# Business Leaders Guide *to Climate Adaptation and Resilience*

World Business Council *for Sustainable Development*

BAIN & COMPANY

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# Foreword

Adaptation is not a new concept for the business community. Businesses are experts at adapting, constantly innovating in response to changes in the market, new technologies, and regulations. So why, then, do only 1 in 5 businesses have a plan in place to tackle *climate* adaptation?[1] Globally, 2023 was the hottest year on record, with annual global temperatures reaching 1.45°C above pre-industrial levels.[2] Physical risks from climate change are rapidly escalating and the cost of inaction is enormous, with 224 major businesses reporting to CDP potential financial impact of physical risks of USD $116 billion[3]. Now is the moment for visionary business leaders to act fast to reduce risk and benefit from an early-mover advantage.

Mitigation efforts must persist, while swift action on adaptation is imperative to safeguard the resilience of workforces, supply chains, and the communities and natural ecosystems upon which businesses depend. This ***Business Leaders Guide to Climate Adaptation and Resilience*** has been developed by WBCSD together with leaders from the business community and experts from Bain & Company and Jupiter Intelligence, to catalyze action. Three key themes recur across the guide:

→ ***Companies must develop a coordinated strategy across the whole business:*** Effective climate adaptation will require a closely-coordinated transformation across all core business functions to integrate climate adaptation considerations and build resilience. Business must undergo a mindset shift, moving from reactive to proactive physical risk management, and participate in a realignment of business and financial incentives for shareholders to prioritize long-term resilience in their investment portfolios.

→ ***The time to act is now:*** There will always be limitations and uncertainty within tools and models. Business cases are unique and there is not one single reason to adapt, but many: to avoid risk, safeguard workforce and local communities, and activate new business opportunities. Businesses should start building the reinforcing loops needed now to continuously improve and gain knowledge and experience together with other stakeholders.

→ ***Local partnerships and collaboration can supercharge action:*** The impacts of physical risk are felt at the local and national level, so adaptation action should be coordinated with diverse stakeholders to avoid maladaptation and build collective resilience within and beyond the value chain. Businesses need to be at the table with national and local stakeholders to both plan and finance the necessary actions together.

It is our hope that the tools and case studies in this guide help you to accelerate action and investment in climate adaptation within your own company, and that you will join us on the journey to building the climate-resilient businesses of the future.

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# About *this guide*

The Business Leaders Guide to Climate Adaptation and Resilience has been developed by the World Business Council of Sustainable Development (WBCSD), Bain & Company, and Jupiter Intelligence with support from leading businesses across sectors and geographies.

The guide supports companies to integrate adaptation and resilience into organizational strategy, governance, and operations. This guide offers nine modules, each containing tools, frameworks, and case studies designed to catalyze action across different adaptation challenges. It also includes a C-suite agenda that summarizes the role of key business leaders in creating an adaptive and resilient organization.

The guide is for all business leaders (not only Chief Sustainability Officers), who can leverage this guidance to:

- → **Build or adjust your organization's approach to managing physical risk and opportunities and consider key needs and actions under each business function.**
- → **Access practical frameworks and best practices for building business resilience.**
- → **Reflect on the experiences and approaches of best-in-class peers through diverse case studies from across sectors and geographies.**
- → **Take immediate next steps to further your organization's adaptation journey.**

*With special thanks to key contributors from the following companies:*

BAYER · DIAGEO · EDF · edp · ENGIE · Meta · MITSUBISHI · Nestlé · PEPSICO · PHILIPS · SWIRE · Swiss Re

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***Key:***
Likely functional lead / main sponsors

- Strategy / Chief Executive Officer
- Finance / Chief Financial Officer
- Operations / Chief Operating Officer & Head of Business Unit
- Risk / Chief Risk Officer

*01.*

# Climate Adaptation: *A business imperative*

# 01. Climate adaptation: *A business imperative*

"After six IPCC assessment cycles, global awareness of the impacts of climate change has never been higher and the need for integrating climate adaptation into decision-making has never been clearer"

*UNFCCC,[4] 2023*

# Rationale *for action*

## *Sustained climate change has led to an increase in frequency and magnitude of physical risk events globally*

With the consistent rise of annual global greenhouse gas (GHG) emissions, catastrophic natural events are **increasing in frequency and magnitude** across all global regions, with over 30% of the world now highly exposed.[5] **Societies and businesses must adapt and build resilience against growing physical risks,** which are expected to cause 250,000 additional deaths per year[6] and potential losses of up to 4.4% of global GDP[7] by 2050 without a significant increase in adaptation efforts.

### *Heat*

Trapped heat in the atmosphere drives up surface temperatures, causing record heatwaves

In 2022, China experienced a record heatwave, causing widespread power shortages and disruption of supply chains[8]

### *Fire*

As temperatures and droughts rise, vegetation becomes drier and more prone to fires

Canada's 2023 fires were the most devastating on record, with 14 million hectares burned[9]

### *Wind*

Climate change is causing wind pattern shifts, resulting in more frequent and devastating hurricanes

Hurricane Ian in 2022 was a 1-in-1,000 year event, responsible for some USD $112 billion in damages[10]

### *Cold*

Changes to atmospheric and oceanic circulation patterns are impacting cold weather patterns

A record cold wave across Europe in 2021 caused "probably the biggest agricultural disaster in the beginning of the 21st century"[11]

### *Flood*

Faster onset of spring conditions and increased water vapour in the atmosphere can lead to flooding

In 2022, one-third of Pakistan was underwater after unprecedented flooding, affecting >33 million people and 2.2 million homes[12]

### *Drought*

Rising temperatures have drastically altered precipitation patterns, leading to increased risk of extreme drought

Climate change increased the severity of the 2020-2023 Horn of Africa drought, leading to the displacement of over 2.3million people[13]

## *Risk across the business will only increase with the rising number and severity of physical events*

### Breakages of value and supply chains

Physical events can impact usual operations, causing losses due to productivity standstills, impacted inputs, and missed sales

Floods in Slovenia (2023) disrupted Volkswagen (VW) supply chains, resulting in a 2-month suspension of production at a VW factory in Portugal[14]

### Asset and infrastructure failures

Events can damage or hinder infrastructure, causing losses from repairs and productivity standstills due to interrupted operations

After a 1-in-200-year flood (2021) caused ~$30bn damages to German factories, BASF adapted their portfolio and forecasting system[15]

### Workforce displacement

Physical events can lead to environmental displacement, which could impact production processes and demand

Severe floods in Peru (2017) affected 450K+ people, including Newmont employees at the Yanacocha operations[16]

### Increased cost of critical inputs

Climate factors influence the demand and supply of critical inputs and can significantly impact commodity prices

Severe storms in Texas (2021) caused shortage of key plastic components for Toyota and Honda, suspending production for several weeks[17]

### Reduction of available utilities

Physical events can cause shortages of natural resources, impeding production processes and sourcing strategies

Sichuan drought (2022) stalled hydropower generation plants, causing week-long production shutdowns for Intel and Apple supplier Foxconn[18]

### Physical risk health implications

Health implications from climate change can impact production and delivery, while also causing respiratory allergens and epidemics

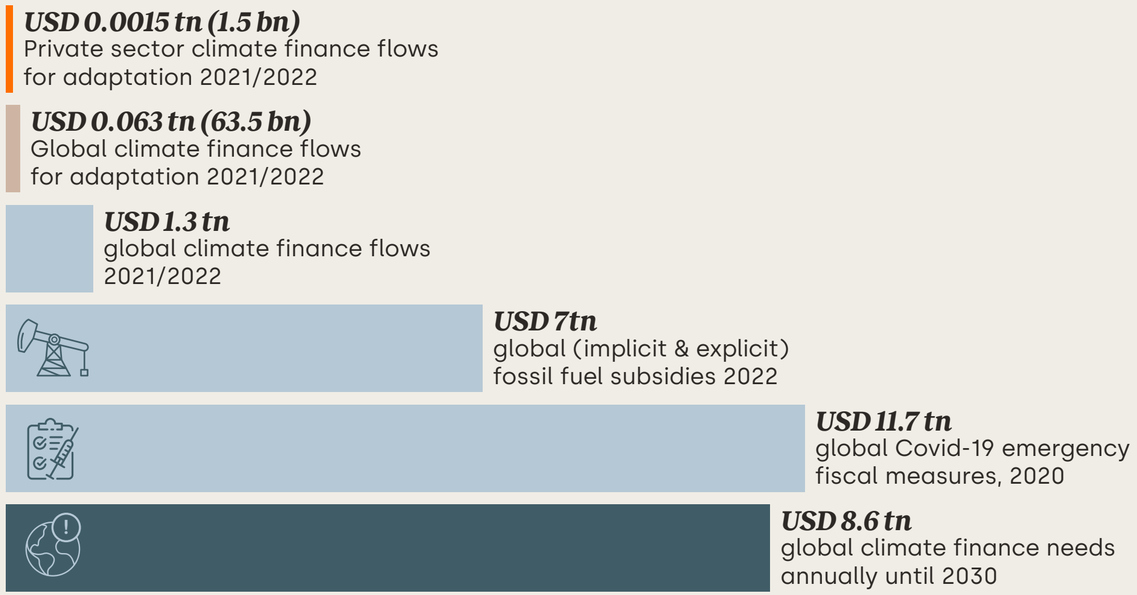
Two percent of total working hours are projected to be lost each year due to heat stress at work, representing more than $4tn annually by 2030[19]

## *Business action and investment in adaptation and resilience must be scaled-up exponentially*

Business action and investment in adaptation and resilience is currently very low. The Climate Policy Initiative report (2023) found that only $63.5bn (4.8%) of $1.3tn climate finance is invested in adaptation.[20] Of that, only $1.5bn (0.12%) was invested in adaptation by the private sector. To ensure that businesses and the communities they support can manage escalating climate impacts, this needs to increase exponentially.

More resilient businesses are also good investments. Studies have shown that investments in improving resilience can have high rates of return with benefit-cost ratios ranging from 2:1 and 10:1 through avoided losses, development of new resilient products and services, as well as wider social and economic benefits.[21]

**Figure 1:** Finance for adaptation, especially from private sector sources, must be scaled up exponentially to meet the challenges of the climate crisis




Source: WBCSD, adapted from **Climate Policy Initiative**

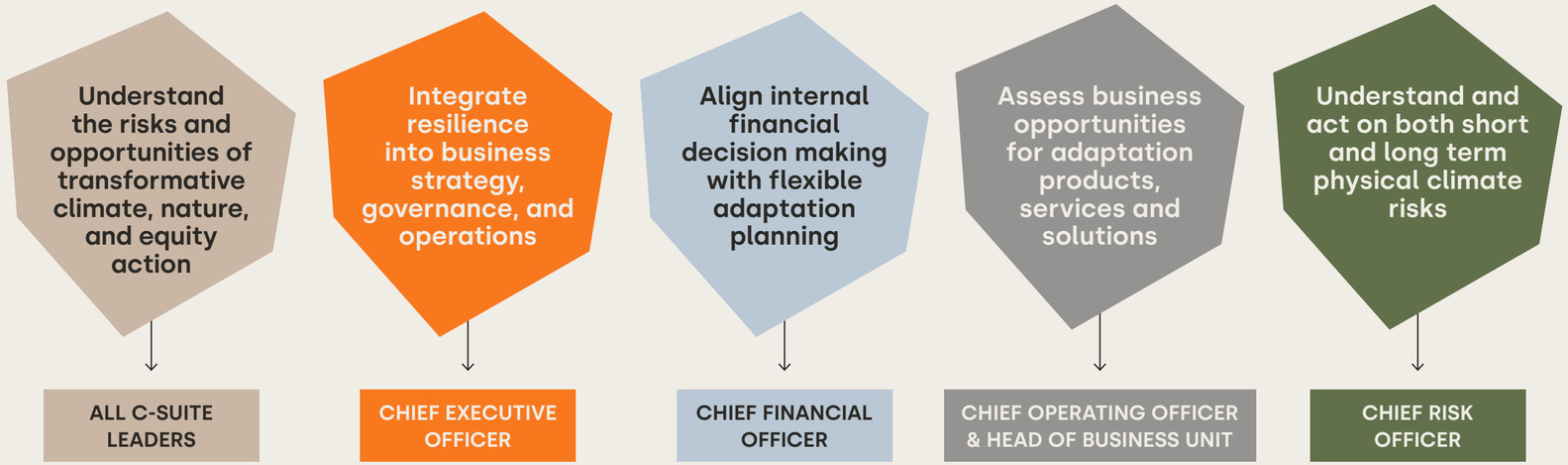
*02.*

# C-suite agenda for *climate adaptation and resilience*

# Call to action *for business leaders*

***The Business Leaders Guide to Climate Adaptation and Resilience sets out the urgent case for companies to increase action and investment on adaptation and resilience within and beyond the value chain.***

**Figure 2:** All business leaders have a critical role and responsibility to increase their organization's action and investment in building resilience




**Climate adaptation action from business leaders must be accompanied by a systems transformation of capital markets**

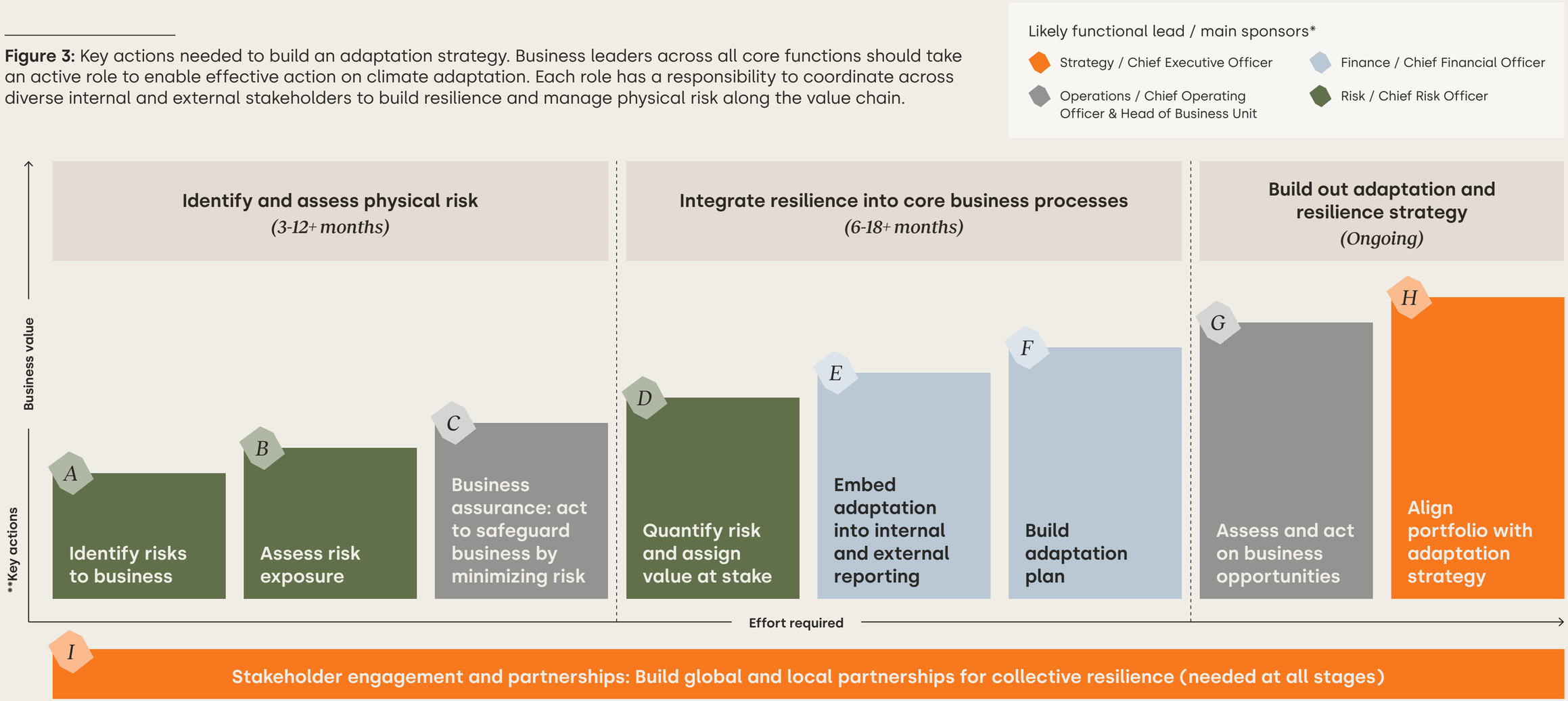
In parallel to the adaptation transformation that businesses must undertake, investors and shareholders must also adjust to recognize and reward actions taken by business to reduce their exposure to climate risks, build long-term resilience and increase business opportunities.

This is vital to ensure their own long-term stability, in addition to being an emerging financial opportunity. Physical climate risks should also be integrated into materiality assessments for climate-related disclosures to create recognition and accountability mechanisms for adaptation in the private sector.

This transformation must, in turn, be supported by robust action from policy makers, particularly to ensure that adaptation finance reaches the most vulnerable regions.

# Building resilience is a multi-year, whole-business *undertaking to adapt organizations to manage physical climate risk and unlock new opportunities*

**Figure 3:** Key actions needed to build an adaptation strategy. Business leaders across all core functions should take an active role to enable effective action on climate adaptation. Each role has a responsibility to coordinate across diverse internal and external stakeholders to build resilience and manage physical risk along the value chain.




***Notes:** the Chief Sustainability Officer should also be involved across all activities. C-suite structure and activity ownership is likely to vary between organizations, and this approach must be tailored to individual companies, to account for their unique strategic priorities and operational contexts. ** Key actions are not linear.

# 02. Chief Executive *Officer*

## *Why should CEOs engage?*

CEOs need to act on adaptation and resilience to protect their organizations from escalating physical risk. Failure to act puts operations, assets, value chains, and communities at risk, jeopardizing long-term sustainability, and competitiveness.

**$2.3 tn**

*losses due to climate change between 2025-2100 under a business as usual scenario, due to increased physical risks*[22]

## *What should CEOs be focused on?*

### *Role*

**H Align portfolio with adaptation strategy**

Play the role of visionary, strategist and coach to develop and enable the execution of an adaptation strategy which not only protects the company from physical risk, but builds adaptive capacity and ensures a resilient future

**I Stakeholder engagement and partnerships**

Identify appropriate stakeholders to engage including peers, supply chain and local communities. Engage via partnerships to build shared resilience against physical risk or communication to promote confidence in company resilience

### *Challenges*

- → Balancing competing priorities to enshrine resilience to physical risk in broader strategic agenda
- → Understanding 'where to start' amidst different pillars of adaptation strategy to begin building resilience
- → Simultaneously engaging multiple members of leadership team to drive forward overall adaptation strategy

- → Understanding which stakeholders to engage and appropriate timing for engagement, as well as level – engaging vs informing
- → Convincing value chain partners who are entrenched in traditional methods which do not build resilience to physical risk
- → Creating momentum throughout the value chain, including in local communities, to ensure shared resilience to physical risk
- → Time needed to initiate and maintain ecosystem partnerships

# 02. Chief Financial *Officer*

## *Why should CFOs engage?*

CFOs must build resilience through investment decisions to safeguard financial stability, foster integrated decision-making, and ensure compliance with rapidly evolving regulation. Failure to address these risks poses threats to the organization's viability and legal standing.

