

MARSH

Addressing systemic climate risks in the energy sector



Executive summary



Climate-driven physical risks are increasing worldwide, creating heightened and growing vulnerabilities for energy companies. Rising frequency and intensity of extreme weather events, expanding asset footprints in exposed locations, and chronic underinvestment in resilience are producing shocks that are larger, faster, and more systemic than many corporate frameworks anticipate.

This reality requires a fundamental reassessment of how energy companies approach risk: mapping current and future exposures across assets and the broader systems they operate within, quantifying financial impacts across the portfolio, and defining a clear, prioritized action plan to address these risks.

At the asset level, energy companies face both acute damage and chronic degradation. Floods and storm surge can destroy or interrupt operations, while rising temperatures and humidity can progressively derate capacity, accelerate corrosion, and shorten asset life, compounding maintenance costs over time.

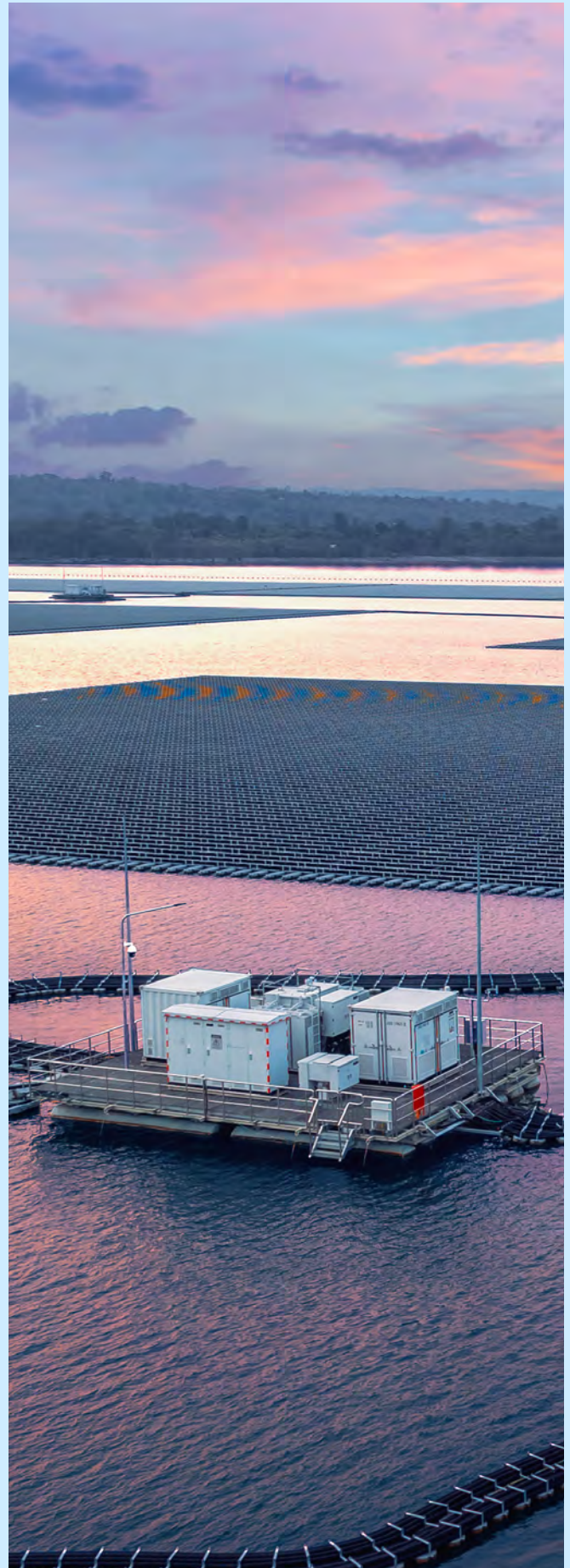
At the system level, interdependencies among suppliers, customers, transport corridors, and other critical infrastructure create transmission channels through which a single disruption can cascade across the value chain, leading to production curtailments or asset shutdowns.

Delaying resilience investment can increase exposure, raise long-term costs, and narrow future options. Early, targeted action can preserve cashflow, protect operations and people, and maintain access to capital and insurance as markets increasingly reprice climate risk.

Approach

The path forward comprises four interconnected approaches:

- Conduct a portfolio-wide climate risk assessment covering current and future risks, to identify asset-level and system-level vulnerabilities, including suppliers, customers, critical infrastructure, and resource dependencies.
- Translate physical exposures into financial metrics. This may include expected loss, value at risk, and recovery timelines to understand where risks concentrate and how they affect the balance sheet.
- Build a prioritized roadmap to strengthen assets, promote operational continuity, and mitigate supply chain risks.
- Revisit insurance and financing strategies, including multi-year placements, parametric insurance, and blended finance to secure liquidity for resilience investments and manage the total cost of risk where it cannot be fully eliminated. Structured correctly, these investments can increase cashflow certainty, smooth loss payouts, and reduce the effective weighted average cost of capital (WACC).



