severity and frequency, causing exponential economic loss, ecosystem damage, and human rights issues.

The 2020s: What Defined the Decade

CLIMATE POLICY AND EFFORTS TO REVERT NATURE LOSS STALLED

- **Climate policy stalled** due to political gridlock, economic concerns, and the ascendancy of nationalist, anti-green parties. Environmental regulations focused on disclosures, resulting in low compliance costs for business. Warming diverged from a 1.5°C by 2050 trajectory.
- The lack of corporate climate and nature action resulted in the unsustainable exploitation of natural resources as businesses focused on growth. Land, freshwater, and marine system change, coupled with increasing pollution, amplified the risk of **ecosystem degradation and biodiversity loss** in critical biomes. This impacted supply chain resilience by destabilizing supply and quality of goods and services, and businesses began to face **sourcing disruptions, flat margins, and community discontent**.

LIMITED INVESTMENT WAS DIRECTED TO THE ENERGY TRANSITION WHILE LAND-USE CHANGE EXPANDED

- Most **governments continued to rely on fossil fuels**, with global investment reaching nearly US$1 trillion per year in 2030. Renewables (wind, solar, hydro) accounted for only 10% of the global total energy needs and less than 50% of the electricity by 2030.
- Fossil fuel extraction drove previously unthreatened ecosystems to become water-stressed, risking the quality of freshwater sources communities and economies relied upon. This decreased the supply of, and thus increased competition for, critical inputs required across industries such as uncontaminated water, forest products, and aquatic resources. Extraction sites pushed adjacent agriculture into previously undisturbed landscapes, **disrupting migratory pathways** and further increasing GHG emissions. In Kenya, fossil fuel activities out-competed agricultural production and rural livelihoods, forcing farmers into marginal land. **Land acidification**, driven by heavy metal and chemical discharges into ecosystems supporting agriculture, further **disrupted agricultural productivity**.
- **Businesses faced increased scrutiny** around environmental permitting and **tension with stakeholders** from local communities and Indigenous groups as access to traditional livelihoods, such as hunting, were diminished and access to resources decreased.

PHYSICAL IMPACTS BROUGHT DISRUPTION

- By 2030, the chronic impacts from climate change cost the global economy US$5 trillion annually. In Africa, droughts caused GDP losses of nearly 8%, increasing the risk of species decline and decreasing community access to water. Businesses sourcing from African nations struggled over **increasing food prices caused by crop failures**. In Asia, heatwaves drove 5% GDP loss as excessive heat and humidity disrupted fragile ecosystems, endangering flora and fauna. Countries south of the equator experienced **increasing species die-offs, habitat fragmentation, and the slow erasure of critical carbon sinks**. With regulating services to agriculture, logistics, and manufacturing losing effectiveness, **supply chain volatility rose**.
- Global climate impacts disrupted agricultural production, manufacturing, and transportation, leading to an increase in **climate migration**. This was exacerbated by **nationalist and anti-globalization** sentiment, which further threatened global supply chains.
- Companies relocated parts of their supply chains away from the most affected regions. In Latin American and African countries where enforcement of site-remediation rules for **textile and technology manufacturing** was limited, the exodus of global supply chains **stranded factories and other assets**, reducing local wealth and leaving community members struggling to find new employment.

Current Policies

SECTOR HIGHLIGHTS:

- **Agriculture and rural livelihoods** were forced to relocate due to expanding fossil fuel production and physical climate impacts.
- Droughts in Africa caused crop failures, and **food companies** had to raise prices to maintain profits.
- **Textile and technology manufacturing** in Latin America and Africa were stranded due to rising nationalism and physical climate impacts.

The 2030s: What Defined the Decade

EMISSIONS AND NATURAL RESOURCE EXPLOITATION ESCALATED

- Fossil fuels comprised nearly three-quarters of global energy needs by the decade's end. Roughly US$54 billion of natural gas power plants were added each year, with roughly 60% constructed in Asia, the Middle East, and Africa. The construction of pipelines, drilling sites and infrastructure in these regions drove erosion, land clearing, and habitat fragmentation, disproportionately impacting endemic species and other critical natural capital. Less stringent requirements and enforcement around the use of diesel, paints, solvents, and chemicals in construction operations and waste **increased soil, water, and air pollution, eutrophication, and ocean acidification**.
- Continued fossil fuel investment and offshore infrastructure expansion led to **migratory disruptions** and declining **aquatic** and **marine** ecosystem health and biodiversity. Toxic soil and water pollution contaminated local water tables, promoted land acidification, and deteriorated forests. Manufacturing companies requiring large quantities of freshwater faced increased costs and water scarcity.

CLIMATE AND NATURE IMPACTS CONTINUED TO ACCELERATE

- Physical hazards strained economies and food systems. Hurricane damages in the U.S. climbed 30% above 2015 levels, and **river flood** damage in Central Europe rose 80%. Crop failures in key breadbaskets sparked **export bans** and price spikes for staple grains.
- To shore up food supplies, governments converted forests and wetlands to cropland, **infringing on Indigenous natural and cultural capital**, increasing human disease exposure, and raising invasive species prevalence. These land use shifts weakened ecosystem resilience just as storms, heat and drought became more frequent.
- Offshore manufacturing hubs also became a major point of vulnerability as **ports and shipping routes faced increasing threats** (e.g., hurricanes, high winds, heavy precipitation). **Businesses redirected scarce capital toward reactive adaptation**, leaving even less for low-carbon technologies and nature-positive solutions.

ASSETS BECAME UNINSURABLE, LACK OF NATURAL RESOURCE BUFFERS INTENSIFIED RISK

- Climate damages reached 10% of global GDP by 2040, rendering many high-risk assets uninsurable. **Insurers raised premiums, restricted coverage, or exited entire markets**, including coastal U.S. regions and parts of Southeast Asia. Businesses increasingly relied on costly self-insurance or government relief, straining public budgets and balance sheets.
- Widespread insurance market withdrawal left vulnerable **wetlands, estuaries, and floodplains unprotected from erosion and contamination**. As these key ecosystems continued to degrade, driven by coastal development, pollution, and warming-related bleaching, their natural role in buffering storm surges and floods collapsed. This **loss of "natural insurance" intensified physical risks for built assets**, leading insurers to reassess exposure and driving up premiums or exclusions across entire geographies.
- As insurers reassessed exposure, asset values declined across entire geographies. **Companies pursued nearshoring and relocation** to less exposed regions, but rising land prices, persistent physical threats, and disrupted logistics undercut financial returns.

Current Policies

SECTOR HIGHLIGHTS:

- **Manufacturing companies** requiring large quantities of freshwater faced increased costs and water scarcity.
- **Construction of pipelines, drilling sites, and infrastructure** threatened endemic species and critical natural capital.
- **Ports and shipping routes** faced increasing physical climate risks, threatening **offshore manufacturing** stability.

The 2040s: What Defined the Decade

SHORT-TERM ADAPTATION MEASURES LEFT NATURE BEHIND

- Wealthy countries ramped up spending on adaptation such as constructing seawalls, flood defenses, and climate-resilient infrastructure, but the lack of global cooperation **hindered technology transfer** (e.g., drought-resistant crops, early detection systems) to middle- and low-income countries struggling to adapt. In many of these regions, **nature-dependent livelihoods**, such as small-scale farming, fishing, and tourism, suffered from severe ecosystem degradation that impacted food security, soil fertility, and biodiversity, further reducing local adaptive capacity, and intensifying economic challenges. Rural livelihoods eroded, driving migration to urban centers.
- Businesses that could afford it focused on **engineered solutions like bio-crops, greenhouse farming, and expanded transport corridors**, which sometimes disrupted water cycles, fragmented habitats, and raised maladaptation costs. These approaches often **delivered short-term relief while deepening long-term nature and climate vulnerabilities** by missing co-benefits.

INEQUALITY EXACERBATED

- Climate-driven **food insecurity and extreme weather intensified**, disproportionately affecting vulnerable communities. As agricultural productivity declined and commodity prices grew more volatile, **millions were pushed into poverty**.
- As **fisheries collapsed, farmlands dried, and forest-based livelihoods vanished**, large populations were forced to migrate, adding to geopolitical instability and increasing supply chain risk for companies reliant on those labor or production zones. Climate migration overwhelmed urban infrastructure and public services. Communities with limited adaptive capacity were **left without adequate protection, deepening inequality and driving social unrest**.
- These inequalities were further compounded by accelerating nature loss, where the erosion of natural capital deepened poverty traps, destabilized local economies, and elevated reputational and social license risks for companies operating in ecologically sensitive regions. As shocks accumulated, **businesses struggled to maintain trust**, and **political instability increased**, especially where **natural resource access was contested or poorly governed**.

CLIMATE IMPACTS CAUSED HUGE ECONOMIC LOSSES, ECOSYSTEMS COLLAPSED

- By 2050, chronic climate damages approached 15% of global GDP, with the **most significant losses stemming from droughts, heatwaves, and water stress in Africa and Asia**, limiting government funding of public services, recovery and adaptative measures.
- **Natural capital preservation was abandoned in lower-income countries** as they struggled to respond to physical and economic impacts: many governments removed some nationally protected biodiversity sites to cut maintenance costs and promote growth by allowing corporations to develop these areas. Ecosystems that Indigenous and local communities relied upon were degraded beyond repair. Tourism declined in developing regions, crippling their economies further.
- **Multiple ecological tipping points were crossed** including permafrost thaw released methane, Amazon dieback disrupted regional rainfall, and coral reef collapse destabilized fisheries, triggering cascading effects across systems. As climate and nature risks became increasingly interconnected and unpredictable, businesses struggled with supply chain breakdowns, stranded assets, and losses.

Current Policies

SECTOR HIGHLIGHTS:

- **Small-scale farming, fishing, and tourism** suffered from ecosystem degradation that impacted food security, soil fertility, and biodiversity.
- **Agriculture companies** invested in bio-crops, greenhouse farming, and expanded transport corridors.
- **Fisheries** struggled with water pollution, declining aquatic biodiversity, and a retreat from globalization.

Net Zero 2050

A cooperative global effort to act now on climate change and nature loss* drastically lowers risks by 2050.

Key Scenario Characteristics

- Carbon prices spike to US$ 183/ton CO_2 by 2030, and US$ 748/ton CO_2 by 2050
- Businesses are forced to absorb high costs to transition their operating models, production, and supply chains to meet net-zero standards
- Renewables comprise ~90% of global electricity production by late 2030s
- In the 2030s, governments and companies recognize the strategic value of natural capital, protecting biodiversity and securing vital ecosystem services, spurring investment in scalable nature-based solutions
- Global temperatures begin falling in 2040, physical climate impacts stabilize

Key Scenario Assumptions

- 1.6°C peak warming
- Immediate and smooth policy reaction
- Fast technology change
- Medium/high use of carbon dioxide removal
- Medium regional policy variation

***Important Note**: Though this scenario exhibits a “best case” for nature compared to the other three BSR scenarios, given that they are climate first, nature second projections, nature is not prioritized equally from a policy and corporate action perspective, leading to a narrow miss of the GBF 2050 ambition. This directly supports the TNFD, IPBES and PIK scenarios, which emphasize that if climate and nature are not equally addressed, a balance between climate and nature will never be possible.

Net Zero 2050

The 2020s

SWIFT CLIMATE ACTION REDUCED EMISSIONS BUT UNDERMINED NATURAL CAPITAL

Following climate science, **lawmakers raised carbon prices and incorporated mandatory emission reduction targets**, yet the land required to scale renewables and transition mineral extraction threatened key nature conservation frameworks.

ECONOMIES ADAPTED, BUT NOT WITHOUT STRUGGLE

Aggressive climate policies brought **inflation, interest, and unemployment rate hikes**, and were especially costly for emissions intensive industries and low-income communities reliant on fossil fuels. Governments and businesses began to fund ecosystem restoration.

CLIMATE AND NATURE IMPACTS WARRANTED INCREASED CONTINUITY PLANNING

Even with emissions cuts, **worsening climate shocks** strained economies and supply chains, further **degrading ecosystem services.**

The 2030s

EMISSIONS REDUCTION BROUGHT UNINTENDED CONSEQUENCES

Policy momentum successfully curbed emissions, but skyrocketed demand for rare earth minerals with **negative environmental and human rights impacts**. Countries with recycling mandates fared better, while laggards faced shortages and supply chain disruptions.

COMPETING CLAIMS GREW ON NATURAL RESOURCES

Renewables comprised the majority of electricity, partially due to **investments in decarbonizing harder-to-abate sectors** such as cement and steel, but energy production **competed with ecosystem conservation and food production needs**.

ECONOMIC RECOVERY ENABLED GREATER FOCUS ON PEOPLE AND NATURE

Economies began to stabilize at the end of the 2030s. Governments focused on preserving natural land, heeding to **indigenous knowledge** in some cases. **Plant-based diets** took hold in lieu of emissions-intensive foods like red meat.

The 2040s

THE WORLD SUCCESSFULLY REACHED NET ZERO AS NATURE PROTECTION GAINED MOMENTUM

By 2050, carbon prices reached US$ 749 /ton globally. **Governments and companies attempted to repair damaged ecosystems**, fronting well planned projects that started to reconnect fragmented habitats and restore biodiversity.

CLIMATE AND NATURE IMPACTS STABILIZED

Historical emissions resulted in persistent but easier to predict **physical impacts**. Food prices grew with carbon prices and physical impacts like droughts or flooding but were partially offset by **regenerative agriculture** techniques.

CLIMATE REPARATIONS BOOSTED EQUITY AND MAINSTREAM BIODIVERSITY ACTION

The economic development of vulnerable areas was promoted through reparation programs. Low-emissions agriculture, accountability tools and integrated biodiversity planning supported resilience though the GBF's 2050 biodiversity ambition remained just out of reach.

View from 2050

The transition to a net-zero economy required **drastic and coordinated global action** from government, business, and civil society.

↓

The **cost of action was initially high**, but most economies and sectors recovered by the mid to late 2030s, just as nature protections gained popular support.

↓

Swift action resulted in **warming peaking at 1.6°C** in 2040, minimizing climate change's physical impacts on communities and ecosystems.

The 2020s: What Defined the Decade

SWIFT CLIMATE ACTION REDUCED EMISSIONS, BUT RAPID RENEWABLE ADOPTION UNDERMINED NATURAL CAPITAL

- By 2030, **carbon prices rose to $183/ton**, and governments imposed strict carbon budgets and emissions targets. Global emissions fell 30%, and annual low-carbon investment surged to $2.8 trillion. **Renewables scaled fast:** their share of global primary energy more than doubled, and they powered nearly half the grid by 2030. This helped reduce air pollution, water use, and fossil fuel spills.
- However, the **expansion came at an ecological cost**. Wind and solar spread across semi-natural and undeveloped landscapes, converting land equal to the size of France and fragmenting habitats and migratory corridors. This growth clashed with conservation goals, such as the **Global Biodiversity Framework 30x30 target** to protect 30% of additional land for conservation by 2030.
- Meanwhile, the clean energy transition triggered a **fivefold increase in demand for transition minerals** like cobalt, lithium, nickel, and copper. Mining and processing activity intensified in regions such as the Congo, Chile, and Australia, placing new pressures on freshwater basins already stressed by climate change, and encroaching on biodiversity hotspots and Indigenous territories.