**< 20%**

*of 6,416 companies surveyed have an adaptation plan to manage physical risk*[23]

## *What should CFOs be focused on?*

### *Role*

**E Embed adaptation into reporting**

Understand evolving regulatory demands, establish internal standards, and seamlessly incorporate physical risk and opportunity assessments into both internal and external reporting

**F Build adaptation plan**

Develop a flexible strategy to invest in measures to proactively manage physical risks and pursue opportunities, aligning with global and company-specific regulatory standards

### *Challenges*

**Internal Reporting Integration:**

- → Large number of stakeholders which must be upskilled and engaged sufficiently
- → Silos of physical risk expertise with lack of organization-wide awareness and collaboration
- → Lack of alignment from board and executive members over embedding physical risk into the strategic agenda

**External Reporting Integration:**

- → Regulatory requirements can result in the need for resource-heavy data collection, analysis, and calculations
- → The timing of regulatory changes can be unpredictable and requirements can differ widely between regions
- → Lack of universal adaptation and resilience regulations creates uncertainty for business
- → Lack of internal alignment on the amount and type of information to disclose

- → Pushback from board and executive members on investing resources to defend against low-probability events
- → Topics and methodologies such as adaptation pathways are nascent and best practices are still uncertain
- → Lack of understanding on the intersection between the climate adaptation and mitigation agendas

# Chief Operating Officer *& Head of Business Unit*

## *Why should COOs & Heads of BUs engage?*

By engaging early, COOs & Heads of BUs can safeguard their ongoing operations and benefit from an early-mover advantage for developing new climate-resilient products, services & solutions.

***~2-10x***

*pay-off for every dollar invested on climate adaptation and resilience*[24]

## *What should COOs/Heads of BUs be focused on?*

| | C Business assurance | G Business opportunities |
|---|---|---|
| *Role* | Lead the development and execution of strategies and actions to safeguard the company's ongoing operations against physical risks, prioritising uninterrupted business processes across the value chain | Identify appropriate stakeholders to engage including peers, supply chain and local communities. Engage via partnerships to build shared resilience against physical risk or communication to promote confidence in company resilience |
| *Challenges* | → Difficult and costly to gather data to understand physical risks throughout end-to-end value chain<br>→ Risk shared with other stakeholders in exposed area of value chain is complicated to tackle independently<br>→ Overcoming inertia to act proactively versus reactively, when losses have already occurred | → Business cases for physical risk opportunities are difficult to develop due to ROI uncertainty, timing ambiguity, and strategic decision complexity<br>→ Policies are not yet sufficiently developed around ensuring shared positive impact of business opportunities<br>→ Challenging to drive Board/Executive awareness and understanding given uncertain nature of business cases |

# 02. Chief Risk *Officer*

## *Why should CROs engage?*

To safeguard the organization, CROs must effectively identify, assess, and quantify physical risk. Proactive measures will enhance risk management strategies and ensure long-term viability in the face of escalating physical risk.

**~4%**

*Average percentage of market value reported as 'at risk' by major businesses due to potential impacts of physical climate risk*[25]

## *What should CROs be focused on?*

| | A Identify risks to business | B Assess risk exposure | D Quantify risk |
|---|---|---|---|
| *Role* | Actively screen portfolio for potential threats and harness climate models and partnerships to create a comprehensive view of high-risk assets for both today and for the future | Scrutinize existing strategies to adapt to high-risk weather events and build further resilience at high-risk sites, leveraging appropriate insurance where risk is unmanageable | Calculate the monetary value of potential asset loss and downtime across high-risk assets, which provides essential support for prioritization and informed decision-making processes |
| *Challenges* | → Obtaining internal buy-in to physical risk identification process<br>→ Difficult or impossible to have full traceability of a company supply-chain<br>→ Complex partner selection process with ongoing issue of 'black box' providers<br>→ Challenges in replicating risk identification analysis in future | → Prioritization of assets for adaptation investments depending on criticality to business and level of physical risk<br>→ Constructing a compelling business case for adaptation investments including estimated payback period<br>→ Building resilience at supplier sites where the company does not have control over investments | → Quantifying an estimate for 'dollar value' impact for physical risks, including losses from disruptions to business continuity<br>→ Time horizons for acute physical risks are generally very different to traditional financial plans<br>→ Non-quantifiable losses are often overlooked |

*03.*

# Integrating climate *adaptation and resilience into business activities*

*A.*

# Identify risks to business

→ *Understand physical risks and potential implications for your organization*

# A. Identify risks *to business*

***The risk of a negative event or outcome is determined by a function of hazards, exposure and vulnerability***

**Figure 4:** Businesses must consider the complex relationship between hazard, exposure and vulnerability variables to estimate climate risk

**Risk**

Likelihood of a negative event or outcome occurring as a function of hazards, exposure, and vulnerability

=

**Hazard**

The likelihood and scale of a peril or event that has the capacity to damage or destroy a particular asset (e.g. tropical cyclone, wildfire, earthquake)

×

**Exposure**

The amount of the asset exposed to the hazard in a given space or time, including property, vehicles, workforce and/or other assets.

Exposure accounts for a number of asset-specific characteristics that influence interactions between the hazard and vulnerability (e.g. construction method, materials used)

×

**Vulnerability**

The degree of expected impact to an asset at a given intensity of a hazard based on the asset's susceptibility or damageability.

The extent to which an asset is vulnerable to a hazard is also linked to the characteristics of the asset (e.g. its sensitivity and adaptive capacity)

Source: Bain, Jupiter Intelligence, adapted from AXA (2021) Understanding the Climate Risk Equation[26]

**Note to reader:** The relationship between these 3 variables is non-linear, it is also not additive or multiplicative, rather it is a complicated interaction that is non-stationary and is evolving over time. Focusing on one aspect of the risk equation and neglecting the others gives an incomplete picture of how physical risk is going to change in the future.

## *Starting risk identification involves scoping and data gathering*

The first step in risk identification is to **define the scope of the assessment** (i.e. sites in focus), by engaging relevant BUs in the design process.

→ Some organizations' risk will be concentrated within **company assets**, with BU heads being key stakeholders

→ For others, most risk is found **upstream in the supply chain** (e.g. CPG companies), with procurement teams being key stakeholders

After scoping, **gather appropriate data** to kick-off the analysis, including:

→ **Geo-spatial data** on sites in scope (including supplier sites where relevant)

→ **Relevant perils** to assess (e.g. fire, wind, rain)

Additionally, select **climate scenarios** recognised by wider organization (e.g. Paris Accord).

# *Partner with a risk identification provider who can ensure granularity and accuracy of outputs*

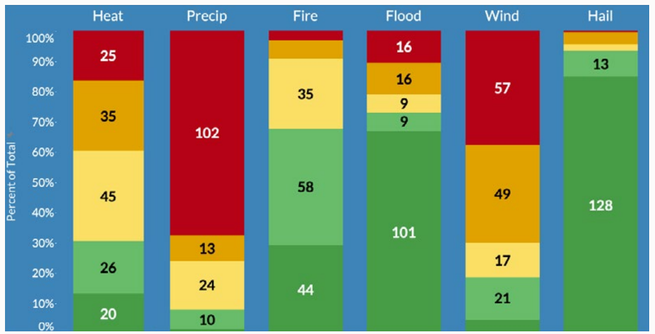
## Practical insights using range of sources

→ Partners have teams of climate scientists, specialized models, and use dashboards to simplify outputs and facilitate discussions

→ Leading partners will leverage latest generation of climate models (e.g. CMIP6*) to generate insights

→ Access to a variety of data sources enables sense-checking of outputs and ranged hazard scores

**Figure 5:** Dashboard showing risk levels at various sites across perils

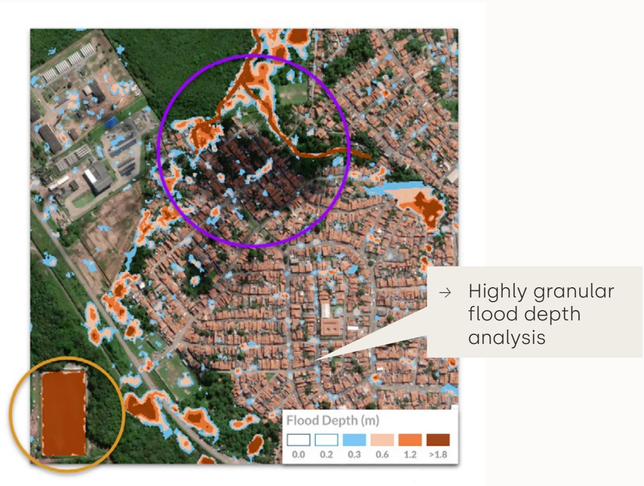



## Targeted risk coverage with site-level output

→ Specialized partners have 'downscaled' location data which enables site-level insights (impact of perils can vary in distances as low as ~100 metres)

→ Risk identification specialists incorporate both chronic (e.g. rising temperatures) and acute (e.g. adverse weather shocks) risk in their models

**Figure 6:** Exceptional precision reveals decision-critical information




→ Highly granular flood depth analysis

**Note:** *Coupled Model Intercomparison Project

→ Most important factor is to select a partner that can **cover desired scope** of your risk identification analysis

## *What makes a successful climate risk identification partner*

| | |
|---|---|
| ***Latest global climate models*** | Access to **multiple global climate models,** including **latest generation CMIP6 models** enabling superior data richness, narrower uncertainty and robust extreme value analysis |
| ***Geography & peril coverage*** | Sufficient geographic and peril coverage to **provide risk assessment for desired scope** (e.g. supplier sites) and globally consistent data outputs to facilitate risk benchmarking use cases |
| ***Downscaled data with uncertainty*** | Location data at sufficient level of granularity to provide **tangible site-level assessments** coupled with uncertainty metrics to capture model level of confidence |
| ***Transparent measurements*** | **Quantifiable peril metrics** (e.g. height of water, speed of wind) to avoid **problems associated with "black box" providers' risk-score centric solutions** |
| ***Accessible outputs*** | Analysis outputs are accessible in both **language and use of visual aids** (e.g. charts) to build understanding and internal alignment across cross-functional teams (e.g. non-sustainability teams) and aid in translating risk identification into actionable business cases and investment strategies. |
| ***Forward-looking*** | Metrics **do not assume patterns and characteristics of climate conditions remain stationary** (i.e. same as today) and are not built only on historical climate conditions |

**Note to reader:** Companies with a mature understanding of their physical risk often work with multiple providers specializing in different areas (e.g., reporting, risk identification, risk quantification, acute vs chronic risks).

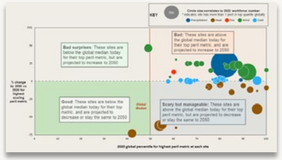
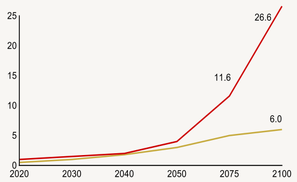
## *Several types of risk identification partners offer distinct use cases, with mature companies often choosing to use multiple providers*

**Figure 7:** Businesses should consider relevant use cases, features and limitations when selecting risk identification partners

| | *Climate risk analytics specialists* | *Insurance/reinsurance providers* | *Open source and national climate data services* | *Catastrophe modelling* |
|---|---|---|---|---|
| *Description* | Self-owned, established product specialising in physical risk | Insurance players who also offer physical risk assessments to clients | Climate risk analytics companies that offer data and/or services at no charge | Focus on risk from catastrophic events only |
| *Relevant use cases* | → Regulatory disclosure (TCFD, EU taxonomy)<br>→ Future-proofing long-term capital intensive investment | → Portfolio and location screening for physical climate risks<br>→ Sophisticated financial risk quantification | → Qualitative asset-portfolio screening at a domestic scale for chronic risk<br>→ Additional source to cross-reference private provider outputs | → Present day screening of portfolio assets for acute risks (expertise on floods, winds and earthquakes)<br>→ Sophisticated financial risk quantification |
| *Product features* | → Access to various global climate models, including latest CMIP6<br>→ Rich peril metric data offering with a focus on long-term climate trends<br>→ Global data availability<br>→ Appropriate for scenario analysis | → Access to large database of historical insurance claims data<br>→ Global with similar features to catastrophe models (vulnerability, insurance models)<br>→ Can combine with engineering insight for risk adaptation use cases | → Freely accessible to users<br>→ Strong regional or domestic focus with tailored models for specific geographies<br>→ Strong data quality assurance and local expertise | → High resolution vulnerability and insurance financial modelling<br>→ High resolution vulnerability and insurance financial modelling<br>→ Appropriate for short-term events (insurance and emergency response) |
| *Product limitations* | → Limited financial modelling capabilities due to complexity of economic systems and projections<br>→ Lower spatial and temporal resolution | → Lower spatial resolution<br>→ Typically limited to acute perils (especially for damage/loss metrics) | → Limited geography coverage<br>→ Limited to no hazard metrics<br>→ Focus on chronic risks<br>→ No user support, no vulnerability or financial modelling<br>→ Often use single climate model | → Limited peril and geography coverage<br>→ Assumes stationary/perfect present-day climate conditions |
| *Example providers* | CLIMATE X, JUPITER, The Climate Service, XDI | Munich RE, Swiss Re | IPCC, Met Office, Copernicus | CoreLogic, RMS, AIR |

## *During analysis, apply three lenses to assess portfolio for risk: current risk level, change in risk and risk across transition scenarios*

**Figure 8:** Current and future risk, and transition scenarios should be considered when analyzing portfolio risk

| | *Best practice approach* | *Key insights* | *Example outputs* | |
|---|---|---|---|---|
| 1 *Assessing current risk…* | Understand the **intensity of natural hazard by segment/geography**<br><br>**Asset breakdown by risk category** – e.g. through comparing **scores to a global sample** of similar assets | Granular portfolio views of **hazard intensity** uncover **current high-risk assets to watch out for** |  | Priority categorization of sites by one in 100-year event precipitation levels<br>(red – high; orange/yellow – moderate; green – low) |
| 2 *…while proactively anticipating future risk…* | Examine **intersection** between **current risk level and future change in risk** over sufficiently **extensive time-horizon** | Portion of portfolio at risk from perils both today and projected in the future, **surpassing a "static" portfolio assessment** to uncover **future "hotspots" on a risk score/risk change matrix** |  | Matrix of sites by 2020 and 2050 peril score* |
| 3 *…across transition scenarios* | **Run sensitivity analyses observing how level of portfolio risk evolves** across a range of climate transition scenarios | Allows you to understand the **sensitivity of the portfolio to different climate scenarios** |  | Precipitation increase forecasts by climate scenarios<br>(red – worst case scenario; yellow – best case scenario) |

***Note:** Deep dive follows

*Case Study*

## *Developing Climate Resilience in Nestlé's Supply Chain*

### Building internal buy-in

→ Focus of analysis informed through modelling potential vulnerability of key raw materials to climate-related risks, such as heatwaves, drought and water stress

→ Strong collaboration between ESG, Procurement and Risk to develop a framework to incorporate climate-related risk assessments as part of the annual strategic portfolio review

### Physical risk analysis overview

***1. Qualitative risk analysis across commodity supply chains***

→ Highlighted the extended time-scale for physical risk when compared to transition risks

→ We are likely to see shifts across commodities, and we need to support farmers through these transitions

***2. Quantitative risk analysis mapped to Nestlé's supplier physical footprint***

→ Potential yield changes in 2040* versus today for key raw materials, representing an important portion of the procurement total spend

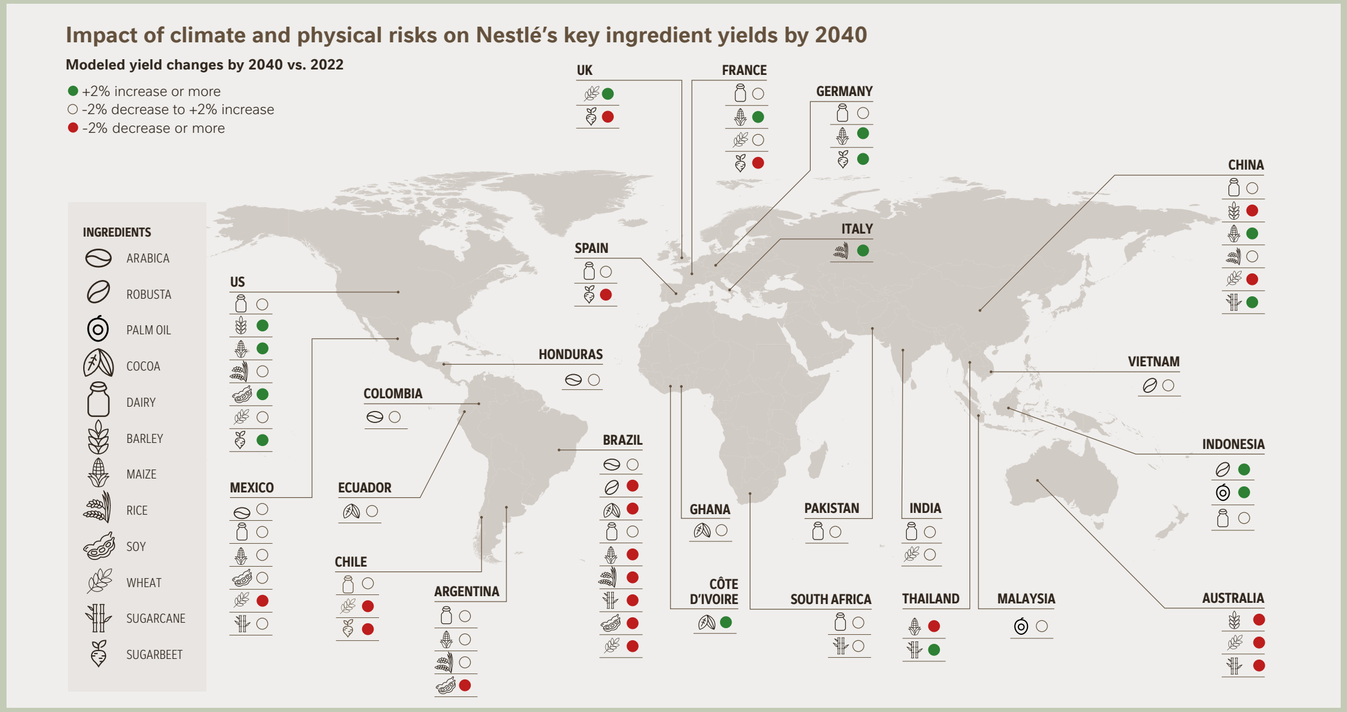
→ Analysis continues to inform discussions on enhancing the resiliency of farmers and communities who are key to the supply chain

→ ESG, Procurement and Risk working together to tailor outputs and learnings of the quantitative analysis

***Case study context:***

Food industry is exposed to physical risk in its supply chain, sourcing commodities such as cocoa, dairy and palm oil. Nestlé's risk team conducted a multi-stage risk identification process with a risk modelling partner to improve understanding, as part of the enterprise's risk management process.

