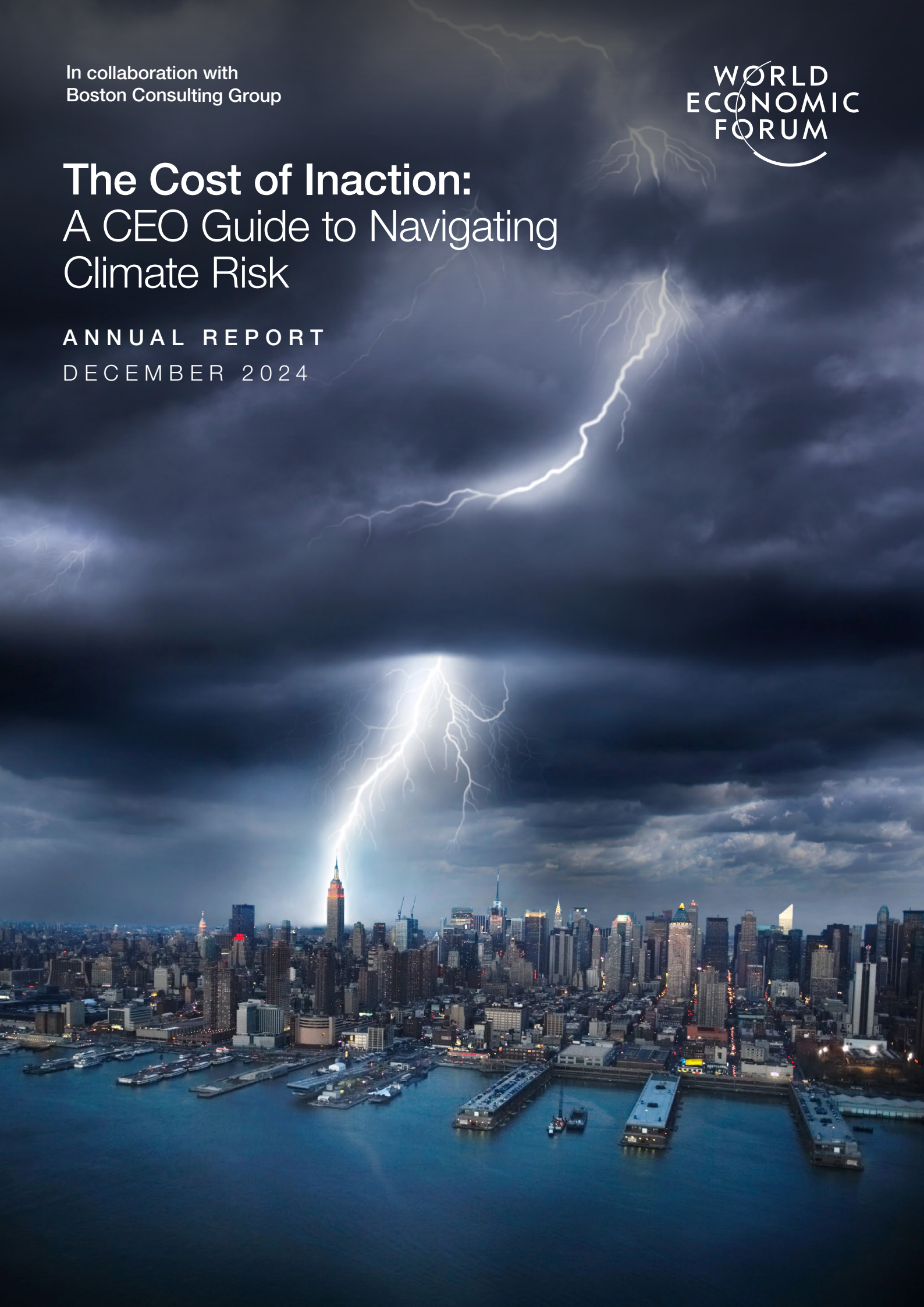
In collaboration with
Boston Consulting Group

WORLD ECONOMIC FORUM

The Cost of Inaction:
A CEO Guide to Navigating Climate Risk

ANNUAL REPORT

DECEMBER 2024



Images: Getty Images, Pexels

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Foreword

Patrick Herhold
Managing Director
& Senior Partner,
Boston Consulting Group

Pim Valdre
Head, Climate Action,
World Economic Forum

Climate risks are no longer distant threats – they are materializing today, with impacts already felt across industries and regions. Companies and societies must now confront a new reality: the world we operate in today will look quite different tomorrow. Last year, we called for systemic global change to combat the climate challenge. This year, we focus on something equally critical: how corporate leaders should step up to manage climate-related risks and seize opportunities as we navigate this complex landscape.

Climate inaction comes at a cost, even for businesses. The companies that fail to act could face substantial operational, financial and reputational risks in the near term, while early movers are already realizing tangible benefits from adaptation and decarbonization. For those who take bold steps, there is a path to sustained success.

This report is a call to action for CEOs to redefine their approach to climate risks and seize climate-smart opportunities. Climate leadership is not about avoiding risks – it is about building resilience for businesses and societies and unlocking value in a transforming world. Businesses face intensifying physical risks and transition risks that will likely reshape industries, but within these challenges lies the potential for growth, innovation and competitive advantage to shape a growing climate adaptation market.

Featuring innovative case studies and comprehensive frameworks for managing climate risks, this report equips CEOs and their companies with a blueprint to take decisive steps towards climate transformation, ensuring resilience, innovation and long-term success.

The World Economic Forum's *Business on the Edge: Building Industry Resilience to Climate Hazards* further explores how resilience strategies can be embedded across the C-suite.

Now is the time for business leaders to act boldly and decisively. The decisions made today will not only shape the future of individual businesses but will also determine the trajectory of the global economy and the future of our planet for decades to come.

Executive summary

All companies will face a cost of climate inaction: how their leadership prepares for a warmer or greener world will determine whether they thrive or fall behind.

Rising climate risks are already impacting the global economy and the business case for collective action is clear. Intensifying climate events will cause significant economic costs in the next two decades. However, climate inaction could cost far more than global action, as climate adaptation and mitigation investments could be "repaid" five to six times in avoided losses and damage in the long run.[1]

Physical risks of climate change are becoming material for businesses, putting significant value at risk and increasing potential opportunity costs in the medium term. Under the current climate trajectory, companies are becoming increasingly exposed to both systemic risks arising from lower global economic growth and individual physical risks threatening supply chains and operations. For unprepared businesses, individual physical risks alone could put 5% to 25% of their 2050 EBITDA at risk, depending on sector and geography, with infrastructure-heavy sectors being most exposed. The cascading effects of such losses would ultimately disrupt communities, with impacts on jobs, lives, livelihoods and the cost of goods and services.

Transition risks for businesses are also significant. After a decade of very significant (albeit insufficient) progress, ambitious climate action has recently seen more public resistance, triggering doubts about the pace of decarbonization and the future course of climate policies. But as climate change affects the life and wealth of people and businesses more seriously, relying on the status quo is a risky bet to make and businesses need to prepare for a broader range of developments.

In a scenario of accelerating climate action, unprepared companies risk significantly higher cost pressure from carbon pricing or comparable regulation, write-downs on their fossil asset base and a much faster-than-expected demand decline for fossil fuels and technologies. Under a "well below 2°C path", the impact of carbon pricing alone could create additional costs equivalent to 50% of EBITDA in certain emission-intensive sectors. As capital markets respond to long-term threats to future performance, early signals of heightened transition risks could affect company valuations well before those risks fully materialize.

Corporate inaction also comes at a cost: there is a clear business case for adaptation and a better case for mitigation than most might think. Companies report that their current adaptation and resilience investments could yield between $2 and $19 for every dollar invested. On mitigation, while full decarbonization across sectors comes at a cost, sustainability leaders can still find cost-efficient ways to reduce emissions in the short term. Addressing these risks also informs companies how to navigate the transition and adaptation opportunities and develop innovative offerings fit for a warmer and greener world.

Companies need to change the way they manage climate risks and opportunities, as outlined in the CEO Guidebook presented at the end of this report. Climate-related incidents and market shifts are hard to predict and discontinuous, but have potentially high-impact consequences. While many companies are aware of these risks, most are insufficiently prepared:

- Climate risks and opportunities should be a critical component of company strategy, guiding risk management, financial, strategic and operational decisions at all levels. Understanding climate risks is key for maintaining business resilience, unlocking opportunities and ensuring a competitive edge.
- Businesses need to ramp up scenario thinking to be prepared well ahead for both a 3°C world and a future with accelerated decarbonization.
- Climate transition and resilience plans to manage these risks should be informed by a quantified assessment of underlying climate risks across a range of scenarios.
- Capital allocation should match climate risk strategy, balancing short-term profits with long-term strategic resilience and optionality.
- Climate risk management should become part of business-as-usual for all employees, as these impacts are far reaching and likely to influence many aspects of business operations.

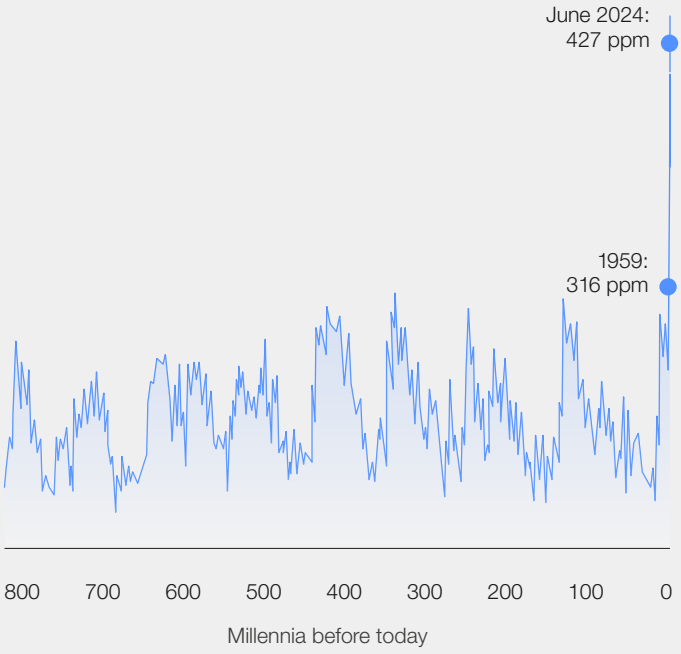
1

Climate inaction could severely harm the world economy

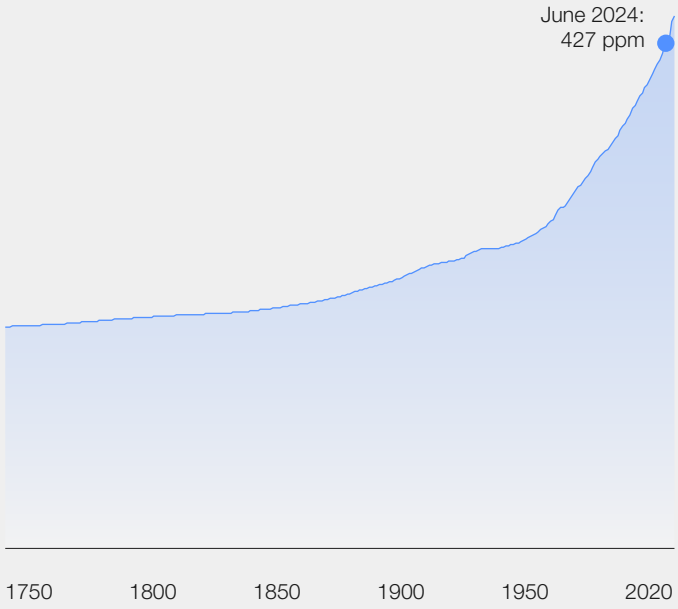
Climate change has caused over $3.6 trillion in damage since 2000. Without urgent action global GDP could drop by up to 22% cumulatively by 2100.

FIGURE 1 | **Atmospheric CO_2 is increasing**

Atmospheric CO_2 concentration across millennia
parts per million (ppm)



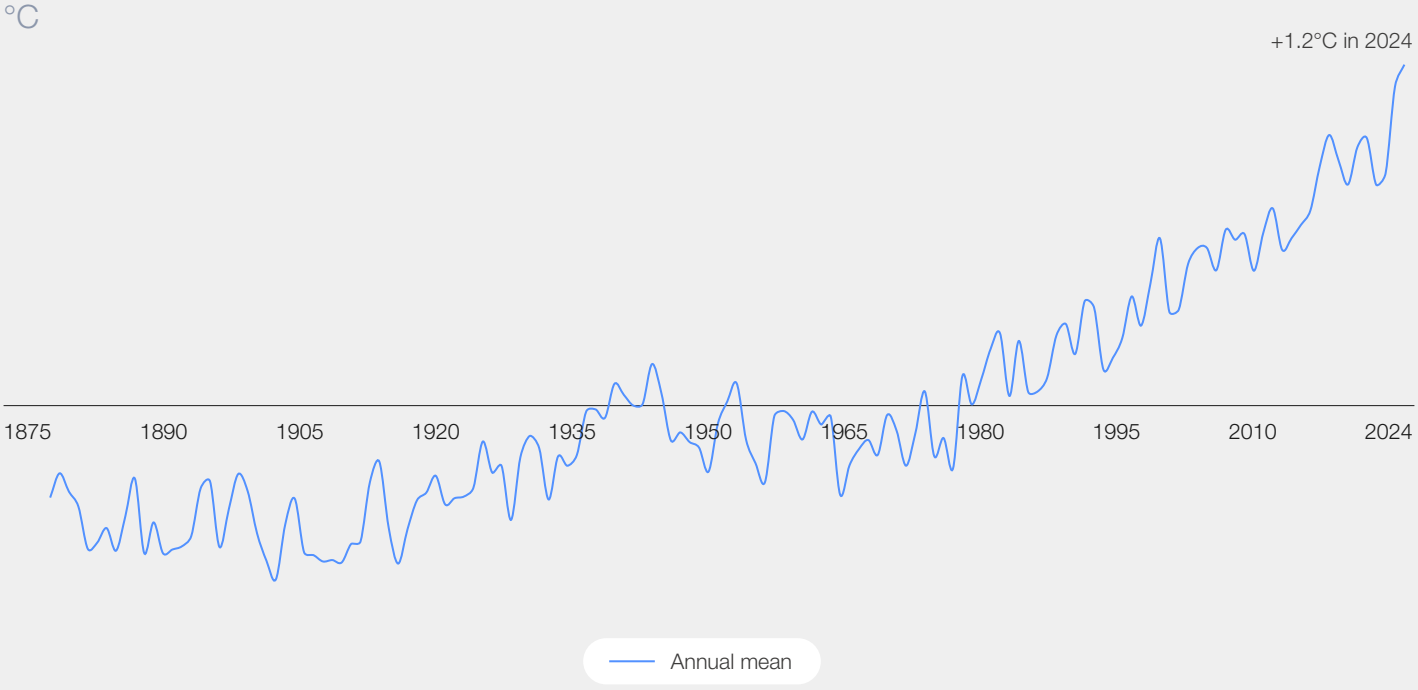
… and since the industrial revolution
parts per million (ppm)



Sources: National Oceanic & Atmospheric Administration (NOAA), NASA's Goddard Institute for Space Studies.

FIGURE 2 | **Our planet is getting warmer**

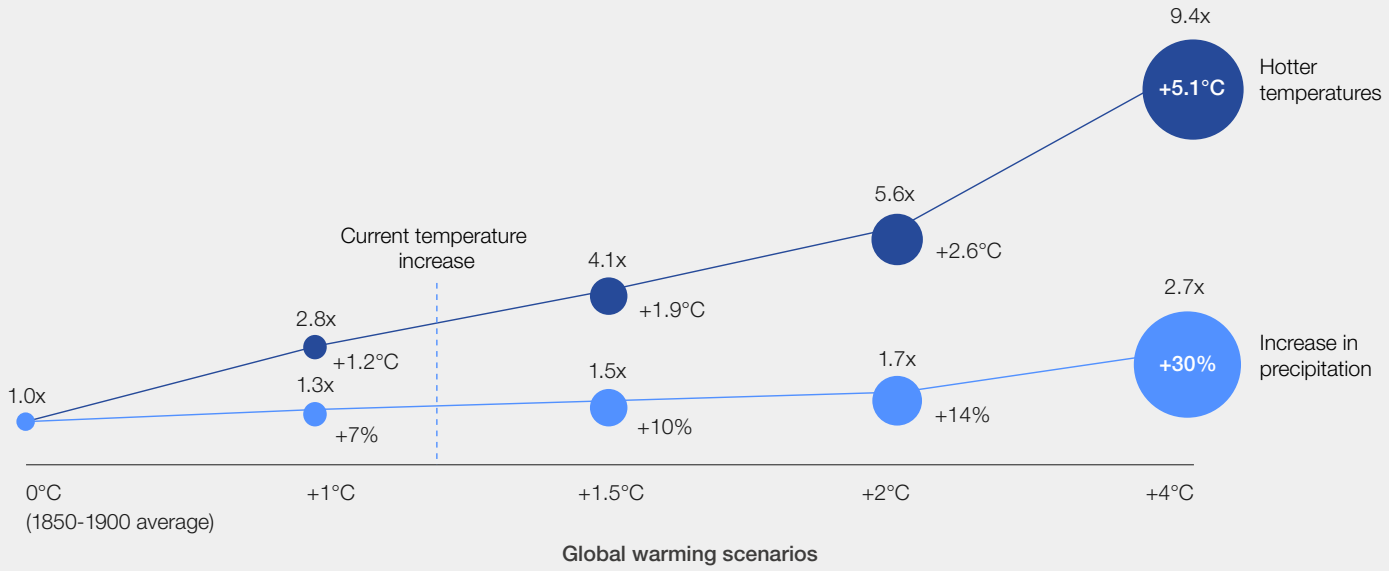
Temperature anomaly
°C



Note: Global average land-sea temperature anomaly relative to the 1961-1990 average temperature.
Source: Met Office Hadley Centre.

FIGURE 3 | **Frequency and intensity of extreme events rise with temperature**

Increase in frequency and intensity of extreme events[1] under different warming scenarios
x for increase in frequency, °C for increase in temperature, % for increase in precipitation intensity

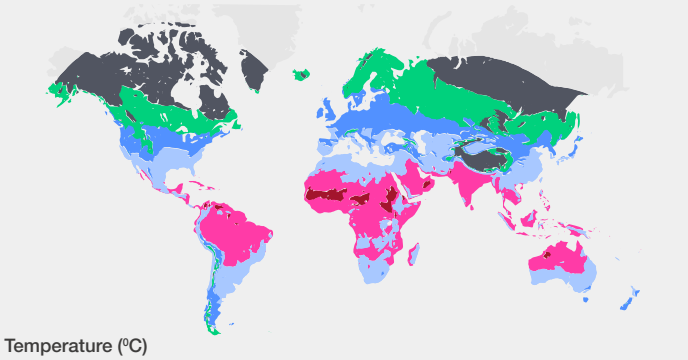


1. Vs. 1850-1900 average; variation in frequency and intensity for extreme heat event or 1-day precipitation event that occurred on average once every 10 years in a climate without human influence.

Source: Intergovernmental Panel on Climate Change (IPCC).