ECONOMIES ADAPTED, BUT NOT WITHOUT STRUGGLE

- **With increasing carbon prices and regulations, companies incurred high costs to adapt their operations and cut emissions. Inflation surged**, and global electricity prices rose 50%, driving up the cost of food, transport, and consumer goods. Low-income communities were hit hardest, particularly in countries where fossil fuel job losses were concentrated. Manufacturers faced major expenses as they retooled to produce heat pumps, EV motors, and LEDs, while also complying with new emissions standards. Some early transition efforts, such as energy efficiency upgrades, helped reduce costs over time.
- To soften economic shocks, some governments launched job retraining programs and public works projects to **restore abandoned mines and wells**. This increased employment and ecosystem services like erosion control and habitat connectivity. Still, **active mines and quarries reported worsening water access**. Industrial operations dependent on water suffered delays and cost overruns.

CLIMATE AND NATURE IMPACTS CONTINUED TO ACCELERATE, WARRANTED INCREASED CONTINUITY PLANNING

- Despite sharp emissions cuts, **the physical impacts of climate change intensified throughout the decade**. Heatwaves in Asia and droughts in Africa cost nearly 4% of GDP annually, exposing weaknesses in global food and water systems.
- Businesses suffered increasing supply chain disruptions, price volatility for essential commodities, and competition for natural resources. In response, many invested in **new storage and warehousing hubs** to protect against shipping delays, crop failures, and energy shortages. However, the location of these facilities had major consequences. Sites built on **undeveloped or mixed-use land** often required clearing trees and vegetation that previously provided erosion control, water filtration, and **local climate regulation**. This **fragmented wildlife corridors, increased runoff, and intensified heat island effects**, driving up operational cooling costs.
- Projects built on already industrialized land avoided the brunt of these impacts, demonstrating that **site selection played a critical role in determining long-term ecological and financial outcomes**.

Net Zero 2050

SECTOR HIGHLIGHTS:

- **Manufacturing companies** faced inflation and retooling costs as carbon prices rose, especially in regions hit by fossil fuel job losses.
- **Mining and processing operations** expanded in water-stressed, biodiverse areas, triggering pollution, delays, and access disputes.
- **Warehousing and logistics** hubs built on undeveloped land fragmented habitats, reduced local climate regulation, and raised cooling demands.

The 2030s: What Defined the Decade

EMISSIONS REDUCTION BROUGHT UNINTENDED CONSEQUENCES

- **Carbon prices continued to climb up to $433/ton by 2040, and global emissions fell 73% from 2025 levels.**
- **As green infrastructure scaled, so did mining for transition minerals, especially in biodiversity-rich regions like the Congo, Chile, and Australia, deepening environmental justice concerns for Indigenous groups and low-wage workers.** Governments with strong recycling mandates and domestic mineral quotas—like the EU, South Korea, and Brazil—faced fewer disruptions than others. Companies that delayed investment in circular systems saw escalating compliance risks and material shortages.
- **Waste from early-generation solar panels and batteries leaked cadmium and other heavy metals into soil and groundwater**, harming pollinators, disrupting habitats, and triggering compliance costs for manufacturers. Water-intensive industries such as agriculture, semiconductor fabrication, and battery gigafactories faced operational constraints due to contaminated freshwater.

EFFORTS FROM HARDER-TO-ABATE SECTORS REDUCED EMISSIONS BUT INTENSIFIED NATURAL RESOURCES COMPETITION

By the mid 2030s, **renewables, nuclear, and biomass supplied the majority of the world's primary energy and electricity**. However, biomass expansion displaced food crops, degraded pollination services, and increased nutrient runoff into freshwater systems with **feedstocks grown on marginal land partially mitigating land use change and social insecurity.**

- **Emissions from heavy industry fell 62%, in part due to a fourfold expansion of hydrogen capacity.** Hydrogen production shifted risks within shared basins, due to raised withdrawals and chemical discharges that strained access for communities and water-intensive sectors. In response, some companies began siting hydrogen and solar more carefully, co-locating with agriculture, adding pollinator habitat, or installing natural buffers around hydro sites.
- Demand for biodiversity credits surged as monitoring tools improved, and stakeholder pressure mounted to address biodiversity loss.

ECONOMIES BEGAN TO RECOVER, ALLOWING FOR GREATER FOCUS ON PEOPLE AND NATURE

- As inflation stabilized and clean tech costs declined, **businesses adapted to higher carbon prices by investing in circular value chains and recycled inputs**. Electricity prices dropped from their 2030 peak, increasing household disposable income and easing pressure on consumers.
- With greater economic stability, governments expanded protected areas and **revisited the narrowly missed 30x30 biodiversity targets**. Political attention began to shift toward addressing equity gaps in climate negotiations, and **Indigenous communities, low- and middle-income nations, women, and youth gained greater influence**.
- Rising incomes allowed more consumers to adopt low-impact behaviors. Healthy, plant-forward diets **doubled global consumption of fruits, vegetables, legumes, and nuts**, while red meat and sugar intake dropped by half. This shift cut food-system land use by around 50% and reduced associated GHG emissions by approximately 30%.

Net Zero 2050

SECTOR HIGHLIGHTS:

- **Mining and processing operations** expanded into biodiverse, water-stressed regions, triggering pollution, compliance costs, and local opposition.
- **Heavy industry** scaled hydrogen and circular systems but faced backlash over water use, chemical discharge, and siting decisions.
- **Agriculture and food companies** responded to shifting diets and land pressures by investing in lower-emissions inputs and regenerative practices.

The 2040s: What Defined the Decade

THE WORLD SUCCESSFULLY REACHED NET ZERO AS NATURE PROTECTION GAINED MOMENTUM

- By 2050, emissions fell to just 11.3% of 2025 levels, with nearly 90% of **residual emissions captured or offset through natural and technological removals**. **Carbon prices reached US$ 749/ton**, prompting final fossil fuel phaseouts. Technology breakthroughs helped slash emissions in hard-to-abate sectors, for example, transport, emissions fell 43% in the decade.
- Governments and companies funded **widespread afforestation and reforestation**, which reconnected fragmented landscapes and stabilized soils and groundwater, especially where native species and ecologically appropriate locations were prioritized. However, poorly planned efforts in non-forest biomes introduced **invasive species and did not restore degraded local ecosystems**.
- As coal mines and refineries closed, remediation efforts helped restore **soil and erosion-control services**, though underfunded sites continued to leach petrochemicals and acid mine drainage.

CLIMATE AND NATURE IMPACTS STABILIZED

- Although emissions declined and temperatures began to stabilize, physical climate impacts persisted across much of the world. **Heatwaves in Africa and Asia were still 80-100% more frequent than in 2020**, making it harder to grow certain crops—particularly those dependent on strong pollination, like almonds and strawberries. **Inflated food prices persisted** due to high carbon costs and shifting growing regions, but governments, businesses, and researchers invested in climate-resilient crops and growing techniques.
- Flooding in the U.S. and Western Europe plateaued at around 35% above 2020 levels. **Ecosystem restoration and stronger habitat connectivity helped reduce erosion** and protect aquatic and terrestrial species.
- By 2050, **chronic physical damages reached 7.3% of global GDP but became more predictable,** making them easier for governments and businesses to plan for and adapt.

CLIMATE REPARATIONS FACILITATED INCREASED EQUITY, AND CONTINUED BIODIVERSITY EFFORTS SCALED

- As the climate stabilized, international frameworks **held entities responsible for past emissions.** Reparations funded adaptation, restoration, and development in low-income countries and historically-marginalized communities. Transition costs rose another 50% by 2050 but were accepted as necessary for building a more equitable, resilient economy.
- Nature-based solutions like **mangrove buffers, regenerative grazing, and floodplain reconnection** became mainstream. Demand radically grew for attribution tools and accountability mechanisms to address biodiversity loss.
- **Transition mineral production and recycling became more distributed** globally, easing freshwater pollution and reducing habitat fragmentation. **Food, beverage, and agriculture companies adopted low-emissions fertilizers and diversified supply chains**, though shifting to second-generation biomass and plant-based inputs required ongoing R&D and relocation costs.
- While the **Global Biodiversity Framework's 2050 goals remained just out of reach**, nature was increasingly integrated into business models, national policy, and international finance.

Net Zero 2050

SECTOR HIGHLIGHTS:

- **Forestry and land restoration** projects scaled rapidly, with outcomes shaped by species selection, site planning, and long-term maintenance.
- **Transportation and logistics** firms cut emissions but faced siting challenges and climate-linked disruption from persistent heat and flood risks.
- **Food, beverage, and agriculture** companies adopted low-emissions inputs and second-gen biomass, but incurred relocation and R&D costs to maintain efficiency and ecosystem stability.

Delayed Transition

A decade of delays leads to hasty climate policies that greatly disrupt business, society, and the planet.

Key Scenario Characteristics

- As climate and nature policy stall before the 2030 inflection point, physical impacts continue to increase through the late 2030s, early 2040s
- Global carbon prices spike nearly from around US$ 10/ton in 2030 to US$ 100/ton in 2035
- Inflation, unemployment, and interest rates spike in the 2030s in response to rushed policies and a lack of focus on nature conservation and restoration degrades critical ecosystem services
- Annual GDP losses due to chronic climate damages eventually stabilize by 2050 below 11% of global GDP

Key Scenario Assumptions

- 1.8°C peak warming
- Delayed policy reaction
- Slow, then fast, technology change
- Low/medium use of CO_2 removal
- High variation in regional policies

Delayed Transition

The 2020s

POLICYMAKERS ADDED MINIMAL CLIMATE AND NATURE MEASURES

Weak regulation left emissions flat, while **habitat loss, pollinator decline, and resource exploitation reduced ecosystem services**, increasing risks to food production and supply chains. Companies set **voluntary targets,** but few followed through on implementation.

RELIANCE ON FOSSIL FUELS CONTINUED

Fossil fuel extraction polluted soils and groundwater and raised freshwater demand, forcing manufacturers, power producers, and seafood supply chains to operate under increasing scarcity and ecological volatility.

PHYSICAL IMPACTS BECAME MORE APPARENT

Intensifying **droughts, hurricanes, and heatwaves** degraded cropland, eroded soil fertility, damaged ports, and disrupted provisioning services, raising input costs and destabilizing global supply chain resilience.

The 2030s

AN ABRUPT CRISIS RESPONSE BEGAN

As physical impacts escalated, many governments took forceful and disruptive action to reduce emissions. The surge in solar, wind, and mining expansion **fragmented habitats, disrupted migratory routes, and strained water systems**, exposing land- and water-dependent industries to mounting risk.

BUSINESSES FACED HIGH COMPLIANCE COSTS DURING THE TRANSITION

Carbon taxes and transition mineral mining raised soil erosion and water stress that increased expenses for agriculture, manufacturing, and communities. Outdated grids and mineral shortages made electricity unreliable, forcing companies and consumers to pay higher costs.

EMISSIONS FELL, BUT NATURE PRESSURES PERSISTED

Emissions reduction was successful but turbulent, yet **irreversible biodiversity loss and weakened ecosystem services** left businesses exposed with damages still cutting GDP.

The 2040s

A LOW-CARBON ECONOMY EMERGED AND NATURE EQUITY IMPROVED

Equity-focused policies supported **regenerative farming and restoration**, strengthening soil health and agricultural resilience while lowering long-term costs for food processors and supply chains.

HABITATS FACED DIFFERENT PRESSURES AS HEAVY INDUSTRY DECARBONIZED

Companies in heavy sectors relied on **hydrogen and carbon removal**, cutting emissions but increasing freshwater withdrawals and land competition, shifting risks for agriculture and water-dependent industries.

TEMPERATURES AND PHYSICAL IMPACTS STABILIZED

Warming peaked at 1.83°C, but **droughts, floods, and biodiversity decline** persisted, driving higher adaptation costs for businesses and forcing long-term investment in supply chain resilience.

View from 2050

A **decade of inaction** in the 2020s drove mounting pressure for climate action.

↓

This led to the adoption of hasty and reactionary policies in the 2030s, while **nature was often an afterthought**.

↓

The disorderly approach came with **high social and environmental costs** but ultimately led to a halving of emissions and peak warming at 1.8°C and eco**system restoration** by 2050.

The 2020s: What Defined the Decade

POLICYMAKERS ADDED MINIMAL CLIMATE MEASURES AND LARGELY DISREGARDED EXISTING NATURE PROVISIONS

- Initial momentum from legislation like the U.S. Inflation Reduction Act and the EU Green Deal faded by the second half of the 2020s, **due to political resistance, inflation concerns, and land-use competition.**
- Without strong climate and biodiversity protection regulations, **most corporate efforts remained voluntary** and lacked credible strategies or accountability.
- Habitat loss and resource exploitation remained largely unabated while **land-use change persisted as a dominant driver of biodiversity decline.** The result was a continued decline in global natural capital, even while awareness of nature's importance grew as communities suffered from diminished ecosystem services for recreation, livelihoods, and sustenance.

RELIANCE ON FOSSIL FUELS CONTINUED

- **Low-carbon energy investments failed to keep pace with rising global energy demand as fossil fuel extraction continued.** With renewables still comprising a minority of energy supply and electricity by 2030, many businesses struggled to procure the green energy they required to meet their short-term climate goals
- **Shale, tar sands, and offshore drilling expanded**, intensifying soil and groundwater contamination. Refineries and petrochemical plants became increasingly reliant on **new sources of uncontaminated freshwater for drilling and processing**, increasing operational risk for water-intensive industries like manufacturing and power.
- **By 2030, global freshwater demand outpaced supply by 40%.** Meanwhile, offshore drilling damaged seabed habitats, disrupting aquatic ecosystems and exposing seafood supply chains to stock volatility and resource shocks.

PHYSICAL IMPACTS BECAME MORE SEVERE AND APPARENT

- In 2030, droughts alone wiped away nearly 4% of Africa's annual GDP and heatwaves cost Asia 3.5% of its annual GDP, disrupting ecosystems and economies alike. Topsoil loss and declining pollinator populations strained food production, putting an estimated **$577 billion in annual crop output at risk.** Soil fertility and water retention declined across African croplands, while pollinator-dependent crops became more unstable.
- **Mexico, an emerging manufacturing hub, experienced a 38% rise in hurricane damage**, disrupting port operations and exposing global supply chains to risks tied to coastal ecosystem degradation, particularly the loss of mangrove buffers. Meanwhile, **businesses faced volatile input prices, resource competition, and mounting disruption costs**. By decade's end, climate impacts had become a **visible drag on growth and society, galvanizing support for stronger climate and nature policy in the 2030s.**

Delayed Transition

SECTOR HIGHLIGHTS:

- **Energy producers** expanded shale, tar sands, and offshore drilling, increasing freshwater use and degrading ecosystems.
- **Agriculture and food companies** faced pollinator loss, soil degradation, and rising crop volatility linked to ecosystem decline.
- **Manufacturing and logistics firms** struggled with energy procurement, storm-damaged ports, and competition for clean water.