**Figure 9:** Map showing expected change in key ingredient yields for Nestlé by 2040 across major supply regions




***Note:** Climate scenario used based on the AR6 Climate Change 2021: The Physical Science Basis - IPCC

Source: Nestlé

*Case Study*

## *Commodity Co worked with Bain and Jupiter to identify risk across its global footprint*

### Results

→ Commodity Co already conducts detailed site-level physical risk assessment annually but wanted a rapid, portfolio-level external perspective to feed into a detailed assessment

→ Bain and Jupiter conducted analysis that showed (a) each site's current risk across perils (compared vs a global sample) as well as (b) change in risk from today to 2050

→ The analysis helped Commodity Co identify which perils its portfolio was most at risk to – and also which sites had the highest risk

  – Assets currently in the third quartile + increasing >30%

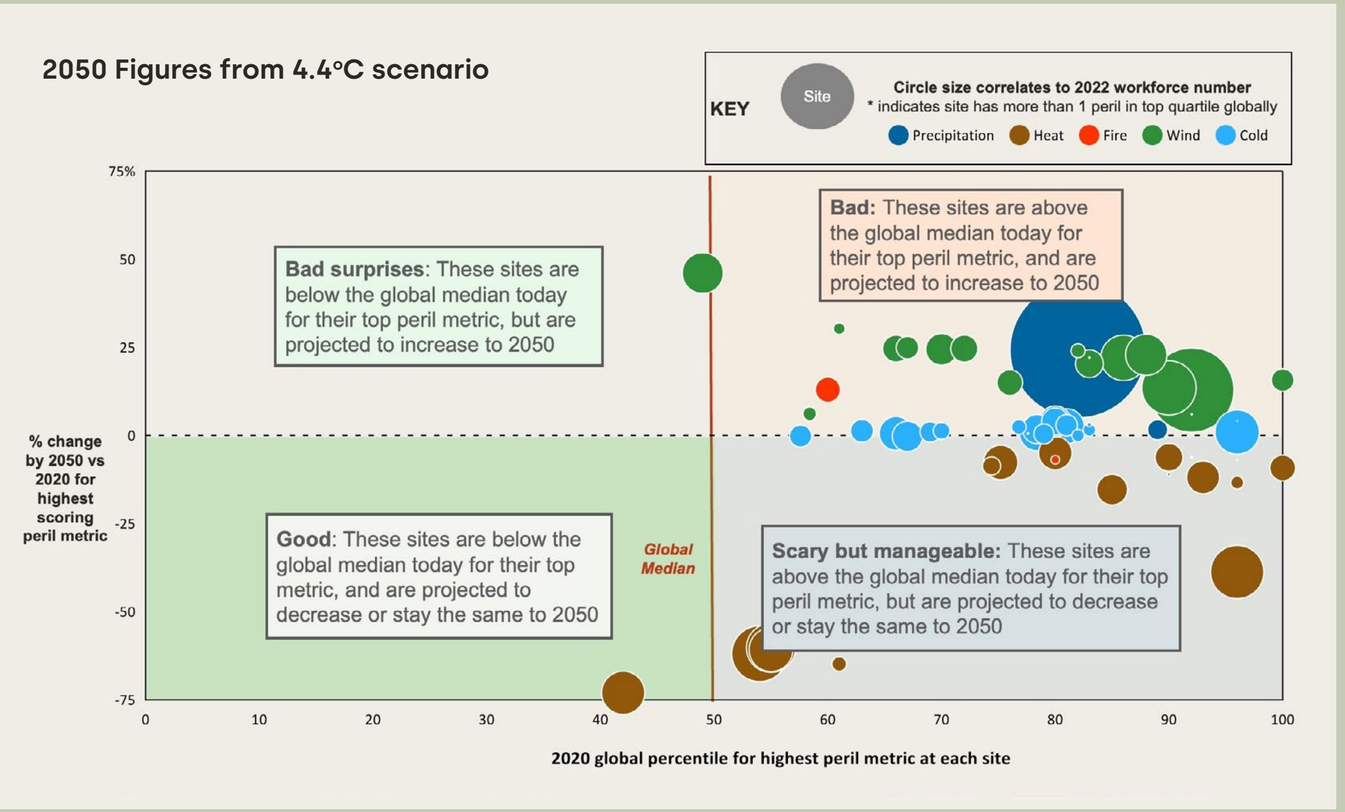
  – Or assets currently in the fourth quartile + increasing >15%

→ These high-risk sites were then compared with internal risk assessment to ensure sufficient adaptation

**Note:** *The illustrative output matrix has been adjusted to ensure client confidentiality

*Case study context:*
Commodity Co has a global footprint of industrial and logistics / transport sites.

**Figure 10:** Illustrative output* - Sites by risk today and expected change by 2050



*B.*

# Assess risk exposure

→ *Assess level of exposure and vulnerability across assets and the value chain, identifying key barriers & actions*

# B. Assess *risk exposure*

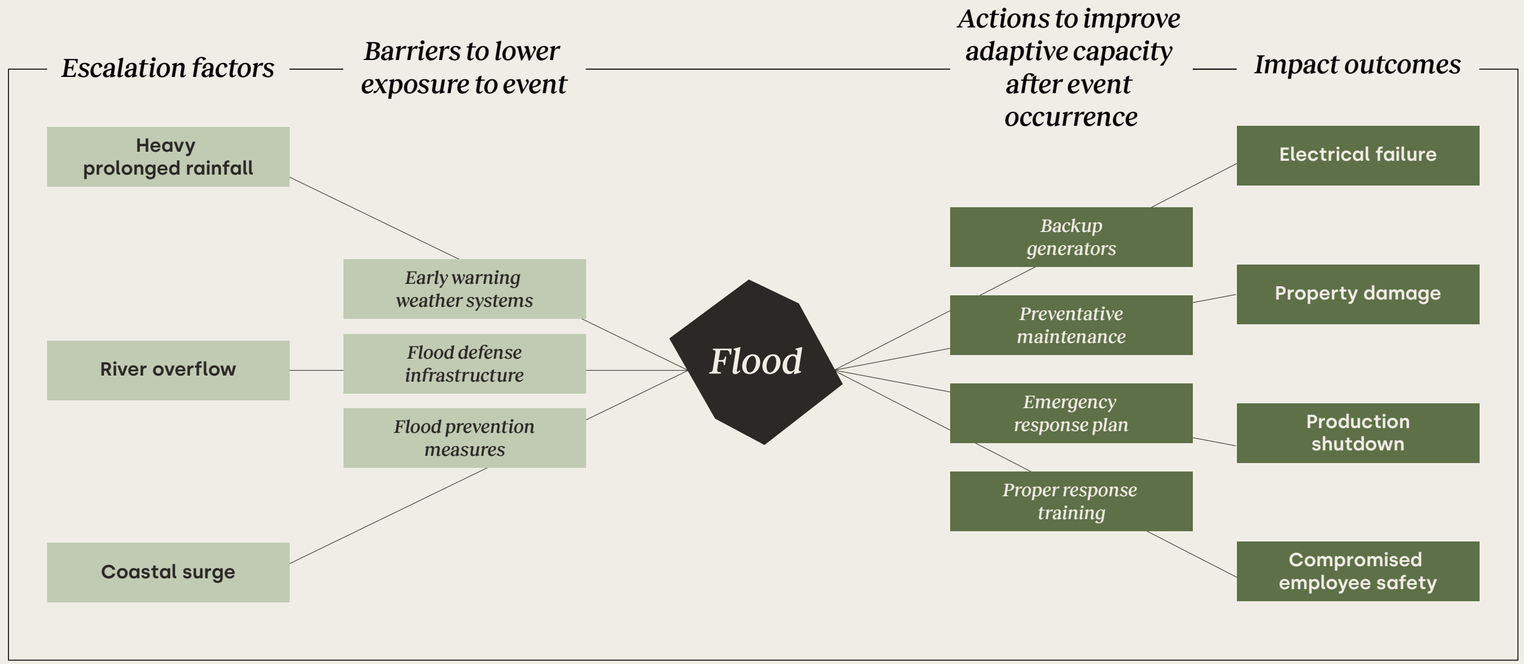
## *Risk functions typically begin by applying a bow tie analysis to assess physical risk resilience at an asset level and identify potential gaps*

**Bow tie analysis helps visualize escalation factors that can cause adverse physical events and barriers/ adaptation actions that can reduce risk**

→ Bow tie analysis is a visual and analytical risk assessment technique that enables organizations to better understand and manage complex risks

– This analysis identifies the potential causes, consequences and controls associated with a specific hazard

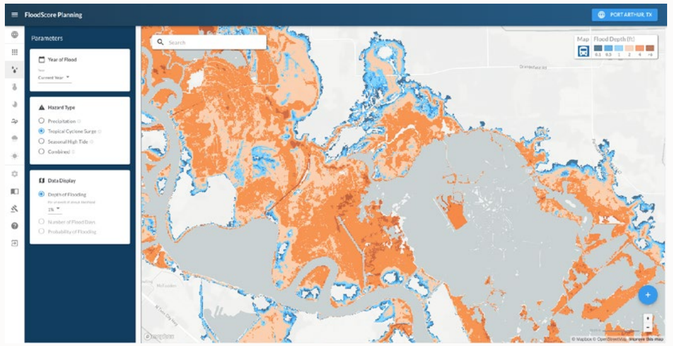
**Figure 11:** Example of bow tie analysis for a flood event




**This analysis can be taken further with scenario modeling**

→ Some risk identification partners can model disaster scenarios on specific sites, assessing the impact of perils on operations, while accounting for existing barriers (e.g., flood defense systems)

**Figure 12:** Graphic indicates outcome under tropical cyclone surge scenario (1% probability), where areas colored orange and brown would be subject to >4 and > 6 feet of flooding respectively.



# *Insurance is typically used in parallel with barriers and adaptation actions to limit financial losses from major physical risks*

## Holistic risk management combines barriers, adaptation actions and relevant insurance coverage

**Figure 13:** Example of holistic risk management; combining barriers, adaptation actions and insurance coverage

| | *Barriers and adaptation actions* | *Insurance coverage* |
|---|---|---|
| *Description & use case* | On-site measures to lower exposure to or reduce vulnerability to physical events | Financial protection against losses and damages from physical risk |
| *Examples* | → Early warning weather systems<br>→ Flood defense measures<br>→ Resilient building design | → Property insurance<br>→ Business interruption insurance |
| *Benefits* | → Reduced magnitude of impacts from physical events<br>→ Improved business continuity and employee safety | → Financial safety net in case of unexpected, low probability shocks<br>→ Risk sharing with an insurer |
| *Limitations* | → High initial investment required | → High cost of premiums<br>→ Coverage limitations and exclusions |

## Limitations of insurance as a tool to manage physical risk

→ Insuring rare, catastrophic physical events is difficult due to several factors:

- Limited historical data: Lack of past occurrences hinders data-driven risk assessment
- High uncertainty: Difficulty in predicting both likelihood and severity of physical events
- Increasing risk: Price of insurance in areas with heightened physical risk (e.g., South Florida hurricanes) is likely unaffordable

→ Parametric insurance is a form of "top-up" insurance to cover more extreme risk scenarios, typically not covered by standard insurance products

- Offers fixed payout on the satisfaction of predefined conditions, relying on measurable data (e.g., wind speed) to initiate compensation
- Can prove valuable for managing physical risks, for example, where resilience measures cover up to category 3 wind speeds and parametric insurance can cover higher risk scenarios, such as category 4-5 wind speeds

→ Case study deep dive follows in this section

*Case Study*

## *Con Edison has used a stage-based risk management framework to assess physical risk exposure and vulnerability*

**Con Edison[29] used a resilience management framework to assess robustness of barriers and adaptation actions**

### 1. Identified shortfalls in design standards

→ Current design standard for coastal flood protections includes the FEMA* 100% annual flood hazard elevation, 1 foot for sea level rise and 2 feet of freeboard

→ Under high-end scenarios, this threshold could be exceeded by 2030 (10% probability); under more likely scenarios, it could be exceeded between 2040 and 2080 (100% probability)

### 2. Updated standards and committed to continued review

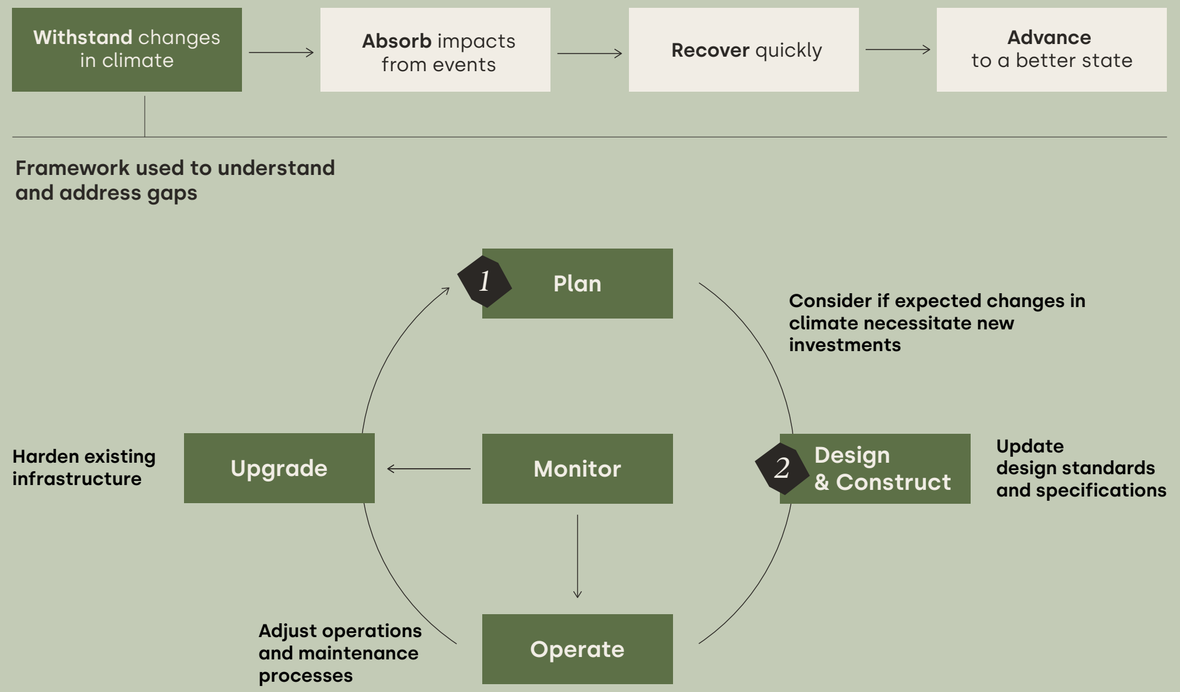
→ Con Edison updated its flood design standards to add 2 feet of freeboard plus a sea level rise increment based on the sea level rise pathway and the useful life of the site to FEMA's 1% annual chance base flood elevation[30]

→ As climate information is updated, Con Edison will review affected existing assets and identify any changes necessary

*Case study context:*

Con Edison had undertaken a range of measures to increase its resiliency to physical risks, with significant capital investments made on reducing vulnerabilities exposed during past weather events (e.g., Superstorm Sandy, 2012; winter storms Riley and Quinn, 2018). In 2019, Con Edison produced its Climate Change Vulnerability Study, a comprehensive assessment of future climate change vulnerability throughout the business.

**Figure 14:** Con Edison's resilience management framework




***Note:** U.S. Federal Emergency Management Agency

*Case Study*

## *EDF Group has developed internal expertise to inform its risk management strategy and asset design standards*

### Internal climate service and external partnerships

→ The EDF Group has a team of 15 permanent scientists providing climate data at a granular scale, as well as scenario analysis for all entities

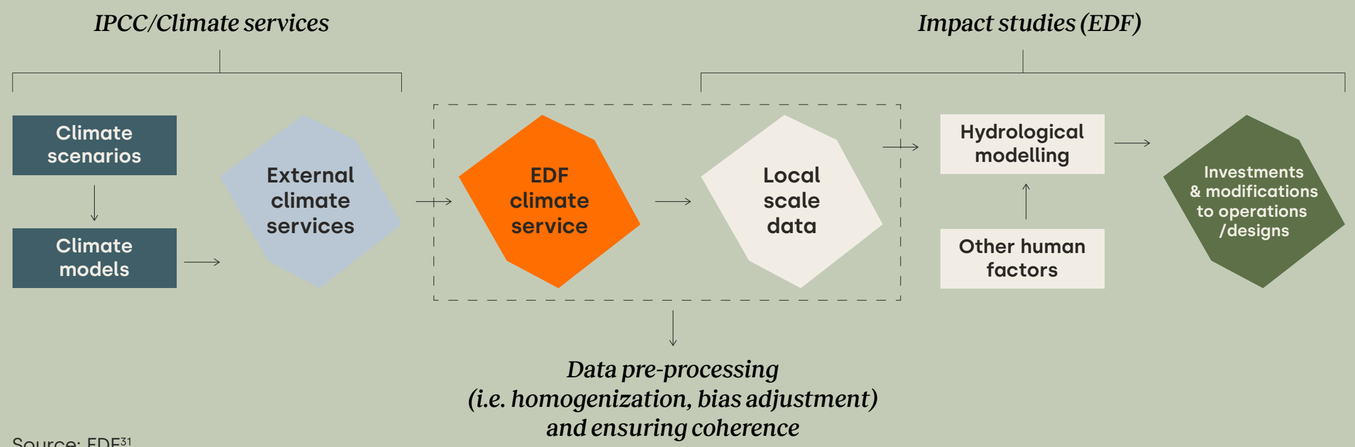
→ EDF also maintains partnerships to access external expertise, e.g., a partnership with Meteo France, scientific collaborations with the CNRS* and direct relationship with the Intergovernmental Panel on Climate Change (IPCC)

*Case study context:*

EDF Group is a French multinational electric utility company. Physical events have significant impacts on electricity supply, making weather analysis and climate projections key in the design and sizing of electrical systems. EDF has been building physical risk identification and assessment expertise since 1990.

