



Climate Change Adaptation, Risk and Resilience: **A Global Snapshot**

A guide for sectors

June 2024

Foreword

Climate Adaptation, Risk and Resilience are sometimes nebulous concepts.

In this report, we demystify these terms and show “how” and “why” all sectors, and all geographies, are impacted by climate change.

In recent years and across the world, we have experienced firsthand the impacts of worsening weather-related events and the disaster response and recovery that inevitably follows. The economic costs of fires, floods and storms are already into the billions, and if left unchecked, are estimated to reach trillions of dollars in the decades to come.

The economic costs however are only one facet: infrastructure loss and damages, the degradation of our natural environment, widespread social costs, and ongoing cultural losses particularly in the ‘global south’ are all growing, and compounding. The aggregate effect of these impacts is a steadily declining resilience to a changing climate.

It is therefore critical to consider Climate Adaptation Risk and Resilience (CARR), as a suite of measures that are essential to the prosperity of our built, social, economic and natural environments. Maturity in CARR recognises that our current period of disruption demands complex, proactive, and systems-oriented rules of engagement, combined with purposeful integration of the common attributes of effective adaptation. CARR efforts must be paired with effective decarbonisation and overall emissions reduction.

Understanding and applying climate adaptation, risk and resilience approaches will help elevate you as a leader in this era of transformative change, and enable you to protect your important assets.



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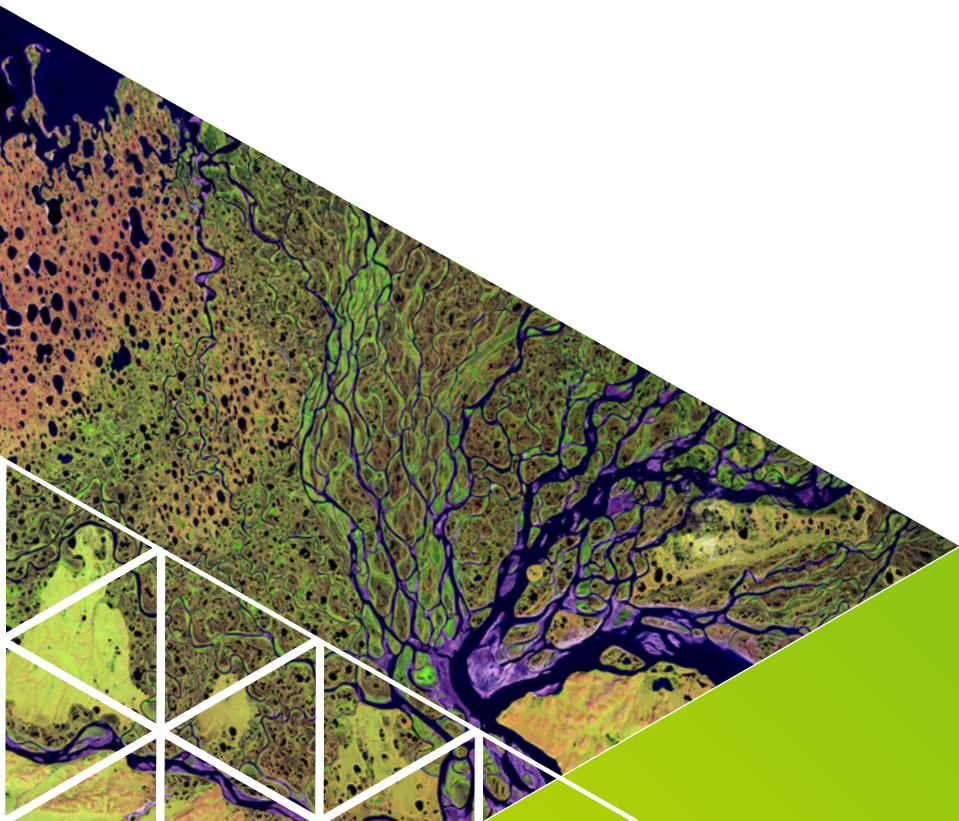


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About this Report

At Deloitte, we understand the immense risk – and opportunity – climate change poses for organisations globally.

As climate change continues to challenge business as usual, we see evidence across sectors of evolving practices to embed CARR solutions into organisational strategy, operations and actions. This report provides a high-level view of five sectors that are relevant to CARR: financial services (with a focus on insurance); energy, resources and industrials (spotlighting mining and utilities); consumer services (highlighting transport and agri-food systems); technology; and government.

Change is inevitable, and history proves that it is the agile organisations and institutions that stay relevant. In this report, discover how to identify and assess climate risk, as well as how sectors are approaching CARR and what shifts lie ahead for their competitiveness amid rapid climate change.

Climate change impacts are escalating. Recent climatic events have led to major disruptions for people, livelihoods, economies, ecosystems, services, resources, infrastructure, and cultural and social assets around the world.

An Introduction to Climate Adaptation, Risk and Resilience

Disaster events, in terms of impact and frequency, are increasing.

Figure 1 provides an overview of the scale and diversity of recent climate events in 2023.



As the world gets hotter, the frequency and severity of climate-related hazards and impacts will continue to increase. Disaster events also face additional, compounding and cascading, challenges, where multiple or concurrent hazards are experienced across multiple points of exposure or vulnerability.

Understanding climate adaptation, risk and resilience can inform decisions and actions, putting downward pressure on exposure and vulnerability, while taking advantage of upside opportunities.

Table 1: Definitions of climate risk, climate adaptation and climate resilience.