FIGURE 4 | **Some regions will suffer more than others – a glimpse of a 3°C world**

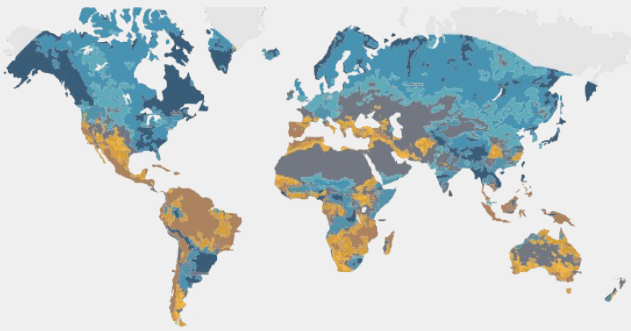
Average temperature



Temperature (°C)

No data	-30 — 0	1 — 7	8 — 14	15 — 25	26 — 31	32 — 60

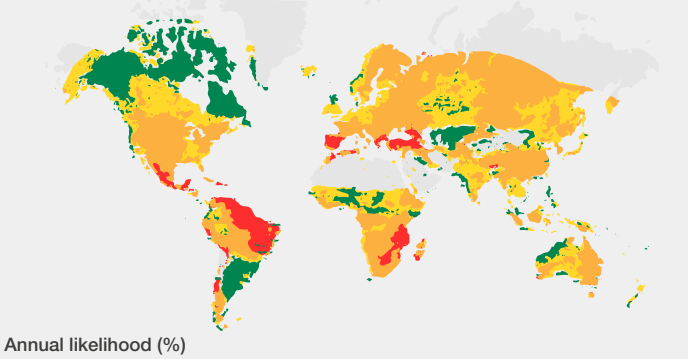
Change in total annual precipitation



Change in precipitation (mm)

No data	< -100	-100 — -51	-50 — -26	-25 — +24	+25 — +49	+50 — + 100	> +100

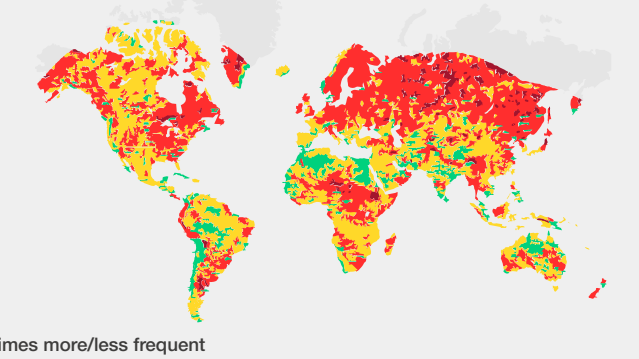
Likelihood of 1 year-plus droughts



Annual likelihood (%)

No data	0 — 10	11 — 33	34 — 50	51 — 67	68 — 90	91 — 100

Change in frequency of historical "1-in-100-year" storm

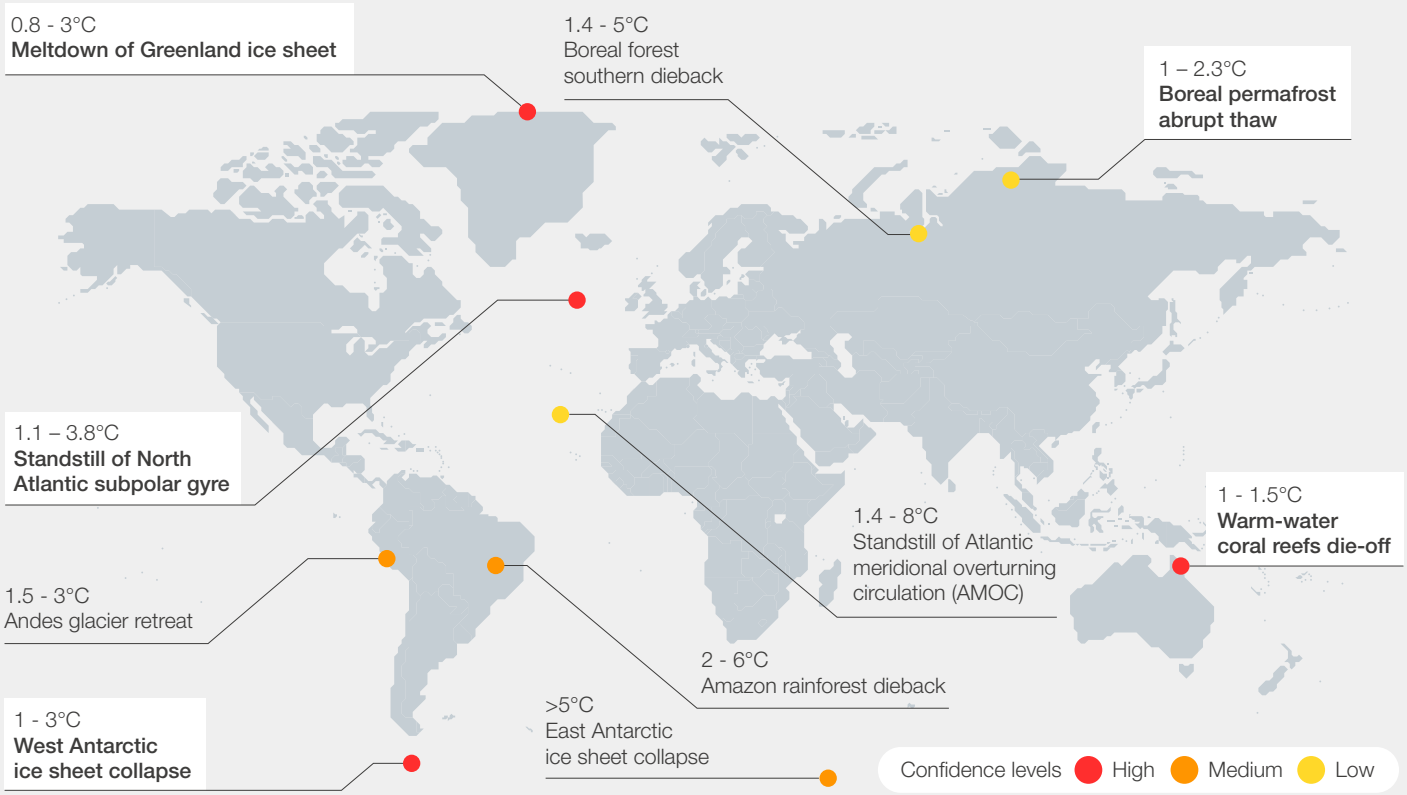


Times more/less frequent

No data	< 1	1	2	3 — 4	> 4

Source: Adapted from the Probable Futures climate tool.

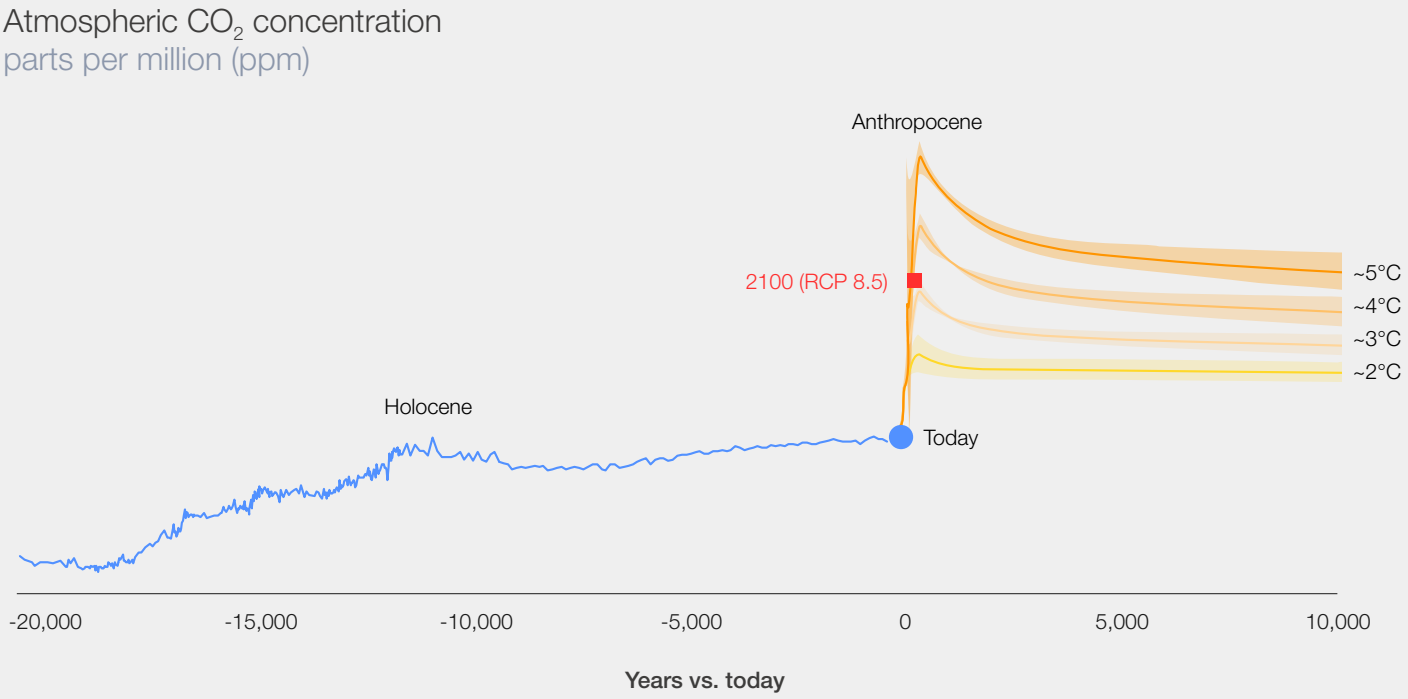
FIGURE 5 | **Several earth systems tipping points risk accelerating warming irreversibly**



Note: Earth system tipping points are displayed as a function of temperature increase, although other factors (e.g. deforestation, precipitation levels, water salinity) also play a significant role in triggering them. Five Earth systems (highlighted) are at immediate risk of tipping into irreversible decline, accelerating warming on a planetary scale.

Source: *Global Tipping Points Report*, Lenton, T. et al., Boston Consulting Group (BCG) analysis.

FIGURE 6 | **The next three decades of emissions will shape the temperature of the next 10 millennia**



Note: RCP 8.5 scenario represents a high-emissions "business-as-usual" scenario characterized by sustained increases in greenhouse gas emissions.

Source: Clark, P. et al.

1.1 Impacts of climate change are increasing and will accelerate with further warming

> Carbon dioxide concentrations in summer 2024 hit a level not previously seen in at least 3 million years.

The effects of human-induced climate change are already being felt today

Since the beginning of industrialization, about 2,300 billion tonnes (gigatonnes or Gt) of anthropogenic CO_2 have been released into the atmosphere,[2] with over 900 $GtCO_2$ (approximately 40% of that total) added within the last three decades.[3] This pushed the CO_2 concentration beyond 427 parts per million in the summer of 2024[4] — a level not previously seen in at least 3 million years[5] (see Figure 1).

As a result, average global temperatures have already increased approximately 1.2°C versus pre-industrial levels[6] (see Figure 2). Meanwhile, according to the World Meteorological Organization, the frequency of natural disasters such as extreme heat, floods, droughts, storms and wildfires has increased five-fold over the past 50 years.[7]

While it is difficult to attribute any one individual disaster to climate change, there is very high certainty that the increasing frequency has been strongly influenced by man-made emissions.[8] For example, the European 2019 heatwave, which caused approximately 2,500 excess deaths across the continent, was made 10 to 100 times more likely by human-induced climate change.[9] Extreme rainfall in Brazil (Rio Grande do Sul) in April and May 2024 led to catastrophic flooding, displacing over 580,000 people. Human-induced climate change made this event twice as likely and increased its intensity by 6% to 9%.[10]

As global temperatures continue to rise, so will the rate and severity of extreme weather events

As long as humanity continues to add greenhouse gases to the atmosphere, global temperatures will continue to increase. This will not only increase the frequency but also the intensity of extreme weather events. Warmer temperatures shift historical weather patterns, resulting in increasing evaporation, lower soil moisture, worsening drought conditions and a greater risk of devastating wildfires. Warmer oceans provide more energy for storms, intensifying both their frequency and strength. Warmer air can hold more moisture, increasing rainfall amounts and flooding risks. The world will also experience more frequent extreme heat events, with higher peak temperatures (see Figure 3).

These events already cost lives, increase damage to infrastructure and threaten global food systems (see Table 1). They also make our societies more unstable by disrupting livelihoods, displacing populations and straining resources. The likely resulting political instability would make global climate-related challenges even more difficult to solve.

TABLE 1 **Climate hazards will increasingly disrupt our way of living**

	A glimpse of 2050	Global scientific projections	Socio-economic impact
Extreme heat	300m+ people could be affected by heatwaves in India[1]	1-in-1,000-day hot extremes 5x as likely with 0.85°C warming[7]	~60k deaths in European heatwave (2022)[8]
Flood	5x increase in annual flood losses expected in EU[2]	70% of population could face 5x surge in flood impacts at +4.0°C[9]	2021 flooding losses were $18.4bn in China & $3.2bn in India[10]
Drought	80% chance of decade-long droughts in the US starting 2050[3]	Current 1-in-100-year droughts could occur every 2-5 years[11]	Food lost to drought can feed 81m people daily[12] (= population of Germany)
Sea-level rise	~1.3m Bangladeshis could forced to migrate due to sea-level rise[4]	Global mean sea level expected to rise 1m by 100 per RCP8.5[13]	Jakarta is sinking ~28 cm yearly[14] & facing $186m p.a. in flood damage[15]
Storm	3x increase in annual probability of typhoons in Tokyo[5]	Hurricane frequency could double by 2050[16]	~8,500 FTE jobs & $1.5bn of value lost in Cyclone Debbie (2017)[17]
Wildfire	~35% increase in area burnt yearly by bushfires in Sydney[6]	Wildfires likely to increase by a third[18]	Canadian wildfires displaced 230k people & claimed 8 lives (2023)[19]

Note: RCP 8.5 scenario represents a high-emissions "business-as-usual" scenario characterized by sustained increases in greenhouse gas emissions; FTE = full-time equivalent. **Sources:** 1. University of Cambridge, 2. European Environment Agency, 3. NASA, 4. De Lellis, P. et al. and New York University, 5. Bloemendaal, N. et al., 6. Hotspot Fire Project, 7. Fischer, E. et al., 8. Multiple sources estimate 55,000-72,000 death toll, 9. Alfieri, L. et al., 10. World Meteorological Organization (WMO), 11. Naumann, G. et al., 12. World Bank, 13. Kulp, S. et al., 14. National Geographic, 15. Budiyono, Y. et al., 16. Bloemendaal, N. et al., 17. Lenzen, M. et al., 18. United Nations Environment Programme (UNEP), 19. BBC.

"Rainfed agriculture covers 95% of cultivated land and accounts for 10%-70% of the GDP of most local economies.

"Today, five Earth systems are at immediate risk of tipping into irreversible decline, accelerating warming on a planetary scale.

Some regions will suffer more than others

Although contributing the least to global warming, low- and middle-income countries will generally be hit hardest (see Figure 4). These countries face the highest average risk of extreme weather; but compounding this risk, they have economies that are more dependent on vulnerable activities such as outdoor manual labour and agriculture, their infrastructure tends to be weaker and they have fewer resources to invest in adaptation. In Sub-Saharan Africa, for example, 160 million people already live with water scarcity today;[11] this is expected to worsen as warming intensifies. At the same time, vulnerable rainfed agriculture currently covers 95% of cultivated land and accounts for 10% to 70% of the GDP of most local economies.[12]

However, developed nations will also be increasingly affected. In the Southwest of the United States (US), rising temperatures and more frequent droughts are expected to increase competition for water resources, affecting cities, agriculture and energy production, while the Southeast is likely to be hit by more regular storms and floods, becoming a threat to life and infrastructure and depreciating values of real estate.

Today, five Earth systems are at immediate risk of tipping into irreversible decline, accelerating warming on a planetary scale (see Figure 5):[13] these include the melting of the Greenland and West Antarctic ice sheets, the thawing of boreal permafrost, the extinction of warm-water coral reefs and the standstill of the North Atlantic subpolar gyre (part of the Atlantic Meridional Overturning Circulation or AMOC), which plays a vital role in regulating the climate of Western Europe as well as global weather patterns.

When global temperatures surpass 1.5°C above pre-industrial levels, irreversible warming will become a reality as some of the Earth's landscapes turn into net emitters of carbon (such as permafrost) or accelerators of heating (such as the loss of sea ice). The World Economic Forum publication *Business on the Edge: Building Industry Resilience to Climate Hazards* provides a detailed briefing on Earth system tipping points[14] and their implications for business risk across landscapes, supply chains and societies. In this new era of the Anthropocene, the warming triggered over the coming decades will shape Earth's climate for millennia (see Figure 6), making it a global imperative to understand and respond to Earth systems disruption.

1.2 Climate-related economic costs have more than doubled over the past 20 years

Climate-related disasters have caused more than $3.6 trillion in economic damage since 2000, more than half of which is attributed to storms – this figure very likely underestimates actual costs.

Climate change is already causing significant economic costs

According to EM-DAT's international disaster database, climate-related disasters have caused more than $3.6 trillion in economic damage since 2000, more than half of which is attributed to storms.[15] This figure very likely underestimates actual costs, as it primarily reflects direct damage such as infrastructure destruction, insured losses and immediate economic impacts, while excluding indirect effects such as longer-term health consequences, loss of productivity and natural resource depletion. The economic strain of climate change is already massive, with a significant portion, especially the unaccounted indirect effects, currently borne by society at large.

Since the turn of the century, average damage costs have more than doubled

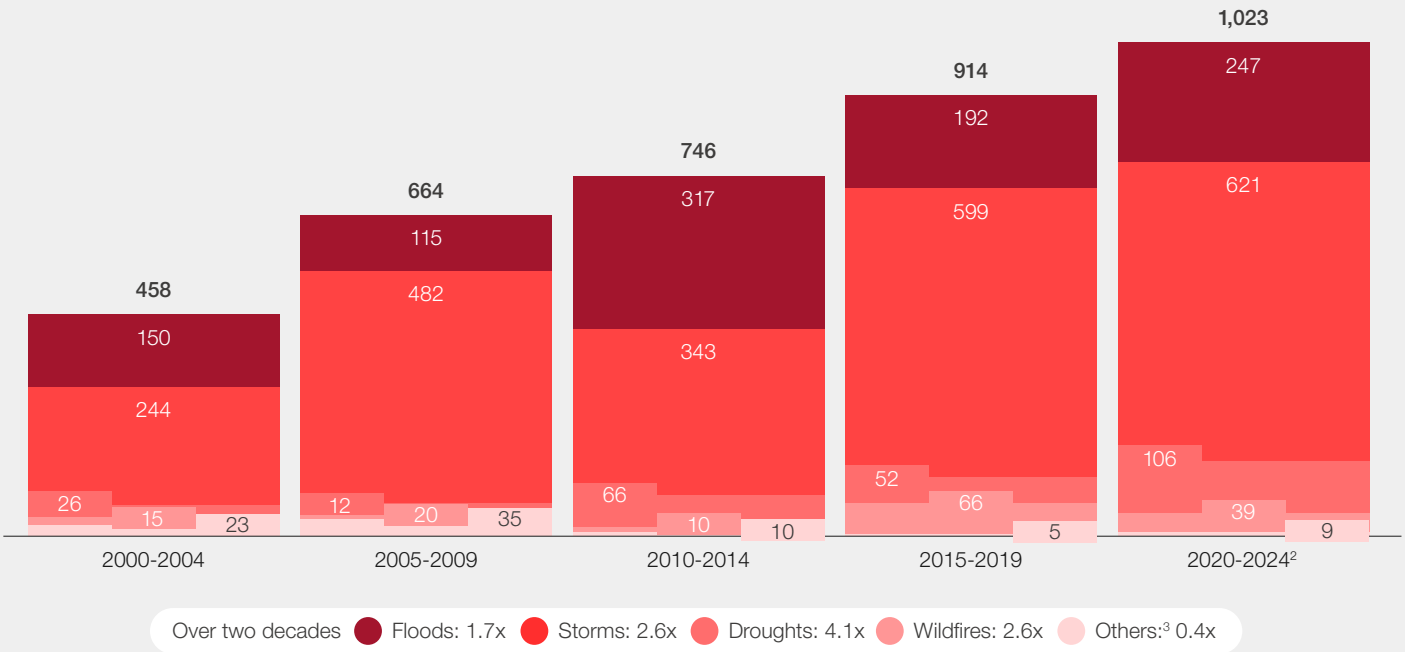
The costs of climate-related damage increased from around $450 billion between 2000 and 2004 to more than $1 trillion between 2020 and 2024 (see Figure 7). Early estimates for Hurricane Helene, which wreaked havoc in Southeastern US states in September 2024, indicate that this event alone might be responsible for over $100 billion worth of damage,[16] making it one of the costliest hurricanes in US history. An increasing frequency and intensity of such events would mean that costs are likely to escalate further.