**EDF translates insights from external climate services to its needs business impact studies** → **Influence on investment decisions and construction design**

**Figure 15:** Representation of EDF's translation of external climate knowledge to inform business impact studies




Source: EDF[31]

*Note: Centre national de la recherche scientifique

→ EDF group entities can make key adaptation investment decisions based on data at a granular geographic scale sourced from the latest climate models (CMIP6)

→ EDF has designed all group power plants currently under construction to take into account the most recent climate scenarios

– In particular, this has involved revising the expected rise in sea levels upwards

*C.*

# Business assurance

→ *Act to safeguard the company's infrastructure, supply chain and operations*

# C. Business *assurance*

## *The impact of physical risks are increasingly complex and impact operations throughout the end-to-end value chain*

**Figure 16:** Physical risk and adaptation impacts at different stages of the value chain (example shown for consumer-packaged goods)

### Increasing water scarcity

Fresh water demand is expected to **exceed supply by up to 40% in 2030**[32]

**Climate change** causes dry areas to **become even drier**

### Impacts on workforce safety

**Customer boycotts** and media publications on companies **affiliated with unsafe practices** across the value chain

Increasingly **challenging to work outside due to rising temperatures**

### Damage to travel infrastructure

Extreme weather events can damage infrastructure, **disrupting upstream and downstream** operations

Severity of climate change will **impact the probability** of such events

DESIGN → SOURCE → MAKE → TRANSPORT → USE → END OF LIFE

### Decreased availability of key commodities

Climate change **impacting the yield** of key global commodities (e.g., dairy, wheat, cacao, coffee)[33]

Companies may be forced to **adjust product mixes** or **location of suppliers**

### Changes in product demand

Climate change will directly impact the **demand for certain types of products** (e.g., heating and cooling systems)[34]

Physical risks will also introduce **new opportunities** for products and services

→ Deep dive on **new business opportunities** follows in this section

## *Companies should deploy business assurance measures at their own sites, as well as those within the broader value chain*

→ Deep dive on how to assess **existing barriers and resilience measures** included in B. **Assess risk exposure** section

| | *Less mature companies focus solely on…*<br>**Owned company operations and assets** | *More mature companies also focus on…*<br>**Upstream and downstream in value chain** |
|---|---|---|
| ***Rationale for implementing business assurance measures*** | → Preventing damage to assets and infrastructure<br>→ Safeguarding against business continuity interruptions<br>→ Protecting employee wellbeing | → Building upstream and downstream value chain resilience against potential future physical events<br>→ Protecting communities within the value chain ecosystem |
| ***Actions at disposal***<br>*(examples shown not exhaustive)* | → Building resilience measures at own sites to reduce vulnerability to physical events, e.g.,<br>– Creating a virtual working contingency plan for the workforce<br>– Increasing storage capacity to withstand supply shocks<br>– Deploying appropriate nature-based solutions at sites<br>→ Think global, act local by addressing assurance measures at the local level, based on a unified approach<br>→ Engage communities and local businesses to find mutually beneficial resilience measures | → Build shared resilience with supply chain through enhanced redundancy, adaptability and prediction capability<br>→ Engage with value chain partners to introduce barriers and resilience measures at high-risk locations<br>– For example, transportation infrastructure around critical sites<br>→ Managed retreat in collaboration with local communities where heightened physical risk is unavoidable |
| ***Examples*** | AstraZeneca<br>AstraZeneca's USD $20 million resilience investment in a Puerto Rican manufacturing plant included maintaining a storage of three-month's worth of inventory in case of supply interruptions[35]<br>– Deep dive on next slides | BASF We create chemistry<br>BASF developed an early warning forecast system in 2019 to predict how water levels would impact suppliers, enabling better logistics and inventory planning[36] |

## *Physical risk can be integrated into state-of-the-art supply chain resilience management*

**Figure 17:** Bain and Company's Smart Resilience framework adapted for physical risk

### *Prediction capability*

**Real-time physical risk monitoring with full system heatmap**

→ Tracking critical components/vendors and regional vulnerabilities

→ Key performance indicator (KPI) monitoring for physical risk factors

**Supplier visibility and traceability**

→ Maintaining constant market awareness regarding critical bottlenecks across components (e.g., supplier capacity, resource availability)

→ Forecasting with shared data from key suppliers

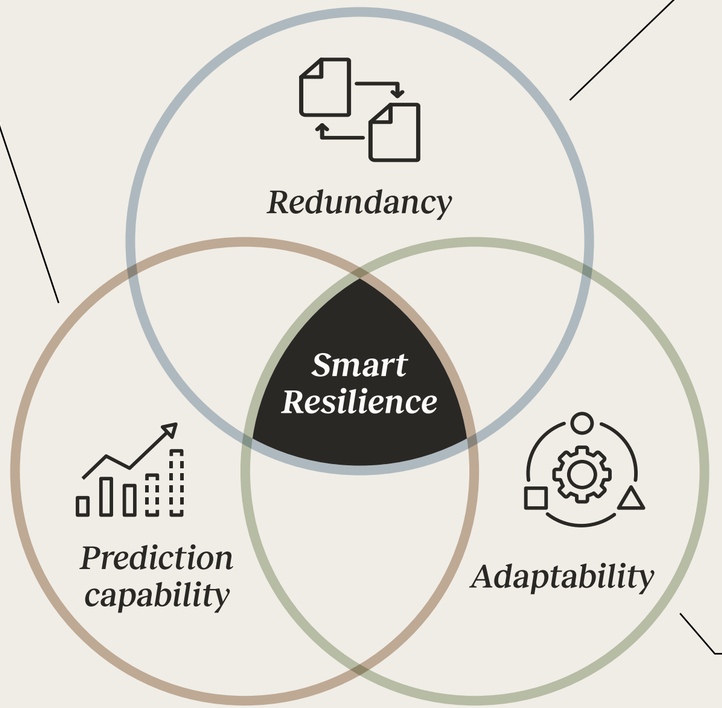
→ Establishing organizational framework for ongoing capacity monitoring

**Physical risk-controlled procurement awards**

→ Evaluating physical risk factors across all supplier and component combinations

→ Awarding different valuation within award matrix depending on criticality of component risk factor

→ Securing of ad-hoc production capacity demand




**General supply chain resilience principles that can be adapted to incorporate physical risk**

### *Redundancy*

**Enhanced material redundancy**

→ Accumulating strategic inventory at the level of parts, components or systems (e.g., sharing cost with suppliers)

**Enhanced production redundancy**

→ Implementing regional, independently managed supply chains with dedicated supplier base (e.g., employing a "China plus one" strategy)

→ Facilitating dual-sourcing for critical parts/ vendors while considering intellectual property (IP), machinery/tools and production capacity

### *Adaptability*

**Design for flexibility**

→ Initiating early design flexibility for products/ parts to accommodate future adjustments

→ Permitting late-stage vendor adjustments and establish seamless switching process

**Operate for adaptability**

→ Implementing a regionally interconnected operating model with a comprehensive cross-functional view

→ Engaging with suppliers to promote adaptation investment

*Case Study*

## *AstraZeneca made significant business assurance investments after experiencing negative shocks from physical events*

***Case study context:***

AstraZeneca made investments to protect against physical risk at two of its manufacturing sites, which had previously suffered consequences from adverse weather events.*

### *Sites and catalysts for action*

### *Outcome of investment*

**Canovanas, Puerto Rico**

→ In 2017, Hurricanes Irma and Maria devastated the island

→ The plant was completely unmanned for 24 hours and experienced 3 weeks of total business interruption[37]

*USD $20 million*

*adaptation investment*

→ Decreased dependence on local grid via installation of LNG cogeneration plant and PV solar power

→ Increased water storage capacity by 1M cubic meters to defend against future storm surges

→ Hold sufficient levels of inventory to defend against 3 month outage

**Sodertalje, Sweden**

→ In 2018, an acute heatwave breached environmental control and good manufacturing practice

→ The plant was responsible for 40% (USD $17 billion) of annual total sales value, with 4,600 on-site employees[38]

*USD $4 million*

*adaptation investment*

→ Avoided a manufacturing interruption of up to 8 weeks (USD $2.5 billion in potential output) based on various projections/scenarios

→ Built cooling towers, process chillers and heat pumps to adapt to temperature increases

→ Hold 3 months worth of inventory to defend against supply interruptions

**Note:** *All pharmaceutical products administered to humans/animals must be manufactured under Good Manufacturing Practices[39] (GMP) quality assurance standards.

*Case Study*

## *EDP built climate risk knowledge internally to inform assurance initiatives for its generation assets*

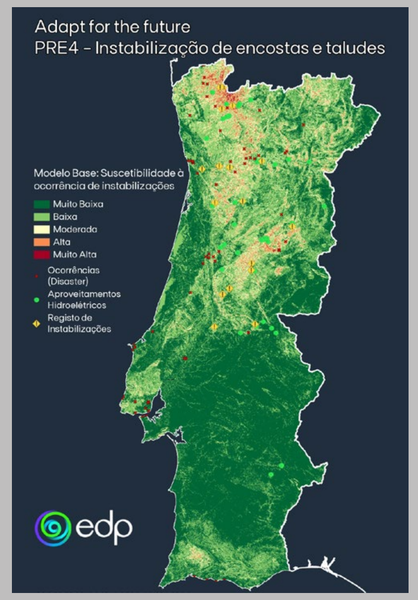
### Building knowledge and partnerships on climate risk

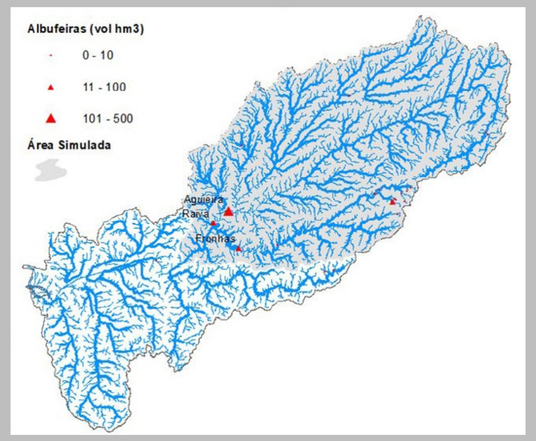
→ EDP is developing a system to record changes and instabilities in slopes to predict landslide risk

→ For better prediction and management of high magnitude floods, EDP is developing external studies with climate specialists

→ The company is also a partner in SILVANUS, a European research project that aims to prevent the threat of and fight forest fires

**Figure 18:** Risk maps generated by EDP's knowledge-building teams




*Case study context:*

EDP is an electricity generation company operating in Portugal that prioritizes adaptation as part of its overall climate action plan.[40] EDP has assessed the level of exposure of its electricity generation assets to physical risk, considering short-, mid- and long-term IPCC scenarios. EDP committed to having adaptation plans in place for all business units by 2022.

### Assurance initiatives in place for generation assets

*Landslides and floods*

→ Develop landslide risk maps to better set priority interventions

→ Promote nature-based solutions, through forest plantation to fix slopes and regulate the hydrological cycle

*Water stress*

→ Invest in water efficiency programs in assets located in water-stressed regions

*Fires*

→ Release of a climate resilient forest management platform to prevent and suppress forest fires

→ In addition, EDP is reinforcing emergency responses to extreme events, including a stronger engagement with safety authorities

*Case Study*

## *Swire Coca-Cola ensures water availability by reducing use, recycling and replenishing water sources through partnerships*

*Case study context:*

Swire Coca-Cola,[41] the fifth-largest bottling partner of The Coca-Cola Company, manufactures, markets and distributes products in Greater China, Cambodia, Vietnam and western USA. Water availability is critical to the business and hence physical climate impacts on water scarcity and quality are a major cause for action.

**Figure 19:** Swire Coca-Cola water management strategy, targets and results

| *Strategy* | *Targets* | *Results* |
|---|---|---|
| **Reduce** the Water Footprint of facilities by improving water efficiency and help co-packers to do the same | → By 2030, reduce overall Water Use Ratio (WUR)* to 1.45<br>→ By 2025, obtain third-party validation of all source vulnerability assessments (SVAs) and water management plans (WMPs)<br>→ Introduce a new governance mechanism to improve water reporting and efficiency of co-packers | → 1.75 in 2022<br>→ 73% of SVAs and WMPs validated as of end 2022<br>→ Mechanism introduced for largest co-packer, CCBMH |
| **Recycle** Treated Wastewater back into operations/natural water systems | → Ensure all waste-water discharged from Swire Coca-Cola plants and co-packers' plants fully complies with regulations[42] | → 100% compliance |
| **Replenish** Natural Water Sources through stakeholder partnerships | → Contribute to The Coca-Cola Company goal of replenishing at least 100% of the water used** in its finished beverages globally | → 159% global replenishment rate in 2022**,*** |
| **Report** Annually via CDP**** | → Continue to participate in the CDP water security questionnaire | → Score of A- |

**Notes:** *WUR is the liters of water used to produce one liter of product; **KPI measured is volume of water replenished as proportion of TCCC's global sales volume (%). Projects may not be in watershed where water was sourced; ***Projects done in partnership with The Coca-Cola Company and other stakeholders; ****Charity running global disclosure system for managing environmental impacts[43]

*Case Study*

## *EDP has collaborated with other stakeholders to build-in resilience to the Portuguese electricity grid network*

**Figure 20:** An example risk analysis tool developed by EDP and partners to map resilience across the Portuguese electricity grid network

**A tool has been developed to assess E-REDE's current and future vulnerability, considering:**

E-REDES

**Phases 1 & 2**

→ Climate variables (T.1.1-1.2)
→ NDG characterization (T1.3)
→ Past events affecting NDG (T2.1)

**Phases 3**

→ Scenario analysis

*Tool*
(machine learning)

*Risk analysis*

*Current risk*

*Future risk*

*Economic analysis*

Non distributed energy

Probability of occurence by asset type and location

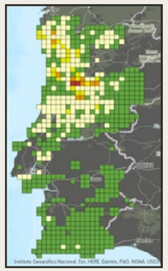


**Figure 1.** Climate grid resolution of 12 km x 12 km

Source: EDP

*Case study context:*

EDP also collaborates with partners to conduct research, perform risk analysis and construct adaptation plans. For example, the company is actively contributing to the development of an adaptation plan for the electricity distribution grids in Portugal, which it relies on to meet customer demand for electricity.

### Climate modeling revealed heightened physical risk within the grid system

→ Climate action plan designed jointly by EDP and Academy as 4 phase process

→ Process was based on current and future risk analysis with several key findings:

- Seasonal maximum temperature increments can reach +6.5°C in NE Portugal
- More frequent heatwaves expected
- Forest fires expected to occur more frequently

### Emergency prevention and response tools put in place

→ The projected increase in acute extreme events (extremely windy days and wildfire events) could lead to an increase in damage to grid assets

→ EDP has developed a grid outage forecasting tool that foresees short-term outages under specific weather conditions, by the number of events and affected locations (85% accuracy)

→ EDP's Crisis Management Plan and the E-REDES Operational Plan for Crisis were tested during severe windstorms and the response proved effective

→ E-REDES are the main electricity distribution grid operator in Portugal

*D.*

# Quantify risk

→ *Assign value-at-stake to identified risks to support better decision making*

# D. Quantify *risk*

## *Differing degrees of risk quantification are available depending on desired output and accuracy*

**Figure 21:** Several approaches to risk quantification ranging from low to high complexity

LOWER risk modelling complexity → HIGHER risk modelling complexity

| | *1. Insurance benchmark estimates* | *2. Asset-specific detailed risk quant. analysis* | *3. Portfolio-wide net risk quantification* | *4. Financial statement risk modelling* |
|---|---|---|---|---|
| *Process overview* | Quantify asset value impact using industry benchmarks for historical loss data | Conduct site-specific assessments to calculate individual asset value-at-stake | Derive bespoke loss and damage functions across asset types to create cross-portfolio view of risk | Simulate various peril scenarios on portfolio, linking outputs to financial statement impact |
| *Key outputs* | → High-level estimate of asset value loss | → Accurate estimate of asset-specific value loss<br>→ Asset revenue cost impact estimate<br>→ Estimate of asset-specific personnel disruption | → Accurate estimate of portfolio value loss<br>→ Portfolio revenue cost impact estimate<br>→ Estimate of portfolio-wide personnel disruption | → Revenue, balance sheet and cash flow portfolio impact estimates<br>→ Estimate of impact from personnel disruption, incl. costs related to impact |
| *Resources and timing* | → Limited resources<br>→ Days | → Moderate resources<br>→ Weeks | → Moderate resources<br>→ Months | → Significant resources<br>→ Quarters |
| *Delivery challenges* | → Limited to relevant insurance data for company footprint, which may be misleading | → Resources required 'on the ground'<br>→ Data accuracy and availability varies by site | → Likely requires partnership with a risk quantification specialist | → High degree of complexity and accuracy required to successfully model impact |

**Note to reader:** Whilst risk quantification is typically CRO-led, it requires significant CFO support, particularly for higher complexity approaches

### Further context on best practice

→ Quantification should cover both underlying asset value and impact of business interruption

  – For business interruption analysis, collect or estimate annual value of site production

→ Regulation mandating disclosure of financial impact of material physical risks expected from 2024 in the EU (CSRD, ESRS E1)

→ More information on the CSRD can be found in E. **Reporting integration** section

→ Contact **Climate.Action@Philips.com** for more information on their risk quantification approach

PHILIPS

*Case Study*

## *Philips have leveraged different approaches to risk quantification analysis*

### Overview of risk quantification process

*2022: Initial risk quantification exercise*

**Selected all manufacturing** that posed material impact to business and used a step-by-step method of risk quantification to first calculate and then refine financial value-at-stake:

1. Insurance benchmark estimates: Leveraged insurance tool to screen potential hazards at deep dive business and supplier sites to create outside-in estimate of financial loss-at-stake

2. Asset-specific detailed risk quantification analysis: Conducted evaluations with site managers at potential risk locations to refine view of financial loss impact across various climate scenarios (RCP)

*2023 (ongoing): Refined risk quantification exercise (key additions to process)*

Building on established process, Phillips is now refining its risk quantification approach by adjusting asset-specific analysis and incorporating financial statement risk modeling:

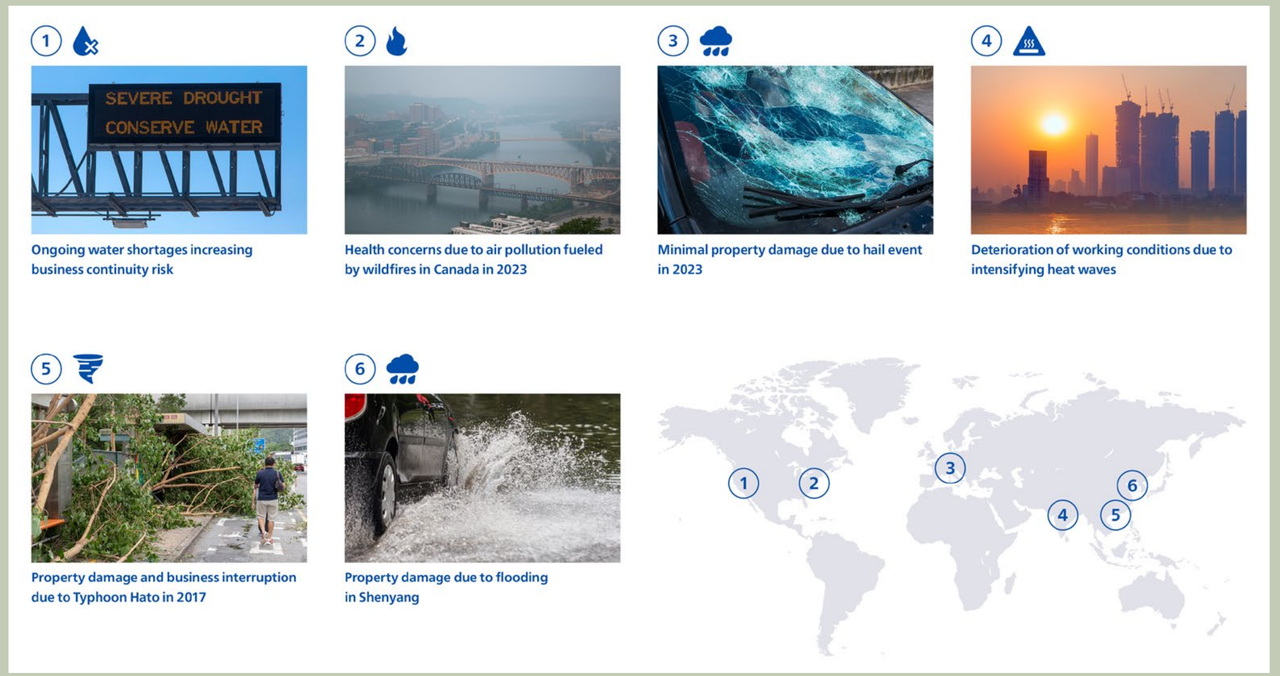
3. Asset-specific detailed risk quantification analysis: Working with finance team and external consultants to create a survey to share with site managers covering various areas of physical risk to generate more comparability across locations (e.g., potential inventory loss and energy costs)

4. Financial statement risk modeling: Once results are codified, aim to link to line items of the Philips financial reports to ensure compliance with ESRS E1 section of CSRD regulation

*Case study context:*

Philips has a global operations network with exposure to various physical risks and managing physical risk has significant internal attention. Phillips is conducting a multi-year risk quantification exercise to create a repeatable process to understand physical financial value-at-stake across its sites and critical suppliers.