Key terms	Definitions
Climate adaptation	In human systems, adaptation is the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. This includes adjusting our behaviour (e.g., where we choose to live), the way we plan our cities and settlements, or how we prepare for disasters and their impacts.
Climate risk	The potential adverse consequences of climate change for human or ecological systems, recognising the diversity of values and objectives associated with such systems. Climate risks can arise from potential impacts of climate change, such as exposure to shifting weather extremes and climate-related disaster events. Alternately, climate risks include human responses to climate change, including regulations and market shifts.
Climate resilience	Resilience is defined as action or actions which seek to foster one or more of the following outcomes: 1) Reducing exposure of assets and other things we value in the built, social, economic and/or natural domains to a hazard or hazards. 2) Reducing sensitivity of assets and other things we value in the built, social, economic and/or natural domains in the event they are exposed to a hazard or hazards. 3) Increasing adaptive capacity, by enabling communities and systems to modify or change their characteristics and behaviours to cope with actual or anticipated stresses. 4) Increasing coping capacity, by enabling communities and systems to use their available resources and abilities to face adverse consequences.

Understanding CARR

Defining climate adaptation, risk and resilience is essential to establish a common understanding when discussing these concepts. Table 1 provides definitions for these key terms.

The following sections further illustrate CARR characteristics.

Climate risk

Climate risks are the impacts that climate change (including the efforts to limit it) have on the things we value (see Table 1). The most robust climate risk assessments will assess these values via mixed methods (qualitative and quantitative), and from there refine priority risk statements. Climate risks are interrelated and dynamic in nature and should be continually reassessed. Climate risks can be defined as physical or transition risks, both of which are underpinned by opportunities (see Figure 2).

Climate risks are also compounded by how they relate to other identified risks, such as economic shocks, or geopolitical instability. Risk interactions can cascade, further amplifying the impacts of climate change.[23]

The climate risk landscape is rapidly changing, due to society now reaching, and in some cases exceeding, global warming thresholds.[24]

At the same time, organisations are now asked to be more transparent about the climate risks that are material to investors and stakeholders, and what is being done to mitigate those risks. This shift in expectations is in part driven by the growing demand for consistency and

comparability in climate reporting and disclosure. It is also increasingly demanded by shareholders, stakeholders and civil society who are attuned to the integrity of CARR actions.

A pivotal shift in understanding and responding to climate risk was the establishment of the International Sustainability Standards Board (ISSB), from the 2021 UN Climate Change Conference (COP26). Intended to formalise the monitoring of progress on climate-related disclosures from the Task Force on Climate-related Financial Disclosures (TCFD), the ISSB standards establish a worldwide foundation for climate and sustainability related financial disclosures. Some jurisdictions are beginning to enforce its adoption through legislation.

While numerous organisations are developing an understanding of emerging climate regulations, interest is now turning towards the strategies employed to manage the risks (i.e., plans for adaptation and resilience). Interest is also shifting to better understand how these strategies are maximising opportunities and delivering resilience and adaptation outcomes.

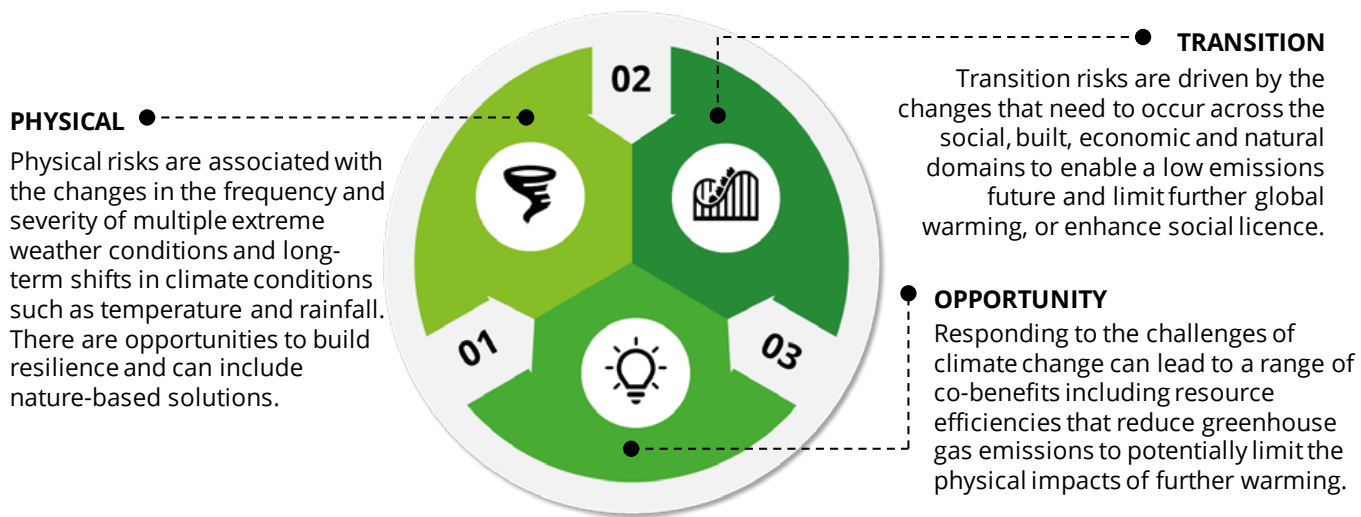


Figure 2: Definitions for the two types of climate risk (physical and transition), along with a summary of the opportunities that can result from effectively responding to climate risk

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In a survey of practitioners across Deloitte's global network, there was strong agreement that climate risk remains the focus across most geographies, sectors and industries. Adaptation and resilience are emerging needs, due to recent climate-driven disruptions to supply chains and operations.

Climate adaptation

As defined in *Table 1*, climate adaptation is the process of adjustment to current or emerging climate changes, to moderate harm and capitalise on beneficial opportunities. Adaptation approaches vary widely across time scales, and over geographical scale (e.g., multi-year or decadal; local, national, regional or global).[25] Adaptation also occurs in a range, spanning from planned to autonomous and often (though not exclusively) at the local and regional scale. Critical to effective adaptation is consideration of vulnerability, and of adaptive capacity.