Introduction:

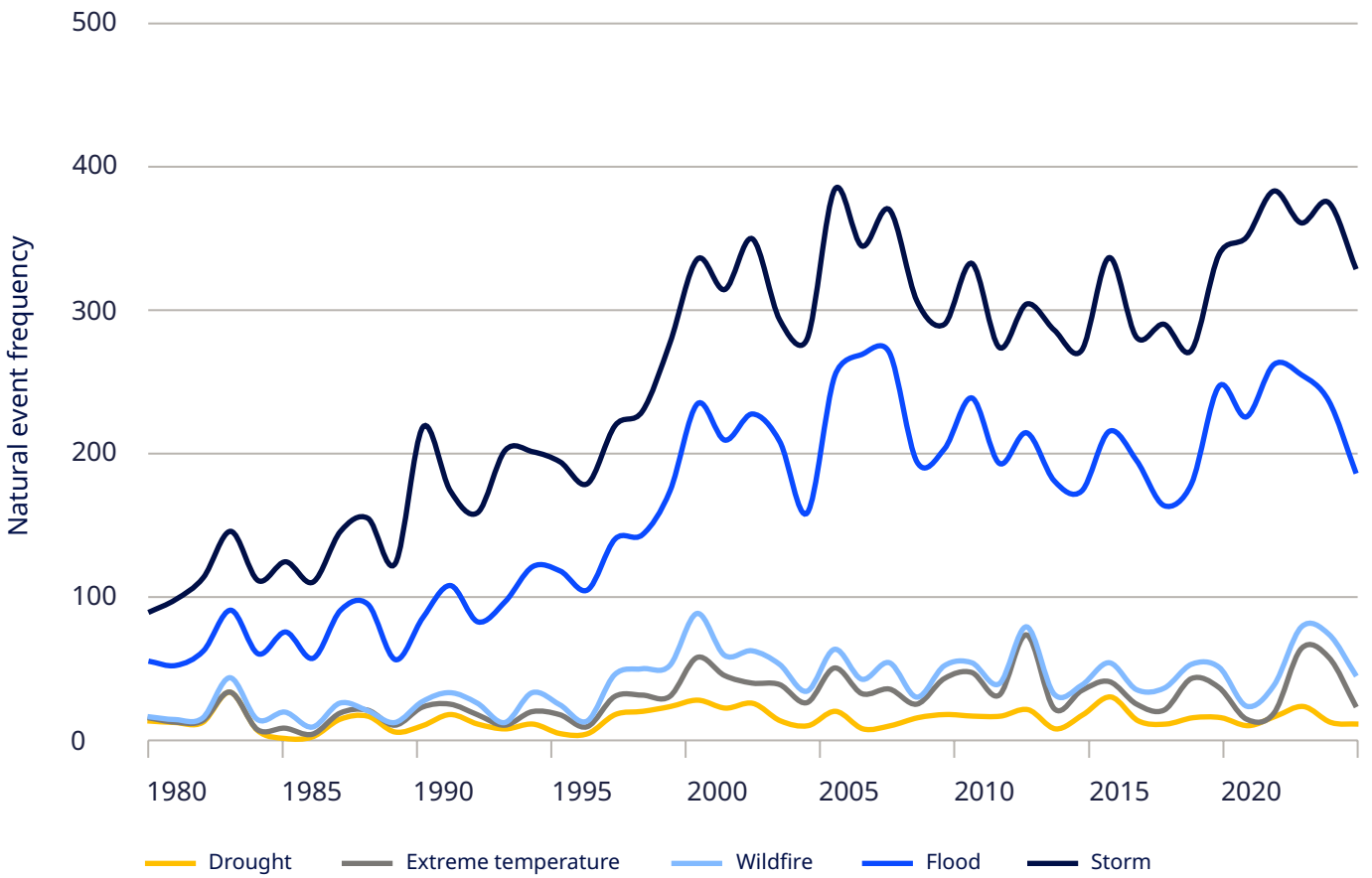
A persistent and increasing threat



Climate-driven physical hazards have shifted beyond episodic disruptions to become a persistent, portfolio-level risk for energy companies. Both the frequency and intensity of climate-driven events have increased markedly across many regions. Heatwaves and heavy precipitation are already posing challenges to the sector, and the [Intergovernmental Panel on Climate Change \(IPCC\)](#) projects that this trend will continue, even under the increasingly unlikely scenario that the Paris Agreement of 1.5°C target is met.

The human and financial consequences are already severe. Cyclones Ditwah and Senyar, along with the resultant flooding that struck Southeast Asia in late-2025, left over 1,600 people dead, impacted millions more, and caused an estimated [US\\$20 billion in damages](#) — a stark illustration of the scale of disruption that concentrated weather events can inflict.