**Figure 22:** Map showing Philips' past and current risk exposure




Source: Philips[44] (2023) Publication of the Task Force on Climate-Related Financial Disclosures (TCFD) 2023

*Case Study*

## *Jupiter quantified the financial impact of physical climate risks on supplier sites for a leading apparel company*

### Analysis results

→ Output shows that at selected site, the average annual loss from flood was USD $0.5 million in 2020, with an increase to USD $0.6 million in later decades

  – Additionally highlighted expected wind loss damage

→ Major insight was that largest sources of losses are expected to be inventory and equipment rather than building damage

→ Preliminary downtime figures were also provided (not shown)

**Note:** Flood loss estimates (USD $) based on percentage of total estimated asset value

***Case study context:***

Financial losses from flood and wind damage and disruption were estimated for Apparel Co's global supply chain, assessing supplier sites to quantify current and future external risk.

**Figure 23:** Jupiter software output showing quantified financial impact of flood risk at individual supplier site

| | 2020 | 2050 | 2075 | 2080 | 2085 |
|---|---|---|---|---|---|
| Depth of the water (in meters) at the 100-year return period | 1.70 | 2.00 | 2.28 | 2.34 | 2.40 |
| Flood Damage Building (100yr) | 26% | 30% | 32% | 33% | 33% |
| Flood Damage Contents (100yr) | 53% | 58% | 62% | 63% | 63% |
| Flood Damage Inventory (100yr) | 63% | 67% | 70% | 71% | 71% |
| Flood Loss Building (100yr) | $790K | $903K | $958K | $976K | $994K |
| Flood Loss Contents (100yr) | $3.7M | $4.1M | $4.3M | $4.4M | $4.4M |
| Flood Loss Inventory (100yr) | $1.3M | $1.3M | $1.4M | $1.4M | $1.4M |
| Flood Average Annual Loss (Total) | $0.5M | $0.6M | $0.6M | $0.6M | $0.6M |
| Maximum 1-minute sustained wind speed (in km/hr) experienced at the 100-year return period | 237.97 | 242.91 | 247.24 | 247.71 | 248.32 |
| Wind Damage Building (100yr) | 24% | 26% | 29% | 29% | 30% |
| Wind Loss Building (100yr) | $713K | $794K | $873K | $882K | $893K |

→ Estimated flood damage over time for property in focus

***Companies may determine the number of suppliers to include in the quantification process based on their total supplier count and prioritization.***

Source: Jupiter Intelligence

*E.*

# Reporting integration

→ *Understand emerging regulation and embed physical climate risk and opportunity into business reporting*

# E. Reporting *integration*

## *CFOs must oversee updates to internal and external reporting to integrate physical risk assessments*

**Figure 24:** Best practices and nuances to consider for different types of reporting

| | *External reporting overview* | *Internal reporting overview* |
|---|---|---|
| *Approach for best practice* | → Ensure appropriate disclosure of physical risks and opportunities in-line with evolving regulatory standards<br>– In the EU, the **CSRD will mandate reporting** for most companies operating in the region<br>– In the US, rules on **mandatory SEC physical risk reporting** were released in March 2024[45]<br>– More countries are **planning to adopt TCFD as mandatory,** including Japan, Singapore and Brazil | → Empower stakeholders within the organization to **track the ongoing measurement of physical risk and opportunities,** ensuring:<br>– Strategic alignment across stakeholders<br>– Informed decision-making for physical risk management<br>– Awareness of operational implications for physical risks |
| *Additional nuances to consider* | → Significant **variance in external reporting maturity** by industry<br>– As of January 2023, S&P **utility companies** had the highest percentage of TCFD integration (>70%), with **communication services** having the lowest (33%)[46]<br>→ There are **potential strategic benefits** to exceeding mandated reporting requirements, as investors look to reward companies 'leading' in managing climate risks | → Physical risks and opportunities have consequences **across business functions;** good internal reporting enables contribution from appropriate stakeholders<br>– HR team: employee safety considerations<br>– CFO team: financial considerations<br>– CEO team: brand considerations<br>→ Clear **governance and internal workflows** are thus necessary to monitor, manage and create buy-in |

## *There are three regulations businesses should be aware of today with implications on physical climate risk reporting*

**Figure 25:** An overview of the major regulations that businesses must prepare to comply with from 2023-2026

| | *International Sustainability Standards Board[47] (ISSB)*<br>→ The ISSB now includes **all TCFD recommendations** | *CSRD[48]*<br>→ CSRD standards are **most stringent today** | *SEC[49]* |
|---|---|---|---|
| *Companies affected* | → Voluntary reporting, with some countries choosing to mandate disclosures as per the framework (deep dive on next slide) | → **Large, public/listed EU entities**<br>→ EU companies (incl. subsidiaries) **which meet 2/3 characteristics:** >250 staff, >€40M revenue, >€20M total assets<br>→ Non-EU companies **with >€150M revenue** | → **All companies** required **to report to the SEC**<br>→ Earlier deadlines for **large companies (>$700M revenues)** beginning in 2025, medium companies ($75 - $750M revenues) beginning 2026. |
| *Expected changes* | → **2023:** TCFD final status report released<br>→ **2024:** Expected to take effect. Transfer of TCFD monitoring responsibilities to ISSB | → Phased mandatory reporting from 2024 onwards<br>– **2024:** Listed companies (with >500 employees)<br>– **2025:** Large non-listed companies<br>– **2026:** Listed SMEs | → 2024: updated rules on climate-related disclosures have been published but are currently on hold pending court challenge (as of April 2024)<br>– A **less prescriptive approach to climate-related risk disclosure,** compared to the 2022 proposed rules |
| *Reporting required* (physical risk lens) | → Sustainability-related risks and opportunities faced over the **short, medium and long-term** | → How material sustainability risks and opportunities are identified and managed<br>→ Resilience of company's business model and strategy towards sustainability risks, including potential financial effects | → Any climate-related risks that have had or are reasonably likely to have a **material impact on finance, strategy or operations**<br>→ Details of any strategies implemented by the company to mitigate or adapt to climate risk. |
| *Penalties* | → **To be decided** by governing bodies if adopted<br>→ **No penalties while voluntary** | → To be decided at **EU state level**<br>→ Likely **sanctions,** orders to change conduct, **financial penalties** | → To be decided by SEC<br>→ Non-compliance **likely to be met with financial penalties** |

## *International Financial Reporting Standards (IFRS) S2 provides a good framework for overall climate-related risk reporting, which should include both physical and transition risks*

### IFRS S2 climate-related disclosures are used in accordance with IFRS S1 and incorporate all TCFD recommendations

Physical risk shares similar external reporting frameworks to transition risk, and organizations often choose to combine both in reporting

As adaptation sits at an interface of climate and nature, the Taskforce on Nature-related Financial Disclosures (TNFD) framework[50] can also be considered alongside the IFRS S2 (taken from TCFD[51]) framework below.

Following external guidance should be the starting point for physical risk reporting, with the IFRS S2 providing a good framework for overall climate-related risk assessment:

**Figure 26:** The core components of physical risk reporting from the TCFD framework, formally adopted by IFRS S2

| *Governance* | *Strategy* | *Risk Management* | *Metrics and Targets* |
|---|---|---|---|
| → Board oversight of climate risks and opportunities, reflected in mandates, role description and other related policies | → Climate risks and opportunities identified over short, medium and long-term | → Processes for identifying and assessing climate risk | → Cross-industry and industry-based metrics used to assess climate risks and opportunities in-line with strategy and risk management processes |
| → Management's role in assessing and managing climate risks and opportunities | → Climate risk and opportunity impact on business, strategy and financial planning | → Processes for managing climate risk and opportunities | → Targets used to manage climate risks and performance against targets |
| | → Resilience of strategy given different climate scenarios | → Climate risk processes and management integration into overall risk management process | → IFRS S2 risk management framework |

**Note:** *ESRS E1: Climate Change, is one of five environment-specific standards of the European Sustainability Reporting Standards

IFRS additions to TCFD include requirements to disclose industry-based metrics, information on planned use of carbon credits to achieve net emissions targets and additional information about financed emissions

CSRD goes beyond IFRS in certain areas (e.g., companies must disclose potential financial effects from material risks as part of ESRS E1*)

## *A growing number of governments, regulators and stock exchanges are mandating disclosures*

**Figure 27:** Timeline of major mandatory disclosures coming into force around the world (non-exhaustive)

### 2021

*In effect*

**Japan:** Certain listed companies must disclose based on TCFD under revised Securities Listing Regulations by **June 2021**

### 2022

*In effect*

**Brazil:** Brazil Central Bank mandates TCFD-aligned disclosures (initially qualitative, not metrics) for regulated institutions by **July 2022**

### 2023

*In effect*

**United Kingdom:** TCFD-aligned climate disclosures required across UK economy by **2025** (certain companies required to begin reporting by **2023 on FY2022)**

IFRS S2 takes over monitoring from TCFD[53]

### 2024

*In process*

**New Zealand:** TCFD-aligned disclosures mandatory for 200 companies by **2024 (on FY23)**[52]

*In process*

**Singapore:** TCFD-aligned disclosure mandatory by **2024 (on FY23)** for key industries

*In process*

**Switzerland:** Mandatory TCFD reporting ordinance for Swiss economies under consultation mid-2022; reporting expected **2024 (on FY23)**

*In effect*

**EU:** CSRD requires reporting according to EFRAG*-developed standards that incorporate TCFD; phased implementation across economies from **2024**

### 2025

*In process*

**Hong Kong:** TCFD-aligned disclosures mandatory for financial sectors by **2025**

*On hold*

**U.S. Securities and Exchange Commission (SEC):** Rules modeled in part on TCFD publishing in **March 2024** requiring public company disclosure - On hold as of April 2024, pending court challenge

→ CSRD incorporates existing frameworks, **including but not limited to TCFD**; may be more encompassing and more stringent than Swiss ordinance

**Note:** *EFRAG - European Financial Reporting Advisory Group

*Case Study*

# *Anglo American publishes physical risk metrics and methods for managing physical risks as part of climate change reports*

**Embedding climate intelligence into reports**

→ **Multiple models used** to build its climate intelligence

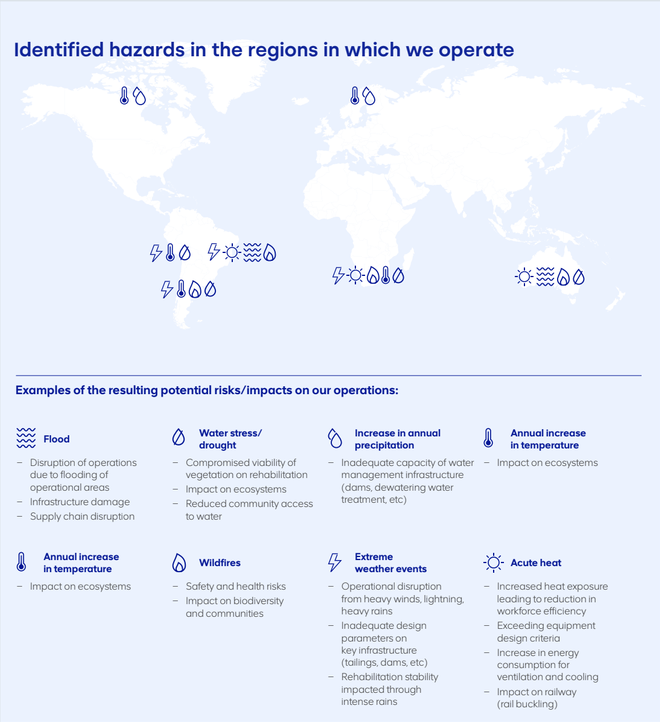
→ **Physical climate risk metrics** are integrated with transition risk metrics in report

→ Anglo is transparent about **both chronic and acute risks** that it anticipates disrupting operations and communicates them clearly

***Case study context:***

Multiple sites and surrounding areas are vulnerable to physical climate risk, Anglo began tracking and reporting physical risk to build investor confidence.

**Figure 28:** Related excerpts from Anglo American's Climate Change Report 2022 *(not exhaustive)*




*Identified hazards and impacts across global site footprint, pg. 19*


*Site-specific case study on managing physical climate risks, pg. 22*

Source: Anglo American[54]

# *Internal reporting helps create alignment and aid decision-making across the various stakeholders impacted by physical risks and opportunities*

## Internal reporting should create alignment and aid decision-making

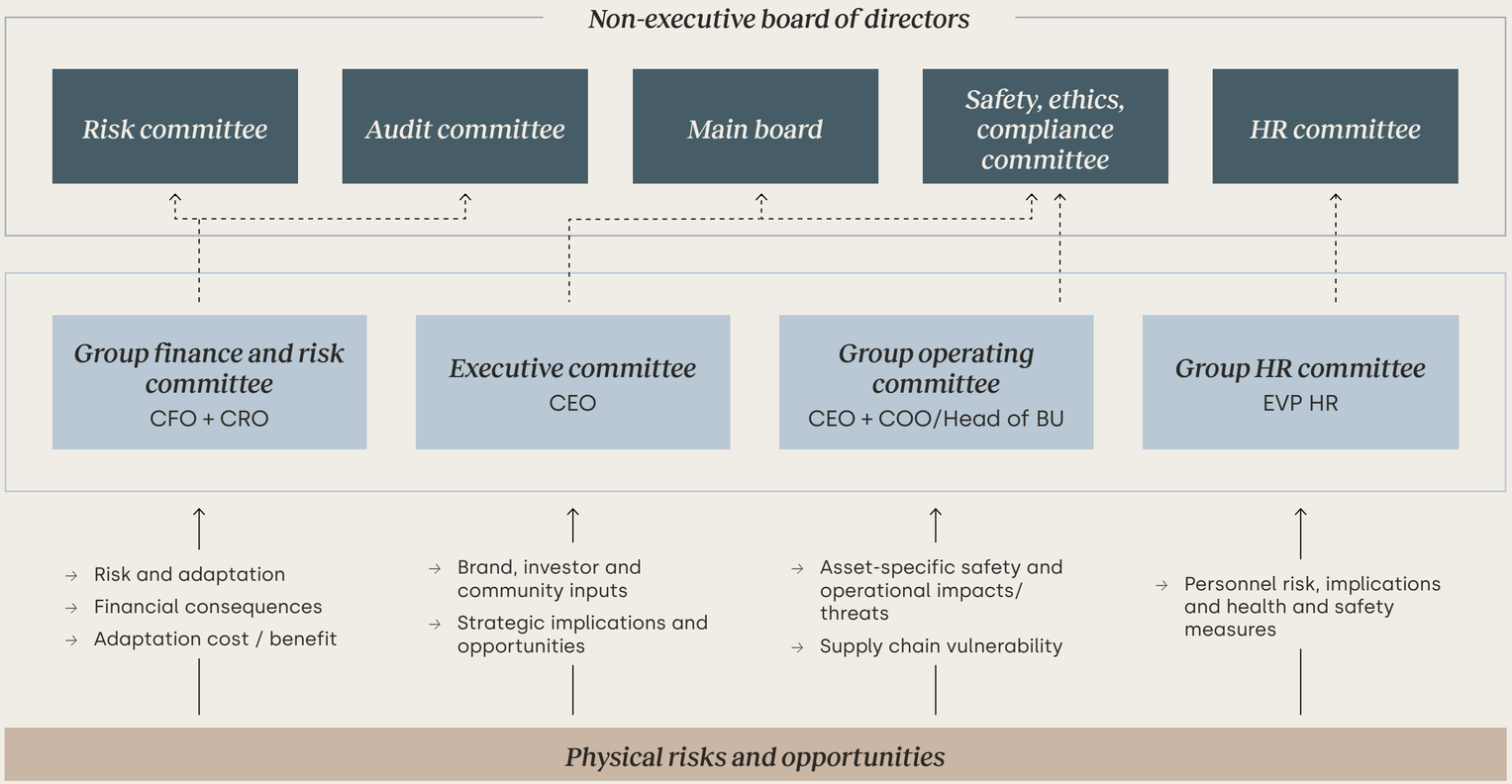
Where external reporting focuses on compliance, internal reporting should be tailored to **address the needs of decision-making in the organization**

Internal reporting should **cover the following areas:**

- → **Strategic alignment:** Provide insights that help align business strategies with potential physical risks and opportunities
- → **Informed decision-making:** Give decision makers the information required to make choices related to physical risk management, resource allocation and adaptation planning
- → **Operational implications:** Highlight operational impacts of physical risks on business functions, enabling proactive adaptation

## Physical risks and opportunities are wide-reaching and impact various stakeholders within an organization

**Figure 29:** Illustrative internal company structure* and responsibilities for physical risk reporting




**Note:** *Different corporations will have different internal structures, example shown

*Case Study*

## *Yara implemented clear governance and internal workflows to monitor, manage and create buy-in*

### HESQ purpose and workflows

→ Yara established HESQ to **focus on physical risk and adaptation**

→ HESQ presents reports **annually to the Board of Directors** and the **Board Audit and Sustainability Committee (BASC)**

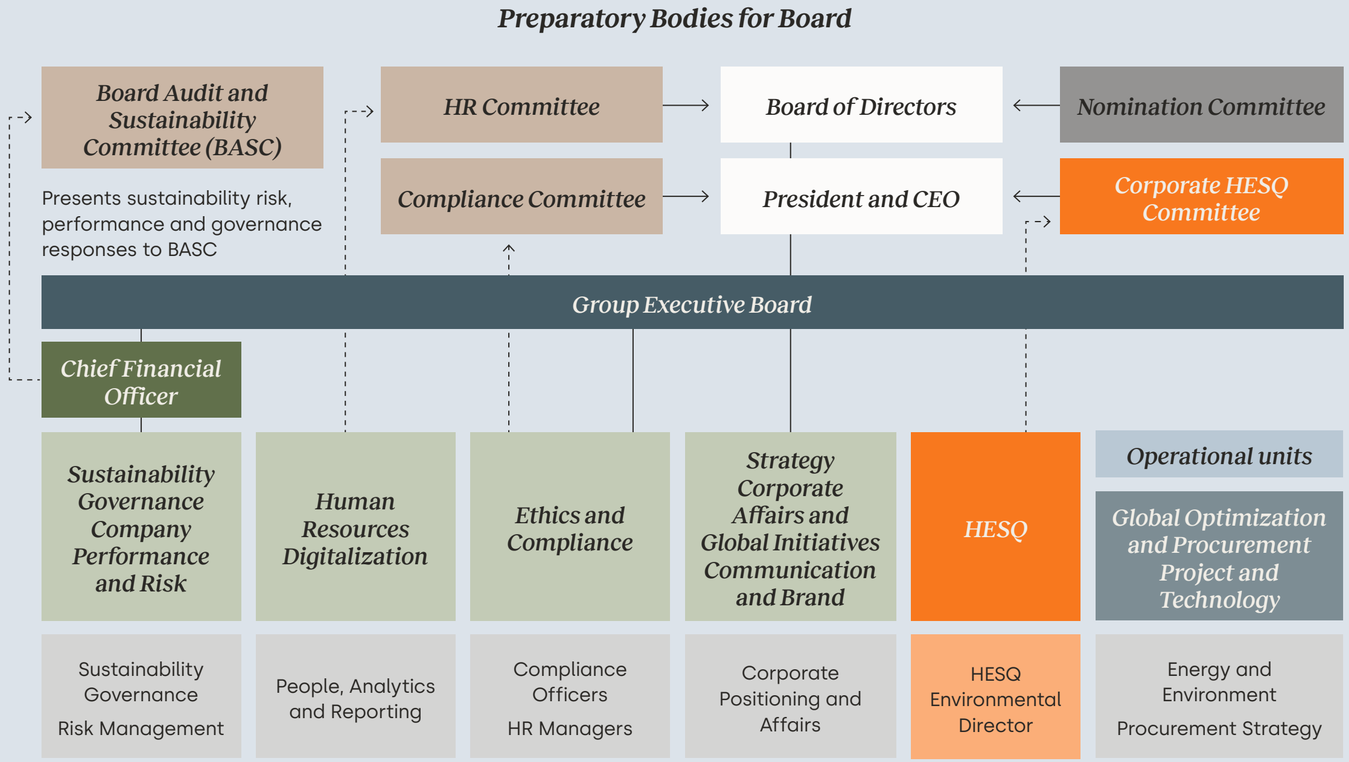
  – The SVP HESQ **indirectly reports to the CEO** via the EVP Global Plants and Operational Excellence

→ Reports are fully embedded and made **accessible to all HESQ employees**

***Case study context:***

Yara launched a Safe by Choice Program 10 years ago which led to the emergence of a **Health, Environment, Safety and Quality (HESQ)** company group.