The 2030s: What Defined the Decade

AN ABRUPT CRISIS RESPONSE BEGAN

- Intensifying climate and nature impacts pushed governments to act, triggering a disruptive, uneven policy shift. **The countries most affected by physical impacts focused on adaptation over mitigation**, while China and the Middle East continued to invest in fossil fuels, favoring economic growth, **increasing pollution near biodiversity-rich aquifers and soils**. Maintaining the operation of these refineries **put millions at higher risk for disease** and concentrated pollution around areas **critical for biodiversity**.
- **Investments to decarbonize the energy system were over $3 trillion annually**, reducing air pollution and freshwater withdrawals, alleviating pressure on river-basin ecosystems, and reducing health problems and deaths caused by elevated temperatures in cities.
- Cleaner grids reduced **pollution-related crop losses**, partially offsetting rising compliance costs for energy-intensive manufacturers. However, rapid solar and wind expansion converted significant land area, **disrupting migratory routes and ecosystem stability**.

BUSINESSES AND CITIZENS FACED HIGH COMPLIANCE COSTS DURING THE TRANSITION

- The rapid rollout of emissions policies in the 2030s caused widespread disruption. **Carbon taxes**, **mandated emissions cuts**, and **investments in expensive, untested technologies** drove up prices for raw materials and inputs. Countries reliant on fossil fuel exports or heavy industry, such as the U.S. and Canada, experienced job losses and rising inflation.
- **Outdated grids** and **transition mineral shortages** made electricity unreliable. Mining for transition minerals proliferated, testing regulators' ability to prevent **soil erosion**, **pollution**, and **water stress** while progressing on decarbonization. Increasing sediment runoff made it more difficult for communities to access clean water for **agriculture**, **manufacturing**, and **cooking**.
- Avoiding volatile supply chains and natural disasters, **apparel and consumer-goods brands** reshored production and shifted sourcing closer to end markets, intensifying land pressure and expanding demand for **local biomass**, **cotton**, and **timber**. While reshoring reduced marine spills and shipping emissions, it also left export-oriented communities behind, especially those in **palm oil** and **cocoa sectors,** further deepening social and ecological instability.

DECARBONIZATION WAS ULTIMATELY SUCCESSFUL, YET NATURE PRESSURES PERSISTED

- By 2040, **global emissions had dropped 45% from 2030**, and renewables grew to supply 80% of global electricity. Policy attention shifted to the industrial sector, and in response, firms produced heat pumps, electric motors, and batteries to meet **production and recycling requirements**.
- Despite this progress, chronic physical damages from climate change and irreversible biodiversity loss had already taken hold. Numerous species went extinct, and **certain ecosystem functions were damaged beyond repair**.
- Companies in the food sector pivoted to low-carbon ingredients, but adoption required major investment in irrigation infrastructure, regenerative agriculture, and product reformulation. Lower-income households struggled to afford **both omnivorous and plant-based diets**, raising concerns around equity and nutritional access.

Delayed Transition

SECTOR HIGHLIGHTS:

- **Mining and processing operations** expanded rapidly to meet transition mineral demand, increasing sediment runoff and straining freshwater supplies.
- **Apparel and consumer-goods brands** reshored production to avoid volatile supply chains, driving up local land use and resource demand.
- **Food companies** shifted to low-carbon ingredients, requiring costly irrigation upgrades and regenerative agriculture investments.

The 2040s: What Defined the Decade

A NEW LOW-CARBON ECONOMY EMERGED AND NATURE EQUITY IMPROVED

- Governments prioritized a just transition, directing **public incentives** toward low-carbon industries in regions with the greatest job losses. Retraining programs created new employment opportunities, while climate equity initiatives restored environments in communities most affected by climate change.
- These efforts brought **co-benefits for nature**, improving recreation, tourism, and local ecosystem services. Freight electrification and rail-shift incentives in high-unemployment corridors reduced air pollution for people and wildlife.
- Stricter regulations increased **accountability for high-emitting sectors** and just transition grants for regenerative agriculture improved soil carbon, reduced nutrient runoff, and supported biodiversity. As a result, food and beverage processors secured more stable raw material supplies, **while farmers had more resilient agricultural systems and required less fertilizers**.

DECARBONIZATION EFFORTS SHIFTED TO HARDER-TO-ABATE SECTORS, WITH ADDED RELIEF FOR HABITATS

- While many sectors like freight and electricity saw prices begin to stabilize, policy attention turned to **steel**, **cement**, **aviation**, and **mining**. Industrial hydrogen use grew nearly fourfold from 2035 to 2050, lowering emissions of greenhouse gases and other pollutants but increasing **freshwater withdrawals** and introducing localized chemical pollution.
- Innovations in cement and mining limited **habitat fragmentation impacts** and resource use, improving projects' community acceptance. Carbon removal technologies expanded despite high costs, boosting bioenergy and afforestation projects but also heightening **competition for land** between food production and carbon sequestration.
- Second-generation **biofuel crops and tree plantations** scaled, often replacing mixed-use landscapes and altering local ecosystems.

TEMPERATURES AND PHYSICAL IMPACTS STABILIZED

- By 2050, global temperatures peaked at **1.83°C above preindustrial levels**. Expanding forest and peatland restoration programs rebuilt carbon sinks, stabilized hydrology, improved pollination routes, and reduced flood risk for manufacturing hubs downstream.
- Although these efforts were successful at slowing down climate change, **physical damages still cut into national GDP across the world**, with acute impacts, such as droughts, cyclones, and floods, causing major disruptions in Africa and Asia.
- Adaptation investments improved resilience for some populations and industries, but key biodiversity hotspots remained at risk from irreversible warming. Sustaining a livable climate required continued, long-term investment in ecosystem health and coordinated action between governments and the private sector.

Delayed Transition

SECTOR HIGHLIGHTS:

- **Forestry and land restoration** projects rebuilt carbon sinks, stabilized water flows, and improved pollination routes in restored habitats.
- **Agriculture and food companies** benefited from more resilient supply chains due to regenerative practices but faced risks in biodiversity hotspots.
- **Manufacturing hubs** in Africa and Asia remained vulnerable to acute climate impacts such as droughts, cyclones, and floods.

Fragmented World

A delayed and fragmented policy response leads to both high physical and transition risks.

Key Scenario Characteristics

- Countries without net-zero targets follow current policies. Countries with net-zero* targets push forward, but eventually achieve just 80% of their target
- Carbon prices and renewable use spikes in net-zero countries, but remains low in non-net-zero countries where the fossil fuel status quo persists
- By 2050, chronic impacts from climate change cost the world nearly 13% GDP annually
- Policy costs in net-zero aligned countries are more than double the policy costs elsewhere, and food prices are nearly 2-3x higher

Key Scenario Assumptions

- 2.4°C+ warming by 2100
- Delayed and fragmented policy reaction
- Slow, then fragmented technology change
- Low/medium use of CO_2 removal
- High variation in regional policies

*See appendix for list of countries with net-zero targets included in this analysis

Fragmented World

The 2020s

CLIMATE POLICY—ALONG WITH NATURE ACTION—STALLED

Global collaboration collapsed, pushing resource extraction into previously natural ecosystems. **AI-driven water withdrawals** pushed US river basins to critical levels, raising costs for data centers, agriculture, and other water-intensive industries.

RELIANCE ON FOSSIL FUELS CONTINUED, IMPACTS ON NATURE BECAME EVIDENT

Expanding **fossil fuel use degraded biodiversity**, while black carbon and ozone pollution lowered crop yields, damaged forests, and weakened agricultural resilience.

PHYSICAL IMPACTS BECAME MORE SEVERE AND APPARENT

Droughts and water stress degraded soils and cut yields, forcing higher water treatment costs for communities. Nationalist retrenchment amplified volatility and left ecosystems increasingly fragile. Companies faced **higher costs, increased stakeholder scrutiny, and more frequent operational disruptions.**

The 2030s

THE GLOBAL POLICY RESPONSE DIVERGED

Net-zero countries restored degraded industrial sites and wildlife corridors, but **non-net-zero nations with weak safeguards** faced worsening deforestation, overfishing, and industrial runoff, leaving global supply chains increasingly exposed to ecological and regulatory risk.

FRAGMENTED POLICIES LED TO GEOPOLITICAL TENSION AND ECONOMIC TURBULENCE

Carbon tariffs and fertilizer substitution in weaker markets shifted deforestation, polluted rivers, and destabilized fisheries, raising costs for global companies reliant on imports, while geopolitical tensions disrupted trade and resource security further.

INCREASING CLIMATE AND NATURE RISKS AMPLIFIED INEQUALITY

Soil degradation, wetland loss, and climate migration deepened poverty in sourcing regions, cut agricultural productivity, and forced businesses to absorb greater disruption costs while investing in community resilience and emergency adaptation strategies.

The 2040s

COMPLEX TRADE SYSTEMS INTENSIFIED NATURE LOSS

Carbon tariffs fractured supply chains, duplicating land, water, and energy use as companies operated dual systems. This amplified ecosystem degradation, raised operational costs, and forced businesses to navigate growing logistical and compliance challenges.

PROGRESS FROM NET-ZERO-ALIGNED COUNTRIES WAS TOO-LITTLE, TOO-LATE

Net-zero nations cut emissions, but **toxic battery disposal polluted ecosystems** and weakened biodiversity recovery, while non-net-zero regions collapsed ecologically, leaving firms vulnerable to resource shortages, market volatility, and higher compliance burdens.

PHYSICAL IMPACTS FROM CLIMATE CHANGE CONTINUED TO INCREASE

By 2050, **Asia and Africa lost ~15% of GDP** to heat, drought, and pollinator decline. Food systems destabilized further, and adaptation costs soared as businesses faced escalating infrastructure damage, yield losses, and supply chain breakdowns.

View from 2050

A decade of inaction in the 2020s **drove mounting pressure for climate action in some geographies**.

↓

Hasty decarbonization policies were adopted in the 2030s but only by **only net-zero-aligned countries**.

↓

The **fragmented policy response heightened geopolitical tensions and nature impacts** as countries tried to become self reliant, all the while global emissions continued to rise. By 2100, warming surpassed 2.4°C.

The 2020s: What Defined the Decade

CLIMATE POLICY, ALONG WITH NATURE ACTION, STALLED

- After early progress from measures like the U.S. Inflation Reduction Act and the EU Green Deal, policy momentum slowed in the late 2020s due to **political gridlock**, **economic concerns**, and surging **energy demand from AI**. Rising AI data center demand increased water withdrawals, with some U.S. river basins reaching **extreme risk levels** in peak seasons.
- Global collaboration collapsed, leaving countries isolated in their emissions and adaptation strategies. The global average carbon price stayed below $11/ton, and ambitious corporate **biodiversity goals for 2030 went unmet**.
- **Nature conservation became politicized** as land conversion, fossil fuel extraction, and disaster recovery took priority over ecosystem protection. Early regional gains in emissions reductions were not enough to offset global increases, and natural ecosystems continued to degrade under weak safeguards and fragmented action.

ENERGY SYSTEMS REMAINED RELIANT ON FOSSIL FUELS AND IMPACTS ON NATURE BECAME EVIDENT

- As energy demand continued to increase, **fossil fuel extraction grew through the decade**, **with repercussions for natural ecosystems**, which became even more scarce. Greenhouse gas emissions generated black carbon particles that darkened snow and ice, while ozone damaged crop leaves and extreme heat further stressed crop productivity.
- Without significant progress on decarbonizing the energy supply, scope 2 emissions remained high while physical hazards such as increasing storms and hurricanes battered ports and coastal estuaries, leading to **increasing damages** and business disruptions.

PHYSICAL IMPACTS BECAME MORE SEVERE AND APPARENT, ECOSYSTEM SERVICES DEGRADED

- In the second half of the decade, the **physical impacts from climate change became more frequent and severe**. These challenges were further compounded by a retreat from globalization driven by a rise in nationalistic ideologies and security concerns.
- African **droughts affected monocultures the most**, reducing yields, increasing land conversion, and disrupting ecosystem balances as water supplies dwindled.
- But the effects of water scarcity were not just seen in Africa. By 2025, nearly **60% of the global population spent at least one month facing severe water stress**. Water taxes and restrictions became more commonplace.
- Manufacturers, farmers, and energy producers faced **higher costs, increased stakeholder scrutiny, and more frequent operational disruptions**. Difficulty accessing high-quality freshwater resulted in increasing investment costs for companies to improve water filtration technologies or pay higher premiums for third-party providers.

Fragmented World

SECTOR HIGHLIGHTS:

- **AI data centers** drove extreme water withdrawals in stressed U.S. river basins.
- **Agriculture** in Africa faced yield losses as drought hit monocultures and drove land conversion.
- **Manufacturers and energy producers** faced higher water costs and more frequent operational disruptions.

The 2030s: What Defined the Decade

THE GLOBAL POLICY REPSONSE DIVERGED

- As climate and nature impacts intensified, some major economies, including China, the U.S., India, Japan, and EU member states, accelerated emissions cuts, while the rest of the globe did not follow their lead, partly due to political pressure to prioritize economic growth over climate mitigation. **International tensions grew** and cooperation on climate and nature action weakened.
- In net-zero countries, **replacing fossil fuels with renewables reduced pollution**, easing acid rain and giving nearby forests and rivers room to recover. Where plant and mine retirements were paired with site restoration plans and disused pits and refineries were restored, former pollution hot spots were eventually turned into fresh carbon sinks and wildlife corridors.
- In contrast, ecosystems in non-net-zero countries, many **holding the world's highest biodiversity**, continued to degrade under weak safeguards, forest clearing, overfishing, and industrial runoff, pushing threatened species levels higher. Limited resources left these nations unprepared for escalating climate shocks and market shifts.

FRAGMENTED GLOBAL POLICIES LED TO GEOPOLITICAL TENSION AND ECONOMIC TURBULENCE

- Uneven climate action and delayed policy responses amplified **inflation**, **interest rate spikes**, and **unemployment** when regulations suddenly tightened. In net-zero countries, protectionist trade measures disrupted global supply chains, while non-net-zero countries continued high-emissions commodity exports.
- Shifting land use pressures simply relocated deforestation rather than halting it, as high-carbon soy and beef were rerouted to less-regulated markets. **Forest loss accelerated in non-net-zero regions**, eroding biodiversity and ecosystem services.
- Companies sourcing key agricultural commodities faced higher carbon taxes and greater supply chain volatility. In agriculture, rising fertilizer costs in non-net-zero countries led farmers to switch to **cheaper, higher-polluting nitrogen sources**, worsening nutrient runoff and threatening coastal fisheries.