The impact of future disasters can already be felt

Insurance premiums for climate resilience and protection from "natural catastrophes" are estimated to increase by around 50% until 2030, reaching a total of $200 billion to $250 billion.[17] As companies pull back coverage in vulnerable areas, properties in certain parts of the world are essentially becoming uninsurable.[18]

FIGURE 7 **Economic cost of climate-related disasters has more than doubled since 2000**

Economic cost of climate-related disasters[1]
($ billion) five-year sum of reported cost of disasters from 2000-2024[2]



1. EM-DAT's database categorizes and shares economic data across: floods; storms; extreme temperature events; droughts; "mass movement (dry and wet)" – i.e. landslides & mudslides; wildfires; volcanic activity; and earthquakes. Disasters related to volcanic activity and earthquakes are excluded here as they are not directly linked to climate or climate change. **2.** Data is extrapolated for 2024's disasters, based on 2020-2023 averages, to show the trend for five years from 2020-2024. **3.** "Others" include extreme temperatures and mass movement (dry and wet); data for these fluctuates due to reporting.

Notes: Graph uses 2023 adjusted dollar figures across the analysis for parity; pre-2000 figures have reporting biases, hence excluded from analysis. These costs are only a subset of total damage from physical risks and hence underestimate likely total impacts and costs.

Sources: EM-DAT's international disaster database, hosted by the Centre for Research on the Epidemiology of Diseases (CRED), UCLouvain; BCG analysis.

1.3 Further warming could put an increasing strain on the world economy

By investing 2-3% of cumulative global GDP in mitigation and adaptation measures, humanity could prevent 10-15% in GDP losses over this century.

Climate change is slowing down global GDP growth

Compared with the physical impacts of warming, its systemic effects on GDP are more difficult to quantify. Climate-related events have many indirect consequences that are almost impossible to measure. At the same time, it is hard to project to what degree economic systems self-adapt. Even in cases where the immediate consequences are clearer, such as property damage after increased flooding, the sustained strain on GDP is often less obvious.

Global warming has several impacts that slow down GDP growth by reducing economic output and/or funnelling resources away from growth-orientated activities. For example:

- **Reduced labour productivity**: Extreme heat reduces productivity, especially in outdoor manual labour such as construction and agriculture. According to the International Labour Organization (ILO), by 2030, heat stress alone could reduce global work hours by 2%.[19]
- **Lower agricultural yields**: Increasing droughts and extreme precipitation events reduce agricultural productivity. In recent years, affected regions have seen up to a 10% reduction in yields during extreme weather.[20]
- **Infrastructure and property damage**: Climate-related disasters repeatedly destroy infrastructure and property, diverting public and private funds from productive investments towards costly repairs.
- **Ecosystem decline**: The collapse of key ecosystem services, such as wild pollination, marine fisheries and timber, would further impact GDP, particularly in countries reliant on natural resource exploitation.

Severe macroeconomic impact could already be felt in the next decades

Numerous studies that have attempted to quantify the impact of climate change warn it could already put a material strain on global GDP in the coming decades. By 2100, the current 3°C trajectory could reduce global cumulative GDP by 16% to 22% – that is 10% to 15% more than on a trajectory of less than 2°C.[21] Some recent estimates, such as Kotz et al and the fifth vintage of NGFS' macroeconomic climate scenarios, indicate that the impacts on GDP of current emissions could be even greater and felt sooner.

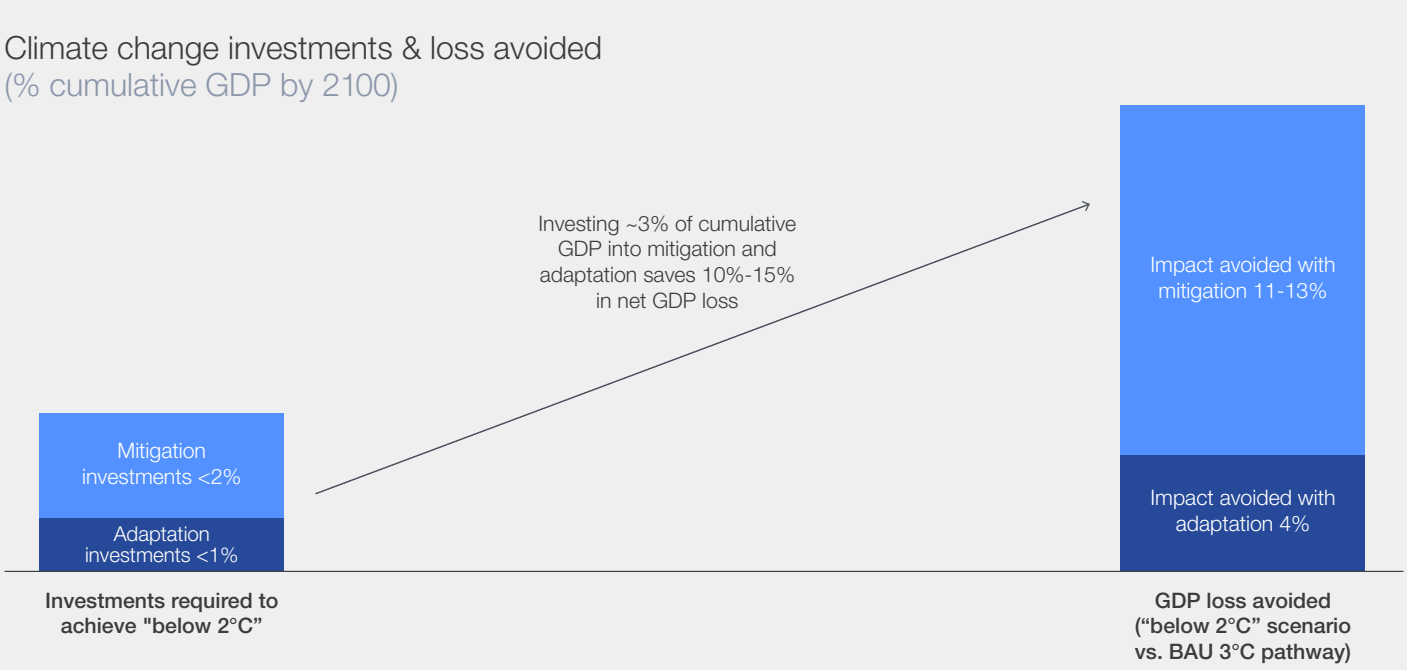
Global climate action very likely has a positive economic business case

Several studies indicate that humanity would need to invest around 2% of cumulative global GDP in mitigation measures to move onto a "below 2°C pathway". On top of this, around 1% of cumulative global GDP needs to be invested to adapt to already unavoidable warming.[22] Given these investments could prevent 10% to 15% in losses to global GDP over this century, they would jointly pay off up to fivefold (see Figure 8). These investments will require government mandates and incentives, as voluntary business actions alone are unlikely to be sufficient.

Any delay to emissions reduction in the present will cost humanity dearly in the future both in hard economic terms and through long-term impacts that could fundamentally reshape our societies, such as the increasing risk of mass migration, increased mortality, biodiversity loss and conflicts over resources. There will also be a greater risk of reaching critical environmental tipping points, where damage to lives, nature and the economy would become even more significant. While the long-term benefits of climate action far outweigh the immediate costs, human behaviour is prone to overvaluing short-term expense and underestimating future gain. This mental discounting cognitive bias leads to hesitation, even when the positive net present value of climate action is clear and urgent change is economically justified.

> **In too many businesses, climate risks are wrongfully perceived as a pure compliance topic. The most advanced companies are looking at them from a financial perspective to inform strategy, risk management and disclosure assurance at the highest levels.**
>
> Sarah Barker, Managing Director, Pollination Law, Co-Chair of the World Economic Forum's Climate Governance Community of Experts

FIGURE 8 | **Climate inaction would cost far more than climate action globally**



Notes: All effects relative to hypothetical baseline without climate effects – 2023 GDP with IPCC AR6 WGIII growth assumptions (global GDP growth (ppp) range from 2.5 to 3.5% per year in the 2019–2050 period and 1.3 to 2.1% per year in the 2050–2100 (5–95th percentile). Rounding to nearest tens/hundreds. Temperature scenarios refer to 2100.

Source: Benayad, A. et al. (2024). *Why Investing in Climate Action Makes Good Economic Sense*, BCG.

Businesses will need to carefully navigate risks associated with climate change (see Figure 9). The following chapters of this report analyse both physical and transition risks to businesses, as well as the opportunities that adaptation to climate change can bring.

Chapter 2: Physical risks are becoming more significant, contributing to lower revenues caused by supply chain disruptions and higher operational and capital expenses due to structural damage.

Chapter 3: Transition risks are reshaping industries at the same time, driven by factors such as changing regulations, asset write-downs and shifting customer and investor perceptions.

Chapter 4: Opportunities. These challenges also bring opportunities for higher revenues, lower operational costs through energy efficiency and the preservation of assets by adapting early.

FIGURE 9 | **Corporates need to navigate a new array of risks and opportunities**

Corporate cost of global inaction

Physical risks (acute and chronic)

– Lower revenue due to downtime, productivity loss and supply chain disruptions
– Higher CapEx due to restoration of structural damage to facilities
– Higher OpEx due to increasing input prices, insurance premiums

Corporate cost of own inaction

Transition risks (legal, technology, market, reputation)

– Higher OpEx due to changing input prices and new regulation
– Value adjustments on investments terminated prematurely
– Lower revenue due to declining demand on grey portfolio
– Lower capitalization due to shift in investor perception

Action opportunity

New products and services, new markets, resilience, resource efficiency and more affordable energy source

– Higher revenue & margins from commercialization of new offers
– Preserved assets due to proper adaptation and conscious investment decisions
– Lower OpEx due to energy and resource efficiency
– Lower cost of capital
– Easier hiring and retention

Sources: Task Force on Climate-Related Financial Disclosures (TCFD).

2

Corporate cost of global inaction: physical risks on the rise in the next two decades

With climate inaction increasing the frequency and intensity of extreme weather events, companies face mounting physical risks that could put up to 25% of their EBITDA at risk within the next two decades if they do not prepare.

2.1 Climate change poses substantial physical risks to private sector

The physical impacts of climate change put companies' operations, infrastructure and supply chains at risk

Headlines about storms, floods, fires, heatwaves and droughts are now routinely followed by reports of their impacts on individual companies' assets, revenues or costs. For example, consider the following:

- Due to a 2022 drought, Sichuan's hydropower generation dropped to about 20% of its typical capacity, forcing Toyota and Foxconn to halt production at their plants, while supply chain disruptions extended to Tesla and SAIC Motor.[23]
- Heavy flooding in Germany in 2021 inflicted $1.4 billion in damage to the tracks, bridges, stations and other assets of railway operator Deutsche Bahn.[24]
- Two years of wildfires in California led to the 2019 bankruptcy filing of PG&E (Pacific Gas & Electric Company), with the utility reporting that it faced $30 billion in liabilities.[25]
- The historic 2011 floods in Thailand, which displaced millions and saw 800 people perish,[26] devastated a key industrial corridor and severely disrupted global supply chains. Toyota estimated its operating profits were reduced by approximately $1.6 billion over the year.[27]

In addition to these acute events, chronic climate impacts such as water scarcity, rising sea levels and prolonged heatwaves are also becoming more frequent.

As warming continues to accelerate, these risks will materially increase

Each of these events was a shock at the time, but the conditions that triggered them will become increasingly likely down the line. As global warming drives more frequent and extreme weather conditions, the risk of physical damage to assets and infrastructure rises, along with reduced worker productivity and disruptions to supply chains that are vulnerable to natural hazards. An in-depth analysis of the ways in which physical risks might trigger value chain and societal losses are available in the World Economic Forum's report *Business on the Edge: Building Industry Resilience to Climate Hazards*.[28]

2.2 Physical risks will translate into material costs within the next two decades

Climate risks could already trigger material losses in the next two decades

Figure 10 shows how companies in different major sectors would be impacted by physical climate risks under different temperature scenarios. In a scenario of unchecked climate change (>3°C pathway), companies in these sectors could find an additional 5% to 25% of their EBITDA at risk by 2050. Under a Paris-aligned scenario, these costs would be materially lower.

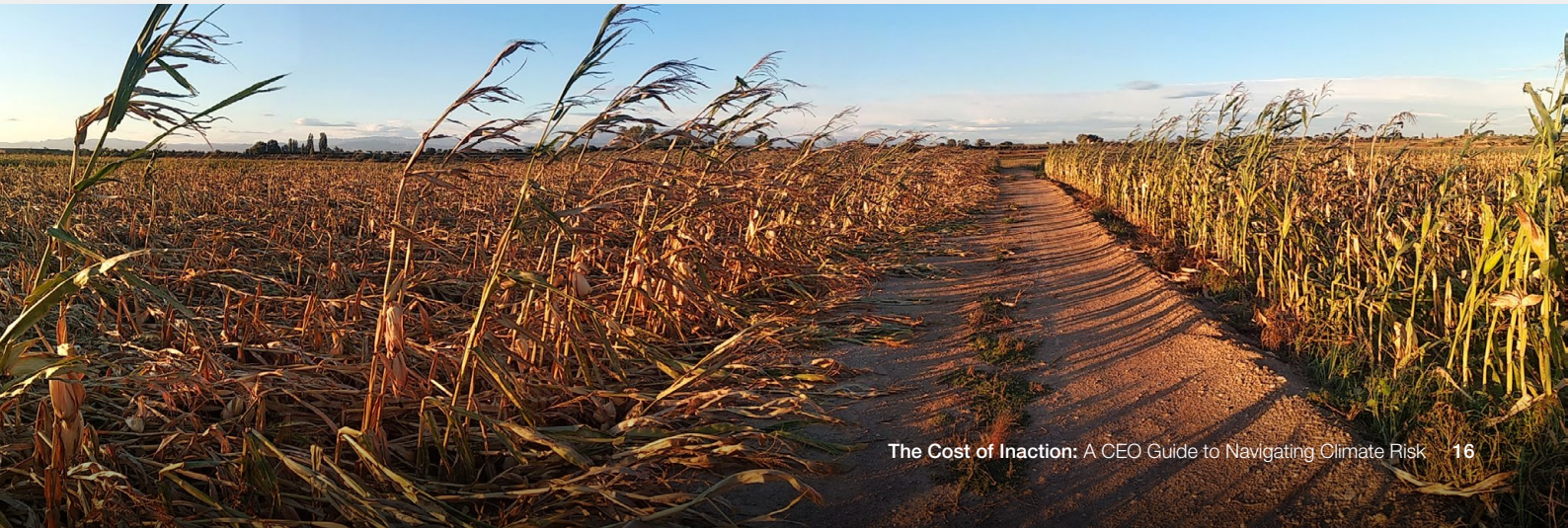
FIGURE 10 **Physical risks could harm 5-25% of EBIDTA under current trajectory (by sector and region)**

Average financial impact of physical risks by 2050
% yearly EBITDA at risk vs. today in a >3°C (current trajectory) vs. <2°C (Paris-target) scenario

	>3°C scenario								>2°C scenario							
	Communication services	Utilities	Construction & infrastructure	Materials	Food & beverages	Oil & gas	Healthcare	Industrials	Communication services	Utilities	Construction & infrastructure	Materials	Food & beverages	Oil & gas	Healthcare	Industrials
Europe	10-15%	10-15%	5-10%	5-10%	5-10%	<5%	<5%	<5%	5-10%	5-10%	<5%	<5%	<5%	<5%	<5%	<5%
North America	10-15%	10-15%	5-10%	5-10%	<5%	<5%	<5%	<5%	5-10%	5-10%	<5%	<5%	<5%	<5%	<5%	<5%
South America	15-20%	15-20%	10-15%	10-15%	5-10%	5-10%	5-10%	5-10%	5-10%	5-10%	<5%	<5%	<5%	<5%	<5%	<5%
Asia-Pacific	>25%	>25%	10-15%	10-15%	5-10%	5-10%	5-10%	5-10%	10-15%	5-10%	5-10%	<5%	<5%	<5%	<5%	<5%
Africa & Middle East	>25%	>25%	10-15%	10-15%	5-10%	5-10%	5-10%	5-10%	5-10%	5-10%	5-10%	<5%	<5%	<5%	<5%	<5%
Sector average	20-25%	15-20%	10-15%	10-15%	5-10%	5-10%	5-10%	5-10%	5-10%	5-10%	<5%	<5%	<5%	<5%	<5%	<5%

Notes: Estimates include economic impact from asset damage and business interruption from wildfire, heat, coastal flooding, fluvial flooding, cyclones, water stress and droughts vs. historical baseline normalized to today; >3°C scenario is based on SSP3.7-0, which is a moderate- to high-emissions scenario projecting temperature increases of 1.7-2.6°C by 2050 and 2.8-4.6°C by 2100. Translation of impact from % of asset value to EBITDA margin is carried out using sector benchmarks on median fixed asset turnover ratios (FAT) and EBITDA margins assuming sector and regional composition in 2050 is identical to current levels. Individual company impact estimates can vary vs. sector estimates shown here depending on differences in e.g. share of fixed assets and EBITDA margins vs. benchmarks. See Appendix for methodology and sources.

Sources: Swiss RE, S&P Global Sustainable, Oxford Economics, Capital IQ, BCG analysis.



Exposure to climate risks varies significantly across sectors

Companies with extensive physical assets, complex supply chains and/or operations in high-risk areas are generally more vulnerable. The exact exposure is of course highly individual and not always apparent. Companies with similar business models can be impacted differently, depending on their specific circumstances. But few companies are unexposed given the numerous ways in which climate change can impact corporate operations. The following examples of more strongly impacted sectors show why:

- **Communication services and utilities.** Cell towers, communication lines, data centres and other extensive communication infrastructure can be severely damaged by storms, floods, fires and other extreme weather events, leading to service interruptions and increasing repair costs. The same goes for power plants and transmission lines, which are costly to repair. Prolonged power outages can also expose utilities to fines and significantly reduce their revenue. For example, Australia's 2020 bushfires caused widespread communication outages and inflicted millions of dollars of damage to the infrastructure of Telstra, the country's leading telecom player, with 36 cell towers affected.[29]

- **Food and beverages.** More frequent extreme weather events and growing water stress would reduce crop yields and increase costs for irrigation and protective measures, particularly in water-intensive sectors. In a CDP (Climate Disclosure Project) report, Nestlé detailed the impact on its operations of exceptional droughts in Brazil's arabica coffee regions between 2014 and 2016. Reduced coffee production led to price increases of over 50% for arabica and 40% for robusta beans, with an estimated cost to Nestlé of CHF 0.8 billion to 1.0 billion (approximately $925 million to $1.15 billion).[30]

Companies operating in emerging markets will be more impacted

The Asia-Pacific region, home to six of the 10 countries most affected by extreme weather events and disasters,[31] along with many emerging economies in Africa, the Middle East and Latin America carry higher-than-average exposure risk to climate impacts, while at the same time struggling to finance the resilience projects needed to protect their societies and economies. Companies that are exposed to these regions – either directly or through their supply chains – would therefore face greater financial impacts. However, these impacts are not limited to emerging economies and certain regions in developed markets will also be exposed to significant losses.

On top of physical risks, companies will be impacted by slowing overall GDP growth

If unchecked climate change limits the world economy's ability to grow, this would also be detrimental to the top-line growth of businesses, but is more difficult to adapt to this scenario.

Companies at the forefront of climate risk management are building a comprehensive view of their exposure and vulnerability to various hazards across their full value chain. This can lead to surprising discoveries, both in terms of new risks and the scale of existing risks and where they are located (see Case Study 1).

CASE STUDY 1

Why are these costs so high? Case study from a European highway operator

A case study from a European highway operator illustrates why future cost risks are so high, even in the short to medium term. The company historically incurred average annual costs of 5% of EBITDA to deal with physical damage to its infrastructure from natural hazards. In a scenario of unchecked climate change, the company expects these costs to roughly double by 2050, even though the frequency of weather events such as extreme precipitation might only increase by 10% to 15% over this period. The reason is that such events will not only become more frequent, they will also become more severe and spread over larger geographical areas. As a result, assets that were previously unexposed now face greater potential risks and high-damage infrastructure events in the future (see Figure 11).