**Figure 30:** Model illustrating Yara's HESQ and wider sustainability workflows




Source: Yara[55]

*F.*

# Adaptation planning

→ *Develop a flexible adaptation plan to navigate climate impacts and build organizational adaptative capacity*

# F. Adaptation *planning*

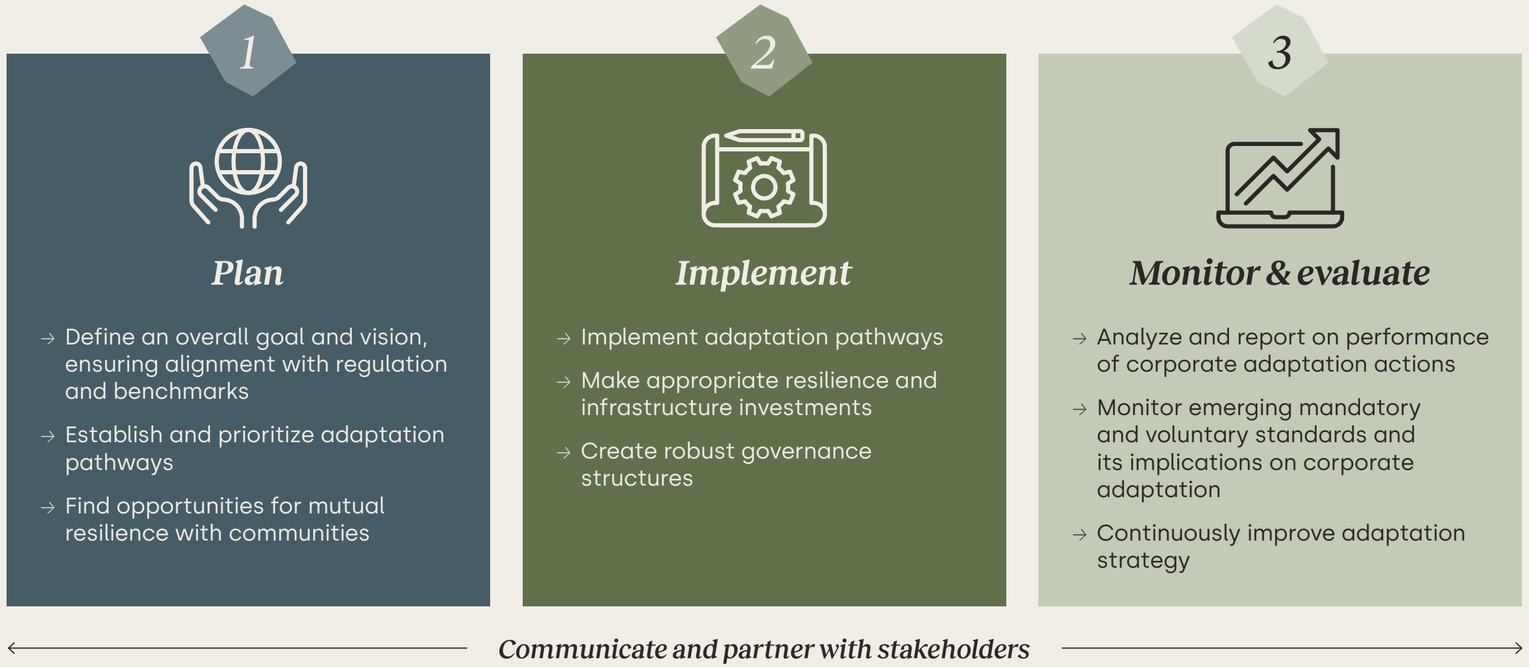
***Adaptation planning helps an organization understand the actions and investments needed to manage physical risks and opportunities***

## Definition and pillars

***Adaptation plan***

An actionable plan to navigate the uncertainty of emerging climate impacts by changing business models, processes and practices to reduce risk and unlock opportunities associated with climate change across a company's value chain.

**Figure 31:** The three key stages of creating a business adaptation plan




## Adaptation planning uses

Adaptation plans are a key **tool for building business resilience** and managing climate-related risks and opportunities. The TCFD[56] recommends the inclusion of adaptation plans as a core component of a business climate strategy, alongside transition plans and they are expected to become mandatory for some jurisdictions as early as 2024.[57]

By developing an adaptation plan, business leaders can identify and set an organizational **goal on adaptation** and increase organizational **adaptive capacity.**

Businesses can use an **adaptation pathways approach** (next page) to understand the adaptive options available to respond to climate risk and **proactively plan adaptation action and investment.** The plan can be applied in different geographies to understand how a business can adapt to changing physical risk over time.

A full methodology is beyond the scope of this guide. However, WBCSD will publish further guidance in 2025.

## *Businesses can navigate uncertain climate impacts by using a flexible adaptation pathways approach*

An adaptation pathway strategy consists of a sequence of decision-points over time, which are triggered by change; selection of an option is based on analysis of the future situation and knowledge available and assessed as a business case with goal of preventing risk

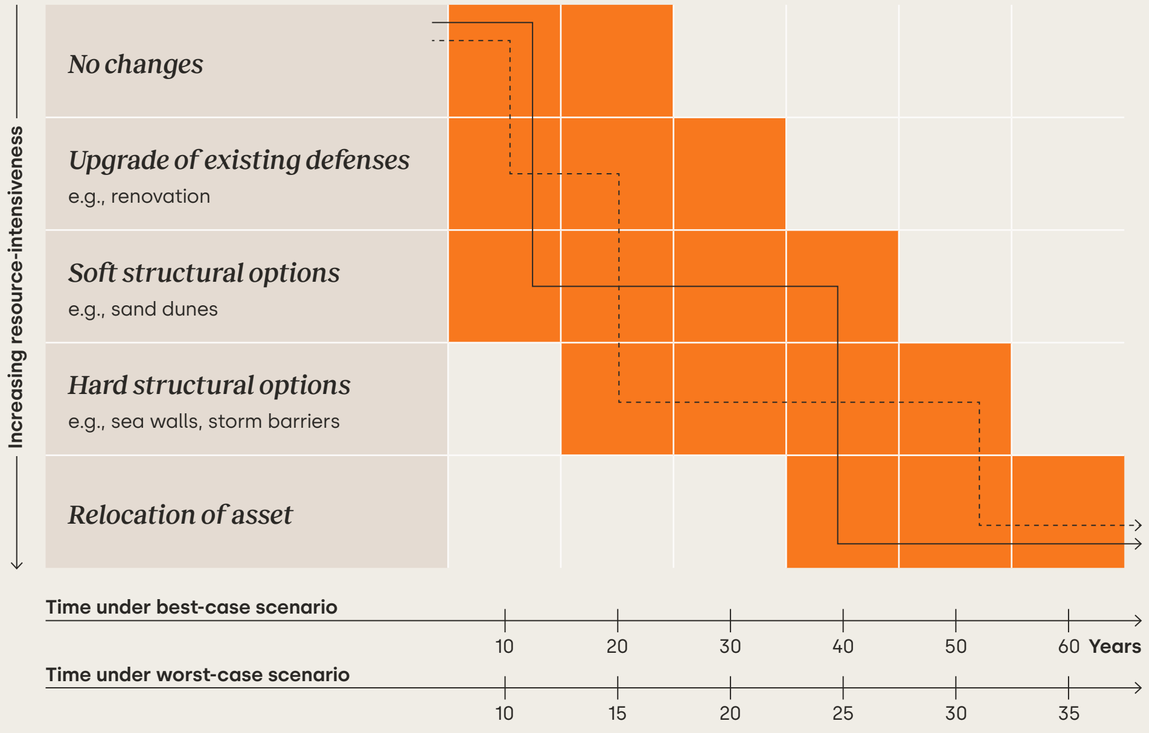
### Advantages of pathways approach

1. **Can help appropriately tailor decisions and actions**
   Trigger points are set at requisite future points, removing urgency
2. **Events, not time, are the bases of decision-points**[54]
   Reduces uncertainty and allows for action to be taken at appropriate point
3. **Can reflect changes in local circumstances**
   Flexibility encompasses both environmental and social changes
4. **Options are kept open until more support is available**
   Higher impact and cost actions can gather funding
5. **Enables learning along the adaptation journey**
   Past decision-making can inform future decision-making

Source: WBCSD; Bain; CoastAdapt[58]

**Figure 32:** An example of applying adaptation pathways to determine flood defense requirements for a manufacturing facility over different time horizons.

**Illustration of flood defense pathways for a plant**




→ Decision-points are event-based (e.g., in response to a physical risk event, change in business strategy or updated climate scenarios for example); timing is indicative

*Case Study*

## *Copenhagen Infrastructure Partners (CIP) works with Swiss Re to improve climate resilience of their portfolio & new investments*

### Evaluation of existing portfolio and new investments

→ Leading renewable energy **investment firm,** had a recently developed solar site **impacted by a natural catastrophe**

  – Works with Swiss Re to gain insights to screen asset portfolio for physical risk

→ Moved to integrate **climate risk insights into decision-making** to ensure the realization of new renewable energy projects

  – Assessments are used to inform both future development designs and due diligence processes

  – Upload investment portfolio and technology information to create a single source of information across teams

### Greater resilience of the asset portfolio

→ Future adaptation measures are now factored in with the **choice of new asset sites** and throughout the **planning and construction process** (e.g., flood protection for battery storage plants)

→ **Technical modifications** to future products are also considered (e.g., installation and mounting designs, as well as additional hail-resistant solar modifications)

*Case study context:*

CIP is a global leader in renewable energy investments and makes significant and meaningful contributions to the green transition. By leveraging the Natural Catastrophe Models and Climate Risk Scores produced by Swiss Re, CIP evaluates climate risk of existing and new investments to enhance greater resilience

Swiss Re

*Case Study*

## *Swiss Re worked with a global energy group to empower them to strategically plan for climate risk and implementation*

### Empowering a wider team to plan for climate change

→ The global APAC-headquartered energy group has been increasingly affected by extreme weather, flooding, and other perils across its portfolio

→ They recently developed an overall strategy on climate risk management, focusing on financial impacts of physical events to key regions

  – Flood risks were a key consideration, worked with Swiss Re to build future flood loss models for high risk sites to help prioritize investments

### Strategic approach to climate risk across the company

→ Risk engineers across Swiss Re and the client worked together to identify potential adaptation investments using simulation technology

  – Investments were prioritized by identifying locations driving highest potential losses in climate models

  – First risk management measures have since been implemented

*Case study context:*

Swiss Re developed Natural Catastrophe models and Climate Risk Scores for internal underwriting purposes, and now teams up with clients to share this knowledge to foster greater resilience. A global APAC-headquartered energy group uses Swiss Re's models to strategically manage the financial impact of climate change.

*G.*

# Business opportunity

→ *Identify new climate-resilient business opportunities through risk management and transformative adaptation*

# G. Business *opportunity*

***Identify and prioritize physical risk opportunities, which can range from incremental innovation to new business building***

**Stage-based process to identify and select opportunities**

**Figure 33:** Process for selecting adaptation-related business opportunities

1. Identify commercial opportunities arising from physical risk (e.g., new technologies, products and services)
2. Prioritize new business opportunities based on accessible value and ability to win, while screening out maladaptive opportunities*
3. Develop the business case for investment, which is more challenging given physical risk uncertainties

→ An example of a maladaptive opportunity is construction in high-risk flood zones due to lower land costs

**Business opportunities can range from incremental actions to building an entirely new business alongside the core**

**Figure 34:** Business opportunities for adaptation are divided into three categories

| *Incremental* | *Transformative* | *Disruptive* |
|---|---|---|
| **Small, gradual improvements** to existing products to further incorporate physical risk | **Substantial additions** to existing products representing a shift in approach to managing physical risk | Reimagining of the business model to create a completely **new, revolutionary product** focused on physical risk |
| ADT[59] and SimpliSafe[60] have incrementally expanded home security offerings to include **features that address** physical risks (e.g., fire and flood monitoring) | Bayer[61] acquired The Climate Corporation**, which uses data analytics and Machine Learning to provide farmers with **real-time weather and climate information** to optimize crop yields and minimize risk from extreme weather events[62] | Danish start-up Third Nature[63] has developed a new product, Climate Tile, which can collect and divert large amounts of rainwater and hence **reduce damage to cities caused by heavy rainfall** |

**Notes:** *Maladaptive opportunities refer to opportunities that may appear beneficial or profitable in the short term but ultimately contribute to heightened physical risk or diminished adaptation and resilience to physical risks; **Acquisition was indirect as Bayer acquired Monsanto in 2018, which had acquired The Climate Corporation in 2013

1 *Opportunity identification*

## *Adaptation-related opportunities span technological advancements, products and services to help with adaptation and risk management*

**Figure 35:** Example adaptation-related opportunities for four sectors (non-exhaustive)

| | *Agriculture* | *Technology* | *Chemicals* | *Automotive* |
|---|---|---|---|---|
| ***Technology advancements*** Innovations in software and data-driven solutions to help manage physical risks | → Data analytics for weather changes and events<br>→ Agriculture technology (AgTech) platforms for supply chain optimization<br>→ Online procurement marketplaces | → Advanced data backup and recovery systems to protect data during climate events<br>→ Artificial intelligence (AI)-powered automatic response platforms for emergencies<br>→ Early warning systems for hazards | → Industrial internet of things (IoT) systems that shut down chemical processing systems during extreme physical events | → Advanced driver assistance systems to reduce accidents during extreme weather events<br>→ Inter-vehicle communication systems to enhance safety in weather events |
| ***Products*** Physical goods or devices that help companies or consumers adapt to emerging risks | → Novel food farming alternatives (e.g., insects)<br>→ Innovative irrigation and drainage systems<br>→ Disaster-resilient farm equipment | → Backup mobile data centers that can be deployed in the event of physical risks<br>→ Solar microgrids that can provide power during outages | → Advanced safety equipment and containment systems to prevent spills under duress<br>→ Improved chemical processes to reduce resource intensiveness | → Bi-directional charging electric vehicles for backup power generation<br>→ Vehicles with shatter-proof glass and other 'hardened' materials |
| ***Services*** Services to help businesses and governments effectively manage physical risks | → New farm services (e.g., irrigation as a service)<br>→ Soil health improvement programs<br>→ Regenerative agriculture consulting services | → Takeback programs to enable responsible end-of-life product management | → Water treatment to enable water reuse in water-stressed production areas | → Vehicle refurbishment to enhance climate-resistance<br>→ Takeback programs to enable responsible end-of-life product management |

Source: Bain

## 2 Opportunity prioritization

***Organizations should prioritize opportunities based on potential business value, including impact to resilience and ability to deliver***

**Figure 36:** Adaptation-related opportunity prioritization mapping

### *Business value**

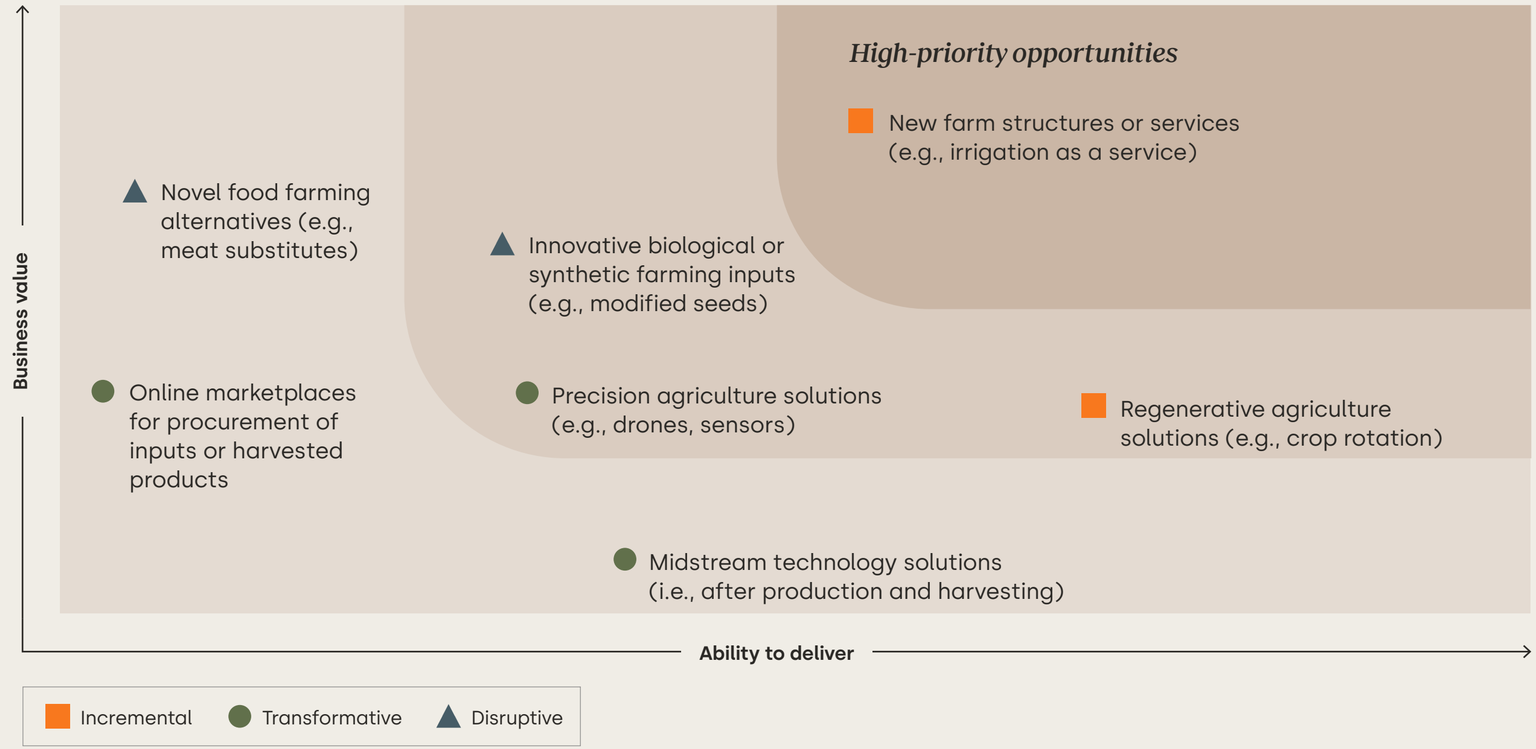
- → Resilience impact
- → Market size and growth
- → Addressable spend
- → Potential resiliency impact
- → Alignment with broader ESG goals
- → Regulatory environment
- → Community need

### *Ability to deliver*

- → Overlap with existing offering
- → Competitive landscape
- → Partnership / M&A potential
- → Technological advantages

**Example opportunities shown for crop producer in the agricultural industry**

*Examples / Not exhaustive*




**Note to reader:** Important to screen out maladaptive opportunities, which may offer short-term revenue but do not enhance overall adaptation to physical riskCruncher, Tracxn; physical risk.