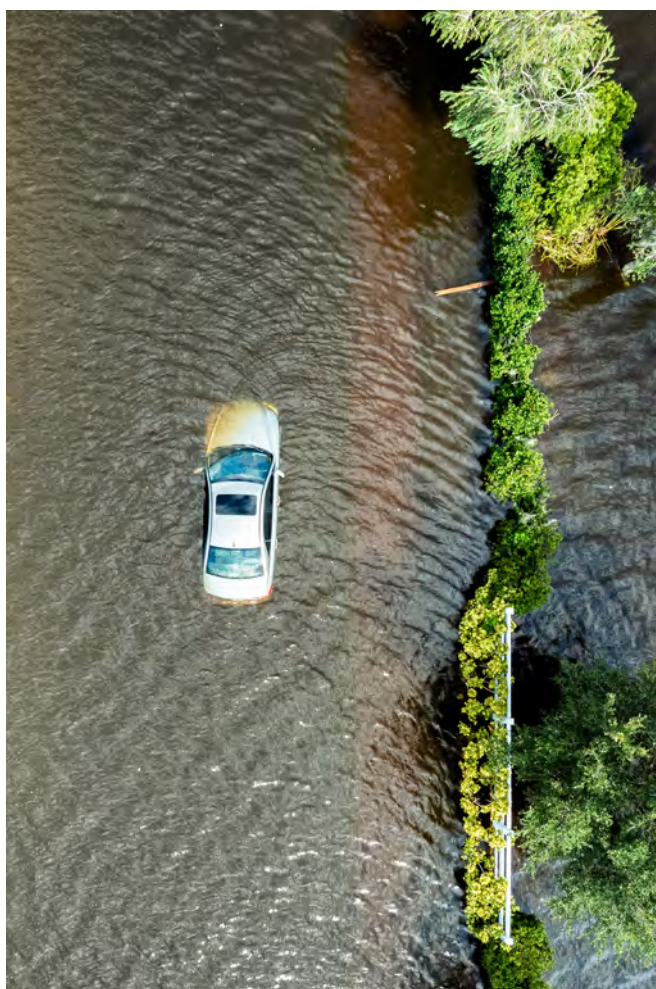
Figure 1. Global natural event frequency data



Source EM-DAT

As hazards intensify, direct losses and insurance costs are rising in parallel. [The Marsh Risk 2025 Climate Adaptation Survey](#) found that 74% of respondents reported losses or disruptions to physical assets from extreme weather events. Encouragingly, 78% of surveyed organizations said they are assessing their future climate risks. Yet a critical gap remains: more than half of businesses do not use cost-benefit analysis to build the business case for adaptation investments, leaving resilience programs without the financial rigor required to secure executive and board commitment.

Why energy operators are acutely exposed



Energy infrastructure sits at the intersection of multiple climate hazards. Coastal refineries, power plants, and import-export terminals are vulnerable to storm surge and flooding. Drought-driven water level declines on major inland waterways constrain freight movement and feedstock supply — the 2018 low-water episode on the Rhine River disrupted production cuts in petrochemical and steel plants and depressed Germany's output by about [0.5% of GDP](#).

It is not only acute extreme weather events that need to be assessed, as chronic exposures also exist. Rising air and water temperatures can drive increased asset degradation and reduced processing capacity by impacting cooling.

The financial cost of climate risks to the energy industry is significant and rising. Without immediate adaptation and resilience measures, these costs are expected to increase significantly, with some estimates exceeding US\$150 billion by 2050. [Research](#) has shown that electricity companies in Asia are already experiencing losses amounting to US\$6.3 billion.

Physical climate risks relevant for the energy sector

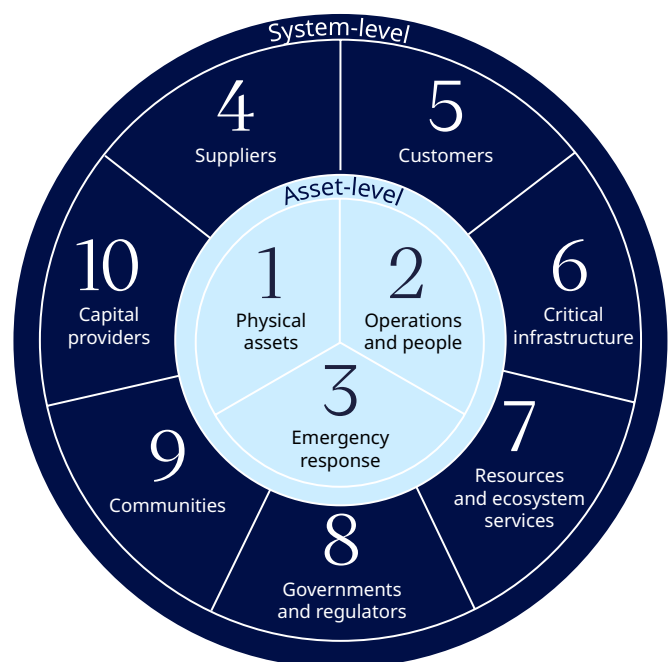
Both asset-level climate impacts and system-level cascading effects pose threats to energy operations. These risks are amplified by worsening climate conditions and the consolidation of global operations — making resilience-building a priority.

Assessing climate risks requires a dual focus on both asset and system levels. At the asset level, physical risks are often well understood: from flood damage to facilities, extreme heat reducing worker productivity, to droughts increasing wildfire risk. However, focusing only on individual asset risks overlooks the broader context and underestimates overall exposure.