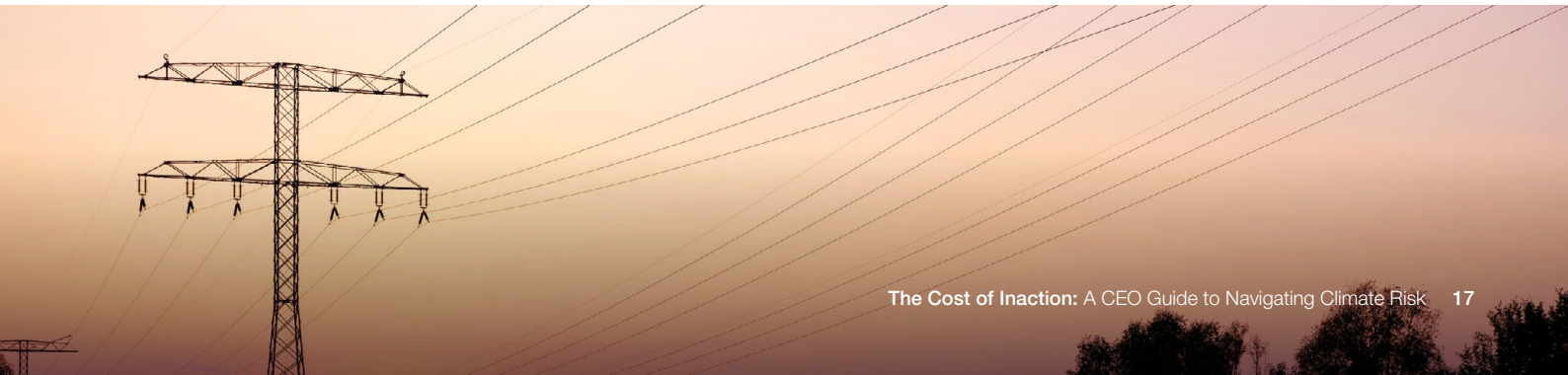
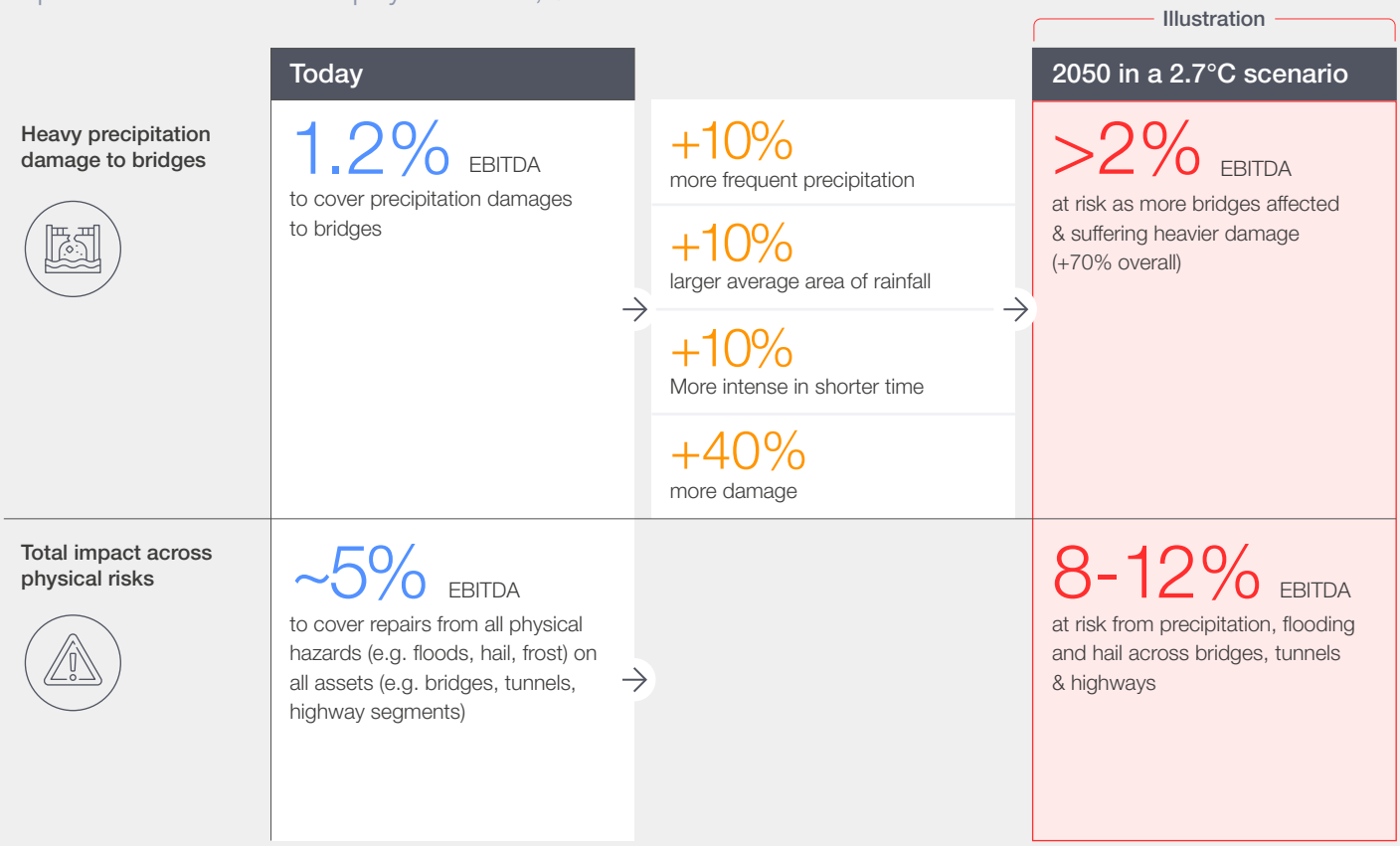


FIGURE 11 | **Seemingly small changes in risk can create disproportionately more damage**

Example: EU highway operator
Impact of climate-related physical risks, % EBITDA



Note: Total EBITDA lost compared to today's financial baselines.
Source: BCG analysis.

2.3 Companies recognize physical risks but likely underestimate their impact

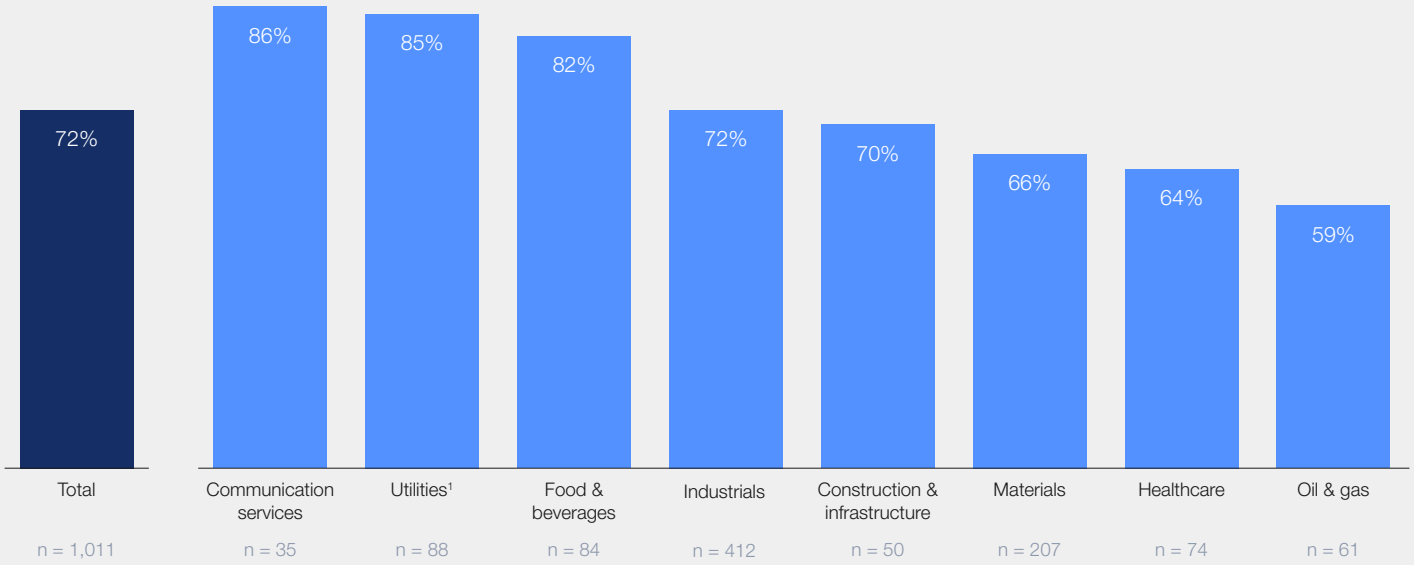
Companies increasingly recognize physical risks, but likely underestimate the financial impact of these risks

In response to CDP's annual climate change questionnaire in 2023,[32] 72% of the largest thousand or so respondents across eight sectors indicated that they identified physical climate risks which could substantially impact their business (see Figure 12). Yet many companies struggle to translate broad climate scenarios and general physical impacts into measurable business risks. Climate risk data is often fragmented and inconsistent, making it difficult to assess the full impact across a company's value chain and integrate climate risks into traditional planning processes.

The relatively few that do attempt to quantify climate-related business risk (and report their financial exposure) report lower figures on average than analysis conducted for this report would indicate (see Figure 13). One reason for this could be that many businesses currently identify only their most immediate risks and treat them in isolation. However, as global inaction increases the threat and diversity of exposure, this approach is increasingly inadequate for most businesses.

FIGURE 12 | **More than 70% of companies see significant impact from physical risks**

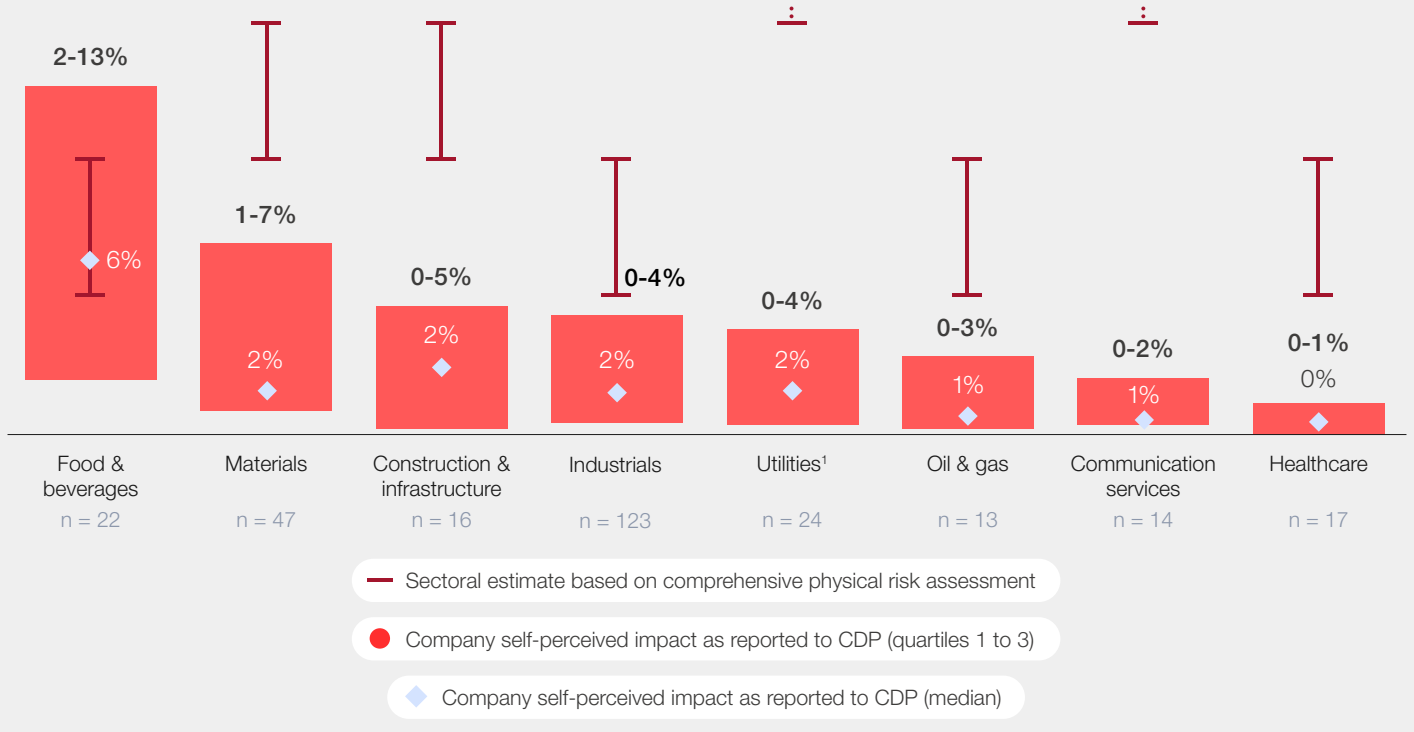
Companies identifying physical climate risks with potential to have a substantive impact on their business
% of CDP respondents



1. Utilities include power grids.
Source: BCG analysis, based on data from the *CDP Climate Change 2023 Questionnaire.*

FIGURE 13 | **Companies likely underestimate the financial impact of physical risks**

Company self-perceived financial impact of physical risks
% annual EBITDA at risk



1. Utilities include power grids. **2.** CDP questionnaire sample size: n = 276.
Note: Based on companies' reported potential maximum financial impact from identified physical climate risks at medium- and long-term time horizons.
Source: BCG analysis, based on data from the CDP Climate Change 2023 Questionnaire.

2.4 Corporate adaptation investments have an increasingly positive business case

Companies can reduce their exposure to physical risks through a mix of strategic, financial and operational measures.

Investments in adaptation and resilience measures can reduce companies' financial exposure. These solutions can be divided into three categories: strategic, financial and operational.

Strategic solutions involve adjustments to the business model to enhance long-term resilience. This includes increasing the role of service-based revenue streams and/or reducing reliance on physical assets such as owned real estate.

Financial solutions involve managing climate risks through financial strategies. Companies can transfer risk via innovative financial tools – such as catastrophe bonds or parametric insurance which provide rapid pay-outs based on predefined events – or retain risk through designated budget allocations for climate contingencies.

Operational solutions focus on protecting and enhancing the resilience of key assets and operations. This can include both physical infrastructure improvements and nature-based solutions to mitigate climate risks, including the following:

- **Fortifying assets**, such as installing flood protection barriers and/or reinforcing critical facilities to withstand extreme weather. Nature-based solutions, such as mangrove plantations, can economically buffer against natural hazards while enhancing the security and livelihoods of surrounding communities.
- **Resource security**, such as investing in water conservation technologies, for example drip irrigation or energy storage systems to ensure operational continuity. Additional strategies include onsite water reuse systems and nature-based solutions such as permeable surfaces and retention ponds to manage flooding and support continuous operations.
- **Supply chain resilience**, as highlighted in the World Economic Forum's report *From Disruption to Opportunity: Strategies for Rewiring Global Value Chains*. Leading companies are already pre-qualifying new suppliers as standby options and building globally connected, multi-local supply chains to enhance resilience and flexibility.[33]

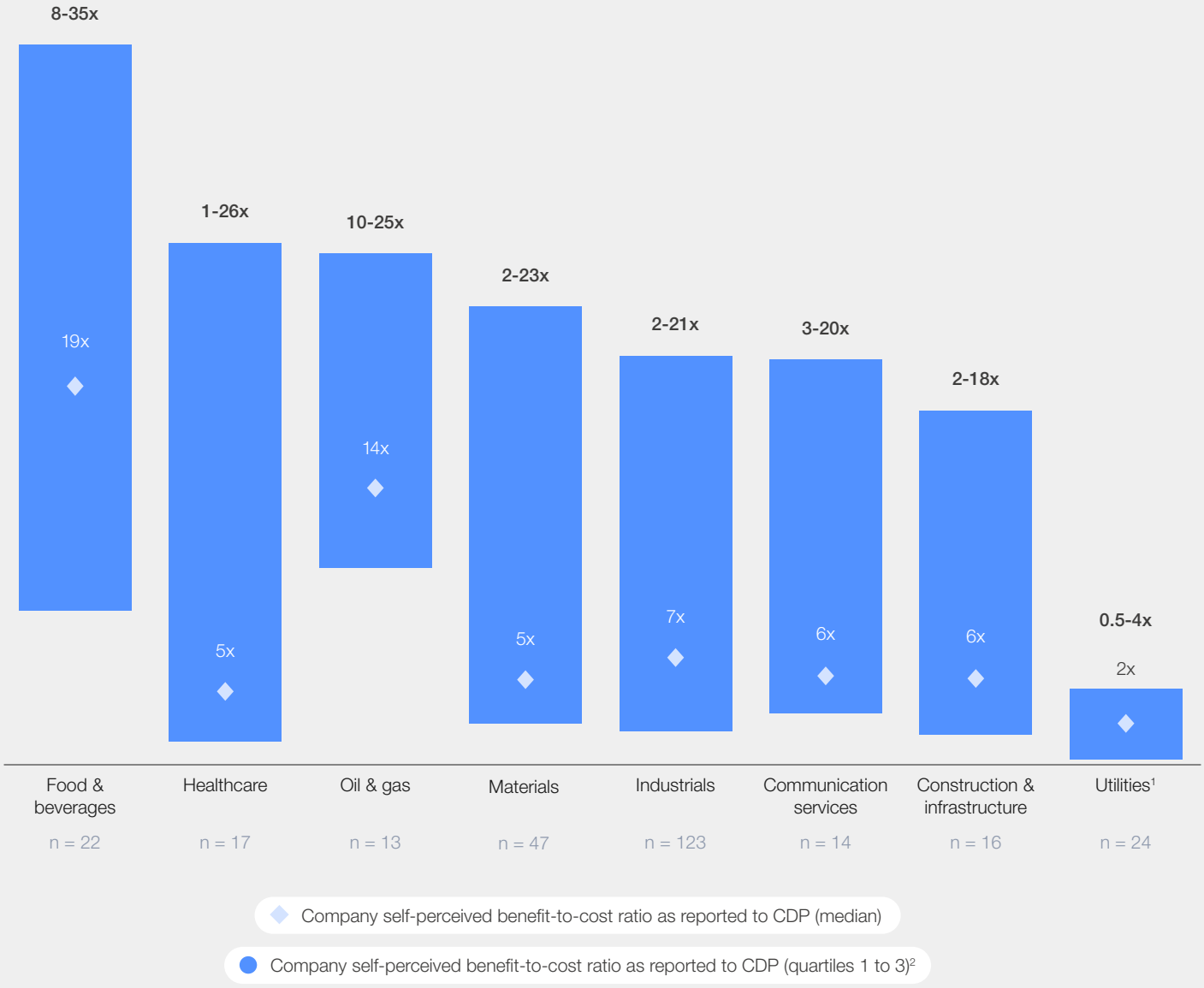
Companies that do make such investments report a very positive business case

Few companies comprehensively assess their risk exposure and make adequate adaptation investments. Those that do and disclose the returns to CDP report a very positive anticipated payback, ranging from $2 to $19 for every dollar invested (see Figure 14). Climate adaptation investments pay off across a range of different measures: an analysis by the US Agency for International Development (USAID), in collaboration with BCG and the Global Resilience Partnership, highlights a benefit-to-cost ratio of 2x to 7x from flood protection measures and 2x to 6x for water efficiency collection technologies such as drip irrigation and other low-flow technologies, with even greater returns in emerging markets.[34]

The message from these figures seems clear: companies should develop a more scientific understanding of the risks that they face and invest in adapting to them, both for their own benefit and to help mitigate rising global costs from inaction.

FIGURE 14 **Many companies see a positive business case for adaptation**

Company self-perceived benefit-to-cost ratio of adaptation and resilience measures
Benefit-to-cost ratio



1. Utilities include power grids. **2.** CDP questionnaire sample size: n = 276.

Notes: Based on companies' reported potential maximum financial impact from identified physical climate risks at a medium- and long-term time horizon and the associated cost of responding to the risk. Considerable complexity underlies these numbers: first, the companies use a variety of methodologies in their calculations; second, the nature of the returns on adaptation investments is a challenge. The investments require capital expenditures today, whereas the returns are often a mix of avoided losses (such as prevention of costly damages and business interruptions) and potential opportunities (such as enhanced operational efficiency, access to new markets, or improved reputation) that are realized in an uncertain timeframe and are not as bankable as traditional cashflows.