**Note:** *Ranking for business value linked to level of venture capital (VC) funding in 2022 | Source: Bain, Crunchbase, Bain Startup Investment Cruncher, Tracxn.

## 3 Business case development

***Business cases should be categorized into three distinct opportunity types to allow for easier investment sign-off***

### *No-regret moves*

Decisions that are likely to create value under most/all climate scenarios

### *Measured bets*

Decisions with uncertain outcomes that create options that are either valuable under many climate scenarios **and/or** support critical learning

### *Big bets*

"One-way door" decisions, for which climate scenarios present conflicting views, requiring significant conviction in the future state

**This categorization ensures the right decisions are made, in the right sequence and at the right pace to capitalize on all "measured bets" and "big bets", without holding up investment for "no-regret moves"**

Source: Bain & Company strategy under uncertainty framework

## *Building a business case for adaptation comes with several challenges; companies are adopting new tools to aid decision-making*

**Figure 37:** Building the business case for adaptation

| *Common challenges* | *Emerging tools to help address* |
|---|---|
| **Risk-adjusted return on investment (ROI) uncertainty**<br>It is difficult to accurately size financial and non-financial impact of opportunities, given uncertain scale of future physical events | **Consider extreme but plausible scenarios**<br>→ Represent extreme but plausible end-states to capture edge all potential outcomes<br>→ Account for interconnections and linkages between change vectors<br>→ Clarify which variables matter the most (and therefore what you set signposts on) |
| **Timing ambiguity**<br>Investment decisions are hindered by long-term timescales for both value creation and risk, with precise moment to act unclear | **Identify trigger points, signposts and metrics**<br>→ Provide options in line with different climate scenarios, highlighting most probable scenarios<br>→ Drive strategic choices (including "stop and redeploy") and/or course corrections |
| **Strategic decision complexity**<br>Multiple potential strategies to address downside risk or pursue opportunities, difficult to choose most effective approach | **Incorporate flexibility and optionality into strategic choices**<br>→ Explicitly capture the value of any "real options" created (or destroyed)<br>→ Recognize the implicit value of flexibility in an uncertain physical environment |

**Note to reader:** This framework applies to business cases for both pursuing opportunities and adaptation investments

Source: Bain & Company strategy under uncertainty framework

*Case Study*

## *Ford and Tesla both identified opportunities to develop backup power sources for customers to rely on during power outages*

*Case study context:*

Physical risk causing more regular power outages due to both damages to electrical infrastructure caused by extreme weather events as well as increased electricity demand due to higher temperatures. Companies are adapting product offerings to capitalize on new demand for backup sources of electricity.

### Ford

→ Ford adapted to customer interest in backup generators by **adding functionality to an existing product** (F-150)

→ In 2021, Ford unveiled an electric version of its popular F-150 pickup truck called the Lightning[64]

→ The F-150 Lightning can act as a **backup generator for up to 3 days**


### Tesla

→ Tesla **developed a new product** seeking to address customer interest in backup power generators

→ Tesla introduced a **rechargeable home energy storage** product in 2015[65]

→ The Powerwall is **compatible/integrated with solar panels** and automatically activates in power outages[66]

Source: Bain; The New York Times, Tesla.

*Case Study*

## *Wine Co diversified into new regions and grape species to unlock new opportunities and increase resilience*

### 1. Initial awareness

→ Wine Co previously focused on the impact of **short- to medium-term weather forecasts** on its expected yields

→ It was, however, aware that some regions (e.g., California) are **subject to significantly more future physical risk** than others (e.g., Northern France)

### 2. Project risk

→ Wine Co worked with Jupiter to **project future physical risk** of its growing regions

→ These projections were of **longer-term horizons (20-30 years), across key business-relevant perils:** heat, drought, precipitation and wildfire

Source: Jupiter Intelligence

*Case study context:*

Wine Co is a major US-based wine producer with a global footprint of wineries and vineyards. Wine quality is closely linked to weather and land investment decisions typically require multiple decade-long commitments, making Wine Co very sensitive to the long-term climate impact on its growing portfolio.

**Based on the analysis, Wine Co considered several diversification actions**

Investing in **new growing regions** in Europe

Enhancing **grape species selection** to adapt to future climate conditions

**Rebalancing wine growing portfolio** to favor less climate-impacted growing regions

*Case Study*

## *Bayer is developing new climate-resilient corn plants to support resilient agricultural systems*

### Opportunity awareness

→ Bayer views its **product range and innovative capability** as an enabler to explore new sales opportunities[67]

→ It is **enhancing its analytical capabilities** and **expanding its climate models** in order to be in a better position to identify future challenges and opportunities

### Opportunities considered

→ Plants with increased resistance to extreme weather conditions[68]

→ FieldView **digital farming platform** improving farmer response to extreme weather

→ Potential **increased demand for cardiovascular disease products** due to higher temperatures and heatwaves

*Case study context:*

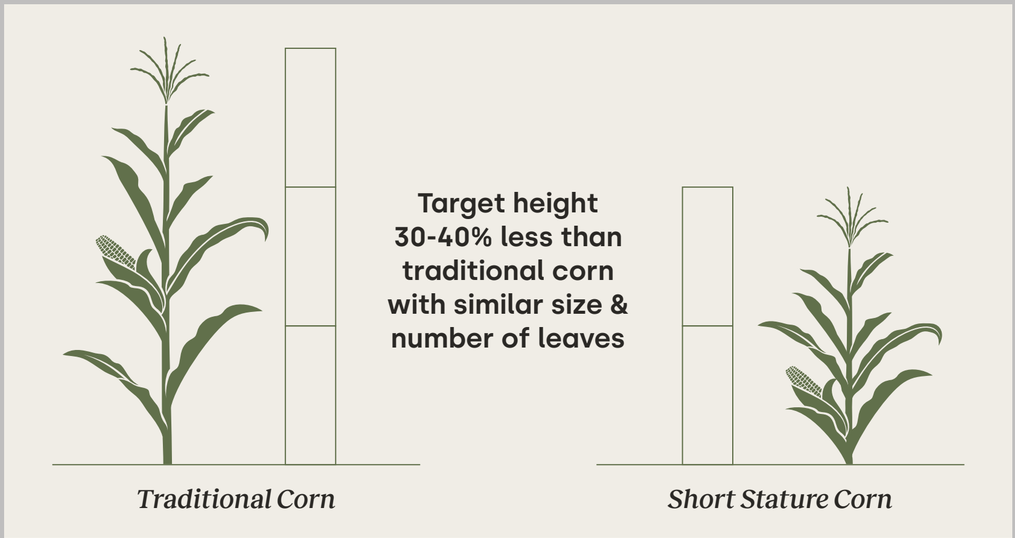
Bayer is a German multinational pharmaceutical and biotechnology company. In 2022, it conducted risk and opportunity analysis on climate change effects from various perspectives, including physical impact.

### Opportunity example – Short-stature corn

→ Damaged **plants from weather events** amount to **between 5% and 25% a year in the United States**

→ Bayer has developed **seed varieties** that enable the growth of **shorter corn plants**

**Figure 38:** Shorter corn has stronger stalks that are less likely to bend




Source: Bayer

*H.*

# Align portfolio with adaptation strategy

→ *Define the vision and goals for climate adaptation and resilience in your business and align with business strategy to enable proactive action*

# H. Align portfolio with *adaptation strategy*

***The CEO is accountable for integrating adaptation into all pillars of company strategy...***

**Figure 39:** Bain & Company sustainable value creation framework applied to adaptation and resilience


*Employees and suppliers*

**Care for employees and suppliers and increase their resilience**

e.g., benefit employees and suppliers' resilience by providing adaptation training

*Risk*

**Prevent value destruction**

e.g., prevent business interruption by enabling COO to build redundancy of sites and assets

*Revenue*

**Prioritize opportunities and invest into a more resilient portfolio**

e.g., climate resilient crops, climate advisory business, resilience financing

*Regulation*

**Stay ahead of changes**

e.g., empower CFO to pre-empt mandatory TCFD reporting

*Community*

**Support local communities and improve brand perception**

e.g., benefit community resilience by providing access to resilient systems at discounted rates

*OpEx and CapEx*

**Allocate resources to further adaptation and resilience**

e.g., allocate CapEx to infrastructure "hardening" and emergency repair spare-parts in accordance with physical risk

*Capital*

**Secure financing to advance adaptation measures**

e.g., obtain better loan rates and higher multiples from lower portfolio physical risk

Source: Bain

## *...and will play three overarching roles to help achieve this*

**Figure 40:** Bain & Company CEO decision-making framework can support CEOs to act on adaptation

### *Visionary*

**Commit to act,[69] inside and outside company walls**

- → Publicly signal and affirm commitment to act for community climate adaptation and resilience
  - – Consider joining existing campaigns (e.g., **Race to Resilience** public pledge for 2030 action)
- → Make the case for why adaptation matters to the company
- → Paint the vision for the company's future and rally motivation to get there

### *Strategist*

**Set priorities for internal and external action**

- → Take a strategic approach to identifying the internal and external actions the company should take to drive adaptation and link to company strategy
- → Craft the narrative and onboard key stakeholders (e.g., board, investors)
- → Initiate partnerships to accelerate execution and cover capability gaps

### *Coach*

**Maintain accountability for progress**

- → Make sure line leaders own appropriate initiatives and are incentivized and empowered to make decisions to drive adaptation
- → Refine and adjust strategy as needed based on learnings and emerging industry best practices
- → Consistently share actions taken and progress made with key stakeholders (e.g., board, shareholders, public)

Source: Bain

## *As part of each role, the CEO is responsible for distinct activities that will help the organization define, prioritize and achieve adaptation goals*

**Figure 41:** Activities the CEO is responsible for as visionary, strategist and coach

### *Visionary*

**i. Point of departure**

→ Strategically interpret insights gathered from prior activities to discern baseline for risk, adaptation and resilience

→ Chart a forward-looking vision outlining a clear path to resilience

**ii. Ambition and targets**

→ Set value creation ambition for the company linked to emerging frameworks

→ Cascade ambition into quantified, stretched commitments and targets / KPIs

→ Drive buy-in and commitment from key leaders across the organization

### *Strategist*

**iii. Choices and priorities**

→ Identify and categorize material areas of opportunity, supporting the development of delivery and monetization plans

→ Align initiatives with company strategy by prioritizing for holistic value creation potential and ethical approach

**iv. Enablers**

→ Support identification of capability and technology gaps to deliver against plan

→ Oversee the identification and expansion of strategic ecosystem partnerships required to fulfil the company ambition

→ Set aside resources to upskill workforce

### *Coach*

**v. Flexible roadmap**

→ Provide strategic oversight in development of execution plan to reach ambition, including owners and timelines

→ Define metrics to track performance vs. targets and support creation of dashboard linked to internal workflows

**vi. Execute**

→ Assess and, if necessary, align operating model to empower and incentivize employees to support adaptation

→ Engage internal and external stakeholders through strategy-focused communication plan

Source: Bain

*Case Study*

## *Beverage Co* linked its executive bonus package to performance against climate adaptation and risk-related KPIs*

**Figure 42:** Example of applying the sustainable value creation framework within a consumer goods company to integrate adaptation action across different business areas

### *Visionary*

**Adaptation**

→ Reducing vulnerabilities to the impacts of climate change by incorporating climate risk and adaptation in business continuity plans and risk management processes

### *Strategist*

**Risk**

Resilience planning to drive systematic change and protect operations and supply chain against heat, storm, flood and drought

**Regulation**

Completed an updated climate scenario analysis in line with TCFD recommendations

**OpEx and CapEx**

Sustainability Capital Expenditures Fund for investment in adaptation projects

**Revenue**

Positive agriculture strategy to improve crop resiliency in partnership with farmers

**Community**

Water replenishment work in high-risk watersheds helps to support a secure water supply for communities

**Capital**

Green Bonds (USD $2.25 billion senior notes offering) issued to help fund sustainability initiatives

### *Coach*

→ Executive officers have **annual strategic objectives** that are aligned to Climate Action Strategy agenda and climate risk-related KPIs

→ Performance against these is evaluated for each executive officer, impacting the **payout of the annual incentive award**

Source: Bain

*Case study context:*

Beverage Co acknowledges that growing physical events from climate change pose a significant risk to its business and surrounding communities. The company estimated that the financial impact of chronic temperature changes alone could be over USD $1 billion, through direct impacts (e.g., cooling costs), indirect impacts (e.g., health concerns and employee productivity) and value chain impacts (e.g., supply disruptions).

*Case Study*

## *EDF Group's adaptation strategy is driven at the highest governance level*

**Figure 43:** EDF's strategy integrates adaptation across key business operations

### *Visionary*

- → EDF Group has a **CSR Policy with a specific commitment regarding adaptation to climate change,** validated by the Executive Committee of the Group
- → The **CEO is the driver of the strong climate ambition within EDF Group,** with climate adaptation and mitigation handled at the same level

### *Strategist*

**Risk**

All key entities have elaborate adaptation plans, which were presented and validated in the CSR Strategic Committee

**Regulation**

The CEO co-chairs an external stakeholder committee which includes 2 IPCC authors

**OpEx and CapEx**

All major investment decisions of EDF group are evaluated based on contribution to climate adaptation

### *Coach*

- → EDF Group has appointed **two Climate point persons** within its ExCo and Board of Directors
- → The management of adaptation by EDF Group was **subject to an internal audit in 2021 to ensure that the climate risks were properly managed** at the corporate level as well as at the businesses level

Source: EDF

***Case study context:***

With facilities with lifespans over 40 years, EDF Group's assets are particularly exposed to physical risk. Past physical events (e.g., 2003 France heatwave, Storm Lothar, Cyclone Martin) had considerable material impact on networks and productivity, leading to EDF Group identifying climate risks as a business priority in 2018. The company has since developed an adaptation strategy that sees physical risk managed at the highest possible level of governance.

*I.*

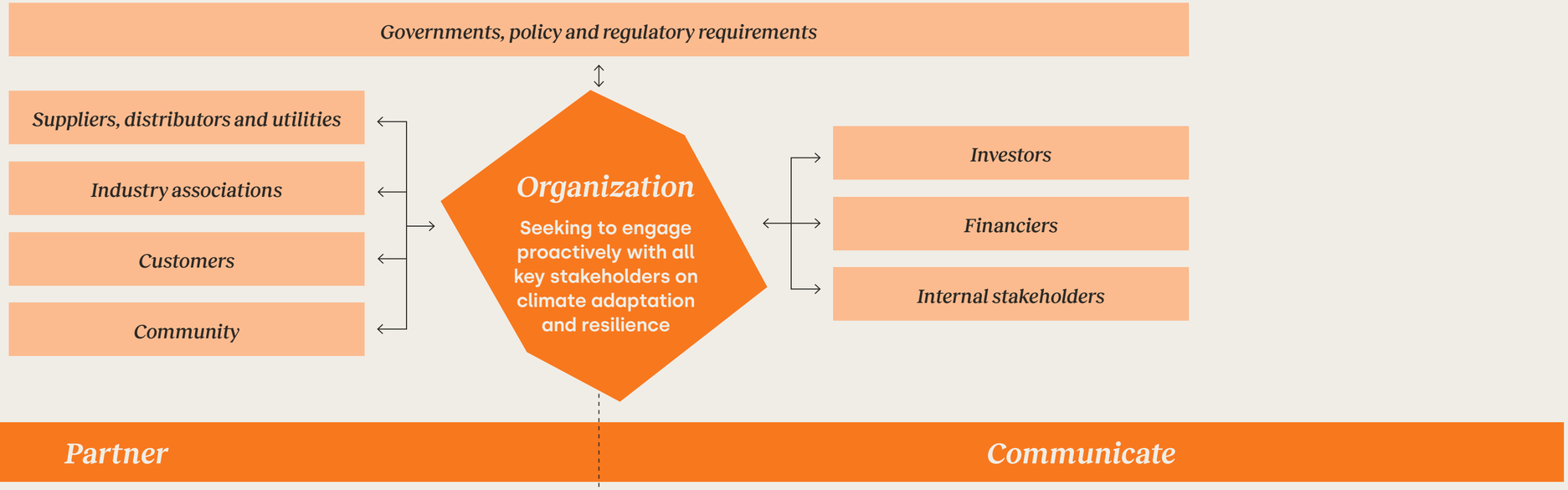
# Stakeholder engagement

→ *Build global and local partnerships for collective resilience through continuous stakeholder engagement*

# I. Stakeholder *engagement*

***Leading CEOs recognize the need to be proactive in stakeholder communications and in collaborating with ecosystem partners***

**Figure 44:** Diverse stakeholder groups must be engaged through partnerships and communications to effectively address adaptation




Partner to **increase understanding** of physical risks and opportunities and **build shared resilience**

- → Bridge gaps in technologies and capabilities through stakeholder partnerships
- → Engage early and proactively to address emerging risks before crises develop
- → Demonstrate leadership by taking initiative in collaborative efforts and advocating for robust adaptation measures

Communicate to **increase awareness** of physical risks and opportunities and **promote confidence** in company resilience

- → Update shareholders whenever there are material changes in physical risk, asset exposure and/or vulnerability and how the business is responding
- → Stay attuned to stakeholder expectations and demands for transparency
- → Introduce a section on physical risk adaptation in annual and/or sustainability reports to provide a comprehensive overview
- → Implement internal employee training programs to enhance knowledge and readiness for adaptation measures

Source: Bain, Jupiter Intelligence; WBCSD

## *The nature of engagement naturally varies across key stakeholders*

**Figure 45:** Objectives of engagement vary across different stakeholder groups

| | *External* | | | | | *Financial* | | *Internal* |
|---|---|---|---|---|---|---|---|---|
| | *Gov. and regulatory bodies* | *Suppliers, distributors and utilities* | *Industry associations* | *Customers* | *Community* | *Investors* | *Financiers* | *Employees* |
| *Goals for engagement* | → Address physical risk while leveraging **gov. support**<br>→ **Influence regulatory developments** to support desired outcomes | → **Knowledge share** on best adaptation practices<br>→ Co-create adaptation plans to **improve joint resilience** | → Contribute to open dialogue and join initiatives to build **industry-wide resilience**<br>→ Leverage **pooled influence** on further adaptation ambitions | → Understand demand for new solutions and services to **meet evolving customer needs**<br>→ Improve **customer perception** by showcasing adaptation leadership | → Foster **relationships with communities** to better understand risk<br>→ Collaborate on joint resilience solutions **beyond purely commercially-driven** decisions | → Communicate impact of **physical risks and opportunities on organization's strategy**<br>→ Notify any **material changes in company risk profile** | → Give assurance on **physical risks for capital investments** being made<br>→ Present physical opportunities to **secure needed investment** | → Share plans to **support and protect employees** from physical risk<br>→ Educate and engage employees on **company's adaptation agenda** |
| *Example engagement points* | **Mining Co**<br>Joined US National Mining Association ESG taskforce to help develop joint perspective and shared solutions on physical risk | **Pharma Co**<br>Supplier outreach to ensure physical risk resilience built into broader business continuity plans | **Insurance Co**<br>Joined insurance coalition focused on advancing research, advocacy and initiatives to reduce losses from natural disasters | **Utility Co**<br>Worked with customers to incentivize building energy storage capacity with an investment funding program | **Mining Co**<br>Presented findings from flood vulnerability study to local council, advocating for shared flood defense systems | **Power Co**<br>Collaborated with investors to assess physical risk implications of acquiring renewable energy portfolio | **Mining Co**<br>Obtained revolving credit facility with interest rate tied to external measure of physical risk resilience | **Chemical Co**<br>Encouraged employees to read and understand climate physical risk reports and assessments |

*Case Study*

## *Driven by senior leadership, companies across various industries have supercharged their strategies through partnerships with relevant stakeholders*

***Case study context:***
Companies have combatted value chain physical risks, furthered industry resilience, accessed resources to build resilience and built shared resilience by collaborating with value chain partners, other industry players via associations, authorities and communities, respectively.