Determinants of climate vulnerability and adaptive capability hinge on intersecting social, economic, built and natural domains, or conditions.[26] As a result, it can be highly localised, ruling out a one-size-fits-all approach. Understanding the diverse factors impacting adaptability emphasises the need for tailored adaptation approaches, ones that effectively work between and move from traditional top-down hazard assessments, and towards asset or sector-specific analyses of social and contextual determinants.[27]

Planned versus autonomous adaptation

"Large-scale approaches to climate adaptation must be based on an explicit awareness of changing conditions, including long-term climate risks. Planned adaptation looks for priorities in responding to known and anticipated changes. A key benefit of engaging in such planned adaptation is that it minimises inefficient allocation of resources and enables the facilitation and coordination of adaptation strategies.

In contrast, autonomous adaptation actions develop organically at the individual and community levels.

These responses are extremely diverse in nature, existing in many forms across every sector and geography and – critically – they allow for local lived experience to help shape the adaptation outcome. However, autonomous adaptation is difficult to track, and even more complex to measure. An advantage of this bottom-up approach is that adaption responses can be tailored to individual needs."

Find out more about the distinction between planned adaption and autonomous adaptation actions in this [Deloitte blog](#).

Climate resilience

Climate resilience entails actions that aim to diminish the exposure and sensitivity of assets across built, social, economic and natural domains to hazards, while simultaneously bolstering adaptive and coping capacities to confront and navigate actual or anticipated stressors (see *Table 1*). The key benefit for developing strong resilience mechanisms is that it reduces the vulnerability of infrastructure, civil society, businesses and governments to the evolving risks associated with climate change.

Given the now unavoidable residual climate-related risks that will remain regardless of mitigation and adaptation efforts, the cultivation of resilience is essential. The ability to bounce back from climate-related impacts can be a critical measure of overall resilience. The longer the 'return to baseline' takes, the more taxing it can be to overall adaptive capacity. Resilience should not however be viewed as a static state of returning to baseline. Rather, climate resilience is iterative, and requires the ability to adapt, learn and transform along with continuous strategic management to continually improve resilience maturity.

Current global action towards progress on CARR

The United Nations has long been leading international cooperation on climate change action. The 2015 Paris Agreement marked a turning point in the global ambition to act on climate change. Bringing together 196 nations at the UN Climate Change Conference, it set a clear objective: limit the rise in global average temperatures to below 2°C above pre-industrial levels, with efforts to cap it at 1.5°C. Emphasising the responsibility of developed nations, the Paris Agreement also underpins climate finance efforts to support more vulnerable countries in their climate mitigation and adaptation efforts.

An important enabler of climate adaptation is access to finance. The United Nations Environment Programme's (UNEP) assessment shows that there is a significant difference between the costs of delivering adaptation commitments and the finance available to support these commitments. As of 2023, the "adaptation gap" stood at a substantial US\$194-366 billion per year.^[28] Disaster-related impacts will exacerbate this.

Some nation states have enshrined the obligation to create and execute National Adaptation Plans (NAPs) into law. These plans provide communities with a level of certainty that governments are forward planning to reduce the impacts of disasters. The associated reduction in supply and value chain exposure to climate change risks drive both public and private investment in effective climate change adaptation. This creates an environment from which technological innovation and start-ups can gain momentum.

While the UNEP's 2023 assessment of adaptation shows that the number of countries releasing NAPs is increasing, more effort is needed. The UNEP assessment illustrates a world that is beginning to invest in adaptation, but not at the scale required. UNEP found that out of 1,100 implemented adaptation actions, details for just 670 (60%) are available, highlighting a gap

between what has been committed and what is being actioned.^[29] From our review of the actions available, they largely target agriculture and livestock, biodiversity and ecosystems as the single sectors most addressed by the NAP actions. Concerningly, only 6% of the 670 adaptation actions implemented reported on outcomes, making it difficult to understand if these actions have increased resilience, or to otherwise evaluate their effectiveness.

Adaptation is a priority on regional, national and municipal agendas. At COP28 (2023), Parties came to an agreement on targets for the Global Goal on Adaptation (GGA) and its framework. The GGA framework reflects a global consensus on the need for finance, technology and capacity-building to achieve adaptation targets. The UN Climate Change Executive Secretary concluded the conference urging that, *"all governments and businesses need to turn these pledges into real-economy outcomes, without delay."*^[30]

In order to meet adaptation targets, governments and organisations will require an understanding of how to enhance adaptive capacity, strengthen resilience and reduce vulnerabilities. This will require an integrated assessment of CARR. This is best done when built on an understanding that this process is interrelated and iterative. By conducting thorough risk assessments and developing adaptation plans, setting clear objectives and embedding climate considerations into decision-making processes, governments and organisations can enhance their adaptive capacity and resilience.

While climate risk management focuses on identifying threats and opportunities, climate adaptation and resilience provides options for measurable actions. Our global survey has revealed that stakeholders and shareholders are now increasingly focused on how organisations are responding to not only climate risks they identify and disclose, but also on the effectiveness of proposed responses; in short, organisations must also be able to demonstrate the effectiveness of their actions to reduce risk.

An adaptation gap occurs when there is a difference between implemented adaptation and a societally set goal, determined largely by preferences related to tolerated climate change impacts and reflecting resource limitations and competing priorities.^[31]

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Actioning Climate Adaptation, Risk and Resilience

“Unchecked climate change could cost the global economy US\$178 trillion in net present value terms from 2021-2070. The human costs would be far greater: a lack of food and water, a loss of jobs, worsening health and well-being, and reduced standard of living.”
- [The Turning Point: A Global Summary](#)

Addressing climate adaptation, risk and resilience is imperative for all organisations, institutions and sectors. From extreme weather events to shifting market dynamics, the impacts are multifaceted and pervasive, affecting operations, supply chains and communities alike. Tools that track the maturity of organisations in these efforts are essential, providing a structured framework for assessing progress, identifying vulnerabilities and implementing effective strategies. By leveraging such tools, we can enhance individual preparedness, foster innovation and contribute to broader collective efforts towards building a resilient future in the face of climate uncertainty.