INCREASING CLIMATE AND NATURE RISKS AMPLIFIED INEQUALITY

- In countries with limited adaptation measures, shifting climate patterns and severe weather events pushed millions into poverty. Droughts in historically water-stressed African and Asian regions degraded soils, reduced staple crop yields, and drove up food prices, prompting further **forest clearing for survival** and accelerating biodiversity loss.
- Weak flood defenses in many low-income countries left mangrove and wetland buffers to shrink, leaving communities unprotected from storm surges. Without resources for restoration, businesses sourcing from these regions faced higher **supply chain disruptions**.
- The resulting migration crises fueled geopolitical tensions and reactionary nationalist movements, adding pressure on companies to invest in **community resilience** in vulnerable areas.

Fragmented World

SECTOR HIGHLIGHTS:

- **Forestry and agriculture** in non-net zero countries experienced accelerated deforestation and biodiversity loss due to shifting land use pressures.
- **Agricultural producers** faced fertilizer cost spikes, leading to higher polluting nitrogen use and nutrient runoff that threatened coastal fisheries.
- **Companies with global supply chains** faced greater disruption risk from climate migration, degraded ecosystems, and weak adaptation measures in sourcing regions.

The 2040s: What Defined the Decade

GLOBAL ECONOMIC NETWORKS BECAME INCREASINGLY COMPLEX INTENSIFYING NATURE LOSS

- To preserve domestic industry and prevent businesses from relocating to lower-cost regions, net-zero countries adopted protectionist policies and carbon tariffs. Many non-net-zero countries retaliated with **tariffs and embargoes of food and transition minerals**. Some businesses onshored production and supply chains, while others created distinct supply chains for net-zero and non-net-zero countries. **Supply chain redundancy** amplified land clearing, freshwater withdrawals and waste streams, spreading biodiversity loss across both net-zero-aligned and unaligned geographies rather than containing it.
- By 2050, the area of cropland in non-net-zero countries was nearly 10% greater than it was in 2025. Land for food production expanded due to **yield inefficiencies, degraded ecosystem services, and a lack of nature policy protections**. Diets in net-zero countries shifted toward fruits, vegetables, nuts, and legumes, diverging from the non-net-zero status quo which still included higher emissions products like red meat and sugar. Global food companies had to adapt their products, procurement, and packaging.
- **Transition mineral demand rose nearly fivefold** from 2025 levels in net-zero countries over the 2030s and ’40s. Geopolitics made it hard for net-zero firms to source from non-net-zero states with most of the transition mineral mining capacity.

PROGRESS FROM NET ZERO-ALIGNED COUNTRIES ALONE WAS TOO LITTLE, TOO LATE

- By 2050, **emissions in net-zero countries were 60% lower than in 2030** but increases in the rest of the world offset much of this progress. Many net-zero nations relaxed their targets as global momentum stalled. While 96% of electricity in net-zero countries came from renewables or nuclear, **battery disposal** continued to damage ecosystems through toxic pollution and habitat fragmentation.
- Nature-based renewable projects in net-zero countries provided some ecological benefits, but **biodiversity in non-net-zero regions remained in steep decline** under ongoing deforestation, overfishing, and industrial pollution.

PHYSICAL IMPACTS FROM CLIMATE CHANGE CONTINUED TO INCREASE

- By 2050, physical impacts continued to worsen: intense heatwaves reduced pollinator activity during critical flowering periods, threatening **8% of global crop volumes** and adding strain to already fragile food systems.
- In Africa, **worsening drought pushed farmers into frontier lands**, accelerating habitat loss and triggering a feedback loop of reduced rainfall, lower yields, and further ecosystem degradation. Net-zero countries used reforestation and reduced pastureland to protect carbon sinks and water quality, but biodiversity in non-net-zero countries faced irreversible damage.
- By mid-century, the world’s uneven response left both net-zero and non-net-zero nations more exposed. **Ecosystems that once buffered heat, floods, and food shocks were depleted**, driving up the cost of lost natural capital. Net-zero countries used reforestation, reduced pastureland, and nutrient runoff cuts to protect carbon sinks, improve water quality, and safeguard key industries, while habitats and communities in non-net-zero nations suffered escalating damages.

Fragmented World

SECTOR HIGHLIGHTS:

- **Agriculture** in non-net-zero countries expanded cropland into biodiverse areas, accelerating habitat loss and ecosystem degradation.
- **Energy and battery industries** in net-zero countries struggled with ecosystem damage from toxic pollution and habitat fragmentation at disposal sites.
- **Food producers** faced yield losses from reduced pollinator activity, threatening 8% of global crop volumes and increasing market volatility.

04 | Sector-Specific Scenarios & Data

Food, Beverage, and Agriculture

Current Policies

High Physical

Low Transition

- Without substantial climate policies, agricultural commodity and input (fuel, fertilizer, water) prices remained relatively stable in the 2020s and 2030s.
- Continued industrial agriculture and land use conversion to offset productivity losses led to habitat fragmentation and a drop in pollination rates, eroding soil fertility and natural pest control, altogether undermining crop yields and compounding productivity losses.
- By the 2040s, physical impacts like droughts and crop failures continued to significantly disrupt crop production in critical regions like the Western U.S. and India, leading to volatile food accessibility, supply chains, and food prices.
- In response to physical impacts, much of the industry was forced to turn to protective technologies like greenhouse farming and bio-engineered crops to improve climate resiliency, facing higher operational expenses.

Net Zero 2050

Low Physical

Low/Med. Transition

- Increased competition for land to support reforestation and bioenergy production, high carbon prices, and increased costs of inputs (e.g., fuel, fertilizer) resulted in rising food prices.
- Meat and dairy were hit particularly hard by climate policies, causing farms to systematically shift their production and food producers to overhaul their recipes as regulatory and consumer tastes shifted in favor of plant-based options.
- The industry invested in pollinator-friendly solar arrays, agrivoltaic fields, and regenerative practices which restored habitats, soil fertility, and pollination services, lowering fertilizer dependence and stabilizing long-term yields.
- Physical impacts from climate change remained manageable with mitigation efforts, but the hardest hit countries, such as those in Asia and Africa, still struggled with water availability and heatwaves that dampened agricultural output.

Delayed Transition

Low/Med. Physical

High Transition

- Beginning in the 2030s, the agricultural sector faced sudden and intense competition for land from reforestation efforts, high carbon prices, and mounting pressure to adopt efficiency and yield saving practices in a very short period.
- Commodity prices for wheat and soy jumped sharply in the 2030s and led to increased food insecurity, particularly in regions also facing high physical impacts like drought, and floods that frequently disrupted agricultural production.
- Solar, wind, and biomass developments mushroomed in the 2030s, increasing competition for land and converting wildlife habitats.
- Pressure to quickly adopt unproven technologies at scale often led to losses for farmers and producers as they tried to decarbonize while maintaining efficiency. Eventually, efficiency and yield improvements combined with efforts to reduce food waste allowed for food prices to stabilize in the 2040s

Fragmented World

High Physical

High Transition

- Physical impacts from climate change continued to increase well into the 2040s. Combined with geopolitical conflicts, this led to regulation of global food trading as countries attempted to preserve food security.
- Costs for food and critical inputs, such as water, pesticides, and fertilizer, increased substantially in net-zero countries, but only slightly elsewhere. Regenerative agriculture practices and reduced agrochemical usage in net-zero countries alleviated price pressures, yet low-income communities across the world struggled to access affordable food.
- Divergent food policies forced global brands to redesign product mix and sourcing for many contrasting consumer bases. Tariffs on high carbon foods created distinct net-zero and non-net-zero supply chains for products like soy and beef.
- By 2050, cropland in non-net-zero regions expanded nearly 10% amid declining pollination and worsening erosion, whereas net-zero countries reduced farm and pasturelands. Biodiversity hotspots, concentrated in non-net-zero countries, degraded as farmland expanded. Habitats and ecosystem services that farms relied upon neared collapse.

FBA Sector

Current Policies

2020s Extreme weather threatens annual yields and global warming shifts productive growing regions — raising food insecurity

2030s Nations onshore food production, where increased land use change threatens soil quality and pollinator effectiveness

2040s Increasing nationalism causes global agricultural traders to fragment, straining global supply networks

Net Zero 2050

2020s Dairy and livestock producers face crippling carbon taxes

2030s Plant-based diets prevail, growers and producers overhaul ingredients and recipes to avoid carbon taxes

2040s Pollinator-friendly agrivoltaics and biomass grown on marginal land restore soil health, cut pesticide use, and raise yields

Delayed Transition

2020s Adoption of unproven ag tech drives sunk costs for farmers and disproportionate disturbances for wildlife

2030s Solar, wind and biomass build-outs sprawl over farms and pastures

2040s Rising food prices leave lower-income consumers unable to afford new diets, dampening demand for premium products

Fragmented World

2020s Disjointed regulations force firms to maintain both net-zero and conventional chains, raising compliance and logistics risk

2030s Carbon-border tariffs divert high-carbon soy and beef to lax markets — speeding tropical deforestation and biodiversity loss

2040s Net-zero countries struggle to maintain popular support as prices at the grocery store rise due to carbon tariffs

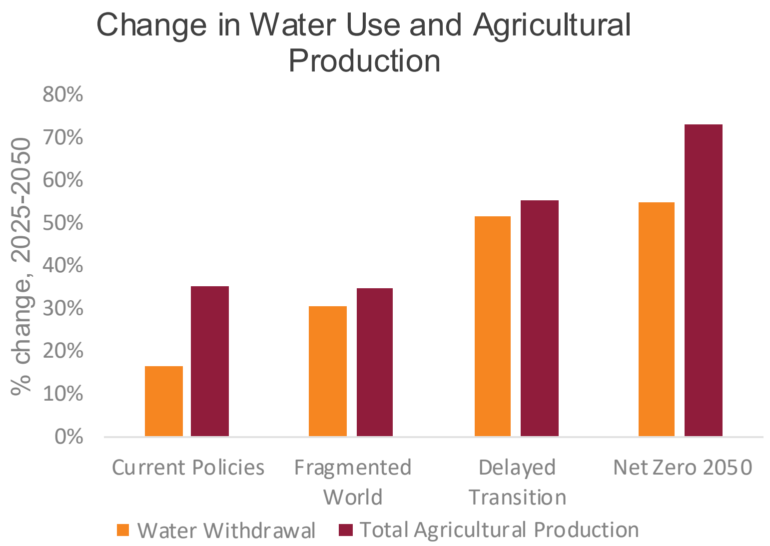
Example of Critical Nature Dependencies for the FBA Sector Across Scenarios

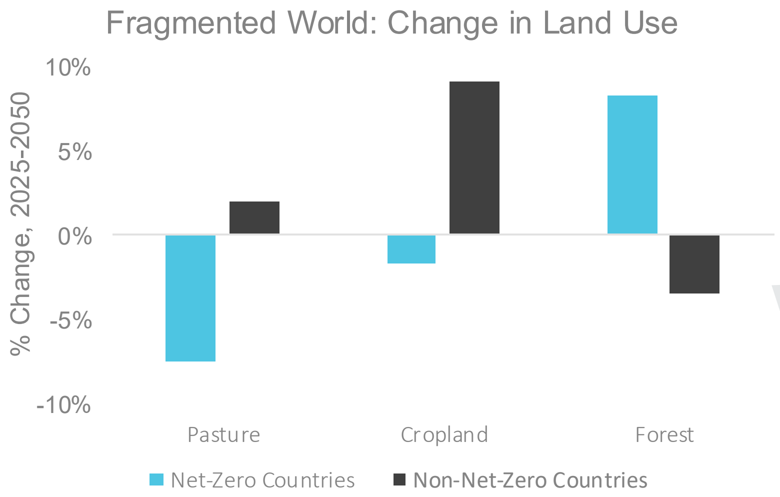
Climate Regulation | Pollination Services | Soil Health & Fertility | Freshwater Supply & Quality

Freshwater and Soil Health

Farms comprise 70% of total global water consumption and 40% of this is lost to inefficient irrigation and management[2]. Heavy consumption along with the introduction of water pollutants, expose the industry to escalating systemic environmental and financial risks.

Transition pathways that align with planetary boundaries strive for more efficient water management to improve recovery rates.





Climate Regulation and Pollination Services

Forests provide climate regulation and pollination services for nearby or integrated agricultural systems. More biodiverse farm ecosystems fend off pests and maintain productive output without or with less agrochemicals.

Net-zero countries will be better positioned to benefit from forest ecosystem services.

[1] TNFD Food and agriculture sector guidance (2024)

World Bank Water in agriculture (2022).

05 | Conclusion

Next Steps for Scenario Analysis

While scenario analysis has long been a business tool used to stress test strategy in a rapidly changing world, the TCFD and TNFD recommendations have made scenario analysis a key recommendation for business. Using its nature-integrated climate scenario narratives, BSR works with business by tailoring the scenarios to a company-specific context and running cross functional strategy workshops.

Identifying Risks & Opportunities

- In collaboration with the member company through a series of discussions and workshops, BSR's nature-integrated climate scenario narratives and the relevant variables will be used **to brainstorm and identify the most relevant risks and opportunities** for the member.

Integrating with Business Strategy

- Once the risks and opportunities are identified, these can then be synthesized into **implications for the entire business and its strategy**.
- The top identified risks should also be incorporated into the company's existing **enterprise risk management** (ERM) taxonomy and process.

Reporting

- Once completed, the findings from the nature-integrated climate scenario analysis, including risks, opportunities, and strategies, can be incorporated into the company's **TCFD or TNFD-aligned and/or CDP report.**
- This reporting is becoming **increasingly mandated**, such as by the CA Climate Bills and the EU's draft Corporate Sustainability Reporting Directive (CSRD).

06 | Appendix

Glossary

Default Variable List

The following variables are always included in BSR climate scenario analyses. The variables are for global data, unless stated otherwise. It is recommended that these variables be reviewed, as needed, for regions or countries of interest. This list does not include the sector slides.

Variable	Current Policies	Net Zero 2050	Delayed Transition	Fragmented World
Global Mean Temperature	x	x	x	x
Greenhouse Gas Emissions	x	x	x	x
Primary Energy Mix	x	x	x	x
Carbon Price	x	x	x	x
Fossil vs. Low-Carbon Energy Investments	x	x	x	x
Energy Demand vs. Efficiency Investments	x			
GDP Loss from Chronic Physical Damages	x	x	x	x
GDP Loss from Transition Damages		x	x	x
Change in Pasture, Crop, and Forest Land		x	x	x
Change in Consumption, Disposable Income, Investment, & Equity Price (US & China)	x			
Greenhouse Gas Emissions by Sector	x	x	x	x
Policy Cost (GDP Change)				x
Physical Climate Damage (GDP) by Region				x
Acute Climate Damage (GDP) by Type	x	x	x	
Carbon Capture and Storage (CCS) Investments		x	x	
Carbon Sequestration		x	x	
Land Use for Carbon Sequestration		x	x	

Net-Zero Aligned Countries in Fragmented World

The following includes net-zero aligned countries in Fragmented World. This is useful for understanding where significant transition risks will take place in the scenario. As a reminder, net-zero aligned countries will reach 80% of their 2050 targets.