It is equally important to consider the broader system in which the business operates. Energy companies depend on a complex network of customers, suppliers, transport corridors, ports, terminals, utilities, and financial markets. A disruption to any single customer, supplier, or infrastructure component caused by a climate event can quickly cascade into lost production.

Physical climate risks can also increase the cost of capital and insurance premiums, impacting the balance sheet and influencing future investment decisions.

Figure 2. Marsh Adaptation Framework



Source: Marsh

Asset-level risk: Physical asset

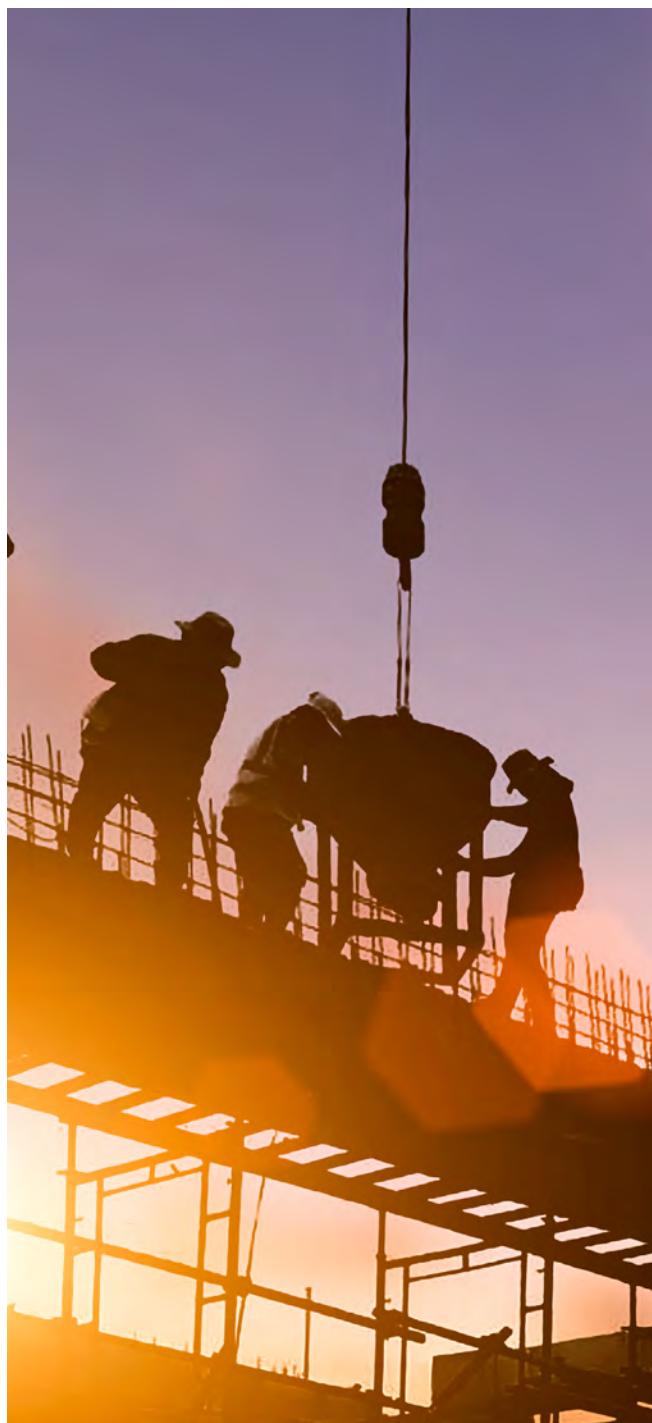
The most apparent asset-level risks involve property damage and resultant business interruptions caused by extreme weather events. However, less visible but equally significant impacts arise from the changing environment, which drives chronic degradation of equipment and operational capacity. Ocean acidification, combined with rising temperatures and humidity, accelerates corrosion of equipment, particularly affecting offshore and coastal assets. Permafrost thaw and soil subsidence threaten the foundations of Arctic facilities and buried pipelines. Additionally, increasing ambient water and air temperatures reduces cooling efficiency, progressively diminishing throughput at refineries and power plants. Collectively, these factors can raise maintenance costs, shorten asset lifespans, increase outage frequency, and reduce overall utilization rates.

Asset-level risk: Emergency response

Climate-related events can undermine emergency response capabilities at asset sites, potentially increasing the magnitude of losses. Drought conditions limit water availability for firefighting, while widespread incidents, such as wildfires, can overwhelm response resources. Emergency plans that depend on external responders or regional mutual aid arrangements face heightened vulnerability when simultaneous or protracted events occur, leaving firms more exposed and extending recovery timelines.

Asset-level risk: Operations and people

People are the most important asset of any organization, and climate change presents direct operational and financial risks to the workforce. Energy operations are often labor-intensive, involving long shifts, heavy maintenance, and tasks that require personal protective equipment (PPE). For example, restrictions on working during extreme weather can reduce productivity,



extend equipment outages during maintenance and turnarounds, and delay project timelines. In 2020, an estimated [295 billion working hours](#) were lost globally due to high temperatures, a figure likely to rise with climate change.