CARR Maturity Index

Deloitte’s CARR Maturity Index is a tool that is used to compare maturity against CARR objectives. The CARR Maturity Index uses traffic light rankings, presented in *Table 2*, to visualise a ‘first pass’ overview across the three CARR categories relative to a broad sectoral analysis, for illustrative purposes. It examines the level of focus being placed on risk and adaptation, along with the level of maturity towards resilience.

Table 2: Traffic light rankings to visualise a ‘first pass’ overview across the three CARR categories.

	Focus placed on Risk	Focus placed on Adaptation	Level of maturity towards Resilience
Limited to no evidence of engagement	<ul style="list-style-type: none">Limited efforts made to minimise climate risks beyond initial scoping activities	<ul style="list-style-type: none">Limited consideration of adaptation options to minimise climate risks	<ul style="list-style-type: none">Limited evidence of ongoing climate risk assessment or adaptation planning efforts
Some evidence of engagement	<ul style="list-style-type: none">Efforts made to identify current climate risks and opportunitiesEfforts made to assess future climate risks and opportunities	<ul style="list-style-type: none">Efforts made to understand risk management methodsAdditional adaptation actions have been identified and roadmap for implementation developed	<ul style="list-style-type: none">Efforts made to identify high priority climate risks and adaptation actions that produce resilient outcomes
Meaningful evidence of engagement	<ul style="list-style-type: none">Consistent reporting of climate risks and opportunitiesActive consideration of how risks can be effectively managed	<ul style="list-style-type: none">Strong understanding of where future adaptation actions are neededAdaptation actions are being meaningfully implemented	<ul style="list-style-type: none">Ongoing risk assessment and adaptation planning programs in place to support long term climate resilience buildingOngoing monitoring and evaluation processes in place to monitor effectiveness of adaptation actions

Depending on circumstances, the CARR Maturity Index can be modified to compare entities within, across, or against a range of sectoral and geographical scales. It may also be used by individual businesses to self-assess their CARR maturity.

Entities should ensure that they have the right capabilities to regularly undertake their own CARR Maturity Index assessments to stay across trends and capitalise on the associated opportunities.

Assessing CARR across sectors

For this report, CARR maturity analysis was conducted for each sector across three grouped geographies. We engaged with Deloitte

practitioners across our major geographies to undertake and validate this analysis. Sectors were analysed as a whole, noting there are high levels of variability across regions and industries, which are not fully captured (see *Table 3*).

Figure 3 describes Deloitte’s approach to building resilience to climate-related shocks and stresses. Our process combines climate and operational data, with strategic information to answer three key questions:

- How are operations impacted by climate change?
- What processes are in place to mitigate these impacts?
- What additional actions should be taken to produce an organisation that is resilient to climate-related shocks and stresses?

CARR Maturity Index

APAC REGION

- Meaningful evidence of engagement
- Some evidence of engagement
- Limited to no evidence of engagement

Industry	Sector	Focus placed on:		Level of maturity	Emerging adaptation
		Risk*	Adaptation^	towards resilience#	opportunity example
Financial services	Insurance	●	●	●	Partnership with government
Energy, resources and industrials	Mining	●	●	●	Innovation in technology and operations
	Utilities	●	●	●	Innovation in technology and operations
Consumer services	Transportation	●	●	●	Strengthening hard and soft infrastructure
	Agri-food systems	●	●	●	Climate-smart agriculture
Technology	Innovation	●	●	●	Opportunity for automation
Government	Public	●	●	●	Translating commitment into action

THE AMERICAS

Industry	Sector	Focus placed on:		Level of maturity	Emerging adaptation
		Risk*	Adaptation^	towards resilience#	opportunity example
Financial services	Insurance	●	●	●	Strategic infrastructure investment
Energy, resources and industrials	Mining	●	●	●	Strengthening infrastructure
	Utilities	●	●	●	Collaboration across industry
Consumer services	Transportation	●	●	●	Leveraging government initiatives
	Agri-food systems	●	●	●	Traceability, technology and innovation
Technology	Innovation	●	●	●	Evolving consumer demands
Government	Public	●	●	●	Coordination and implementation across sectors and jurisdictions

EUROPE

Industry	Sector	Focus placed on:		Level of maturity	Emerging adaptation
		Risk*	Adaptation^	towards resilience#	opportunity example
Financial services	Insurance	●	●	●	Leveraging data for risk prevention
Energy, resources and industrials	Mining	●	●	●	Leveraging data for risk prevention
	Utilities	●	●	●	Leveraging community and government initiatives
Consumer services	Transportation	●	●	●	Data-driven whole of supply chain assessments
	Agri-food systems	●	●	●	Climate-smart agriculture, data-driven decisions
Technology	Innovation	●	●	●	Potential for cross-sector collaboration
Government	Public	●	●	●	Legislation and planning at the national and local level

*Risk: The potential negative impacts that climate change, and efforts to limit it, can have.
^Adaptation: Acting to minimise the impact of the changing climate on business and society by changing the way we do things.
#Resilience: The capacity of systems to cope with a hazardous event and respond in ways that maintain their essential function.

Table 3: Sector analysis across grouped geographies resulting from global engagement conducted by Deloitte.

Our analysis found that many sectors are demonstrating positive action to identify and report risks in line with regulatory requirements. However, we also found that few groups were integrating these findings in ways that optimise adaptation or resilience, into their organisational strategy. This is why so few organisations are engaging meaningfully with resilience.

Resilience is also an often overused and poorly defined concept that can make it difficult to measure. The definition provided in Table 1 provides a range of ways in which the resilience of an organisation or institution can be examined. It also provides useful guidance as to the types of actions that would be most effective in building the resilience of an organisation (e.g., actions that increase adaptation capacity or reduce exposure).