Net-Zero Country / Region	Net-Zero Year
Argentina	2050
Australia	2050
Brazil	2050
Canada	2050
China	2060
Colombia	2050
EU+UK	2050
India	2070
Indonesia	2060
Japan	2050
New Zealand	2050
Russia	2060
South Africa	2050
South Korea	2050
USA	2050

Source: NGFS Phase V Technical Documentation

Key Terms & Definitions

Term	Definition	Source
Acute physical impacts (also see chronic physical impacts)	Physical impacts from climate change that are event-driven and generally short-term in nature, such as floods, tropical cyclones, or extreme heat waves.	EPA
Biodiversity	Biodiversity (amalgamation of biological diversity) refers to the variety of life found in a specific place, including genetic diversity, species diversity, and ecosystem diversity. Biodiversity loss occurs when species and/or genetic diversity are lost to impacts such as habitat destruction and climate change. This loss of biodiversity has negative ramifications for the overall health and resilience of ecosystems.	Smithsonian
Carbon capture and storage	A collection of technologies aimed at combating climate change by capturing carbon emissions from fossil fuel combustion, industrial processes, and other energy production practices that emit carbon (such as biofuels), and then storing the captured carbon (typically underground).	MIT Climate
Carbon price	A market-based approach to emissions reduction that puts a price on carbon emissions, such as through carbon taxes or emissions trading schemes (ETS).	UCS USA
Chronic physical impacts (also see acute physical impacts)	Physical impacts from climate change that are related to longer-term shifts in climate patterns, such as sustained higher temperatures, increased ranges for diseases, sea level rise, or changing precipitation patterns.	EPA
Climate adaptation	Actions taken to adapt processes or structures to moderate the potential damages from climate change.	UNFCC
Climate justice	A term and movement that attempts to address the fact that climate change will have more severe impacts on underprivileged populations, despite that these are the same populations that have often contributed the least to causing climate change.	Yale
Climate mitigation	Efforts to reduce or prevent the emissions of greenhouse gases.	UNEP

Key Terms & Definitions

Term	Definition	Source
Climate-related opportunity (also see climate risk)	The potential positive impacts of climate change on an organization. These often refer to additional benefits that may result from an organization taking steps to address climate change. Examples include cost savings or increased energy security that result from long-term renewable energy procurement plans, or increased sales from the development of new products and services aimed at addressing climate change.	TCFD
Climate resilience	The capacity of a system to withstand, respond, and recover from the impacts of climate change.	U.S. Climate Resilience Toolkit
Climate risk (also see climate-related opportunity)	The potential negative impacts of climate change on an organization. This includes both physical risks that result from climate change, such as extreme weather events, and the transition risks that result from the transition to a lower-carbon global economy, such as carbon prices.	TCFD
Consumption loss	A policy cost of climate change associated with decreased overall economic consumption.	NGFS
Ecosystem services	The contributions of ecosystems to the benefits that are used in economic and other human activity.	TNFD, UN
Energy transition	The transition in the global energy sector away from fossil fuels as the primary energy source and towards renewable or low-carbon forms of primary energy, such as solar, wind, and nuclear.	ENEL
Kyoto gases	A collection of six greenhouse gases that predominantly contribute to climate change and were established as part of the Kyoto Protocol in 1992. The collection of gases includes carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and the so-called F-gases (hydrofluorocarbons and perfluorocarbons) and sulphur hexafluoride (SF6).	UNFCC
Fugitive emissions	Often unintentional emissions of greenhouse gases from leaks, evaporative processes, or windblown processes.	California Air Resources Board

Key Terms & Definitions

Term	Definition	Source
Green hydrogen	Hydrogen produced by electrolysis where the original energy to power the electrolysis process is derived from renewables. As opposed to grey hydrogen (natural gas powered), and blue hydrogen (natural gas powered with carbon capture).	World Economic Forum
Hard-to-abate sectors	Sectors, such as cement, steel, and aviation, that are carbon intensive and currently have few, if any, viable low-emission solutions available.	Deloitte
Just transition	Transitioning to a low-carbon economy to meet climate targets in a way that is as fair and inclusive as possible to everyone concerned, creating decent work opportunities, and leaving no one behind.	ILO
Nationally Determined Contributions (NDCs)	Countries self-defined national climate pledges that detail how they will contribute to the Paris Agreement through actions to mitigate their emissions and adapt to climate change. As established by the Paris Agreement, signatories are required to update their NDCs every 5 years.	UNDP
Natural capital	The stock of renewable and non-renewable natural resources (e.g., plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people.	TNFD, Capitals Coalition
Net Zero	A state of balance where all of humanity's greenhouse gas emissions (inclusive of all Kyoto gases) are balanced by its greenhouse gas removals. In reference to the Science-Based Target Initiative, net zero also requires organizations to achieve at least a 90% reduction in greenhouse gas emissions by no later than 2050.	SBTi
Paris Agreement	A legally binding international treaty to address climate change established at the UN's Climate Change Conference (COP21) in Paris in 2015. The overarching goal of the treaty was to hold global temperature change well below 2°C above pre-industrial levels and pursue efforts to limit temperature change below 1.5°C above pre-industrial levels.	UNFCC

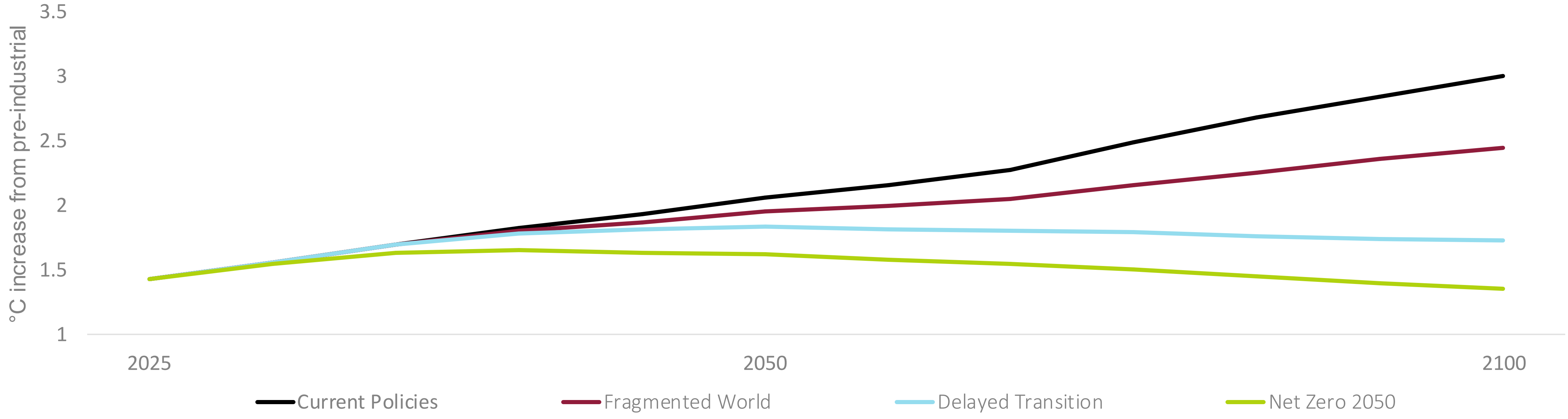
Key Terms & Definitions

Term	Definition	Source
Physical risks (also see transitional risks)	Climate risks related to the physical impacts of climate change, such as extreme heat tropical cyclones. Includes both chronic and acute physical risks (see the first slide of key terms and definitions).	EPA
Policy costs	The costs associated with enacting climate policies, such as decreased consumer spending and unemployment.	NGFS
Primary energy	The final source of energy before it was transformed or exploited. Typical primary energy sources include fossil fuels, renewables, and nuclear. NGFS commonly also mentions final energy, which refers to the final form that an energy source is converted to before being utilized. Typical final energy types include electricity, gasoline, and hydrogen.	EIA
Residual emissions	Emissions that remain after efforts (typically referring to very substantial efforts) have been made to reduce emissions. Residual emissions typically remain because reducing them is economically or technologically unfeasible.	Nature Journal
TCFD	The Taskforce on Climate-related Financial Disclosures is a voluntary framework for companies and other organizations to use to report on their climate performance, risks, and opportunities.	TCFD
Technology transfer	The transfer of knowledge, experience, and equipment for mitigating and adapting to climate change between different stakeholders. This has historically referred to the transfer of technologies from developed countries to developing countries but also encompasses the need for indigenous knowledge and solutions to be adopted and transferred to existing power structures that have ignored the value of their knowledge.	IPCC
Transitional risks (also see physical risks)	Climate risks related to the transition to a lower-carbon economy, such as carbon prices or job loss.	EPA
Transition minerals	Minerals such as cobalt, copper, lithium, and nickel that are essential to technologies (e.g., solar panels, wind turbines, and electric vehicles) that are crucial to the world's transition to a low-carbon economy.	Resource Governance

Additional Climate Data

Global Mean Temperature

By 2100, emissions trajectories resulted in 1.4°C warming in the **Net Zero 2050** scenario, 1.7°C in **Delayed Transition**, 2.4°C in **Fragmented World**, and 3.0°C in **Current Policies**. In all four scenarios, society continued to experience physical risks caused by GHG emissions emitted prior to 2023.



Under the four scenarios, warming continued to increase until the mid-2040s. Early climate action in Net Zero 2050 meant global temperatures stabilized sooner, resulting in comparatively less severe physical climate impacts from the mid-2040s onward.

Source: NGFS Phase 5 Scenario Explorer; Variable: AR6 climate diagnostics|Surface Temperature (GSAT)|MAGICCv7.5.3|50.0th Percentile; Model: REMIND-MAgPIE 3.3-4.8

*Note: The graph depicts the expected temperature increase under each scenario; it does not include ranges of uncertainty. To view the full dataset, please visit the NGFS IIASA Scenario Explorer.

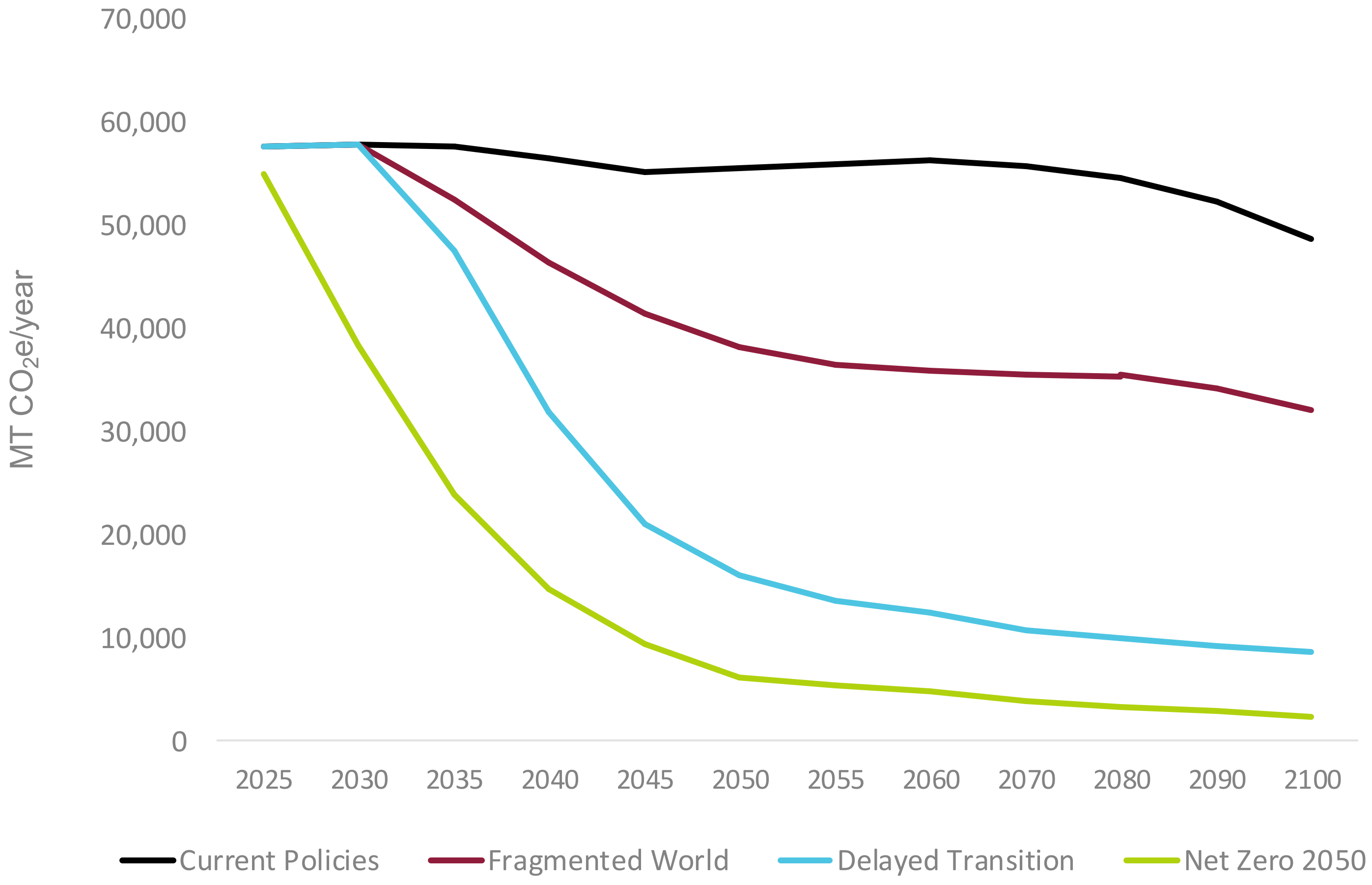
GHG Emissions (Kyoto Gases)

The four scenarios present different emissions trajectories, which define their warming potential and associated physical impact risk. The graph below does not include negative emissions from carbon capture and storage.

Delayed Transition followed a similar, but slightly steeper emissions trajectory compared to **Net Zero 2050,** but on a five-year delay.

Fragmented World begins its emissions reduction at a similar time to Delayed Transition, but on a less aggressive trajectory that stabilizes at higher emissions levels.

Current Policies fails to substantially reduce emissions through 2060.