Source: BCG analysis, based on data from the *CDP Climate Change 2023 Questionnaire*.

3 Corporate cost of own inaction: transition risks are increasing

As global climate regulations tighten, companies that fail to decarbonize would face rising transition risks, with potential EBITDA impacts of up to 50% from carbon pricing alone in energy-intensive sectors by 2030.

3.1 Companies that do not decarbonize may face increasing transition risks

Global climate commitments, regulations and incentive schemes have significantly accelerated in the last decade.

Global climate commitments, regulations and incentive schemes have significantly accelerated in the last decade, particularly since the Paris Agreement was adopted in 2015. While the world is far away from achieving the 1.5°C ambition, significant progress has been made across the world, albeit at different speeds. The following actions are the most notable:

- Over 140 countries, including China, the European Union (EU), India and the US, covering 88% of global emissions, have made national net-zero commitments.[35] At COP30 in Brazil, many countries are expected to strengthen their commitments further.
- In the EU Green Deal, Europe has followed up its net-zero commitment with the most ambitious emission reduction legislation globally, including initiatives such as tightening the emissions cap of its Emissions Trading System (ETS), introducing an emission trading scheme for non-ETS sectors (ETS II), banning new internal combustion engine (ICE) car sales by 2035 and enacting rules to drive the adoption of sustainable fuels and hydrogen.
- The US introduced its Inflation Reduction Act in 2022, which drives billions of dollars of investments in green technologies such as electric vehicles (EVs), renewables, hydrogen and carbon capture, utilization and storage (CCUS).
- China has reinforced its ETS in 2024, adding stricter penalties and a revamped emission reduction market, while at the same time pouring billions into the expansion of renewables, EVs and hydrogen.

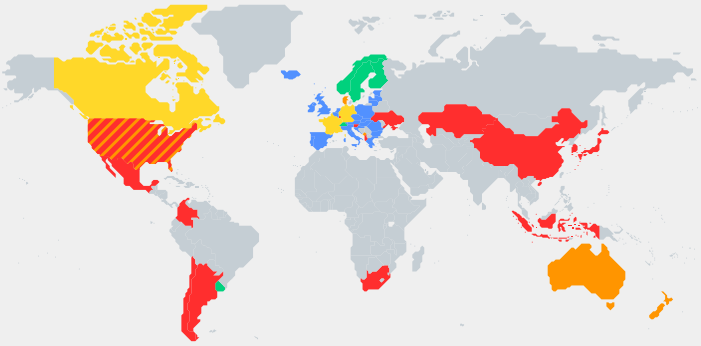
Accelerating climate action creates transition risks for companies. The Task Force on Climate-Related Financial Disclosures (TCFD) identified four main types of transition risks:[36]

- **Policy and legal**, such as carbon pricing rules and the risk of litigation.
- **Technological**, such as lower-carbon ways to make steel or power big ships that disrupt incumbents.
- **Market**, meaning shifts in supply and demand for commodities, products and services.
- **Reputation**, stemming from negative stakeholder perceptions of a company's climate actions.

Similar to physical risks, transition risks can materialize through additional financial costs. They are equally difficult to predict because they depend on future government decisions, future technological innovation and other unknowns.[37]

FIGURE 15 | **Transition is underway – at different speeds**

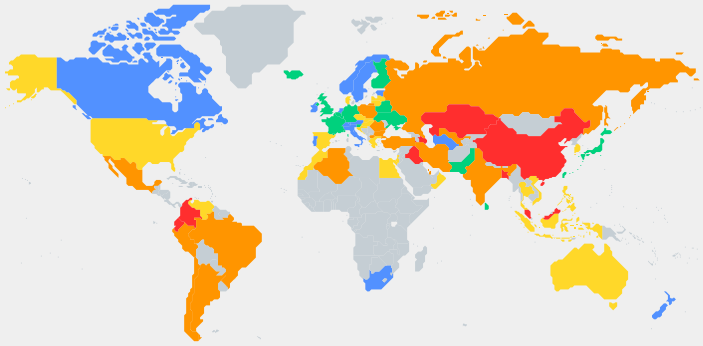
Price of carbon around the world,[1] $/tCO$_2$e



Price range

<$20 | $20-$40 | $40-$60 | $60-$80 | >$80

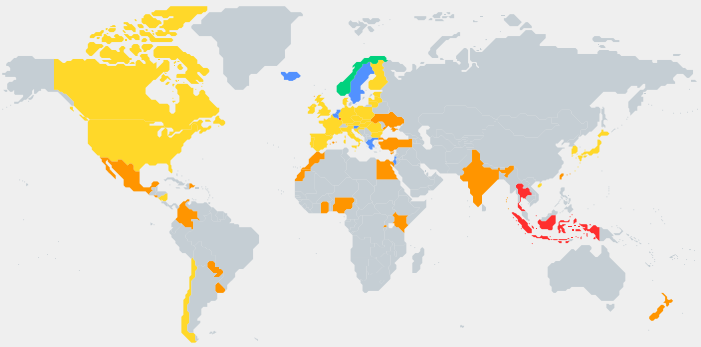
Oil demand evolution, % change from 2018 to 2023



Demand evolution

>12% | 4 to 12% | -4 to 4% | -12 to -4% | <-12%

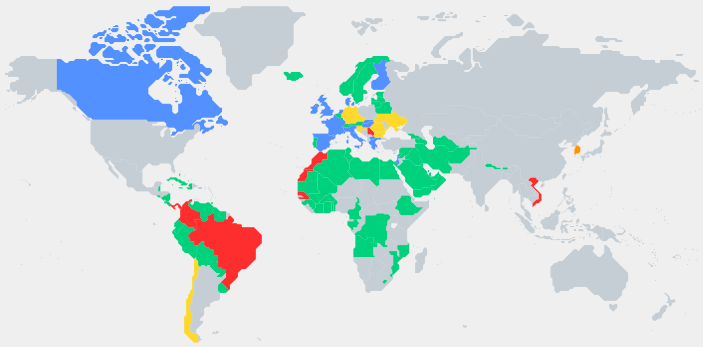
De facto ban of new ICE passenger car sales,[2] target year



Target year

2025 | 2030 | 2035 | 2040 | 2050

Countries phasing out operating coal plants, target year



Target year

No existing coal[3] | 2030 or earlier | 2031-2040 | 2041-2050 | Under discussion

1. Map shows jurisdictions with carbon taxes or emissions trading systems implemented, under development or under consideration. **2.** Map shows jurisdictions with set targets, signed pledges or announced plans to phase out sales of gasoline and diesel cars by a concrete date. Governments include national, provincial and state governments; China and US have phase-out targets in specific provincial and state governments only. **3.** No existing coal due to no legacy coal, regulation already pushing for phase-out, operators deciding to shut down platforms.

Sources: World Bank Group, Energy Institute, International Council on Clean Transportation (ICCT), A2Z Coalition, Coltura, Statista, Powering Past Coal, Beyond Fossil Fuels, Bloomberg Global Coal Countdown, BCG analysis.

Whether transition risks are increasing is uncertain, but it still seems prudent to assume they are

Ambitious national targets present tough choices and regulations are often contentious. They can also be non-linear when different political parties fail to agree on the need for ambitious climate action. The US pulling out of the Paris Agreement was a very visible example of this and Trump's re-election will likely result in more climate headwinds. Beyond the US, Australia repealed and later reintroduced carbon pricing under its Safeguard Mechanism in 2016.[38] The EU pushed forward with a very ambitious regulation agenda, but now key policies face delays and resistance from incumbents. In the corporate world, some businesses, including four major banks, have recently withdrawn from climate initiatives such as SBTi (Science Based Targets initiative).

However, we still live in a world where current national targets are insufficient to achieve a 2°C path, let alone a well-below 2°C path, and today's policies are insufficient for meeting even those targets. Making the assumption that global progress will stagnate or slow down is equivalent to assuming that humanity will not even try to address its most existential threat, despite all the enormous impacts already described. From a sound management perspective, therefore, it seems prudent to assume that global progress will accelerate.

Shifts in public sentiment could also drive more rapid progress on climate policy. Demand for action may be triggered by a series of catastrophic heatwaves or deadly floods, or from new data revealing significantly greater short-term risk from, for example, the slowing of the Atlantic Meridional Overturning Circulation (AMOC), or more specifically from a massive US class action lawsuit against the fossil fuel industry from homeowners facing damage due to storms and floods.

> **Tipping points in public opinion shifts are difficult to predict. You need to anticipate future trends, or you might be late and forced to catch up under pressure.**
>
> Pascal Soriot, Chief Executive Officer, AstraZeneca

BOX 1

Litigation risks

Litigation and reputational risks are becoming increasingly significant. Class action lawsuits seeking compensation for escalating climate impacts, including a failure to manage relevant physical or economic risks, are becoming more likely. "Superfund laws", which legislate responsibility for the cost of climate adaptation onto large emitters, are being enacted in certain US states. Additionally, companies with climate targets face reputational and legal risks if they fail to meet their commitments.

"For diligent and well-advised companies, the perceived legal risks of missing climate targets often exceed the reality. In many jurisdictions, liability depends on whether there were reasonable grounds for the targets at the time they were set. Businesses must develop transparent roadmaps that clearly outline areas of uncertainty, dependency and known implementation gaps and credibly pursue their targets," says Sarah Barker, Managing Director, Pollination Law.

Anti-adaptation litigation is also becoming a key legal risk. Companies are increasingly being held liable for failing to address physical climate risks. In a 2021 report, the United Nations Environment Programme (UNEP) Financial Initiative highlighted how legal action can drive better climate adaptation, with lawsuits serving both as a consequence and catalyst for action. For example, McVeigh v. REST set a precedent for fiduciary responsibility by holding an Australian pension fund accountable for not managing and disclosing the climate risks, including physical climate risks, to its investments.[39]

3.2 If transition risks materialize, they could translate into material financial losses

> Demand for fossil fuels or technologies could decline much earlier than companies currently expect, putting entire business models at risk.

An accelerating transition could trigger financial losses in several ways

Today, returns of fossil fuel business models still benefit from substantial government subsidies – up to $7 trillion globally in 2022, according to the International Monetary Fund.[40] As they accelerate decarbonization, governments would need to reduce or eliminate these subsidies and are more likely to price in negative externalities. As a result, increasing carbon prices or other forms of penalizing climate regulation could increase operational costs. Fossil fuel-based assets may have to be prematurely written down. Demand for fossil fuels or technologies could decline much earlier than companies currently expect, putting entire business models at risk.

Carbon pricing is key to accelerating the low-carbon transition, but it is a risk for companies that do not decarbonize

Since the Paris Agreement, carbon pricing mechanisms have expanded steadily and are now covering around a quarter of global emissions,[41] with Europe leading the charge. By 2030, ETS I & II are expected to cover nearly all emissions in Europe,[42] with prices reaching $90 to $150/t$CO_2$e,[43] while similar schemes are beginning to emerge in North America and Asia-Pacific. To meet "well-below 2°C" goals, both coverage and price levels would need to rise further. This would strengthen the business case for green technologies but expose companies that have delayed action until the regulation is in place to additional costs – and a potential loss in competitiveness if they pass them through. In particular, fossil utilities and energy-intensive sectors such as materials, metals and chemicals that do not decarbonize could risk significant cost increases, potentially up to a level equivalent to 50% of their EBITDA by 2030 (see Figure 16).

FIGURE 16 **Transition risk of 20+% EBITDA for some sectors in a rapid transition**

Average annual financial impact of carbon pricing by 2030, by scenario
% annual EBITDA at risk

	Rapid transition						Slow transition					
	Materials	Metal & mining	Chemicals	Utilities	Industrials	Oil & gas	Materials	Metal & mining	Chemicals	Utilities	Industrials	Oil & gas
Europe	>50%	20-30%	20-30%	10-20%	5-10%	5-10%	>50%	20-30%	10-20%	10-20%	1-5%	<1%
North America	30-50%	30-50%	20-30%	30-50%	5-10%	5-10%	1-5%	1-5%	1-5%	1-5%	<1%	<1%
South America	>50%	20-30%	10-20%	5-10%	5-10%	5-10%	1-5%	<1%	<1%	<1%	<1%	<1%
Asia-Pacific	>50%	30-50%	10-20%	30-50%	1-5%	5-10%	20-30%	1-5%	1-5%	1-5%	<1%	1-5%
Africa & Middle East	>50%	30-50%	>50%	>50%	5-10%	1-5%	<1%	<1%	<1%	<1%	<1%	<1%
Sector average	>50%	30-50%	30-50%	30-50%	5-10%	5-10%	20-30%	5-10%	1-5%	1-5%	<1%	<1%

Notes: Europe data excludes Russia; slow transition scenario is based on average share of emissions taxed per region (excluding EU where sectors under ETS and future share of free allowances are used) and price of carbon per country; net-zero emissions scenario is based on IEA assumptions for carbon prices by country type and BCG estimates for share of emissions taxed (advanced economies: $140/ton, 70%; emerging markets & developing economies with net-zero commitment: $90/ton, 50%; emerging markets & developing economies without net-zero commitment: $24/ton, 20%); translation of impact from share of carbon costs to EBITDA margin is carried out using EBITDA margins assuming sector and regional composition in 2030 is identical to current levels; individual company impact estimates can vary vs. sector estimates shown here depending on differences in e.g. EBITDA margins and carbon intensity vs. benchmarks; carbon intensity is averaged by top 25 companies per sector in the region (per tons of carbon emitted per $ million); see Appendix for methodology and sources.

Sources: International Energy Agency (IEA), company filings, Oxford Economics, Capital IQ, BCG analysis.

Accelerating climate regulation would increase the risk of premature write-downs to fossil fuel assets

Many companies underestimate the impact that faster climate transformation can have on long-lifetime assets. As restrictions on asset exploration, transportation or burning fossil fuels tighten, their useful lifespan shortens. In developed economies that seek to be Paris-aligned, many new investments in fossil fuel assets already carry significant risk of not reaching the end of their economic lifetime (which typically ranges from 20 to 25 years). Under a "well-below 2°C pathway", this would increasingly be the case globally: world coal demand would have to drop by 90% by 2050,[44] preventing any coal plant commissioned after 2010 from reaching the end of its lifetime. Thirty-five percent of the book value of upstream oil assets would have to be written down by 2030. Many industrial assets would also be affected (see Table 2).[45]

> **We are actively assessing the material financial implications arising from climate-related risks related to changes in the useful life of assets, residual values and changes in the fair valuation of assets as a result of our energy transition.**
>
> Bronwyn Grieve, Director of Global Sustainability and External Affairs, Fortescue

TABLE 2

Companies face risk of write-downs of up to 30% on their grey assets[46]

Asset write-downs on grey assets by 2030 (% of 2030 stock value)

	Upstream oil fields[1]	Coal plants[1]	Blast furnances[1]	Heavy fuel vessels[2]	Steam crackers[3]
Slow transition	0%	0%	-3%	0%	0%
Medium-paced transition	-20%	-2%	-5%	-5%	-5%
Rapid transition	-35%	-20%	-15%	-10%	-10%

1. Decommissioning assumptions for coal plants, upstream oil fields and blast furnaces are based on IEA & Mission Possible Partnership consumption provision for STEPS, APS and NZE production forecasts. **2.** Heavy fuel vessels are expected to be decommissioned by 2050 in a net-zero scenario and by 2053 in an announced-pledges scenario. **3.** Steam crackers are expected to be decommissioned by 2045 in a net-zero scenario and by 2049 in an announced-pledges scenario.

Notes: This analysis uses the following IEA scenarios: STEPS – Stated Policies Scenario (slow transition); APS – Announced Pledges Scenario (medium-paced transition); and NZE – Net Zero Emissions by 2050 Scenario (rapid transition); see Appendix for methodology and sources.

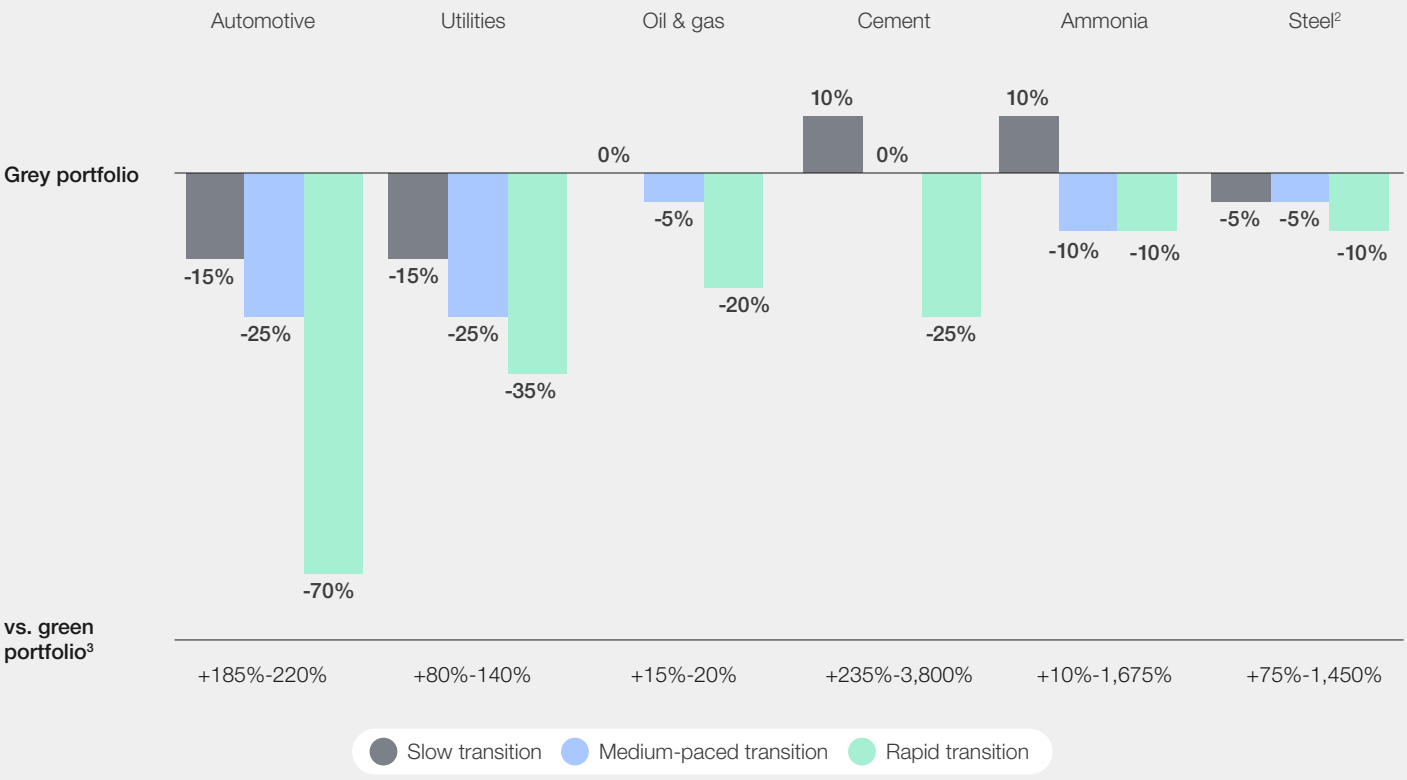
Sources: IEA, GlobalData, S&P Global, European Commission Joint Research Centre (JRC), NexantEca, Rystad Energy, Ucube, Clarkson, Mission Possible Partnership, BCG analysis, BCG UDI database.

Accelerating climate regulation could decrease demand for fossil fuels and technologies

As the low-carbon transition accelerates, demand for fossil fuels and related products will start to decline. In many sectors, fossil fuel technologies are already on track to be replaced. For example, even under current policies, the market for new internal combustion engine cars could decline by at least 15% by 2030 (and more than half by 2035). Under a net-zero pathway, it would even have to drop by 70%. Across major industries, 10% to 70% of demand for fossil fuels or technologies could be at risk (see Figure 17).