Furthermore, large planned turnarounds are typically scheduled during cooler months. With rising annual temperatures and expanding asset bases in regions like the Middle East,

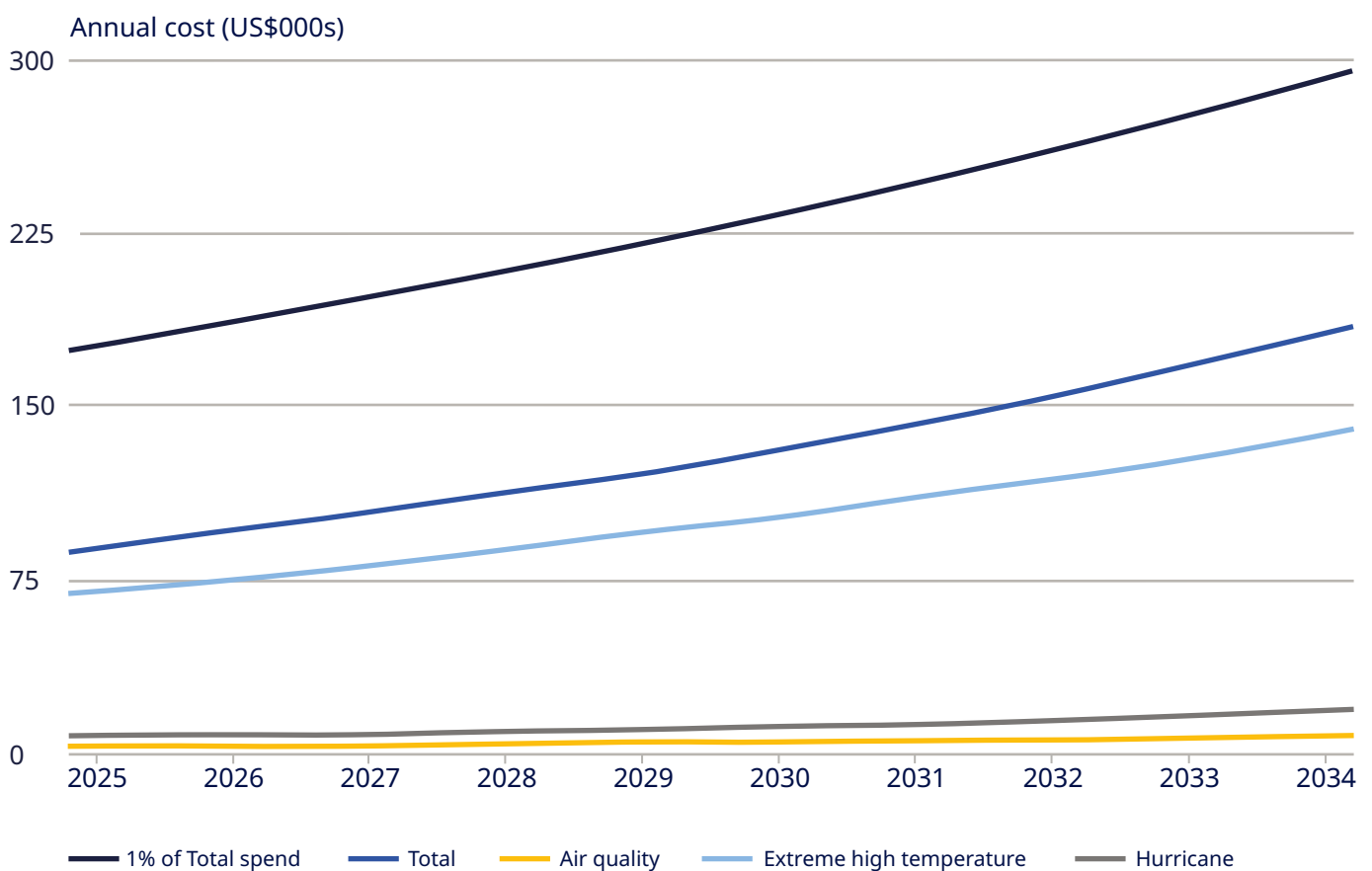
the available window for such activities is shrinking. This trend risks creating a shortage of skilled labor for critical maintenance events, potentially leading to longer outages, reduced work quality, and increased safety and reliability risks.

Extreme weather and climate change also elevate health risks for employees through degraded air quality (such as wildfire smoke), contaminated water after floods, and heat stress

during heatwaves. Climate-related health costs in the US total over US\$800 billion per year. For instance, a 1,000-employee organization in Texas is projected to see a 50% increase in annual healthcare claims related to climate impacts by 2030.

Understanding employee exposure is important for organizations to anticipate healthcare costs, productivity losses, and attendance challenges.

Figure 3. Estimated climate-related health claim costs



Source: [Mercer Health Cost Forecaster](#)

System-level risks: Suppliers, customers, and critical infrastructure

At the system level, energy companies operate within highly complex and integrated networks. Climate-driven impacts on suppliers, customers, or critical infrastructure can quickly cascade into

operational disruptions and significant financial losses. For example, an integrated refinery unable to export products or even low-value byproducts (such as sulphur) due to unavailability of customers, terminals, or ports may be forced to curtail production or temporarily shut down, incurring multimillion-dollar losses. Similarly,

loss of grid power often triggers emergency shutdowns and unplanned restarts, resulting in significant financial losses and heightened process safety risks during transient operations.