**Figure 46:** Several companies have engaged different stakeholders to build shared resilience

### *Value chain partners*

Evaluate gaps and potential holistic solutions to increase upstream and downstream resilience

Coca-Cola partnered with Mexican bottler Arca Continental to address water scarcity risk in Mexico, implementing water saving measures and community programs[70]

### *Industry associations*

Leverage pooled influence to drive progress in industry-wide adaptation efforts

Food Drink Europe, a coalition of many Consumer-Packaged Goods companies, advocated for the inclusion of regenerative agriculture as a pillar of the new EU Soil Health Law, including calling for incentive schemes[71]

### *Authorities/policy-makers*

Proactively engage government bodies and policymakers to access further resources and advocate for investment

After climate events led to losses in Germany, BASF worked with the German Federal Institute for Hydrology to improve water level forecasts used in its early warning system[72]

### *Community*

Engage and support local communities around sites to build mutually beneficial adaptation solutions

Anglo American is working closely with local communities to adapt against wildfire risk in Brazil, including educational programs and fire detection systems[73]

Source: Bain, WBCSD, Arca Continental, Food Drink Europe, BASF, Anglo American

→ Deep dive on Anglo American's community engagement efforts follows

*Case Study*

## *Anglo American develops programs and conducts research to protect local communities*

### The Social Way system[74]

→ First developed 15 years ago, the core is the identification, assessment and management of social and human rights impacts and risks

→ Policy integrates social performance management into core business planning and management processes and is relevant to all employees, contractors and suppliers

*Case study context:*

Anglo American developed The Social Way, a management system for social performance, which includes engaging local communities to collectively respond to physical risk.

**Figure 47:** Examples of engagement with ecosystem partners to build shared resilience

### Working with local communities to combat wildfires in Brazil

→ Forest fires in area around Brazil iron ore operation threaten mining operations and pose risks to community health and safety

→ 1400 hectares burned in Sept 2019 alone, with wildfires expected to increase by 17-30% by 2040 due to climate change

→ Anglo developed a fire management strategy in collaboration with local communities

- Introduced prevention measures on-site, such as biomass clearing
- Educational program for both employees and community members in the local area

### Conducting research on climate change impacts on local communities in Chile

→ Area around Chile copper operation is at risk from climate change impacts, such as wildfires, heatwaves and drought

→ Anglo leveraging partnerships to better understand climate change impacts and to design more holistic adaptation solutions

→ Worked with the Pontificia Universidad Católica de Chile's center for Global Change to analyze the impact of climate change on local communities

- Direct: e.g., impacts of heatwaves on mortality
- Indirect: e.g., changes in availability of water

Case Study

## *Southern California Edison collaborated with communities and customers in a multi-pronged approach to resilience*

### Impacts of climate change on SCE

→ **Assets**

– 2017 and 2018 wildfires cost SCE over USD $7 billion in repairs and third-party liabilities[75]

→ **Natural resources**

– 2015 drought resulted in 80% reduction in generation capacity for hydropower facility[76]

→ **Customers**

– Wildfire concerns in 2021 forced SCE to mandate power shutoffs for 70,000+ customers[77]

→ Other events affected natural resources, suppliers, infrastructure and communities

*Case study context:*

SCE, a US-based utility company, experienced the effects of climate change across its full value chain for decades, prompting engagement with various stakeholders to build shared resilience.

### Communities

→ In 2021, SCE established the Climate Resilience Leadership group to improve engagement with Disadvantaged Vulnerable Communities[78]

→ SCE became a California Resilience Challenge sponsor, partnering with the Bay Area council to award climate adaptation grants[79]

### Developers

→ New Home Energy Storage Pilot is a program that provides funding for new home developers to install energy storage systems[80]

→ These systems can run essential appliances during an emergency

### Businesses

→ Businesses can apply for energy storage system programs

→ They also have access to additional programs connecting solar panels back into the grid, creating shared resilience for all

→ SCE also partners with GoGreen Financing to provide access to up to USD $5 million for energy-efficiency improvements[81]

*Case Study*

## *Nestlé has engaged farmers and suppliers to reduce water-related risk in the agricultural stage of its value chain*

### Identifying and prioritizing water risk...

→ The Nestlé Responsible Sourcing Standard requires suppliers to comply with a set of legal and environmental requirements, including for water[82]

→ In addition, Nestlé conducts assessments of current and future risk to identify weak points in its value chain

→ Annual assessment of current risk using water stress index combining results from four publicly available tools

→ Future water trends and risks using Aqueduct*

→ Commodity footprints using Water Footprint Network methodology

→ Benchmarking results allows Nestlé to accurately identify risk and prioritize actions

*Case study context:*
Water is a key component in Nestlé's value chain, particularly in agriculture. Nestlé engages different stakeholders in order to protect, renew and restore water within its ecosystem.

### ...leading to highly tailored local partnerships and solutions

**Farmers**

→ In Pakistan and South Africa, Nestlé works with dairy farmers to implement use of water sensors and develop water-saving techniques for animal feed production

→ In Vietnam, Nestlé has trained thousands of farmers on best irrigation practices

**Suppliers**

→ In Extremadura (Spain), agriculture is responsible for 90% of water use and rains are seasonal and scarce

→ Nestlé worked with stakeholders throughout the local tomato supply chain to improve water use techniques, e.g.,

  – New technologies such as buried irrigation

  – Analyzing the soil to optimize fertilizer use

→ Water consumption has reduced dramatically since 2012, helping Nestlé facility to become first European food factory to achieve AWS** gold-level certification

**Notes:** *Aqueduct is a tool of the World Resources Institute; **Alliance for Water Stewardship

*04.*

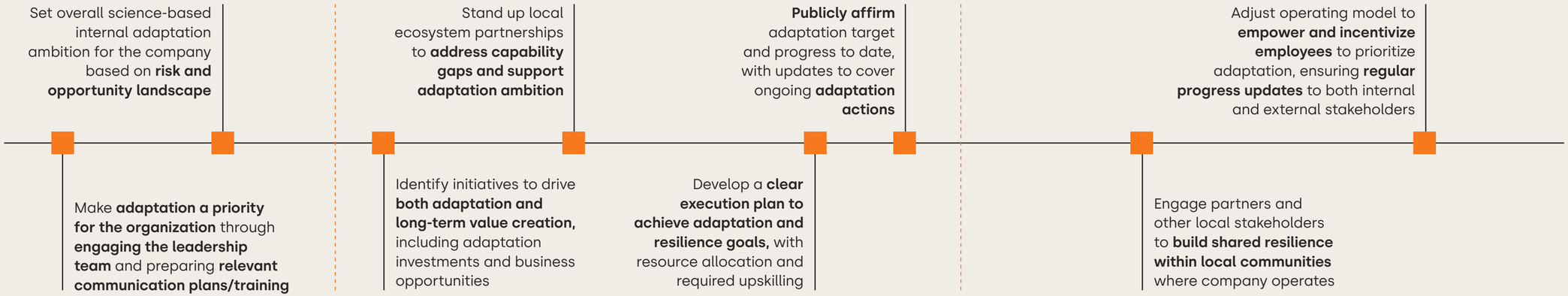
# Climate adaptation maturity assessments for business leaders

→ *Assess the maturity of your organization's approach and understand the immediate next steps*

# Climate adaptation maturity assessment *for Chief Executive Officers*

***Assess the maturity of your organization's climate adaptation approach to determine immediate priorities and next steps***

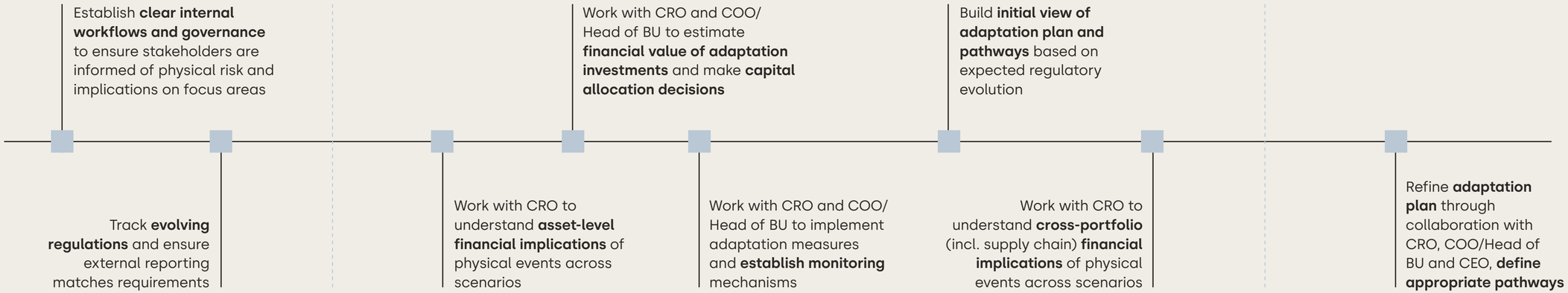
| ***Maturity assessment questions*** | Is the organization aligned on adaptation as a priority, and have we **defined an overall adaptation objective** for the company? | Has the organization developed a **clear path to achieving the adaptation objective** through defining initiatives that will drive adaptation and long-term value? | How well does the organization engage with ecosystem partners to understand perspectives on physical risk and **build collaborative resilience strategies?** | Does the organization leverage its partnerships and influence to **act as a steward for adaptation** within local communities? | Does the organization's operating model support reaching its adaptation targets and are stakeholders updated on progress? |
|---|---|---|---|---|---|
| ***Actions to take*** | ***Doing 'the basics'*** *(6-12 months)* | ***Maturing understanding*** *(+12-24 months)* | | ***Building strategic lens*** *(Ongoing)* | |



# Climate adaptation maturity assessment *for Chief Financial Officers*

***Assess the maturity of your organization's climate adaptation approach to determine immediate priorities and next steps***

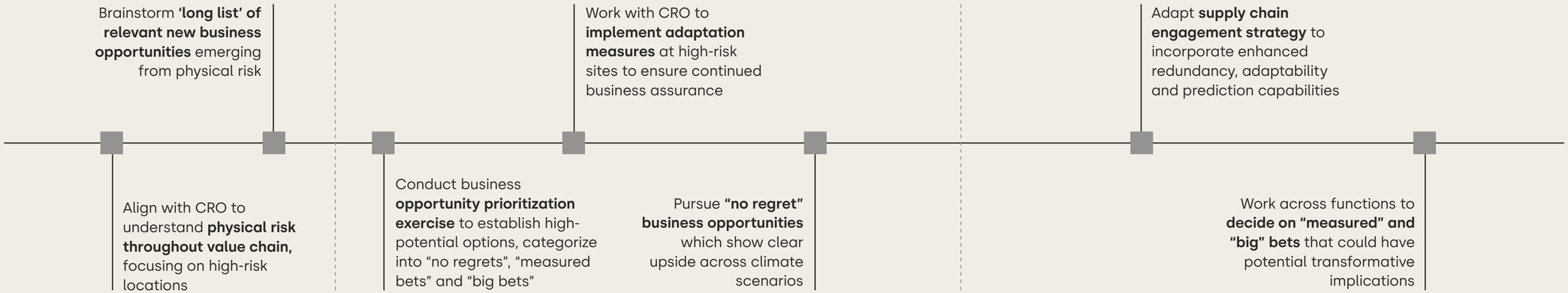
| ***Maturity assessment questions*** | Does reporting comply with **regulations** and are internal stakeholders aware of level of physical risk? | Does the organization understand **financial implications** of identified risks across scenarios? | Is there **collaboration across the business** to ensure appropriate measures to manage risk are identified, with phased investment planned? | Does the organization's understanding of financial implications and necessary adaptation measures span the **wider value chain?** | Do we have a **comprehensive adaptation plan** tied to established regulation, including local perspectives? |
|---|---|---|---|---|---|
| ***Actions to take*** | ***Doing 'the basics'*** *(6-12 months)* | ***Maturing understanding*** *(+12-24 months)* | | | ***Building strategic lens*** *(Ongoing)* |



# Climate adaptation maturity assessment *for Chief Operating Officers & Heads of Business Unit*

***Assess the maturity of your organization's climate adaptation approach to determine immediate priorities and next steps***

| | | | | | |
|---|---|---|---|---|---|
| ***Maturity assessment questions*** | Is the organization aware of **physical risks and opportunities** that could impact operations, as well as specific high-risk sites? | Do 'high-risk' sites have appropriate adaptation measures in place to ensure business continuity? | Do **business cases for high potential opportunities exist** and are "no regret" options being pursued? | Has the organization built in **continuity measures to its supply chain** through outreach and engagement strategy? | Is the organization aligned on potential "measured" or "big" bets that could be **transformative** in the long-term? |
| ***Actions to take*** | ***Doing 'the basics'*** *(6-12 months)* | ***Maturing understanding*** *(+12-24 months)* | | ***Building strategic lens*** *(Ongoing)* | |



# Climate adaptation maturity assessment *for Chief Risk Officers*

***Assess the maturity of your organization's climate adaptation approach to determine immediate priorities and next steps***

| | | | | | |
|---|---|---|---|---|---|
| ***Maturity assessment questions*** | Is the organization aware of **physical risks and opportunities** that could impact operations, as well as specific high-risk sites? | Does the CFO understand **investment required** to increase resilience and is there a well-defined business case process for investment decisions? | Is a **business continuity plan (BCP)** formulated against extreme weather events, including non-quantifiable risks? | Is the organization using insights from risk quantification to inform strategic decisions? | Is the Board aware of level of physical risk and potential **financial implications,** accounting for ongoing adaptation efforts? |

***Actions to take***

| ***Doing 'the basics'*** *(6-12 months)* | ***Maturing understanding*** *(+12-24 months)* | ***Building strategic lens*** *(Ongoing)* |
|---|---|---|
| Partner with risk specialist to identify **high-risk sites** and assess current barriers | Evaluate risk using benchmarks to understand **required investments** and **define business case** for adaptation measures at high-risk sites | Transition to holistic adaptive **strategy** across range of physical risk scenarios |
| Define **scope** for risk identification analysis and collect appropriate data | Work with COO/Head of BU to implement pilot adaptation measures and embed insights into **decision-making process** to aid future investment decisions | Deepen analysis of physical risk on key assets and supply nodes, including non-**quantifiable risks** |
| | | Work with CFO to link risk quantification to **financial implications** on cash flow and balance sheet |

# *05.*

# Annexes

# 05. Annexes

## *Annex 1: Glossary*

→ The entries in this glossary are primarily aligned with the widely accepted definitions provided by the Intergovernmental Panel on Climate Change (IPCC) ((IPCC 20221) or previous UNEP Adaptation Gap Reports (UNEP 20142)

**Adaptation gap** – The difference between actually implemented adaptation efforts and a societally set goal.

**Adaptation** – The process of adjustment to actual or expected climate change and its effects.

**Adaptive capacity** – The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.

**Baseline** – The state against which change is measured.

**Exposure** – The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected.

**Hazard** – The potential occurrence of a natural or human-induced physical event or trend that may cause a loss or damage.

**Impacts** – The consequences of realized risks on natural and human systems. Impacts may be referred to as consequences or outcomes and can be adverse or beneficial.

**Likelihood** – The chance of a specific outcome occurring, where this might be estimated probabilistically.

**Loss and damage** – There is no agreed definition for loss and damage. In practice, loss and damage is commonly understood as the adverse effects of climate change that are not or cannot be avoided by mitigation and adaptation efforts (van der Geest and Warner 20204).

**Maladaptation** – Actions that may lead to increased risk of adverse climate-related outcomes, including via increased vulnerability to climate change, diminished welfare, or increased greenhouse gas (GHG) emissions, now or in the future.

**Mitigation (of climate change)** – A human intervention to reduce the sources or enhance the sinks of greenhouse gases.

**Residual risk** – The risk related to climate change impacts that remains following adaptation and mitigation efforts. Adaptation actions can redistribute risk and impacts, with increased risk and impacts in some areas or populations, and decreased risk and impacts in others.

**Resilience** – The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure. Resilience is a positive attribute when it maintains capacity for adaptation, learning and/or transformation.

**Risk assessment** – The qualitative and/or quantitative scientific estimation of risks.

**Risk management** – Plans, actions, strategies or policies to reduce the likelihood and/or consequences of risks or to respond to consequences.

**Risk** – In the context of climate impacts, the term is often used to refer to the potential for adverse consequences of a climate-related hazard, or of adaptation or mitigation responses to such a hazard. Risk results from the interaction of vulnerability (of the affected system), its exposure over time (to the hazard), as well as the (climate-related) hazard and the likelihood of its occurrence.

**Vulnerability** – The propensity or predisposition to be adversely affected.

## *Annex 2: Methodology*

**This guide was developed by WBCSD, Bain & Company, and Jupiter Intelligence with insights from leading global businesses**

**Figure 48:** Insight and case study collection methodology


*Contributing Companies*

BAYER · DIAGEO · EDF · edp · ENGIE · Meta · MITSUBISHI · Nestlé · PEPSICO · PHILIPS · SWIRE · Swiss Re

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# Acknowledgements

## *Disclaimer*

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The report has been prepared for general informational purposes only and is not intended to be relied upon as accounting, tax, legal or other professional advice.

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The World Business Council for Sustainable Development (WBCSD) is a global community of over 230 of the world's leading businesses, representing a combined revenue of more than USD $8.5 trillion and 19 million employees. Together, we transform the systems we work in to limit the impact of the climate crisis, restore nature and tackle inequality.

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