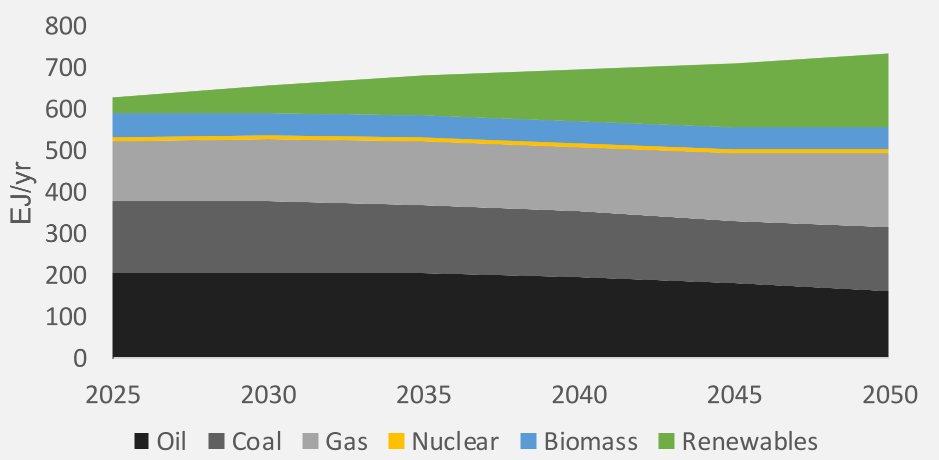
Source: NGFS Phase 5 Scenario Explorer; Variable: Emissions | Kyoto Gases; Model: REMIND-MAgPIE 3.3-4.8

Primary Energy Mix

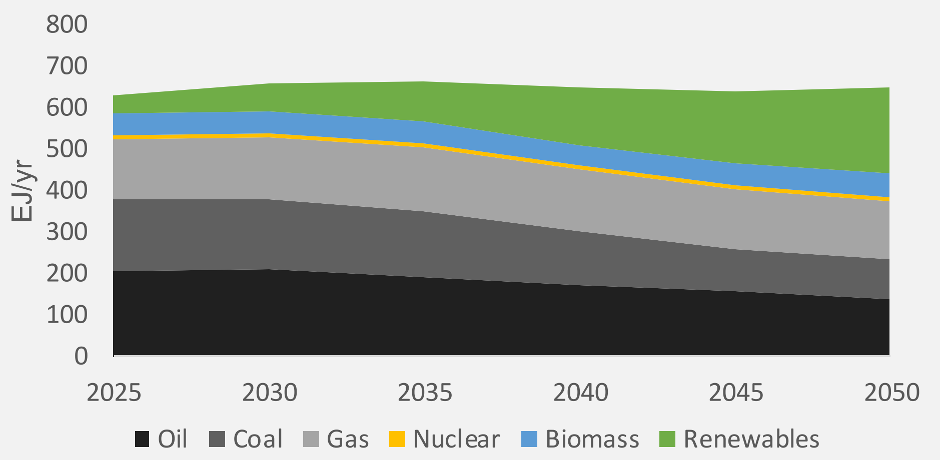
In 2050, renewables and biomass delivered 53% of global primary energy needs in **Fragmented World**, more than 69% of global primary energy needs under **Delayed Transition** and nearly 83% in **Net Zero 2050**.

This is in contrast with **Current Policies**, where fossil fuels continued to be the overwhelmingly dominant source of primary energy.

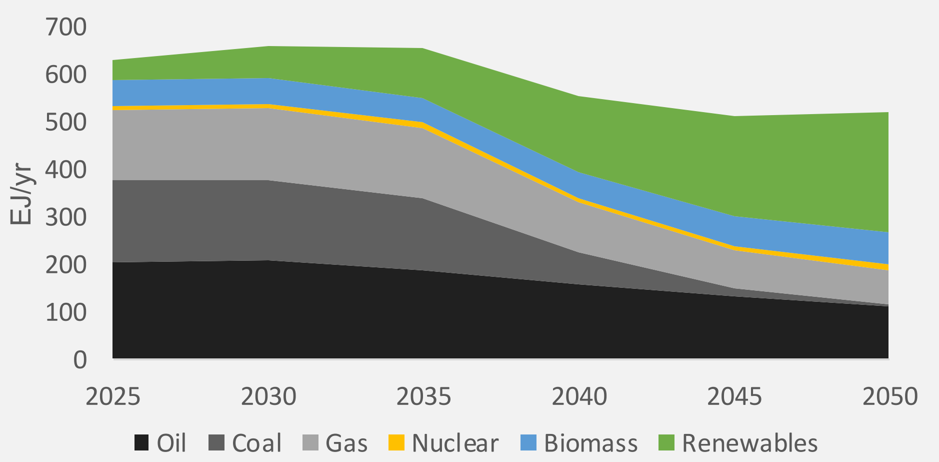
Current Policies



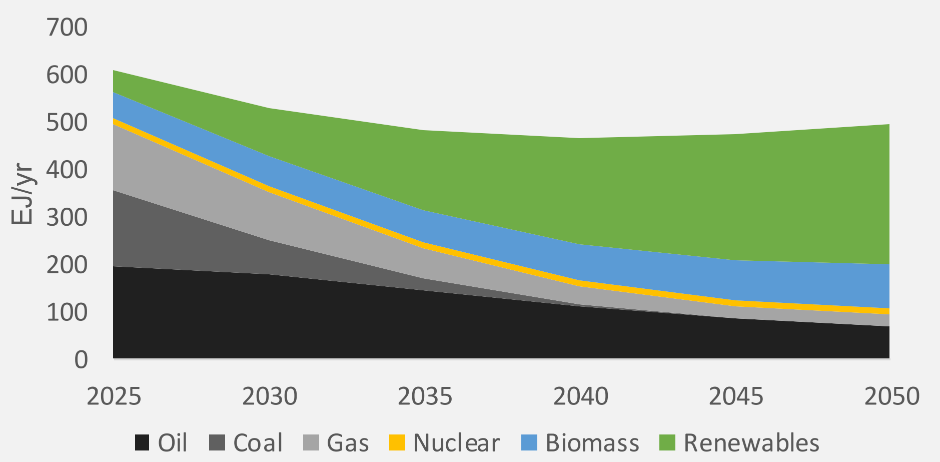
Fragmented World



Delayed Transition



Net Zero 2050



Source: NGFS Phase 5 Scenario Explorer; Variables: Primary Energy | Biomass; Coal; Gas; Non-Biomass Renewables; Nuclear; Oil; Model: REMIND-MAgPIE 3.3-4.8

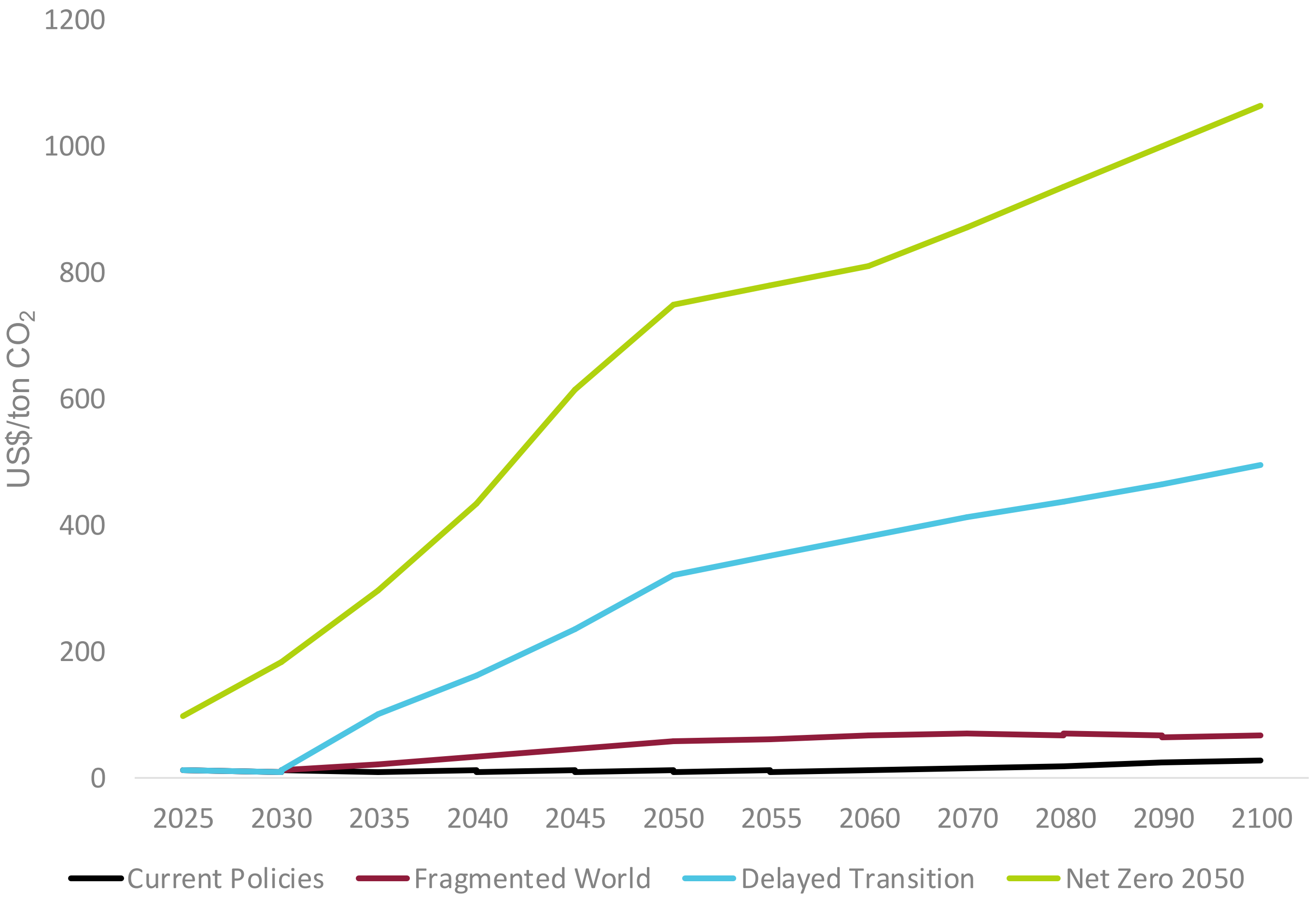
Carbon Price

Carbon price is a useful indicator of transition risk. It serves as a proxy for the intensity of government policies and changes in technology and consumer preferences.

A variety of factors can contribute to higher carbon prices, including greater ambition to mitigate climate change, a delay in action that requires a rapid response, a diversity of policy measures across sectors and regions, and the limited availability of technology, such as carbon dioxide removal.

The late response in **Delayed Transition** creates the conditions for **the most rapid increase in carbon price** in the early 2030s.

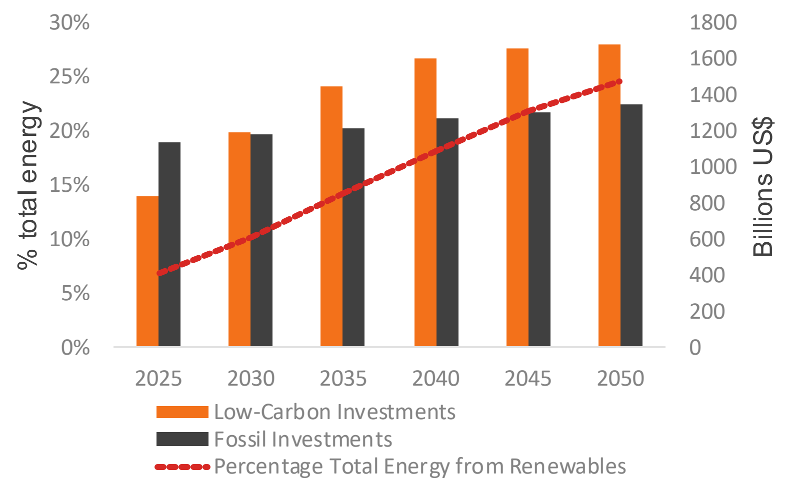
Carbon prices tend to be lower in low- and middle-income economies, which reduces the efficiency of pricing mechanisms but may align with equity considerations.



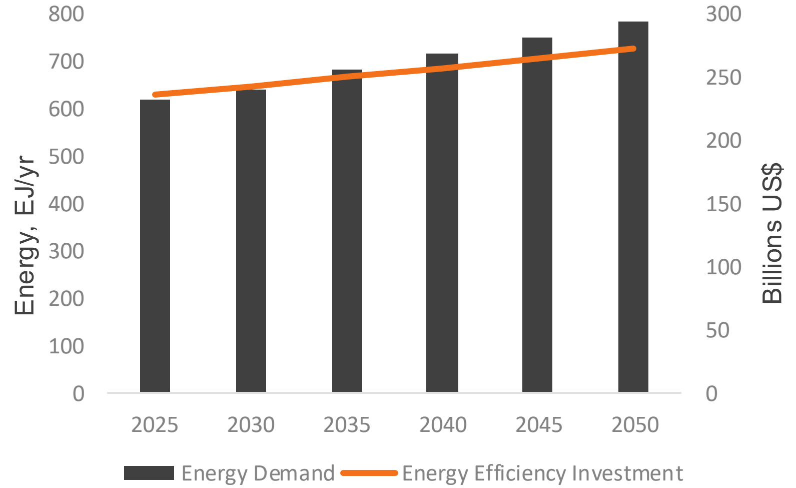
Source: NGFS Phase 5 Scenario Explorer; Variable: Price | Carbon; Model: REMIND-MAgPIE 3.3-4.8

Current Policies

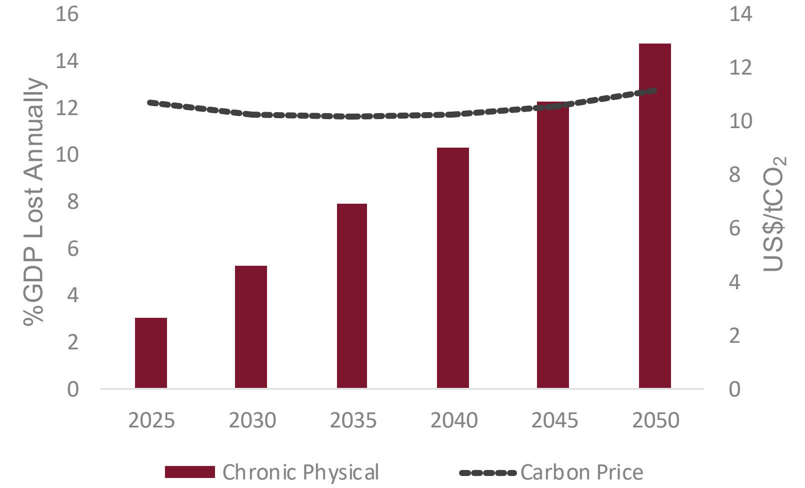
Renewables maintained a smaller share of primary energy output as fossil investment sustained