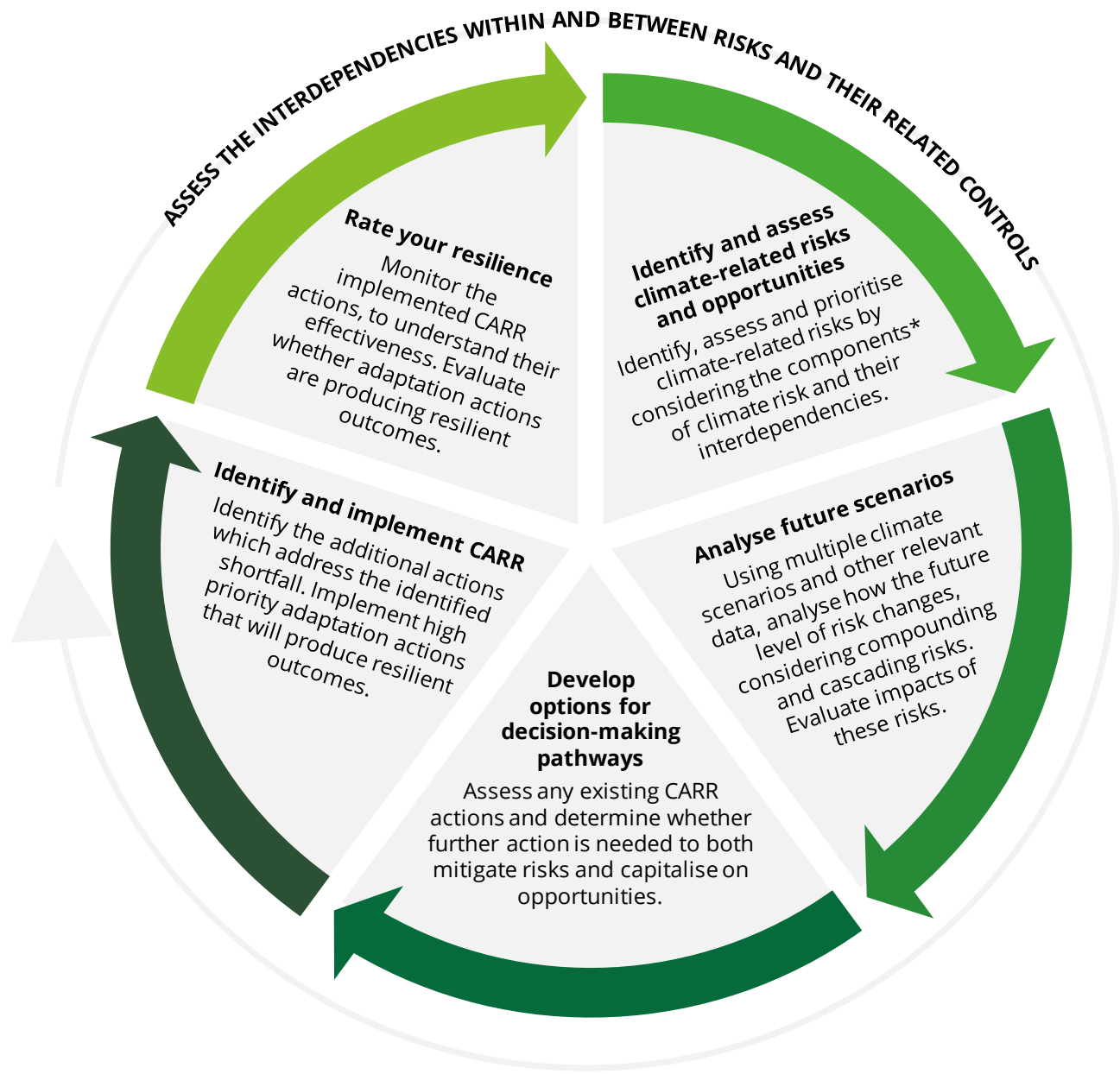


Figure 3: An approach to build resilience to climate-related shocks and stresses. *Components of climate risk include hazard, exposure and vulnerability.

Our Sectoral Overview

Operationalising CARR is a strategic imperative in today's rapidly changing environmental landscape. Embedding CARR into your operations can enhance your capacity to anticipate, mitigate and respond to climate-related challenges, and also foster innovation, competitiveness and long-term viability in an increasingly uncertain world.

Here we explore five pivotal sectors: financial services; energy, resources and industrials, consumer services; technology; and government. The relevance of CARR is discussed across each sector. By examining how these diverse sectors are integrating CARR practices, uncovering emerging opportunities and identifying future drivers, we illustrate the value for each sector to enhance their understanding of CARR.

Financial services

Climate change, with its escalating physical and transition impacts, poses immediate and enduring risks to the financial sector. This includes firms that provide capital and, in particular, for those that provide insurance.

Insurance

The insurance sector is uniquely exposed to climate risks in both underwriting and investment activities. Assets with elevated climate change risk can cause substantial insurance payouts, driving up premiums to levels that may be unaffordable.

This current business model results in a widespread insurance protection gap. Only 43% of global weather-related losses are currently insured.^[32] This insurance gap is expected to rise in line with the increasing frequency and intensity of climate-related hazards and impacts, and the increasing affordability pressures.

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Aleksejs Bergmanis



There is a growing acknowledgment that embedding adaptation and resilience plans into key investments, such as infrastructure, is a game-changer for the insurance sector. Other measures are also needed. Redesigning building codes, discouraging development in high-risk zones and championing public investments in nature-based solutions and protective infrastructure are examples of recent cross-sectoral effort and focus.

Strengthening insurance climate risk governance

A [Deloitte global survey](#) of insurance executives found that insurers face significant financial and reputational ramifications stemming from their unique position in making climate-related investment and underwriting decisions.

While considerable time and effort is being invested in reporting activities, more insurers should be integrating decarbonisation and adaptation strategies throughout their value chain, while also thinking about competitive differentiation through innovations in climate coverage and risk management services.

Partnering to strengthen community resilience

[Insurance Australia Group](#) (IAG) has demonstrated how effective partnerships can reduce risk and insurance premiums. For over a decade, Insurance Australia Group has jointly delivered resilience programs

with the New South Wales State Emergency Service, including storm season awareness campaigns.