A notable case occurred in 2022 when drought-induced low Mississippi River levels caused approximately [US\\$20 billion in economic damage](#). Travel times increased by 23%, and [transit volumes reduced](#) by nearly 25% compared to the previous year.

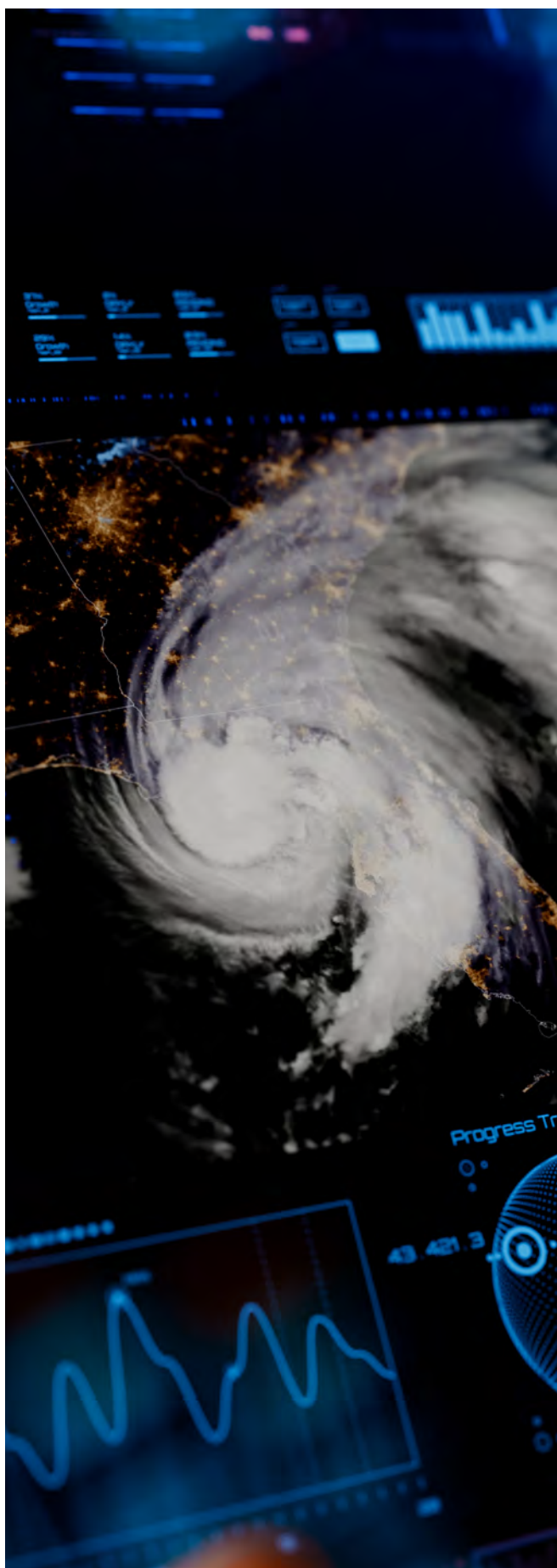
Climate-driven impacts on suppliers, customers, and critical infrastructure can quickly cascade into operational disruptions and material financial losses. The 2025 [Marsh Climate Adaptation Survey](#) found that 35% of organizations reported impacts to customers and 32% to critical infrastructure. Yet, despite these incidents, approximately 82% of businesses lack [full supply-chain visibility](#), leaving risks to suppliers, customers, and essential infrastructure hidden. Furthermore, assets currently unexposed may become more vulnerable as temperatures rise. The [Marsh Flood Risk Index](#) indicated that 23% of power generation capacity and 26% of international ports are vulnerable to flooding, rising to 41% and 61%, respectively, under a 2°C warming scenario.

System-level risks evolving with changes to global footprint

Shifts in the global energy footprint are amplifying system-level risks. Regional differences in feedstock availability, energy costs, and regulatory environments have prompted energy companies to reassess their global asset portfolios. This has led to selective disinvestment in parts of Europe and Southeast Asia by oil, gas and petrochemical companies, while capacity is expanding in lower-cost, policy-favourable regions such as the US Gulf Coast, China, and the Middle East.

In Europe, [five steam crackers have closed](#) since 2020, with another five scheduled to close by 2028. These closures represent a net ethylene





capacity loss of roughly 4.5 million metric tons (Mt), about 17% of 2020 European capacity. In contrast, projects announced since 2018 are expected to add more than 45 million tons of ethylene capacity across the US (~17 Mt), China (~20.8 Mt), and the Middle East (~8 Mt). This trend is mirrored in upstream and downstream industries, with the International Energy Agency estimating that [1 to 1.5 million barrels per day](#) of European refining capacity will close by 2030.