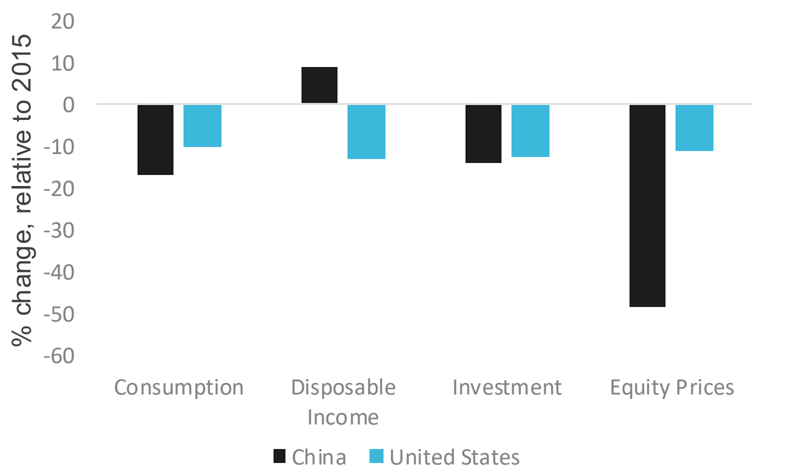
Global energy demand grew ~27% by 2050 due to lack of energy efficiency investment



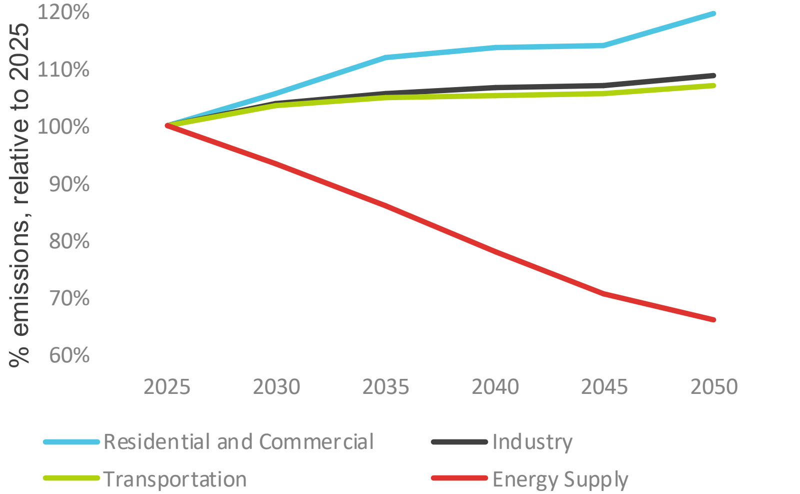
Lack of climate policy & carbon pricing led to exponential GDP loss from climate damage



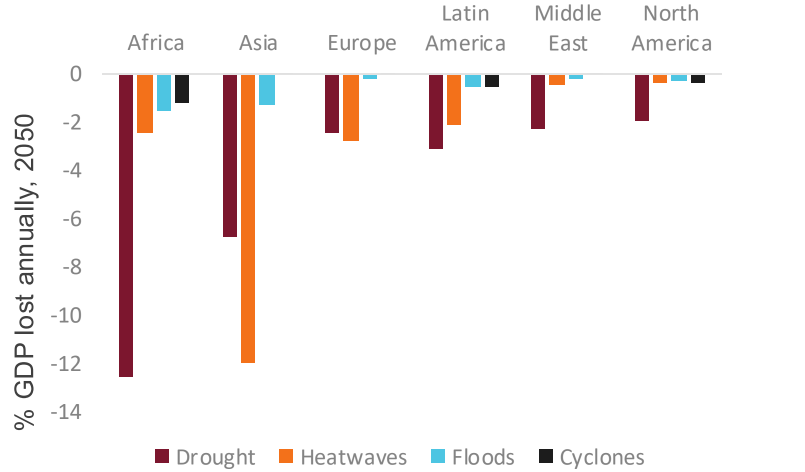
By 2050, climate impacts had notable impacts on consumers and market behavior



Energy supply was the only major sector to achieve emissions reduction through 2050

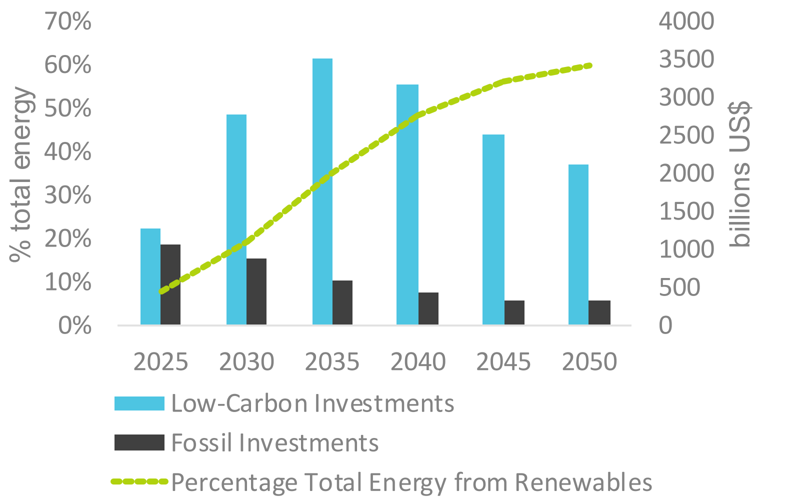


Inequitable climate impacts caused 3-7X greater acute physical damages in Asia/Africa than EU/NA

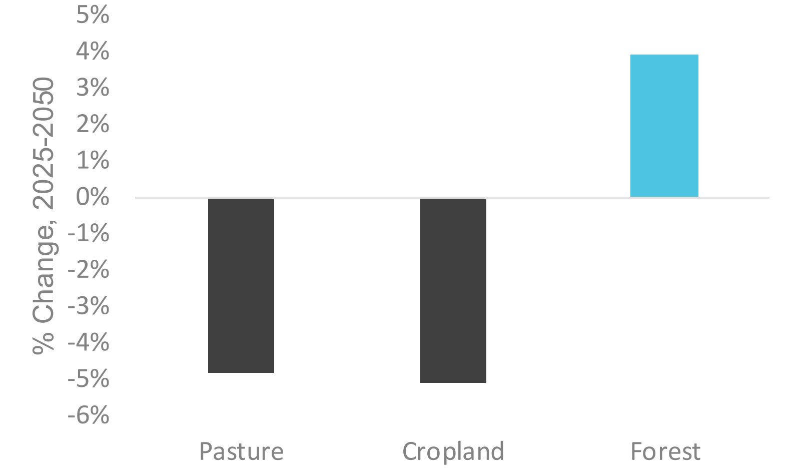


Net Zero 2050

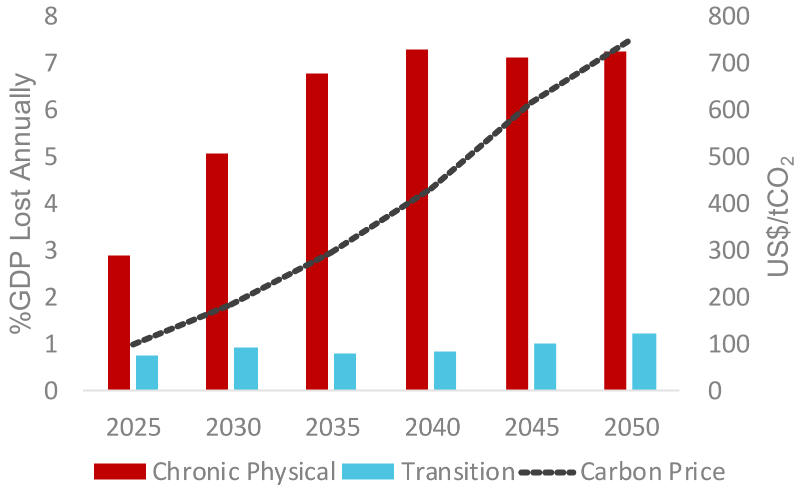
Sustained investment led to 60% of primary energy production being non-biomass renewables by 2050



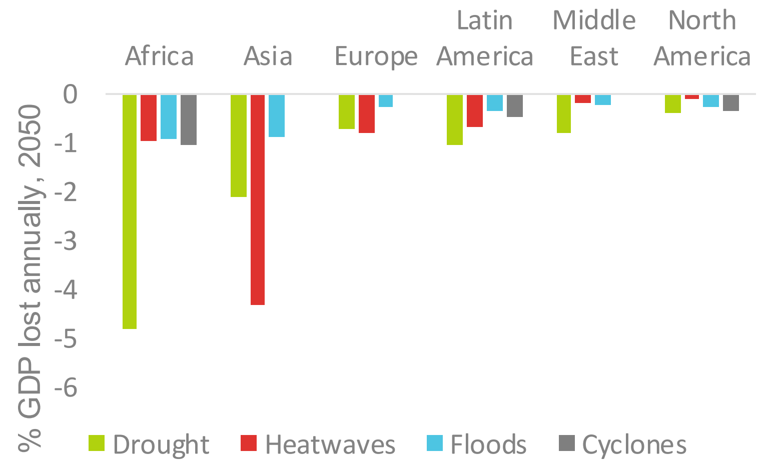
Pasture cover and cropland cover decreased to help forests recover and sequester carbon



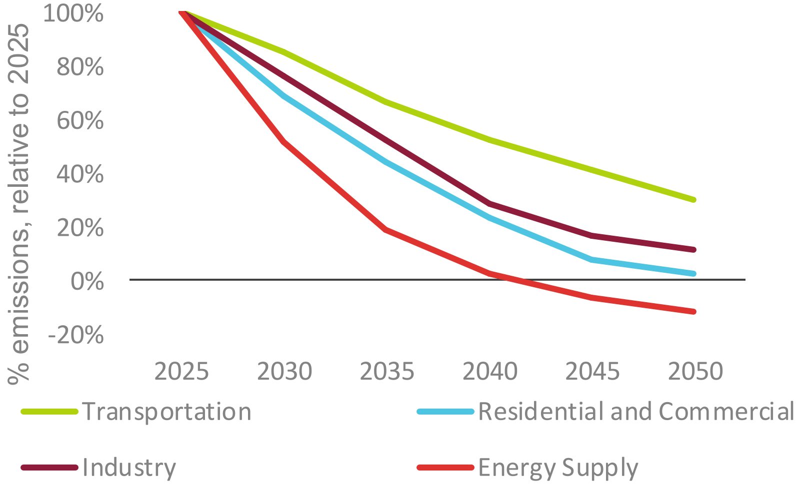
Carbon prices & policies in late 2020s stabilized physical damages, but at the expense of some transition costs



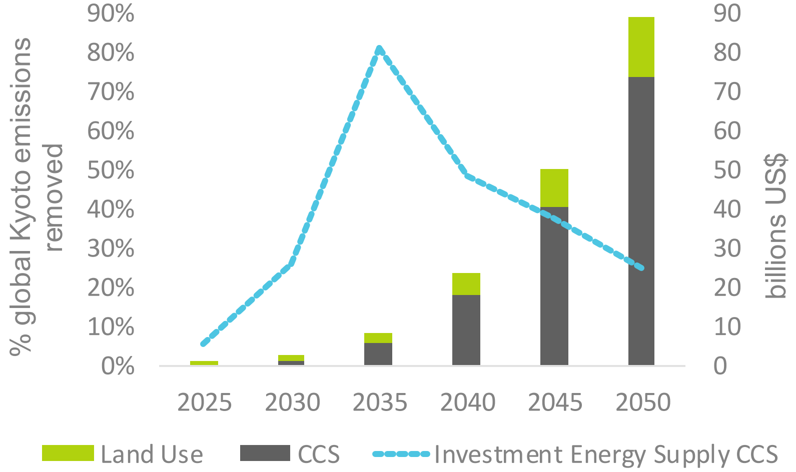
Except for droughts in Africa and heatwaves in Asia, most acute physical risks were kept at manageable levels



Emissions reduction initially focused on energy supply to enable reductions in other sectors

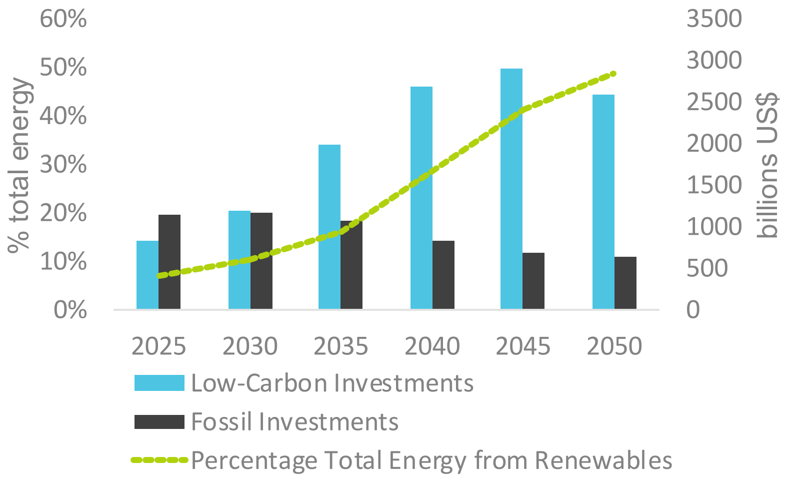


Targeted investment in CCS in the early 2030s helped the world reach net zero by 2050

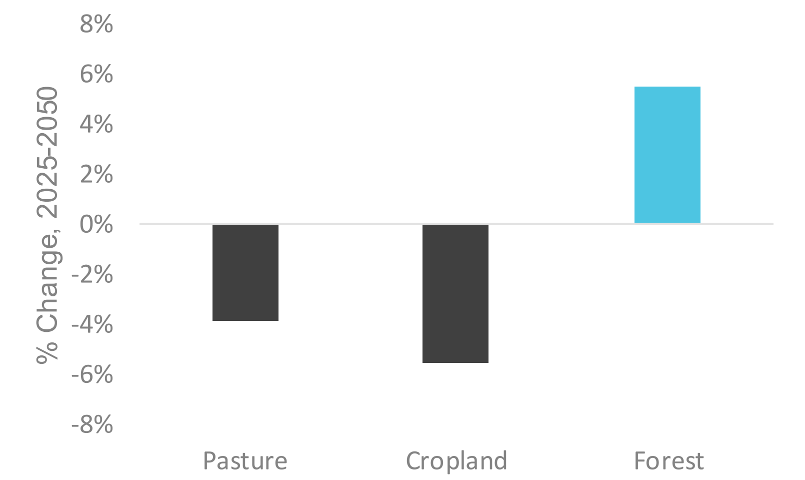


Delayed Transition

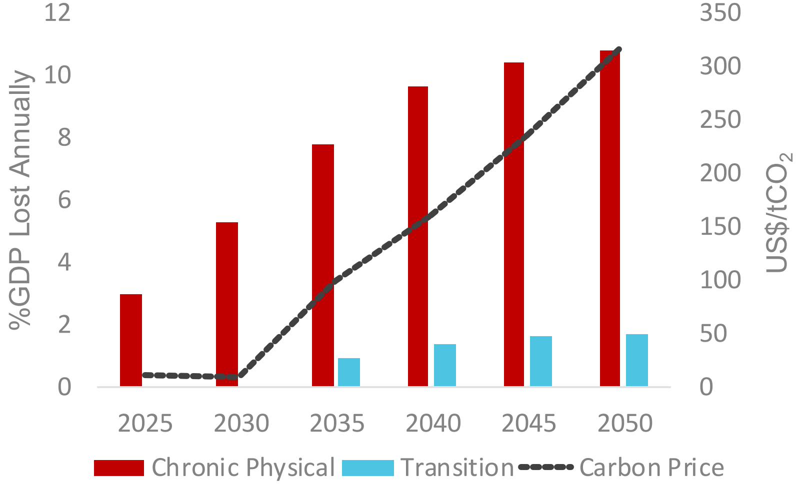
Steadily increasing renewables investment through 2050 helped to clean up the world's energy supply