Another ongoing partnership is with the Australian Red Cross. Together they developed the 'Get Prepared' app, aiding users in building local networks for natural disasters. These initiatives reached 7.49 million people, enhancing community awareness of climate change risks.

Elevating customer understanding of extreme weather risks cultivates resilience, minimising the financial, social and emotional toll of disasters.

Overall, the insurance sector has a relatively mature approach to CARR, notwithstanding the adaptation and resilience challenges. Market leading insurers are developing capabilities to identify physical and transition climate-related exposures, such as QBE Insurance Group's partnership with InsurTech organisation Jupiter to incorporate weather analytics within underwriting, pricing and resilience management activities.^[33]

For private companies, both litigators and regulators are closely monitoring against perceived 'greenwashing' in company climate risk disclosures.^[34]

The value of collaboration for climate adaptation

The Deloitte Impact Foundation report titled "[Nederland Klimaatadaptief](#)", examines the financial sector's role in backing the Netherlands' climate adaptation plans.

The report explores, "How can the financial sector collaborate with government for climate adaptation in the Netherlands?" The report focuses on government, banks, pension funds and insurance companies.

The findings? National governments should prioritise and communicate their adaptation vision clearly. This paves the way for the financial sector to weave it into their short-term plans, enhancing adaptation's value into indicators like wellbeing and profit.

Energy, resources and industrials

The energy, resources and industrials sectors form the backbone of a range of global economic activities. Yet, as the climate becomes more extreme and variable, these sectors face heightened climate risks in operation, regulation, shifting customer demand and resource availability.

Fostering the resilience and adaptability of these sectors will be pivotal in bolstering the clean energy transition.

Mining

The mining sector is currently experiencing physical and transition climate risks. Physical risks can include flooding in mine pits, poor road access, dust storms and the effects of extreme heat on workforces. Extreme heat means workers cannot be outside for as long, or requires a shift in daylight working hours.

Integrating CARR considerations offers benefits for the range of physical and transition climate risks the mining sector faces. This includes building resilience to the physical climate

hazards that are disrupting operations, as well as understanding how customer demand is shifting to ensure that the mining sector can provide the critical minerals necessary to enable the global energy transition.

Strengthening resilience through climate risk analysis

Deloitte supported a mining and metals company, which generates more than \$3B in revenue, in scenario analysis, climate risk and opportunity assessment and TCFD reporting. Deloitte analysed the resilience of the business to key climate-related physical and transition risks and opportunities against three climate scenarios and two time horizons.

Deloitte also supported the business in drafting climate reports in accordance with the TCFD recommendations. This involved the following key activities: physical risk exposure analysis to the mine's processing plants, logistics and supply chain; policy and market analysis to assess impacts of transition risks and opportunities; forecasting GHG emissions, and modelling of projected impacts of carbon and energy pricing on operating cost.

Mining companies must continually assess whether the resources they extract align with future global demands, a task growing more intricate amid the ongoing and rapid climate transition. The mining sector is also facing increasingly robust regulations and government policies that pose significant risks to emissions-intensive value chains. Slow adopters of new regulatory frameworks and operational changes

face potential challenges from factors such as evolving markets, increased regulation, rising energy costs and supply chain disruptions.

Utilities

Utilities keep the lights on, water flowing from our taps and the internet connected. With the escalating risks of extreme weather to both infrastructure and to operations, combined with shifting resource dynamics, it is imperative to implement robust climate risk management strategies. Embracing proactive CARR measures, like bolstering infrastructure and grid adaptability, can elevate the overall resilience of utilities. This may create opportunities for growth and investment.

Gains may also be achieved by diversifying energy resources. Integrating renewables, smart grid technologies and energy storage options can diversify risk exposure, while advanced monitoring systems and predictive analysis of climate related risks can drive efficient adaptation and resilience outcomes.

In response to escalating climate impacts, focus should also be placed on strengthening infrastructure resilience through investment in climate-resilient design and materials.

Deloitte's Water Resource Management Planning (WRMP) tool

Many countries are struggling to match water supply with demand due to a range of external conditions including climate change. Drinking water companies are setting up strategic plans for water supply aimed at relieving this stress.

Most often however, projects are expert-based and the impact on the security of supply is described in a

qualitative manner. Deloitte's WRMP tool incorporates a simulation model of the water distribution network, cross-sector stakeholder input on performance, environmental criteria, costs and services and future predictions of key trends and changes.

Deloitte developed the WRMP tool to support policy makers to take strategic decisions and build a robust investment portfolio. WRMP makes it possible to incorporate both quantitative and qualitative data to compare different investment options to support long-term strategic planning for water supply.

Consumer services

Shifting consumer expectations associated with the growing climate crisis are pushing this sector to adopt practical strategies, in order to be better adapted and more resilient to climate change.

Transport

The transport sector is affected by several climate change risks that cause disruptions to the movement of people and goods. Extreme heatwaves can, for example, cause changes in air density and potential disruptions to airline sensing equipment; rail and road networks can be impacted through buckling and melting of surfaces or storm surge; and rising sea levels can damage transport nodes such as shipping ports.

The transport sector is also a large contributor to greenhouse gas emissions meaning that significant mitigation efforts are required to reduce the growing carbon footprint.

There is a broader societal expectation on the functionality and reliability of essential services. Substantial upgrades are required to energy and water infrastructure to withstand current and future climate impacts. Adaptive water management strategies and enhanced supply chain resilience will be crucial in future utility planning.

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Future-proofing transport stock in ways that encourages longevity is critical. Consideration of how the climate is changing will be central to ensuring that these investments are resilient to climate change.

Integrating climate risk considerations into urban planning tools can enhance social, economic and environmental outcomes, promoting climate-friendly transport methods and optimising land use.

Planning for and managing cascading risks across rail networks

Disruptions to the transportation network during extreme weather events not only affect the movement of goods but also limits the mobility of people. This includes access to employment and critical services such as health care.

To avoid future disruptions, Great Britain's national railway manager, Network Rail, is working to improve its climate resilience. In response to projections of increased rain and flooding over time, Network Rail has implemented an integrated drainage management policy and is investing in drainage systems along key routes to protect the infrastructure from flooding, minimising climate-related disruptions to passenger transport.