Consolidation has concentrated production into regional refining and petrochemical clusters, creating logistics chokepoints. Historically, a geographically diverse asset base and supplier network allowed companies to rebalance production and sourcing after regional disruptions, mitigating financial impacts. Today, with fewer alternative suppliers and more concentrated trade flows, localized events produce larger, more immediate global consequences. For example, Europe's reduced ethylene production capacity means it must import an additional 4.5 million tons annually — equivalent to approximately 1,000 ships — increasing the region's exposure to non-local weather risks such as hurricanes, storms, and extreme cold in the US Gulf Coast; flooding and extreme heat in the Middle East; and weather-driven disruptions at maritime chokepoints that delay shipments and raise freight risks.

In 2017, Hurricane Harvey caused over US\$160 billion in losses (CPI-adjusted), reduced refining utilization along the US Gulf Coast by [approximately 34%](#), and pushed the average US gasoline price up by more than 10%. Since then, the US has become the world's largest exporter of liquefied natural gas (LNG), with exports increasing by over [800% since 2017](#) to exceed 400 million cubic feet per month in 2025 — equivalent to roughly 75 standard LNG ships. If a similar event were to occur today, it would cause comparable domestic disruption and broader effects on Europe's energy market, which depends heavily on LNG imports.

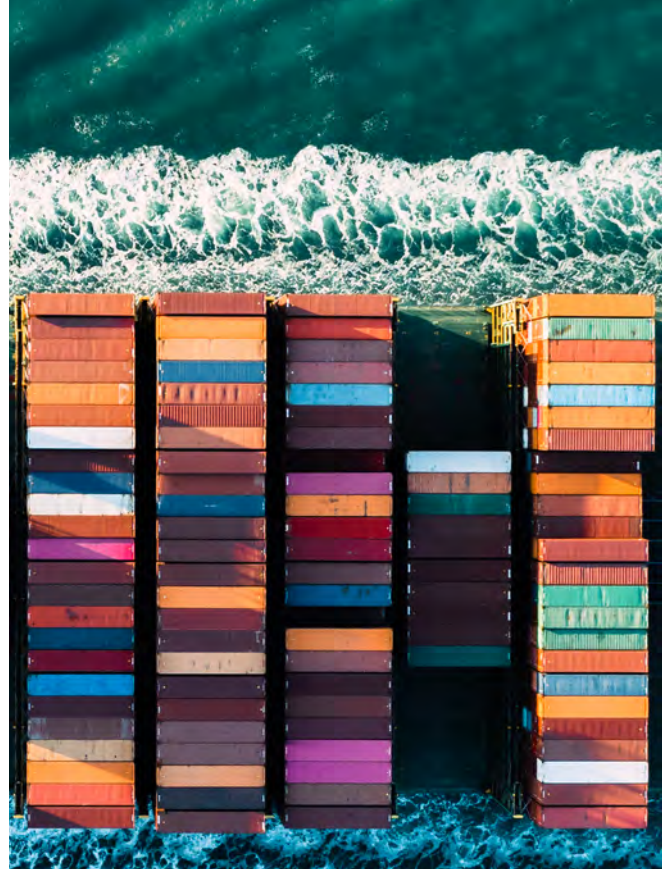
Physical risks outlook

Physical climate risks are [escalating](#), presenting increasingly complex challenges for the energy industry. The [2026 Global Risk Report](#), published by the World Economic Forum in collaboration with Marsh, ranks extreme weather as the highest risk over a 10-year horizon. Businesses need to adapt to the current climate realities and build resilience against future changes.

The global consolidation of energy assets intensifies this exposure. When production and logistics are geographically concentrated, a single weather event can create a point of failure that ripples through the supply chain, causing knock-on impacts and asset losses. These effects propagate more quickly and broadly due to fewer geographically diverse alternatives, tightening global supply and amplifying economic consequences and markets worldwide.

Understanding the evolving [physical risks of climate change](#) remains a challenge. This is often due to incomplete data, such as limited supply chain visibility, or an over-reliance on catastrophe models that primarily focus on current or historical data without adequately accounting for future changes. According to the [Climate Adaptation Survey](#), nearly 22% of respondents reported not assessing future climate impacts at all.

To avoid unexpected disruptions, organizations should consider scenario analysis and climate risk tools to map future exposures. This approach is important for shaping effective resilience strategies that need to be implemented now to safeguard operations in the future.



What companies can do to increase resilience

The increasing risks posed by climate change require businesses to manage physical risks effectively, prepare thoroughly, and invest strategically in resilience measures.

Converting physical climate risks into a competitive advantage requires a holistic risk management approach that integrates comprehensive risk assessment, mitigation, and risk financing strategies to achieve climate resiliency goals.

Organizations should systematically analyze the impacts of adverse climate scenarios across their value chain. This enables informed decision-making regarding resilience options and guides the implementation of measures to reduce or transfer risk (Figure 4).