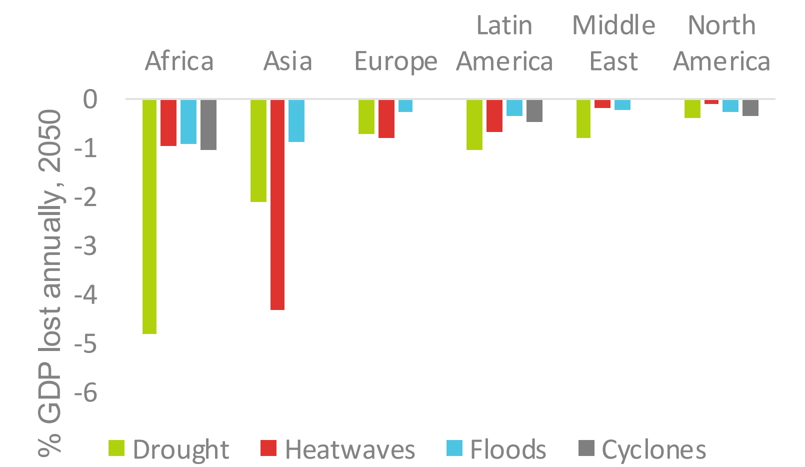
Agriculture land decreased significantly to allow for increase in forests and land-based carbon sinks



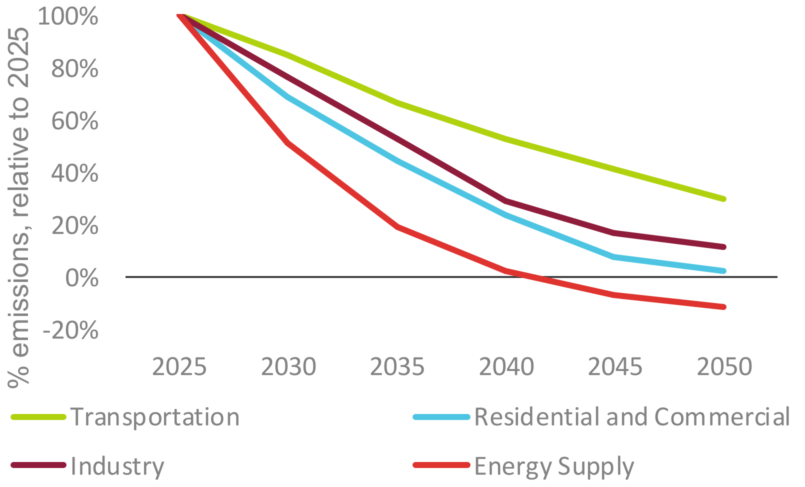
Aggressive carbon prices decreased GDP and consumption, but also reduced chronic physical damage



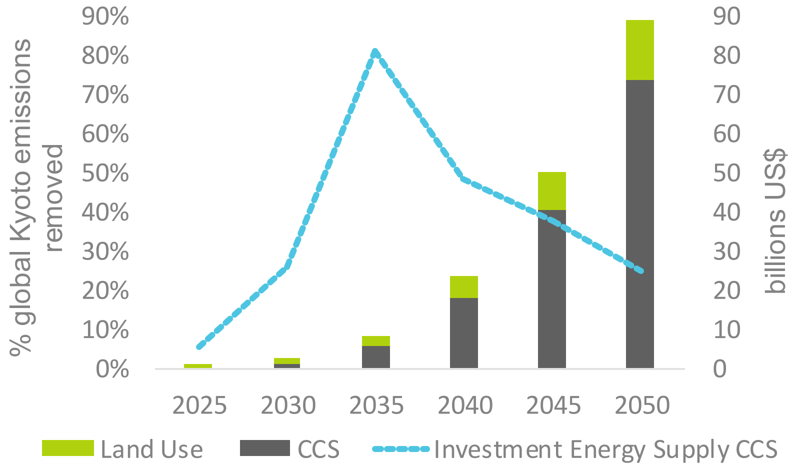
Climate impacts disproportionately damaged GDP in Africa and Asia, especially for droughts and heatwaves



Substantial emissions reduction was required of all sectors in the 2030s

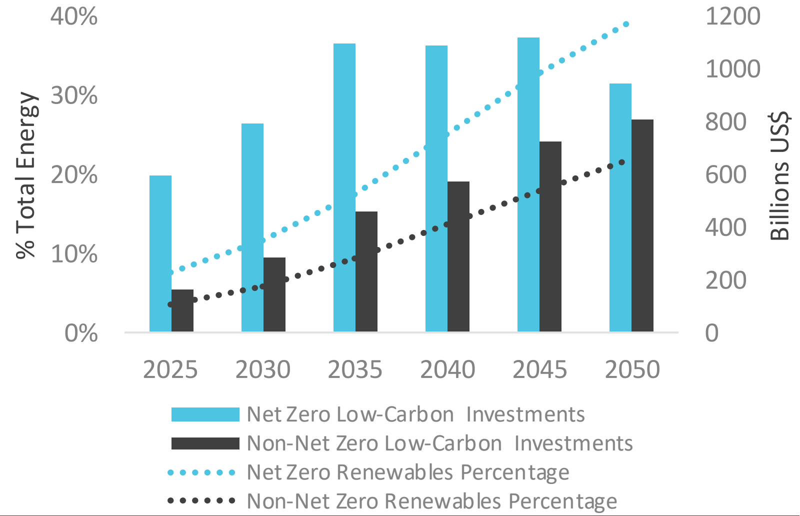


Intensive CCS investment in the early 2040s helped remove nearly 20% of remaining emissions

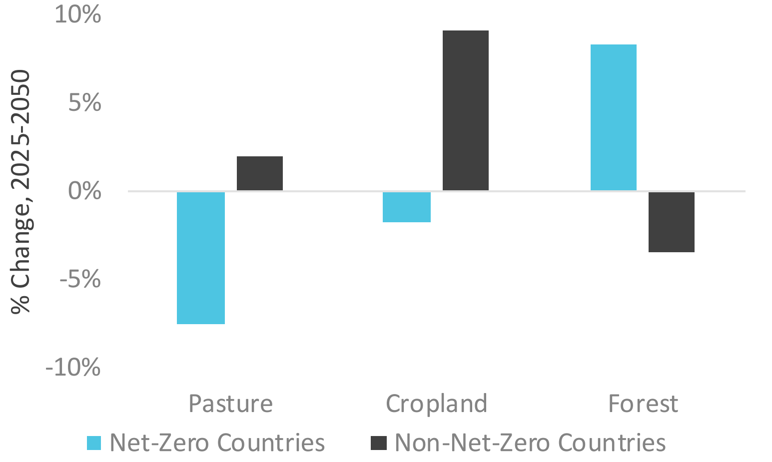


Fragmented World

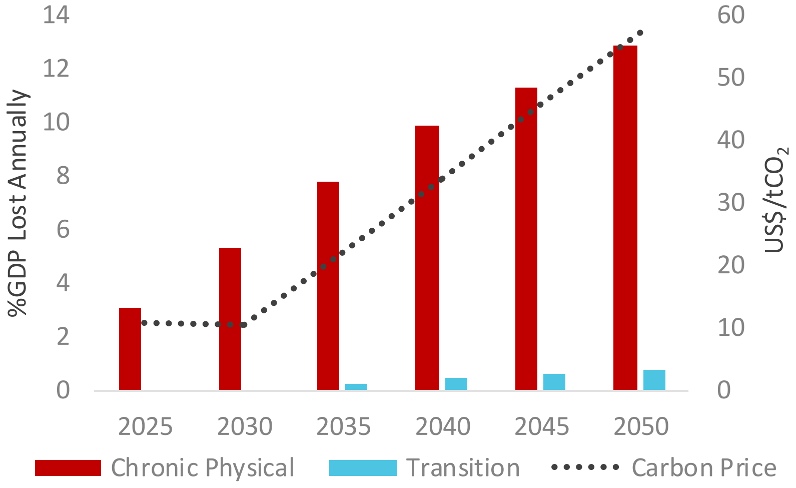
Net-zero countries invested in renewables to transition their energy supply, but non-net zero countries did not



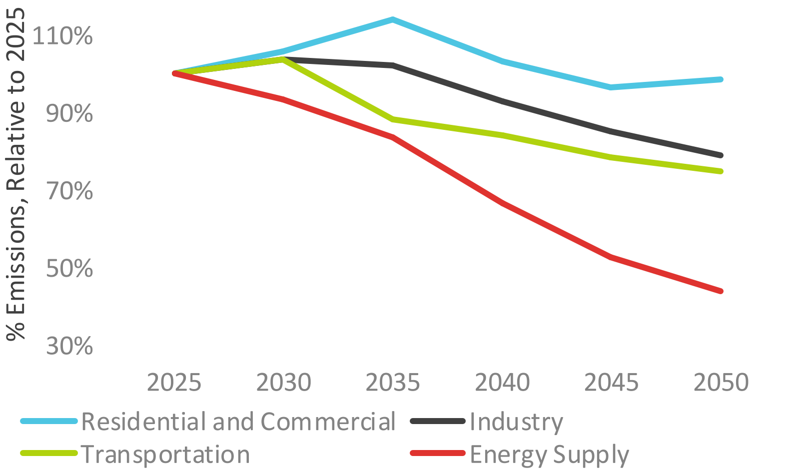
Net-zero countries placed more emphasis on preserving natural lands than non-net-zero countries



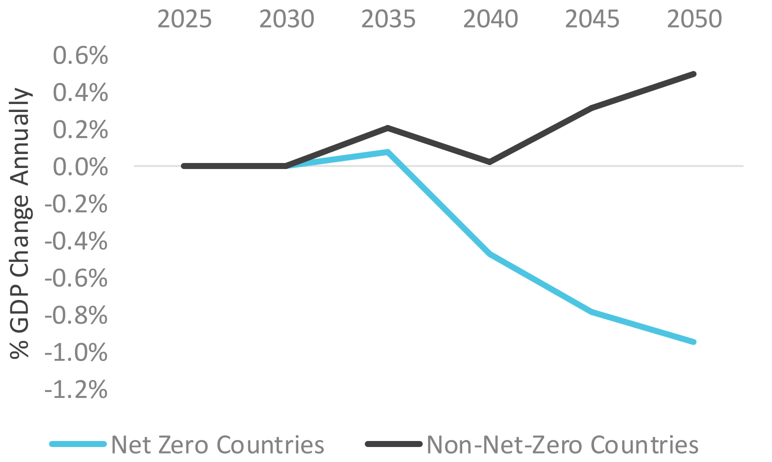
Inconsistent global policies allowed physical climate impacts to continue to spiral out of control



Energy supply was the only sector to achieve major emissions reduction through 2050



By 2050, policy costs caused a 1% decrease in annual GDP in net-zero countries



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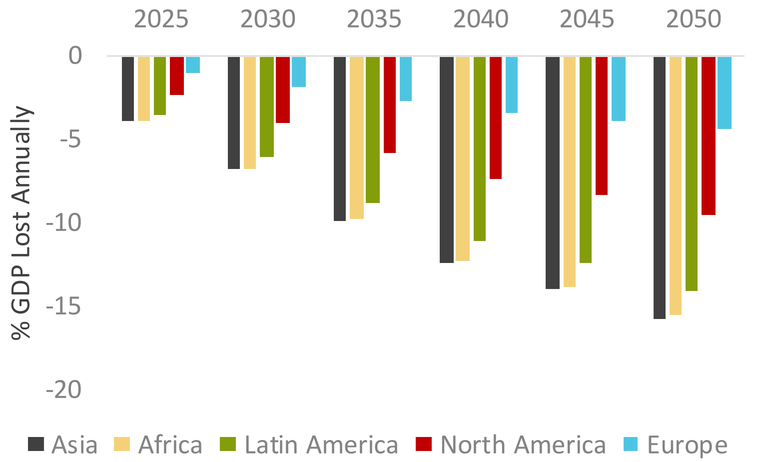

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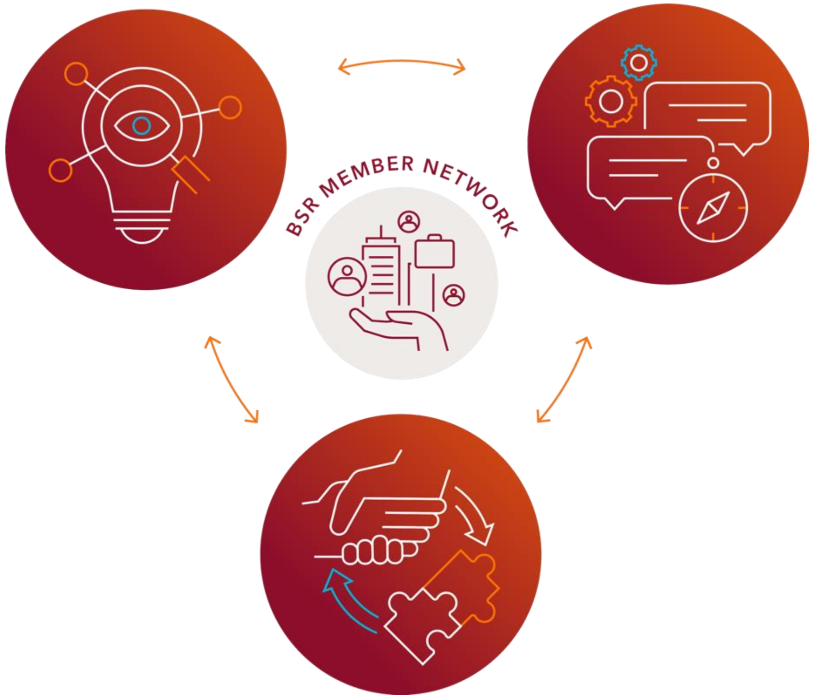

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