FIGURE 17 **Up to 70% demand volume at risk on grey portfolios in a rapid transition**

Global demand evolution of grey & green portfolios in 2030 vs. 2023,[1] by scenario
% volume change by 2030



1. 2022 data used for steel, oil & gas, utilities. **2.** Approximated by iron consumption. **3.** For oil & gas sector, green portfolio is biofuels, ammonia, synthetic oil etc.
Note: Scenarios here are based on IEA STEPS, APS and NZE, corresponding respectively to slow, medium-paced and rapid transition.

Sources: IEA *World Energy Outlook 2023*, World Bank Group, CW Group, Global Cement and Concrete Association, IEA *Ammonia Technology Roadmap 2021*, UBS, BCG analysis.

The impact on capital markets could hit even sooner

Companies could be misjudging how quickly the impact of seemingly distant developments can be felt on capital markets. Investors are forward looking and a significant portion of companies' valuations lies in expectations for future performance. When the energy transition started in Europe, incumbent utilities hardly felt the initial impact in their business results. But once financial markets grasped the longer-term implications of a growing share of renewables and pressure on wholesale power prices, many companies lost significant market value within only a few years.[47] If the transition also accelerates in other sectors, returns of fossil-based business models could therefore turn much less positive than they appear today ("grey discount").

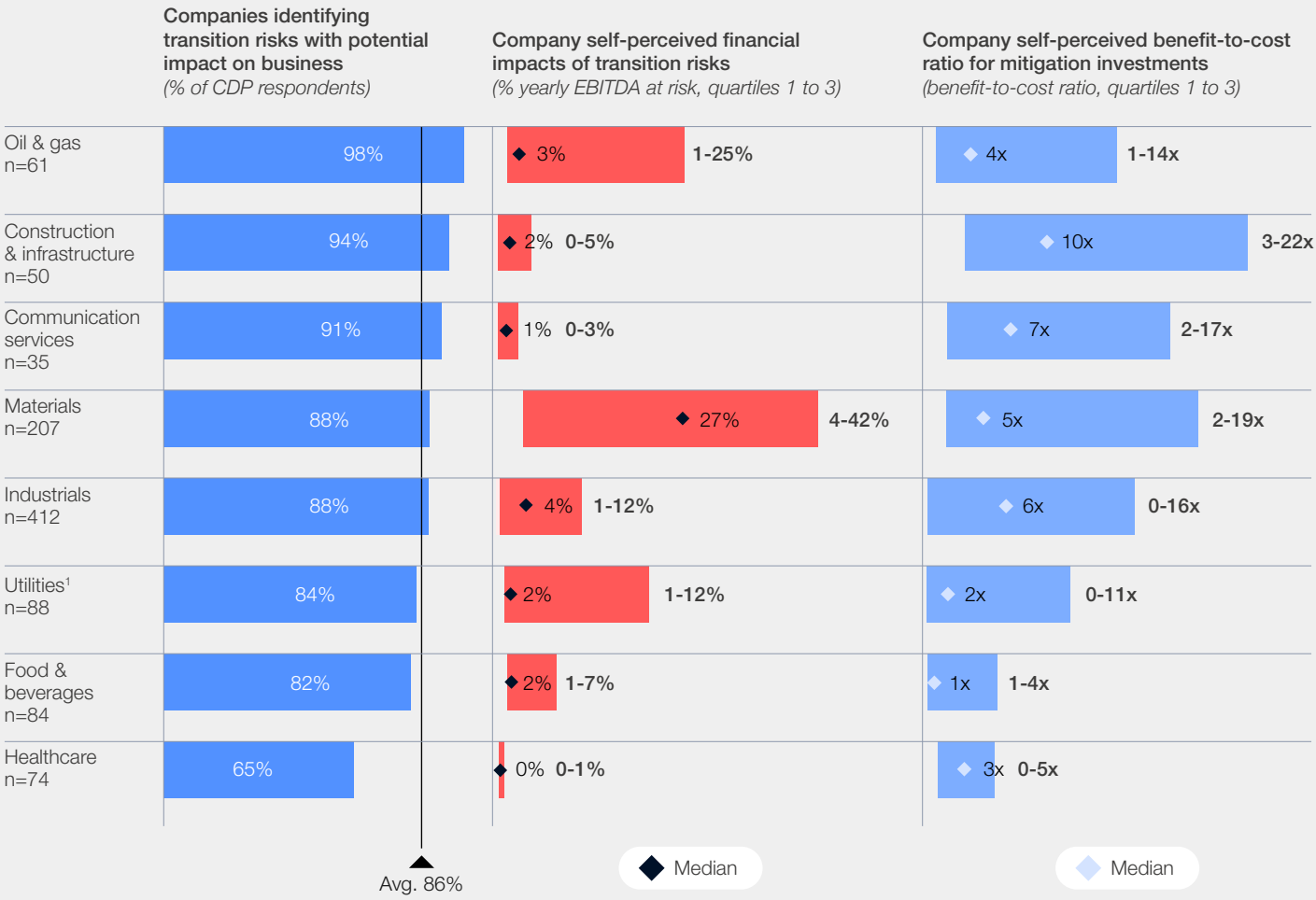
3.3 Companies seem to underestimate these financial losses and overestimate the cost of action

Companies are aware of transition risks but seem to underestimate their impact

Of around 1,000 respondents to CDP's 2023 climate change questionnaire, 86% anticipated significant transition risks for their business (see Figure 18), compared with 72% for physical risks (see Figure 12). However, those that quantified the impact of these risks did not seem to anticipate dramatic changes. Even in sectors highly dependent on fossil fuels – such as oil and gas, energy-intensive industrials and partly-fossil utilities – the median-reported EBITDA impact from transition risks did not exceed 4% (apart from the materials sector, with a median of 27% impact on EBITDA).

This disconnect – high awareness of transition risks but an estimate of their scale that is modest or perhaps a work in progress – is linked to the challenge of predicting how risks might unfold in a fast-changing environment of disruptive technologies, policy shifts and litigation. Nonetheless, it could well happen – and it will need to happen if the world is to keep temperature rise at or below 2°C.

FIGURE 18 **Companies recognize transition risks but estimate limited financial impact**



1. Utilities, including power grid.

Note: Based on companies' reported potential maximum financial impact from identified climate transition risks at a medium- and long-term time horizon.

Source: BCG analysis, based on data from the *CDP Climate Change 2023 Questionnaire*.

> Most industries could abate between 10% and 60% of their carbon emissions without additional costs.

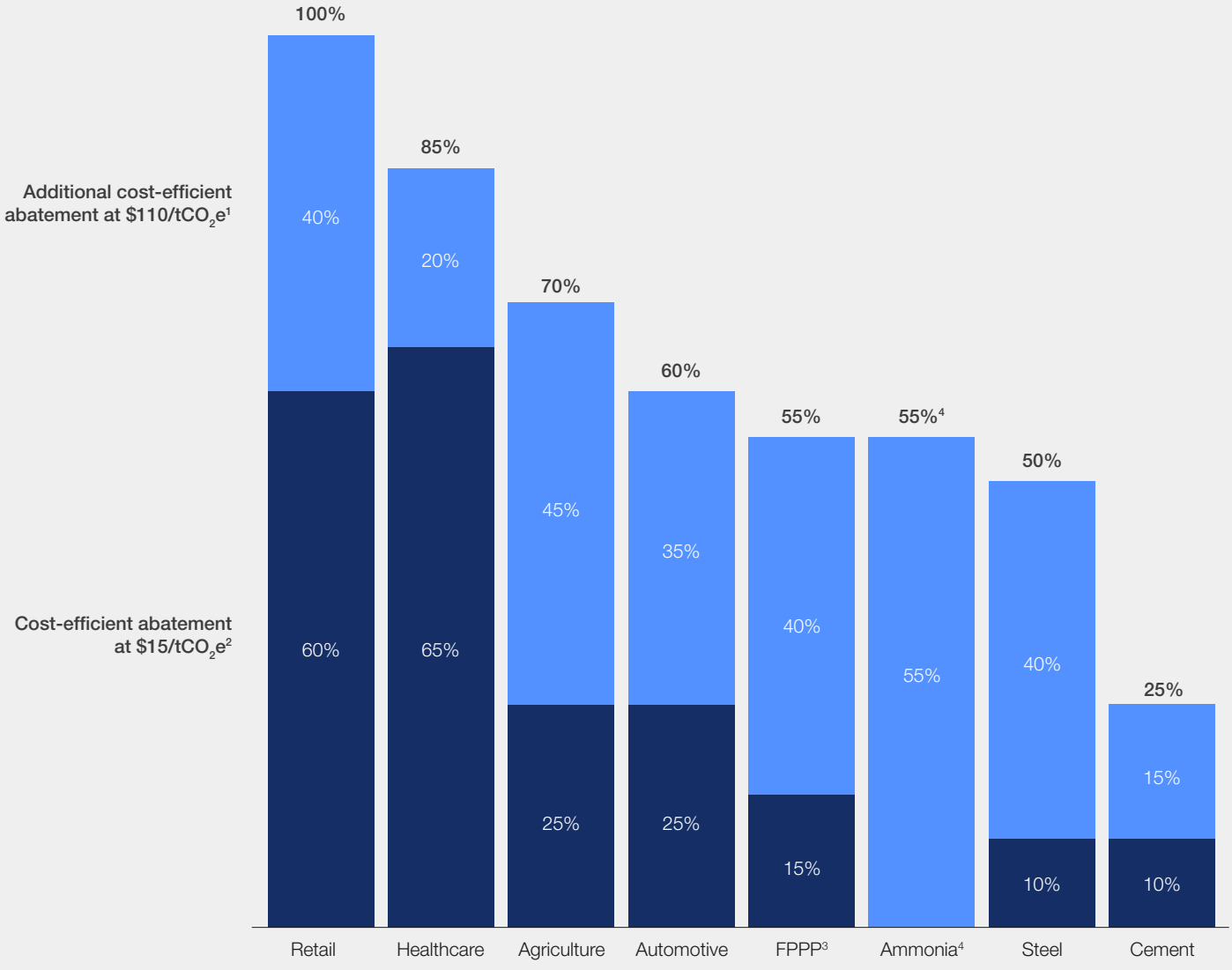
Decarbonization investments often yield financial benefits

Many companies that reduce their carbon emissions benefit from lower spending on fossil energy, a lower risk profile of long-life assets and sometimes stronger market positioning. Levers such as efficiency, renewable power and low-temperature heat electrification are already economical today. As a result, most industries could abate between 10% and 60% of their carbon emissions without additional costs. If (or in regions such as Europe, when) carbon prices climb beyond $\$110/tCO_2e$, most companies could economically abate more than half of their current emissions – and some could even reach net zero, as Figure 19 demonstrates.[48]

This does not mean that decarbonization is not challenging. Companies that have already "picked the low-hanging fruit" often struggle to internally justify much higher spending for long-tail levers. Moreover, companies in emission-intensive industries often have to accept significantly higher costs for implementing immature technologies such as hydrogen or CCUS. Nonetheless, these figures give more reason for optimism than a lot of the conventional wisdom that seems to prevent many companies from accelerating emission reductions more aggressively.

FIGURE 19 **Companies could cost-efficiently cut a large share of their emissions**

Cost-efficient scopes 1 & 2 abatement levels at different carbon prices, by industry
% of total emissions



1. $\$110/tCO_2e$ is based on estimated price of carbon for EU in 2030. **2.** $\$15/tCO_2e$ is based on estimated lowest price of carbon in 2030 for countries currently with carbon pricing systems implemented. **3.** FPPP = forest, pulp, paper & packaging. **4.** Dependent on availability of affordable carbon transport options (e.g. pipelines).

Sources: BCG's decarbonization tool, BCG case experience.

Many companies already realize these benefits

A number of sustainability leaders across a variety of sectors are able to find cost-efficient mitigation investments and report median benefit-to-cost ratios (BCRs) of 1x to 10x (see Figure 18). Moreover, 25% of respondents to a recent BCGxCO2 AI survey reported material decarbonization benefits.[49] These include tangible improvements such as lower operating costs (cited by 44% of respondents) and increased revenues (37%), along with intangible advantages such as reputational gain (46%) and enhanced supply chain resilience (42%).

Companies often focus too much on short-term risks, potentially neglecting longer-term transition challenges

In fact, approximately 80% of companies reporting transition risks to CDP only disclose short-term implications. This short-term view may prevent fossil-dependent business models from fully questioning the long-term sustainability of their portfolios. By overlooking how market shifts and evolving regulations could impact future revenue streams, these companies risk underestimating the financial consequences of transition risks and missing the economic value in making bolder, forward-looking adjustments. Additionally, companies must account for the broader socio-economic costs of an imbalanced transition, which extend far beyond immediate financial losses from regulatory and technological changes.[50]

> **Years ago, we moved to seize the opportunity to work with our high carbon-emitting clients on their sustainable transition, swiftly shifting our mix of traditional fossil fuels activity towards sustainable finance-related business, especially in renewables. The transition has been profitable, and we are on track to generate $1 billion annually in income from sustainable finance.**
>
> Bill Winters, Group Chief Executive, Standard Chartered Bank

4

Unlocking new growth by advancing the climate transition

Climate leaders can unlock significant growth and competitive advantage, tapping into the $14 trillion market for green technologies by 2030, while capitalizing on emerging adaptation opportunities.

The climate transition presents one of the most significant long-term opportunities for growth in modern history

Much like the internet revolution, which created a wave of winners and losers, this transition promises even greater change. Companies that lead the charge are not only opening new growth opportunities, but also creating lasting competitive advantages, disrupting legacy business models in the process.

BCG estimates the market for green technologies and solutions at more than $5 trillion in 2024, headed for nearly $14 trillion by 2030.[51] It spans sectors and value chains, with the largest segments being alternative energy (49%), sustainable transport (16%) and sustainable consumer products (13%). All are growing well above GDP, at annual rates ranging from 10% in consumer products to 20% for alternative energy.

Companies are seeing successes and setbacks – no surprise given the landscape of regulatory change and uncertainties, technology competition and evolving consumer preferences.

4.1 Climate leadership still pays off

Sustainability frontrunners are positioned to create clear advantages in a range of areas.

The advantages of being an early mover start with growth, but do not end there

These advantages were explored in more detail in the World Economic Forum's 2022 report *Winning the Race to Net Zero: The CEO Guide to Climate Advantage*.[52]

Overall, green premiums seem to be persisting today but can be hard to realize amid uncertainties around the expansion of green policies, inflation and geopolitical implications – as well as amid the need to access new customers outside existing customer segments, develop new product propositions and establish novel, green pricing. For certain hard-to-abate industries, transitioning to low-carbon operations will present significant challenges and risks, but underestimating the risks of inaction is dangerous. Companies that delay action risk not only falling behind more proactive competitors but also missing out on the economic opportunities tied to climate leadership.

Sustainability frontrunners are positioned to create clear advantages in a range of areas (see Figure 20), including the following:

- **Deeper talent pools**: Sustainability is a magnet for top talent, with 24% percent of job candidates reporting that they would reject offers from what they perceive as unsustainable companies.[53]
- **Top-line growth**: Green products often outperform, with sustainable consumer goods growing at 9.9% CAGR, driving one-third of consumer goods growth despite being only 18.5% of the current market.[54]
- **Saving cash and carbon**: Operational efficiencies alone can cut emissions by 10%, reducing costs as carbon prices rise, even for carbon-intensive sectors. Across sectors, approximately half of companies' operational scope 1 and scope 2 emissions can be eliminated at no net cost.
- **Reduced regulatory risk**: The EU's carbon border adjustment mechanism (CBAM) will take full effect by 2026. Companies reducing emissions by 55% could see EBITDA margins improve by 2-6 percentage points by 2030 compared with those that take no action.[55]
- **Lower cost of capital**: Top environmental performers benefit from a lower weighted average cost of capital (WACC) compared with their peers.[56] However, the gap has narrowed since 2022, making it harder to measure the full financial benefit with certainty.

However, the pace and scale at which opportunities develop will vary significantly in different scenarios and industries, particularly where legacy grey assets and infrastructure are deeply embedded. New markets, such as hydrogen, also face higher financing costs due to higher interest rates and risks tied to unproven projects. In these sectors, the transition will likely require incremental steps and may progress more slowly as risks and opportunities materialize. Companies transitioning from grey assets to greener technologies must carefully navigate this balance, ensuring that investments in green technologies and assets are aligned with the scale and timing of future risks and policy shifts across various climate scenarios.

> **Within IKEA and through the Alliance of CEO climate leaders, we are demonstrating the financial upside of climate-smart strategies, showing that climate transformation can reduce costs and drive significant returns.**
>
> Jesper Brodin, Chief Executive Officer, Ingka Group (IKEA)

FIGURE 20 | **The green advantage can still exist for those who act**

1. Abatement level for cost optimization without considering any carbon price. **2.** Based on a €75/tCO_2e carbon price assumption for 2030.

Note: CAGR = compound annual growth rate, CPG = consumer packaged goods, WACC = weighted average cost of capital, pp = percentage point, bp = basis point (0.01%).

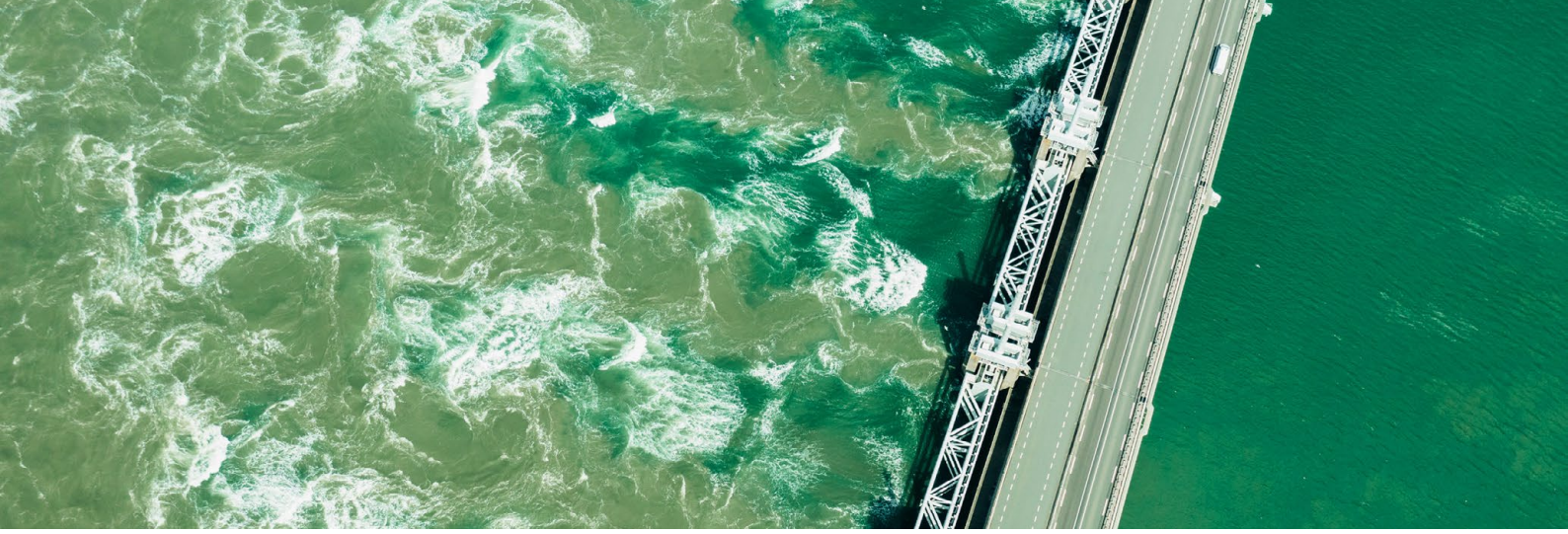
Sources: 2023 BCG/The Network/The Stepstone Group proprietary web survey, IEA *World Energy Outlooks* (2016-2023), European Environment Agency, Statista, Plant Based Foods Association, IEA *Global EV Data Explorer*, Our World In Data, NYU Stern Centre for Sustainable Business, EU announcements, LSEG Data & Analytics, Capital IQ, BCG benchmarks, BCG analysis.