Figure 4. Strategies for companies to assess the impacts of climate change

Use climate analytics and define adaptation strategy

- Identify relevant acute and chronic climate hazards that impact your assets and broader system
- Understand how those hazards are forecasted to change over the planning cycle (circa 10 years)
- Understand gaps in insurance coverage

Undertake climate change-aware risk engineering

- Compile a list of all assets, customers, suppliers, critical infrastructure, and resources. Assess physical vulnerabilities and interdependencies
- Translate physical hazard scenarios into operational impacts using engineering, logistical, and third-party models
- Understand the financial impact of each risk, e.g., expected loss, VaR, and time to recover

Invest in resilience measures

- Identify resilience actions, considering cost to benefit against a range of possible business and climate futures
- Prioritize options to increase asset and system-wide resilience
- Identify signposts for implementation of options over time

De-risk resilience solutions through innovative risk transfer

- Assess alternative risk transfer solutions to support resilience investments
- Consider the use of captive insurance or parametric products

Figure 5 highlights possible actions that energy companies may consider effective for reducing or transferring the growing physical risk exposure associated with climate change. assessment, mitigation, and risk financing

Figure 5. Asset-level and system-level mitigation actions

Asset level	System level
Strengthen risk assets with flood defences to reduce failure probability and exposures	Increase supply chain visibility and conduct frequent supply assessments to identify single point of failures and qualify alternatives
Implement redundant power systems, emergency response plans, and response drills to shorten recovery time and loss magnitude	Quantify optimum safety stock and ullage requirements to minimize supply chain, supplier, and customer outages
Invest in cooling system redundancy, continuous monitoring, and routine cleaning to prevent asset derating	Improve logistics resilience through contracted alternative routing, pre-booked capacity, and contingency agreements with third-party providers
Integrate chronic climate change impacts into future inspection and maintenance plans	Expand insurance coverage for contingent business and parametric to transfer risk

Organizations continue to face significant challenges in developing robust climate risk strategies. Common obstacles include organizational biases that prioritize visible or incumbent business lines over emerging climate risks, uneven or insufficient data limiting scenario coverage, modeling constraints that hinder translating physical hazards into reliable financial impacts, and practical challenges embedding climate results into existing capital allocation and project return frameworks. To overcome these hurdles, energy companies can leverage expertise, explore government support for climate-related investments, and make climate resilience a strategic priority at the forefront of decision-making.



Effective risk transfer and management

Risk transfer must be an integral part of an energy company's roadmap. By deferring investments until the benefit-to-cost ratio meets a defined hurdle rate, companies can preserve capital for other business priorities such as safety, operational reliability, and growth. Key risk transfer strategies include:

1. Alternative placement strategies: Consider using multi-year insurance renewals to lock in coverage and premiums, retain predictable layers through captive insurance arrangements, and participate in pooled insurance solutions. These approaches can reduce year-on-year premium volatility and provide greater certainty for business plans and investors.

2. Insurance-linked securities and alternative transfers: When (re)insurance capacity is constrained, explore insurance-linked securities such as catastrophe bonds and other innovative mechanisms like sidecars or industry loss warranties. These can provide access to additional risk capital and enhance diversification.

3. Insurance as a liquidity tool: Employ parametric insurance solutions that trigger immediate payouts based on predefined metrics, such as river levels, rainfall, and wind speeds. This approach provides critical early cash flow following acute weather events, supporting rapid recovery.

Currently, the insurance market is considered soft, characterized by abundant capacity and less selective underwriting of weather-related risks. However, the market is cyclical. As physical climate risks intensify and insurers potentially tighten underwriting, risk transfer arrangements effective today may become unaffordable or unavailable in the future. Therefore, it is important to develop a clear, forward-looking roadmap that specifies near-term investments, identifies trigger points for further spending, and outlines potential structural responses, such as mergers, acquisitions, or targeted divestments. This proactive planning is essential to manage evolving risks and protect long term resilience.

Conclusion



Physical climate risks are systemic and pose critical challenges for energy companies. Both acute and chronic effects can impact assets directly or disrupt the highly integrated systems on which these assets depend, eroding capacity, cash flow, and safety performance. Studies have shown that the frequency, magnitude, and duration of climate events are increasing, exacerbating existing exposures, and introducing new vulnerabilities.

At the same time, the energy sector is navigating a complex transition and a shifting geopolitical landscape. Decarbonization pathways introduce new risks such as stranded assets, greater reliance on renewables, and capital pressures, while changing trade patterns and geopolitical tensions

alter where and how feedstock and products move. These dynamics mean risks are multifaceted — physical, transition, and geopolitical — that interact and evolve, so treating physical risk in isolation may lead to suboptimal decisions.

As such, energy companies need to define a clear strategy that integrates across physical risk and transition scenarios to understand and manage these risks accordingly.

Immediate priorities are clear: undertake a portfolio-wide risk assessment, quantify exposures in financial terms, and use the results to prioritize resilience investments and operational changes that reduce top vulnerabilities.

Combine targeted hardening and operational resilience investments with liquidity solutions and capital-market transfers where appropriate to retain available capital for other investments and smooth cashflow.

The insurance industry, investors, and regulators are increasingly looking for demonstrable resilience. Energy companies that can share robust adaptation pathways, diversified and visible supply chains, and credible stress testing will be better positioned to secure capital, insurance, and competitive advantage as markets reprice risk. Acting decisively may reduce future costs, narrow retained exposures, and transform climate challenges into a source of competitive advantage.

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