Find out more about how industry and government are managing risks in this [Deloitte blog](#).

Climate change will continue to challenge the transport sector in varied and complex ways.

Determining the most effective ways to intervene will require a whole of supply chain view. The use of data and technology will increasingly become key in accounting for measures such as transport networks. The establishment of databases on transport assets, land use, regional economy and weather are essential to aid decision makers' and investors' understanding of the potential return on investments in adaptation.

The impact of climate change on Australia's road and rail system

In recent years, compounding natural and human-induced shocks, including heavy rainfall and flooding have impacted Australia's freight supply chains, impacting economic prosperity.

In March 2022, the Australian Minister for Infrastructure, Transport and Regional Development commissioned a review into the [Nation's Road and Rail Supply Chain Resilience](#).

Key gaps identified included duplicated efforts across jurisdictions, limited quantification of resilience costs and benefits in business cases, and the need to balance building back better with quickly restoring supply chain linkages following disasters. Wildfires and flooding have been identified as the two natural hazards posing the most significant risks to Australia's road and rail supply chains.

Agri-food systems

Agri-food systems are responsible for feeding the world and account for more than one-fifth of global jobs. CARR measures are vital in both upstream and downstream agri-supply chains to

not only safeguard the sector's economic future, but to ensure the world's food and nutritional needs are secure. Sector-wide trends show that changes to 'agtech' (agricultural technologies) and production systems are aiming to make the sector more reliable, cost-effective and resource-efficient.

Agtech is a burgeoning industry, with constant innovations in mechanisation, genetic technologies, data collection and utilisation, and chemical-use practices, that build the sector's adaptability and resilience to changing conditions.

Given the susceptibility to changing environmental conditions, as well as changing technological, political and economic landscapes, there is a ubiquitous need for whole-sector agility. Creating innovative and stackable finance and insurance products, establishing private sector procurement guidelines, entering long-term purchase agreements, and exploring carbon crediting and ecosystem service payments can assist producers in managing capital and minimising risks while adopting climate resilient approaches.

Climate-smart agriculture approaches (exemplified by the EU Green Deal's *Farm to Fork Strategy*), such as carbon sequestration through reduced tillage, crop-livestock management and/or agroforestry practices, is one such example of reducing emissions while implementing CARR.

Drought resilience self assessment

Deloitte supports clients to provide tools to self-assess their resilience maturity, helping them pinpoint needs, monitor progress, and fill action gaps. [Drought resilience self assessment](#) gives farmers access to climate and spatial information to help build their resilience. It includes practical


options for building resilience and brings together over 3,000 resources like podcasts, videos and links to directories and grants.

Farmers have described the tool as 'simple and straightforward', while advisors working with farmers on holistic approaches to farm management have described the tool as 'game changing'.

Governments also have a role. Governments can design policies and programs that enable farmers to withstand short-term shocks, while also allowing them to quickly shift practices to remain viable in the long-term. This could be achieved through adaptation planning and decision support tools, technology uptake such as new cultivars, improved water management, modified planting practices and explicitly supporting nature-based solutions.

Investing in nature-based solutions builds economic, social and ecological resilience

Deloitte, in collaboration with the World Economic Forum and NTT Data, [developed a report](#) on how climate-smart and regenerative agriculture can transition the sector to sustainable production. The report uses the results of an extensive farmer survey in the EU as a case study to outline how targeted investments in sustainable agriculture can provide positive economic benefits for farmers, improve ecological health and build a more resilient global food supply.



Resilience is inherently linked to systems thinking, requiring an understanding of system identity, its evolution, and threats. Assessing resilience involves a multifaceted framework that considers various dimensions and indicators.

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Jithin Mathew

This report calls for business leaders, policy makers, NGOs, academics and farmers to come together to boost adoption of climate-smart agricultural practices. Our analysis finds that if an additional 20% of EU farmers begin climate-smart farming, by 2030 they can collectively increase their annual incomes by up to €9.3 billion, reduce greenhouse gas emissions by 6%, and improve soil health over 14% of the EU's agricultural land.

Technology

The physical infrastructure associated with the technology sector's outputs are often unseen by consumers; resilience and adaptability to climate change impacts may be neglected. The 'invisible' nature of technological infrastructure leads many to perceive the sector as less vulnerable to physical climate hazards and impacts.

Digital technology is responsible for 1.4% to 5.9% of global emissions, as data centres and server infrastructure require significant amounts of electricity to operate. [35] As the sector grows, so will the need to reduce these emissions in a way that does not disrupt operations and services. The technology sector is heavily exposed to supply chain shocks. For example, in December 2021 extensive flooding in Malaysia caused major disruptions to the main shipping port for semiconductors and microchips worldwide. This caused a temporary breakdown of the semiconductor supply chain globally.

On the upside, the technology sector offers opportunities to enable the uptake of CARR. For instance, data analytics platforms and artificial intelligence algorithms are shifting risk assessment by providing real-time insights into climate-related hazards and vulnerabilities. Remote sensing technologies, such as satellite imagery, offer unprecedented capabilities for monitoring and responding to changes in our environment. Similarly, blockchain technology is increasingly being explored and used for its potential to improve transparency and accountability in climate-related transactions aimed at fostering trust and collaboration within the broader ecosystem.

Cross-disciplinary collaboration for resilience

The University of Colorado Boulder (UCB) have partnered with Deloitte to translate wildfire research and data into innovative solutions to help federal, state and local government agencies manage wildfire risk across the United States. By pairing UCB's leading wildfire research, artificial intelligence and machine learning, alongside Deloitte's business management capabilities, this Climate Innovation Collaboratory aims to equip users with valuable, decision-making tools.

Combining climate data science, systems thinking and human centred design to develop cutting-edge tools that can predict wildfire risk, model evacuation scenarios and apply social sensing data into disaster response processes, will help decision makers before, during and after wildfires.