4.2 In heavy industry, climate leaders play a long-term game

While consumer products can bring sustainable offerings to market in a few years, leaders in hard-to-abate industries such as steel and aviation operate on longer timeframes, often collaborating with value-chain partners and governments to scale-up game-changing solutions.

For example, the Swedish steel company SSAB recently reached a milestone in its years-long effort to bring green steel to the market. In April 2024, the company announced the next phase for its HYBRIT partnership with miner LKAB and energy company Vattenfall: construction of a fossil-free mini-mill in Lulea, Sweden, with a start-up planned in 2028. Formed in 2016, the partnership is already producing steel for customers such as Volvo Group, positioning SSAB as a European green steel leader as it prepares for future regulatory and market demands.

In aviation, Airbus expanded its sustainability efforts in 2024 by becoming the anchor investor in a $200 million fund for sustainable aviation fuel solutions. The company aims to decarbonize the sector with clean hydrogen, targeting the first hydrogen-powered commercial aircraft by 2035, while building a green hydrogen network in the Asia-Pacific region.[57,58] These investments are key to staying competitive and securing the industry's future in a low-carbon world.



4.3 The warming climate is creating a market for adaptation solutions

> Certain companies are positioning themselves as climate change winners by developing innovative solutions to help mitigate climate risks in their value chains, unlocking new markets along the way.

As climate impacts intensify, governments and businesses are increasingly turning to adaptation solutions to protect communities, infrastructure and supply chains. These solutions range from building seawalls and reinforcing infrastructure to withstand floods and storms, to creating climate-resilient supply chains and improving water management with smart irrigation and recycling technologies. For example, to instil rural resilience, Timor-Leste has built flood protection structures, including roads, bridges and drainage systems, to withstand extreme weather events such as floods and landslides. Similarly, community-based resilience initiatives, such as wetland restoration and urban green spaces, also help protect neighbourhoods, assets and operations. China's Sponge City Program helps cities manage floods by allowing excess water to be absorbed naturally, reducing the burden on drainage systems.

Certain companies are positioning themselves as climate change winners by developing innovative solutions to help mitigate climate risks in their value chains, unlocking new markets along the way.

The World Economic Forum's 2023 report *Accelerating Business Action on Climate Change Adaptation*,[59] highlighted examples in a variety of sectors:

Energy:

- Schneider Electric partnered with AiDash in 2023 to launch a service that helps utilities build climate-resilient electrical grids by forecasting storm- and wildfire-related outages and damages.

Construction materials:

- Vetrotech by Saint-Gobain produces hurricane- and fire-resistant glass, offering additional resilience against such hazards.
- Holcim's Hydromedia, a permeable concrete, enables construction of a water management system combining concrete with advanced drainage technology to reduce the risk of flooding by absorbing rainwater from streets, parking lots and structures, driveways and walkways.

Food and beverages:

- OCP Group is encouraging farmers to transition to regenerative agriculture practices, thereby improving soil health and water retention while boosting yields and building resilience against climate change. This initiative leverages carbon credit markets to incentivize smallholders to make this transition and provides advanced technology for rigorous monitoring, reporting and verification of credit quality.
- John Deere's production and precision agriculture unit is developing technologies that help farmers adapt to changing climate conditions and improve yields by optimizing water use and reducing soil erosion. In 2023, the unit generated $27 billion in net sales, up 22% from the previous year.

Financial services and insurance:

- Swiss Re has launched a parametric insurance solution to protect coral reefs in Mexico's Yucatán Peninsula. Developed in collaboration with The Nature Conservancy and local governments, this policy provides pay-outs when hurricane wind speeds exceed set thresholds, enabling rapid ecosystem recovery efforts.

5 The CEO Climate Leaders Guidebook

CEOs need to embed climate risk into their corporate strategy, as failing to act will severely undermine business resilience, competitiveness and ability to capitalize on the growing demand for sustainable and resilient solutions.

Companies must embed climate risks and opportunities into their overall strategies

Climate risks and opportunities are no longer a peripheral concern; addressing them is a critical component of a company's overall corporate strategy. Physical and transition risks and opportunities increasingly impact all aspects of corporate strategy.

> **Our corporate philosophy is that sustaining our business for the long term requires us to protect the planet. Climate adaptation and mitigation are central to our strategy as we strive to reduce our environmental footprint and develop solutions that address the increasing impact of climate change on human health.**
>
> Thomas Wozniewski,
> Global Manufacturing and Supply Officer,
> Takeda Pharmaceutical Company

Risks are already materializing and accelerating, with potentially drastic impacts even in the short term

Escalating climate events could ultimately make certain regions economically unsustainable as businesses struggle to cope with increasing physical risks. In California, rising wildfire risks have driven insurers to withdraw from high-risk areas, increasing costs for businesses. Similarly, regulatory actions can prompt fast sunsetting of so-far prosperous markets. In the European Union, for example, regulatory shifts such as the ban on internal combustion engine vehicles by 2035 are reshaping industries.

Companies should not operate under the illusion of a continued business-as-usual approach

Losses and damage to properties, operations and supply chains will seriously impact people's and businesses' wealth. This, in turn, may trigger substantial and fast changes in public opinion and more drastic climate-related policies are becoming conceivable. As time progresses, the current status quo is at greater risk of becoming outdated by either physical or transition impacts.

The strategic approach to managing climate risk should be tailored to each company's specific context.

For industries that are reliant on long-term trends for their success and stability, proactive yet gradual business evolution can be the most sensible way forward.

> **We incorporate climate risk assessments into our investment decisions to ensure long-term resilience and alignment with regulatory standards.**
>
> Mark Konyn, Group Chief Investment Officer,
> AIA Group

In more dynamic environments, companies may choose a flexible, adaptable positioning that allows them to seize opportunities and manage volatility.

> **We are investing in diverse energy solutions like biomethane and hydrogen-ready turbines to navigate market fluctuations while positioning ourselves for future growth**
>
> Pierre-Alain Graf, Chief Executive Officer,
> GETEC

Companies with the scale and risk appetite to influence their market can also take decisive actions to shape market trends and lead the transition of their sector.

> **Our strategy is to take leadership in decarbonizing shipping through an ecosystem-wide effort.**
>
> Vincent Clerc, Chief Executive Officer,
> A. P. Moller-Maersk

This guide is designed to position climate risks and opportunities as a central component of corporate strategy, elevating them as core CEO priorities. With both downsides and upsides at stake, climate risk should no longer be a compliance effort. It should sit at the heart of the leadership agenda, permeating all levels of organizations, so companies can safeguard their long-term resilience while unlocking value in new, sustainable markets (see Figure 21).

FIGURE 21 | **The CEO Guidebook to Managing Climate Risks**

Core actions

Conduct a comprehensive climate risk assessment	Manage risks in current business portfolio	Pivot your business to unlock opportunities	Monitor risks & report on progress
– Measure **physical risks** – Evaluate **transition risks** – Identify **climate-related opportunities**	– Invest in **adaptation & resilience** – Decarbonize **assets & operations** – Decarbonize **business portfolio**	– Reshape **business portfolio** – Capitalize on **physical resilience** – Align **capital allocation** with climate strategy	– Set up **climate risk monitoring** – Disclose **material exposure** – Disclose **adaptation activities**

Enablers

Upgrade climate risk governance	Integrate climate risk into business-as-usual	Develop effective climate risk systems
– Establish or adapt **risk, financial & strategic governance** – Embed climate risk **into decision processes**	– Create a **culture of climate risk awareness & innovation** – Cascade **climate risk ownership** throughout business units & functions	– Build & adapt **tools to measure** climate risks & opportunities – Build **capacity & know-how** to understand new types of risks & opportunities

Source: BCG analysis

Step 1

Conduct a comprehensive climate risk assessment

> In past years, global leaders have consistently ranked extreme weather events and climate disasters among the top five global risks.

In past years, global leaders have consistently ranked extreme weather events and climate disasters among the top five global risks.[60] Cascading effects such as the failure of climate action, biodiversity loss and critical changes to earth systems have recently risen to prominence, reflecting the growing recognition of longer-term impacts.

Climate risk assessment should be firmly grounded in scenario-based analysis across three key areas: measuring physical risks, evaluating transition risks and identifying climate-related opportunities. To build a comprehensive view, companies should assess these dimensions in the context of their own exposure, their supply chain and the broader societal and economic impacts.

Measure physical risks

The assessment of climate hazard threats to a company's key assets should be performed by applying different warming scenarios and time horizons. Both exposure (how likely are hazards?) and vulnerability (how severe could the damage be?) should be considered – across asset types, value chain steps including the supply chain, and types of hazards such as floods, droughts and wildfires.

Once identified in a structured way, risks can be quantified either by using a scoring approach or a more precise (and more complex) financial approach:

Quantification by scoring uses vulnerability matrices and climate hazard data to generate risk scores based on the vulnerability of an asset type. It enables companies with limited prior knowledge of their climate risks to identify high-risk hotspots that need deeper consideration (see Case Study 2).

CASE STUDY 2

Most material physical risks of a biopharma company

Using a scoring approach, a biopharmaceutical company is building resilience against business disruptions across its value chain. The company assessed critical assets in its own operations as well as those of its key suppliers. Having mapped out the relevant assets, the company analysed them against climate hazards such as flood, heat, frost, wind and wildfires.

Using a hazard, exposure and vulnerability framework, the company identified high-risk areas and then short-listed the sites that needed deeper assessment for quantification of potential financial impact and entered into discussions on adaptation measures with high-risk suppliers.

Source: BCG.

Financial quantification relies on more complex calculations and asset-specific input. The economic impact is estimated using damage functions in a three-step approach:

- For each location, obtain data on the distribution of climate hazards across several warming scenarios, time horizons and probabilities (e.g. distribution of flood depth for a so-far "1-in-100-year" flood in Europe by 2050 under a severe warming scenario).
- For each asset, assess the damage caused for different levels of the climate risk hazard (e.g. percent of asset value damaged due to flooding).
- For each asset, calculate the economic impact (e.g. asset restoration cost, revenue loss, extra maintenance cost).

> **As climate change reality hits, it's critical for any company to integrate climate-related scenario analysis into its risk management framework and assess both the physical risks and transition risks and opportunities over the short, medium, and long term. We are committed to developing and implementing the necessary strategies for ourselves and our customers.**
>
> Olivier Blum, Chief Executive Officer, Schneider Electric

Evaluate transition risks

As with physical risks, transition risks are best identified using scenario-based analysis. One source of scenarios is the Network for Greening the Financial System (NGFS),[61] which regularly updates its analysis of how climate policy and technology trends could shape these risks in different futures.

We are working to quantify transition risks using scenarios including those of IEA and NGFS to understand the impact of carbon pricing and regulatory changes on our operations. We recognize that transformation risks and opportunities will have significant impacts, including on our clean ammonia strategy.

Bernhard Stormyr, Vice President, Sustainability Governance, Yara International

CASE STUDY 3

Quantification of transition risks in the construction supply chain

Using a scenario-based framework, a major construction player found that one of its most significant risks was the potential high cost and low availability of green construction materials. The company assessed its exposure towards risk by translating it into measurable metrics under different transition scenarios.

One identified risk was high cost/low availability of green construction materials. The company measured its vulnerability to these risks by using related CO_2e emissions as a proxy. For the green materials risk, this was tied to Scope 3 value chain emissions abated through green materials adoption. The company then derived synthetic risk scores based on the exposure and vulnerability assessments in order to compare risks. It found that the cost and availability of green construction materials was among the most material risks.

Finally, the company estimated the economic impact of the most significant risks in order to assess the magnitude of transition risks and projected that the higher cost and lower availability of green construction materials could reduce EBITDA by about 1.5% by 2030, considering all known transition factors.

Source: BCG.

Identify climate-related opportunities

By thoroughly assessing and efficiently managing climate risks, companies can position themselves for opportunities in both severe warming and faster transition scenarios.

Climate risks reveal opportunities to create more efficient, resilient and cost-effective properties. By addressing those, we aim to enhance the value and usability of buildings.

Guy Grainger, Global Head of Sustainability & ESG Services, JLL

Improving internal operations, through increased resilience, resource efficiency and an optimized energy mix, can set a company apart from its peers. Navigating the transition skilfully builds muscle for offering new green products and services and expanding into new markets.

On top of transition finance to support the decarbonization of our clients, adaptation financing represents a cost-saving and revenue-increase potential. Insuring against physical risks also presents a significant business opportunity.

Javier Rodríguez Soler, Global Head of Sustainability and Corporate & Investment Banking, BBVA

Step 2

Manage risks in the current business portfolio

Having adequately assessed relevant climate risks, companies can invest in adaptation and decarbonization to keep them under control.

Invest in adaptation and resilience

Companies need a comprehensive adaptation and resilience plan developed across three levels:

- **Strategic** (e.g. shifting the business model to increase service revenue or reduce reliance on real estate)
- **Operational** (e.g. creating backup logistics plans or installing flood barriers)
- **Financial** (e.g. using insurance for risk transfer or setting budgets for risk retention)

An operational adaptation and resilience plan typically includes investing in resilient infrastructure, systems and crisis protocols to ensure business continuity. Implementing predictive mechanisms and early warning systems also allows companies to respond dynamically, minimizing adverse effects.

As part of a successful adaptation plan, companies should collaborate with local authorities to ensure efforts are compliant, appropriate and consistent with local adaptation planning.

> **We regularly assess and enhance our protection measures like the construction of flood barriers and storm-proof buildings. We also cooperate with local authorities to ensure that our risk management strategies align with broader resilience efforts locally.**
>
> Stefan Klebert, Chief Executive Officer, GEA Group

These efforts and investments support the resilience of a business and secure competitive advantage over peers that may need to shut down production as a result of extreme events.

CASE STUDY 4

Utility leveraging resilience to better serve customers

Using customer outcomes to define success, a major utility created an adaptation and resilience strategy to strengthen its electrical grid against expected increases in damaging storms. Key performance indicators require the company to minimize interrupted customer minutes, post-event recovery costs and the number of critical customers without power during a major weather event.

The plan developed by the company focused on three areas: strengthening the grid to withstand severe weather events, modernizing it to minimize the impact of disruptions, and ensuring swift power maintenance during and after major events. For every $1 invested in the plan, the company was able to save $2 to $3 in net utility, customer and community benefits over the life of the investment.

Source: BCG.

Decarbonize assets and operations

Reducing carbon emissions is now critical for businesses not just to meet climate goals but also to ensure long-term resilience. Some early levers that industries can pull include improving energy efficiency, integrating renewable energy sources and transitioning to low-carbon technologies and fuels.

While companies are reducing scopes 1 and 2 emissions, tackling scope 3 emissions – which are often more than 10 times greater than scopes 1 and 2 combined – remains a significant challenge. Companies have limited control over suppliers and customers, while small and medium businesses in their value chains may lack the ability to decarbonize. Addressing scope 3 requires deep collaboration with suppliers and customers across the value chain.[62]

> **To achieve our net-zero target by 2040, it is essential to reduce suppliers' emissions. We are starting to ask major suppliers to aim for net-zero scope 2 emissions by 2030 and plan to support their capacity building.**
>
> Shiro Kambe, Senior Executive Vice President, Corporate Executive Officer, Sony Group Corporation

> **We go beyond tender requirements by using the Open-es platform to help SME suppliers enhance their own sustainability through ESG tools, training and certifications, allowing them to rank higher in our tenders and building climate resilience across our supply chain.**
>
> Concetta Testa, Head of Sustainability, Autostrade per l'Italia (ASPI)

Climate leaders are making headway on their scope 3 upstream emissions by cascading ambition and support to suppliers. Procurement teams are spearheading these efforts, integrating climate goals into purchasing decisions and using their influence to push for cleaner technologies and sustainable practices across supply chains.

To support such ambitions, the World Economic Forum's Net-Zero Value Chain Support Hub,[63] developed by the Alliance of CEO Climate Leaders in partnership with BCG, offers a practical starting point with resources and tools to help procurement and sustainability professionals measure, reduce and set targets for upstream emissions. In certain transition scenarios, financial support for decarbonizing suppliers can be a cost-efficient move.

CASE STUDY 5

A biopharma company's case for decarbonizing the supply chain

A biopharma company assessed the risk associated with a pass-through of a carbon tax across its upstream value chain. It estimated that the cost of not decarbonizing the supply chain was ~2-3x the cost of supporting supplier decarbonization under likely climate scenarios.

Source: BCG.

Decarbonize the business portfolio

For many industries, downstream s cope 3 emissions present the biggest strategic risk and challenge, requiring fundamental changes in product portfolio and design. Companies in high-emission sectors such as fossil fuel-based products, automotive and heavy industry are particularly vulnerable as the global economy shifts towards decarbonization. This transition is not just a regulatory obligation; it is both an opportunity and a threat, with the risk of disruption should competitors adapt more effectively than incumbents.

In addition to decarbonizing their existing operations and value chains, leading players are therefore investing to secure future optionality. For example, Dow is enhancing its feedstock flexibility, allowing greater uptake of bio-based and circular materials. Although the amount of time before it pays off may be longer than usual, these types of investments can help the company stay ahead of future sustainability requirements and mitigate the risk of stranded assets.

> **By investing in our decarbonization and circularity, we are not just mitigating risks; we are opening up new revenue streams with customers seeking to decarbonize.**
>
> Dan Futter, Chief Commercial Officer, Dow Inc.

Ultimately, each company should ask itself "What is the best portfolio of products and services that we will offer in a decarbonized world?" With this as a guiding question, strategic and product portfolio implications and actions can be determined.

> **For example, we have invested $500 million in a near-zero global warming potential propellant for respiratory medicines, which has taken four to five years of development. Our first target launch with the Next Generation Propellant is 2025.**
>
> Pascal Soriot, Chief Executive Officer, AstraZeneca

Step 3

Pivot your business to unlock opportunities

> Reshaping your business portfolio is not just about decarbonization — it is about unlocking growth, boosting resilience and ensuring long-term value for shareholders.

Reshape the business portfolio

As the transition to a net-zero economy accelerates, companies have a significant opportunity to unlock new market potential by reshaping their portfolios and embracing decarbonization. By identifying areas where innovation and sustainable practices can fuel growth, businesses can build strategic resilience. Sectors such as renewable energy and sustainable agriculture, along with circular economy solutions, present substantial long-term opportunities.

CASE STUDY 6

OCP Group's diversification through green investments

The Moroccan fertilizer company is making significant investments in green hydrogen and green ammonia to transform its operations and align with global decarbonization goals. By integrating these sustainable technologies, OCP is not only reducing its carbon footprint, but also positioning itself to lead in the emerging markets for sustainable agriculture and new value chains in the energy space.

Source: OCP, BCG analysis.

Capitalize on physical resilience

Similarly, companies with strong adaptation strategies can outpace competitors and seize new business opportunities. Those resilient to extreme climate events recover faster, leverage broader capabilities to manage disruptions and attract more clients, fostering loyalty.

Align capital allocation with climate strategy

Reshaping the business portfolio will only get as far as capital allocation allows. Balancing short-term profitability with long-term sustainability requires repurposing assets, managing the risk/reward profiles of sustainable investments and ensuring competitiveness in green sectors. Transparent communication with investors is key to maintaining confidence and securing necessary financing.

CASE STUDY 7

Repsol's strategy to transition while protecting shareholder returns

Repsol has committed to progressively shift 45% of its CapEx over the next five years[64] towards renewable energy and biofuels while protecting shareholder returns. It achieves this by redirecting cash flows from conventional businesses into its climate-transition businesses. This strategy enables Repsol to work towards its net-zero emissions goal while protecting current business in the short term and maintaining investor confidence. Market capitalization rose by over $1 billion the morning the strategy was publicly announced.

Sources: Repsol, BCG analysis.

Step 4

Monitor risks and report on progress

Set up climate risk monitoring

While many companies view monitoring and reporting on progress as a burden, it can become a driver for performance. Instead of treating it as a compliance checklist for external audiences, companies should integrate climate risk monitoring and external reporting into their operations and planning.

> **When reporting is integrated as a key driver of performance, it enables organizations to better tackle risks and seize opportunities. But if it is seen as a compliance checklist, reporting can become a burden.**
>
> Simon Henzell-Thomas,
> Global Director of Climate & Nature,
> Ingka Group (IKEA)

Disclose material exposure and adaptation activities

Transparent reporting – on both adaptation and mitigation efforts – is essential for building stakeholder confidence. Reporting does not just ensure compliance with mandatory and emerging requirements (e.g. from the EU's Corporate Sustainability Reporting Directive and the International Sustainability Standards Board); it is also an opportunity to build a differentiated narrative for investors and partners seeking sustainable and resilient investments and green products.

Adopting practices to monitor risks and report on progress enables continuous improvement. Companies need to learn from past experiences and adapt strategies to better manage future climate challenges. Given the ever-evolving nature of climate conditions and risks, this iterative process is essential.

Enabler 1

Upgrade climate risk governance

> **Sustainability decisions should be treated with the same importance as financial decisions.**
>
> Adam Pradela, Chief Financial Officer, Corporate Sustainability, DHL Group

Establish or adapt risk, financial and strategic governance

Climate risk is a strategic imperative that requires ownership at all levels, including the Executive Committee and Board. To truly embed climate risk governance, companies should integrate it fully into their risk management, strategy and financial planning. This is key to ensuring business development plans are adequately informed by climate considerations.

CASE STUDY 8

AIA investment governance

AIA has revised its investment criteria, ensuring that new investments align with the company's net-zero commitments and overall resilience. Its governance structure also includes regular portfolio reviews to maintain alignment with climate goals and allow for adjustments as needed.

Source: BCG.

At the operational level, it is essential to cascade climate risk management objectives and KPIs into business objectives to create ownership and accountability across an organization. This should be supported by clear policies and guidelines from the top, ensuring that relevant functions within a company are actively driving and owning climate risk management.

Embed climate risk into decision processes

Companies should integrate climate risks into their decision-making processes. By systematically embedding climate risk considerations into decisions of all kinds – strategy formulation, CapEx plans, investment approvals, supplier selection, maintenance planning and more – businesses can better anticipate future challenges, avoid unforeseen costs and align strategies with stakeholder expectations.

> **We have built a robust climate governance, which includes a NetZero oversight committee and an executive body committee dedicated to oversee all ESG-related matters, including climate-related matters, monitor performance against ESG goals and ensure that we continue to integrate ESG into our strategy, operations and culture.**
>
> Amita Chaudhury, Group Head of Sustainability, AIA Group

Enabler 2

Integrate climate risk into business-as-usual

Embedding climate risk into business-as-usual makes it a core driver of strategy, decision-making and accountability across all functions.

Create a culture of climate risk awareness and innovation

Establishing a culture of climate risk awareness throughout an organization is crucial because, for many companies, the risks influence every aspect of their business. Climate risk should no longer be confined to a sustainability team. For example, in real estate businesses, it involves not only evaluating location risks, but also using sustainable materials or planning for energy-efficient cooling systems.

Cascade climate risk ownership throughout business units and functions

Climate risk should become a core business topic, with ownership taken throughout an organization. This shift starts at the top, with management aligning on the messaging and leading by example. From there, it is essential to implement operational-level training, workshops and climate risk management into KPIs at the same level as financial objectives.

At real estate services firm JLL, for instance, climate risk management is embedded into investment decisions and operational strategies, with the creation of a net-zero council that assigns accountability for carbon footprint and climate risks to senior business leaders.

At ASPI, we've embedded climate risk into our core operations, supported by our 40+ ESG ambassadors, who promote broader sustainability initiatives, including climate preparedness, across all functions.

Concetta Testa, Head of Sustainability, Autostrade per l'Italia (ASPI)

Enabler 3

Develop effective climate risk systems

Build and adapt tools to measure climate risks and opportunities

Companies should build and adapt measurement tools to assess both physical and transition risks. This involves designing new metrics, data collection methods and analytical models, while updating existing risk-management tools to incorporate climate-related factors.

Depending on the type of company, this may include leveraging data-driven and digital technologies such as drones, internet of things (IoT), earth observation, augmented and virtual reality, advanced computing and AI to assess risks, build resilience and respond dynamically to climate events.

For further information on the role of technology, see the World Economic Forum and BCG's 2024 report, *Innovation and Adaptation in the Climate Crisis: Technology for the New Normal*.[65]

Build capacity and know-how to understand new types of risks and opportunities

Developing the expertise to understand new risks and opportunities is essential. Companies should ensure that their teams have the skills and knowledge to assess and respond effectively to climate risks. Setting up training programmes for employees, adding knowledge resources and hiring experts in risk management can help to meet this goal.

For example, a major utility company, realizing they were not well-equipped to assess the opportunities associated with their transition to a lower-carbon economy, developed new valuation methods and capabilities to calculate the return on investment on unfamiliar asset types (e.g. microgrids, demand response, EV infrastructure).

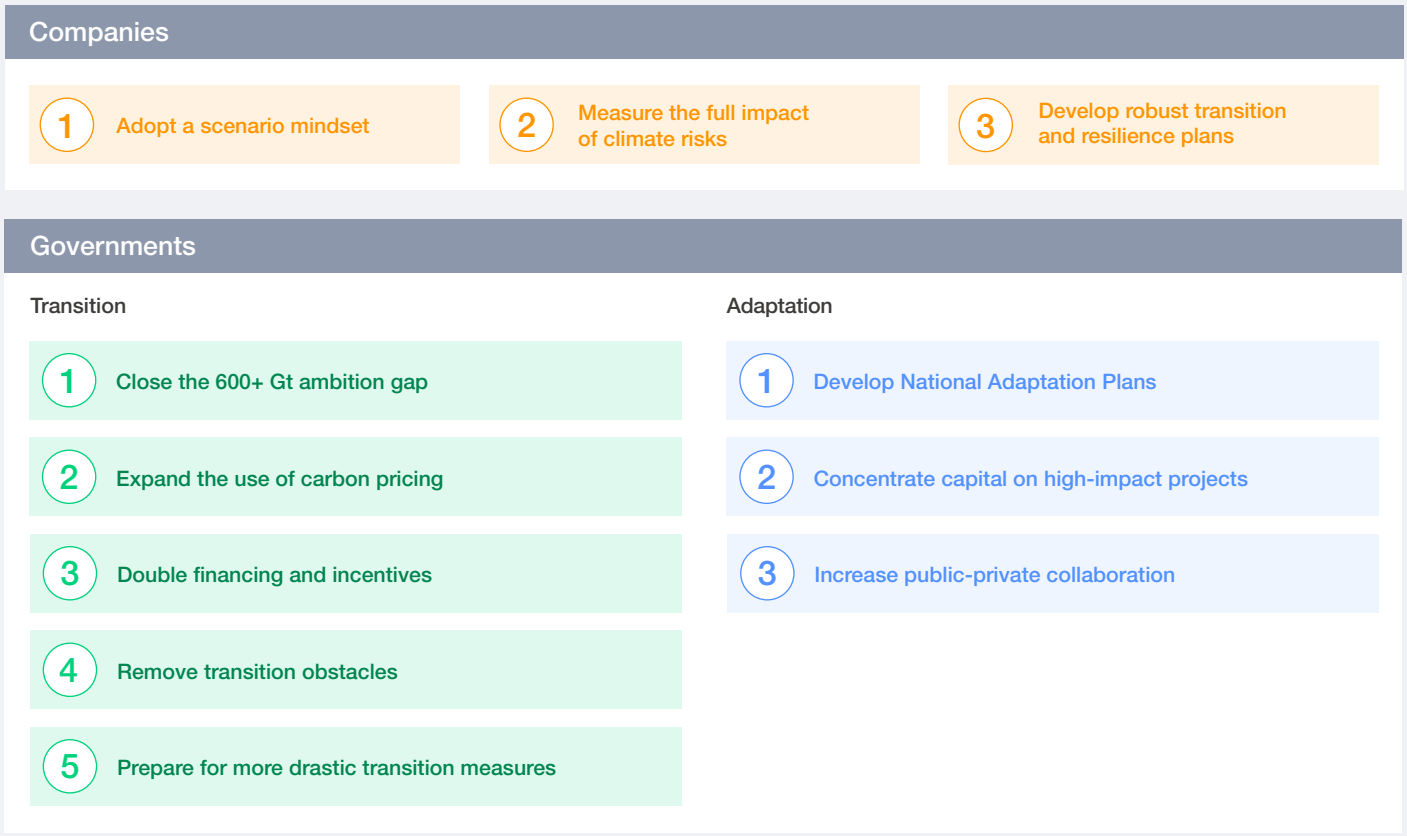
6 How corporates and governments can rise to the challenge

Companies and governments must act urgently on climate risks, as inaction would cost far more than the investment needed and threaten global economic stability and long-term prosperity.

Climate change is becoming concrete and testing government and business leaders in unprecedented ways

The threat climate change poses to livelihoods and economic prosperity has long been evident to the scientific community and to many in government and business. But as risks, predictions and impacts start materializing, the direction of the world's climate and its related risks are expected to return to the top of the corporate agenda.

FIGURE 22 **How companies and governments can prepare for the uncertainty ahead**



Source: BCG analysis

> Business-as-usual scenarios will likely not persist. The new normal is driven by extreme weather and a difficult-to-predict transition to a low-carbon economy.

Business leaders need to prepare for a changing world

Business-as-usual scenarios will likely not persist. The new normal is driven by extreme weather – affecting overall economic growth and threatening individual supply chains, assets and operations – as well as by a difficult-to-predict transition to a low-carbon economy that puts existing products, asset values and business models at risks.

The following three actions can help business leaders prepare for the uncertainty ahead:

1. **Adopt a scenario mindset** to understand how a company's context would change in different versions of the future. The speed of the green transition and the exact impacts of global warming are hard to predict. But climate leaders should know how to model the conceivable effects of shifts on their companies and how to develop resilient strategies against potential developments.
2. **Measure the full impact of climate-related risks** to help make better-informed business decisions. Both physical and transition risks can have major impacts on companies' bottom lines. Quantifying them enables prioritization and the most efficient use of resources.
3. **Develop robust transition and resilience plans** that offer adequate resilience across the full spectrum of relevant scenarios. By building strategic optionality and flexibility, businesses will be able to adapt more quickly to unforeseen challenges and capitalize on emerging opportunities.

> Governments must act urgently to accelerate the transition, scaling-up financing, expanding carbon pricing and preparing for a future shaped by more extreme climate impacts.

Governments need to accelerate the transition to prevent the most extreme consequences of unchecked warming

The World Economic Forum and BCG's January 2024 report *Bold Measures to Close the Climate Action Gap: A Call for Systemic Change by Governments and Corporations* outlined five key actions that governments should take to drive bolder, systemic change.[66] These still hold today:

1. **Close the 600+ gigaton ambition gap** by strengthening Nationally Determined Contributions (NDCs) in the upcoming submission round, multiplying climate finance for low- and middle-income countries and refocusing global negotiations.

2. **Expand the use of carbon pricing** by tracking emissions more fully, broadening the global scope of pricing and rolling out mechanisms to level the playing field for low-carbon solutions. In parallel, governments need to establish a credible, transparent and high-integrity framework for carbon credit markets to ensure credible emission reductions and prevent misuse.

3. **Double financing and incentives** for outsized-impact solutions. More subsidies and green public procurement are the push needed for clean hydrogen, battery storage, carbon capture and storage and other early-stage technologies to grow into cost-competitive solutions.

4. **Remove transition obstacles** to deliver on COP28 pledges to accelerate electrification at least threefold by fast-tracking green projects, de-risking key supply chains, updating government procurement practices, upskilling the workforce and getting civil societies on board.

5. **Prepare for more drastic transition measures**, which may become necessary and economically justified in an ever-warming world.

At the same time, governments need to prepare for a changing climate

As it stands, humanity will likely overshoot its emission budget for keeping warming under 1.5°C – and probably even 2°C.[67] This means all countries need to prepare for a future with a lot more extremes, including the following:

- **Develop National Adaptation Plans (NAPs)** to protect citizens, economies, nature and biodiversity. NAPs serve as an essential tool to guide adaptation and resilience efforts, enabling both public and private sectors to assess and invest in adaptation and resilience solutions.

- **Concentrate capital on high-impact adaptation projects.** Since a rapid closure of the adaptation finance gap looks unlikely, current available funding needs to be redirected towards adaptation and resilience initiatives that maximize the return on investment.

- **Increase public-private collaboration** to scale up adaptation and resilience efforts. In public-private partnerships, the private sector can participate in multiple facets of a project, offering financial support through grants and loans, capability support by providing in-house expertise and execution support by co-owning delivery of the project.

The urgency for both corporates and governments to act, in their own interest, cannot be overstated

This report has focused on the corporate cost of climate inaction and offered a CEO Guidebook to Managing Climate Risks and pursuing opportunities in a highly uncertain world. The decisions made today will shape the economic and environmental landscape for generations to come.

Appendix

Annex 1: EBITDA at risk from physical risks (Figure 10)

This analysis provides an estimate of the financial impact of physical climate risks on companies across different sectors and geographies, expressed as a percentage of EBITDA under >3°C and <2°C warming scenarios.

Data sources:

- Value at risk per sector (in % of asset value) from S&P Global Sustainable1's Quantifying the financial costs of climate change physical risks for companies, 2023.
- Sectoral benchmarks for asset turnover ratio and EBITDA margins from BCG internal databases and Capital IQ.
- Regional climate risk distribution of impact from Swiss Re's The economics of climate change: no action not an option, 2021.

Estimation methodology:

- Sectoral impact:
  - Sector-specific financial impact in % of EBITDA is calculated by dividing the percentage of asset value damage by the asset turnover ratio and EBITDA margin for each sector.
- Distribution by region and scenario:
  - Regional impact variations are based on a weighting factor derived from Swiss Re data.
  - Scenario weighting is applied using Swiss Re data to adjust impact under various warming scenarios.
  - To account for current impact, impacts are discounted by an assumed +1.1°C temperature rise, as of today.

Annex 2: EBITDA at risk due to carbon pricing (Figure 16)

This analysis estimates the financial impact of carbon pricing on companies across various sectors and geographies, expressed as a percentage of EBITDA under both a slow transition (current policies) and a fast transition (net zero by 2050) scenario.

Data sources:

- Carbon intensities by sector and region are sourced from BCG benchmarks.
- Carbon price:
  - For slow transition: 2030 carbon price levels are sourced from the IEA Stated Policies Scenario where available and the current value (from World Bank) when no target 2030 price is available.
  - For rapid transition: carbon prices are based on IEA projections under Net Zero Emissions by 2050 scenario.
- Share of emissions taxed, by region:
  - For slow transition: regional estimates are derived from World Bank's State and Trends of Carbon Pricing, 2024. For the European Union, a bespoke analysis assesses the coverage of EU ETS and CBAM using European Environment Agency data and BCG internal databases (for iron and steel, cement, aluminium, fertilizers, electricity and hydrogen).
  - For rapid transition: regional estimates are based on BCG assumptions, building on an IEA Net Zero by 2050 scenario.

Estimation methodology:

- Sector- and region-specific carbon intensity is multiplied by the estimated share of emissions taxed and the regional average price on carbon to determine the initial impact on each sector.
- The financial impact is converted into EBITDA at isk, using sectoral EBITDA margins from BCG benchmarks and Capital IQ.

Annex 3: Stock value at risk from asset write-downs (Table 2)

This analysis estimates the potential asset write-downs on key asset categories (upstream oil fields, coal plants, blast furnaces, heavy fuel vessels and steam crackers) expressed as a share of total 2030 stock value under slow, medium and rapid transition scenarios.

Data sources:

- Asset unitary CapEx and lifespan are derived from benchmarks of public and industry sources.
- Lists of grey assets (including commissioning year and capacity, for current and announced assets) are sourced from industry databases (e.g. WFR for shipping, UCube for oil).

Estimation methodology:

- For upstream oil fields, coal plants and blast furnaces:
  - 2030 demand for grey commodities is derived from IEA scenarios (Stated Policies, Announced Pledges, Net Zero Emissions by 2050).
  - Global 2030 capacity is estimated per grey asset class, accounting for current capacity, pipeline additions and projected retirements – highlighting a potential overcapacity vs. future demand under each scenario.
  - Total asset write-down value is calculated per asset class based on the residual book value of assets to decommission to meet demand under each scenario, assuming older assets are retired first and CapEx is depreciated linearly.
  - This value is then divided by the residual book value of total 2030 stock.
- For heavy fuel vessels and steam crackers:
  - A theoretical "required decommissioning year" is estimated for grey assets, based on the date by which capacity for these assets is projected to fall below 10% of current capacity, under different IEA scenarios.
  - For each asset, lost useful value is estimated by calculating the difference between "required decommissioning year" and regular decommissioning year based on usual lifespan, assuming linear CapEx depreciation.
  - Total sector write-down is calculated by summing all asset-level lost useful values and dividing by total stock residual book value as of 2030.

Contributors

World Economic Forum

Pedro Gomez
Head, Climate;
Member of the Executive Committee

Pim Valdre
Head, Climate Ambition Initiatives

Boston Consulting Group

Olivia Bendixen
Consultant

Jens Burchardt
Managing Director & Partner

Giovanni Covazzi
Partner

Lorenzo Fantini
Managing Director & Partner

Patrick Herhold
Managing Director & Senior Partner

Rich Lesser
Global Chair

Marion Merenda
Consultant

Cornelius Pieper
Managing Director & Senior Partner

Nicolas Salomon
Project Leader, World Economic Forum Fellow

Rishi Sinha
Consultant

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Ester Baiget
President and Chief Executive Officer, Novonesis

Sarah Barker
Managing Director, Pollination Law

Olivier Blum
Chief Executive Officer, Schneider Electric

Jesper Brodin
Chief Executive Officer, Ingka Group (IKEA)

Greg Brouwer
Senior Vice President, Operations Excellence, Teck

Amita Chaudhury
Group Head of Sustainability, AIA Group

Vincent Clerc
Chief Executive Officer, A. P. Moller-Maersk

Dan Futter
Chief Commercial Officer,
Dow Inc

Pierre-Alain Graf
Chief Executive Officer,
GETEC

Guy Grainger
Global Head of Sustainability
& ESG Services, JLL

Bronwyn Grieve
Director of Global Sustainability and External Affairs, Fortescue

Simon Henzell-Thomas
Global Director of Climate & Nature, Ingka Group (IKEA)

Shiro Kambe
Senior Executive VP, Corporate Executive Officer, Sony Group Corporation

Stefan Klebert
Chief Executive Officer, GEA Group

Mark Konyn
Chief Investment Officer, AIA Group

Adam Pradela
Chief Financial Officer, Corporate Sustainability, DHL Group

Ingrid Reumert
Senior Vice President, Global Stakeholder Relations, Ørsted

Feike Sijbesma,
Chairman, Royal Philips

Sumant Sinha
Chairman and Chief Executive Officer, ReNew

Javier Rodríguez Soler
Global Head of Sustainability and Corporate & Investment Banking, BBVA

Pascal Soriot
Chief Executive Officer, AstraZeneca

Bernhard Stormyr
Vice President, Sustainability Governance, Yara International

Concetta Testa
Head of Sustainability, Autostrade per l'Italia

Bill Winters
Group Chief Executive, Standard Chartered Bank

Thomas Wozniewski
Global Manufacturing and Supply Officer, Takeda Pharmaceutical Company

Boston Consulting Group

Joud Almaiman
Consultant, Boston Consulting Group

Avital Amrany
Consultant, Boston Consulting Group

Sylvain Santamarta
Managing Director & Senior Partner, Boston Consulting Group

Annika Zawadzki
Managing Director & Partner, Boston Consulting Group

Production

Laurence Denmark
Creative Director, Studio Miko

Charlotte Ivany
Designer, Studio Miko

Cat Slaymaker
Designer, Studio Miko

Jonathan Walter
Editor

Endnotes

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    - Rapid: Faster and more successful changes to policy and technology landscape, with limited temperature increase beyond 1.5°C.

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World Economic Forum
91–93 route de la Capite
CH-1223 Cologny/Geneva
Switzerland

Tel.: +41 (0) 22 869 1212
Fax: +41 (0) 22 786 2744
contact@weforum.org
www.weforum.org