As the effects of extreme weather become more apparent, industry, government and society will require technological solutions to both manage climate risks and to take advantage of opportunities. Considering the increasing importance of data centres within the global networked economy, increased severity of disaster events will have a domino effect across most sectors.

By building the technological infrastructure needed to embed adaptation and resilience into all facets of business, technology sector organisations will play a crucial role in driving market momentum and building new and emerging CARR markets into the future.

Deloitte’s physical and transition climate risk assessment tools

Deloitte supports clients to identify and prioritise their current and future exposure to climate risks and opportunities through our physical and transition climate risk assessment capabilities.

Deloitte’s Climate Infinity is a centralised digital tool that supports the identification, assessment, evaluation and monitoring of multi-sectoral climate risks and opportunities. It can enable bespoke climate risk assessments based on your desired scope.

This tool has been developed by Deloitte’s team of climate risk experts and leverages knowledge that we have built through our vast experience in conducting climate risk assessments for clients across all sectors.

Climate Infinity can be used to:

- Assess specific risks and how the exposure to multiple climate hazards will evolve over time under selected scenarios
- Identify areas where social vulnerability to physical risks are more acute and associated demographic profiles
- Analyse projections of emissions, energy usage and carbon prices, across sectors and scenarios.

Another relevant tool is Deloitte Decarbonisation Solutions™ (DDS). DDS is a market-leading suite of mitigation and adaption modules, that translates complex science and commercial data to help clients visualise their risks, optimise their strategies, and fulfil their climate disclosure and reporting requirements.

Government

Governments, often referred to as the ‘insurers of last resort’ because they take on risk that other parties are unwilling to, are significantly challenged by climate-related risks.[36] They are also significant investors in the natural, social, built and economic infrastructure required to build resilience to climate risks.

Governments set the policy guidance needed to embed adaptation and resilience into their strategies and operations and day-to-day lives. This positions governments as key enablers of CARR.

The recent past tells us that regardless of efforts to reduce emissions, nations will continue to be impacted by larger and more significant climate-driven events.

As the world’s climate warms, adaptation options implemented now can result in increased resilience across the natural, social, built and economic spheres of society. The longer it takes to make substantive investments in CARR, the more costly disaster events will be.

Governments also guide collective action on CARR through the enactment of legislation,

regulations and the establishment of national frameworks. By setting regulatory standards and incentives, including mandatory reporting requirements for climate-related risks and opportunities, governments create a conducive environment for entities to prioritise and integrate CARR measures into their strategies.

Table 4 outlines some recent climate adaptation-related legislation and frameworks, highlighting the diverse approaches taken by governments and the importance of promoting investor certainty.

Table 4: Recent climate adaptation-related legislation and/or frameworks.

Jurisdictions	Legislation and/or frameworks
Australia	National Climate Resilience and Adaptation Strategy 2021-2025 – Australia’s focus is on the broad collection and dissemination of climate resilience information that is relevant to governments, businesses and communities.
China	National Climate Change Adaptation Strategy 2035 – The Strategy shows intentions to improve institutional mechanisms for resilience to extreme weather events, and to integrate climate adaptation technologies into Chinese cities.
European Union	Corporate Sustainability Reporting Directive (CSRD) – The EU enforces mandatory adaptation planning policies. Under the CSRD, large enterprises operating in the EU must comply with mandatory adaptation reporting, paving the way for climate resilience in the corporate landscape.
India	National Action Plan on Climate Change (NAPCC) – India recognises their own vulnerability to climate change, as well as the costs associated with climate resilience. The NAPCC aims to allow for climate change adaptation that avoids damage to economy and community.
Indonesia	National Action Plan on Climate Change Adaptation (RAN-API) – The RAN-API identified adaptation needs for rising sea levels and changes in weather and climate. Emphasis is on infrastructure and technologies that promote resilience.
South Africa	Climate Change Bill 2023 – In South Africa’s first comprehensive climate legislation, the emphasis is on GHG emission reduction and economic adaptation to the impacts of climate change.
United Kingdom	Climate Change Act 2008 (2050 Target Amendment) Order 2019 – This Act advocates for cuts in carbon emissions and highlights proactive adaptation to climate change risks. This legislation demonstrates the UK’s meaningful commitment to expeditious international action.
United States	Inflation Reduction Act – The Inflation Reduction Act marks a colossal investment in climate action. Adaptation is a central focus, with a line-up of investment programs that target adaptation changes in government, businesses and households.

Adaptation demands sophisticated policy analysis skills and a robust monitoring and evaluation capability to gauge the efficacy of these interventions. National approaches need to be aligned with metro, regional and rural deployed adaptation initiatives. Our natural environment provides a range of services which help protect against the impacts of climate change. Innovative governments

are recognising the various co-benefits that investments in nature can return. For example, investments in conservation can result in a range of economic, social and environmental benefits, including enhancing resilience.

Climate change cuts across every facet of the public sector. Equipping policymakers with the skills to navigate the complexities of climate change is crucial. Governments will need to integrate considerations of climate risk and adaptation throughout their policy design and implementation cycle, as well as across their own operations.

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The forward trajectory of climate change means that CARR is intrinsic to all business- and sector-led strategies.

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How to Engage Effectively with CARR

There are common attributes that are associated with effective engagement with CARR. These can be used to guide all CARR-related actions and are aligned to five themes (see Table 5):

Table 5: Common attributes of effective engagement with CARR

Theme	Description
1. Nature	<p>Effective adaptation recognises the interconnectedness of nature, climate and human systems, meaning nature must be a focal point in CARR actions.</p> <p>Nature-based solutions offer a way to mitigate natural hazards and enhance societal resilience to climate change. Approaches such as environmental conservation, restoration and enhancement provide economic, practical and social benefits.</p>
2. Systems approach	<p>By taking a systems view, we can account for shifting goalposts, embrace diversification and understand cascading and compounding implications.</p> <p>Governments and organisations must adopt a proactive, adaptive approach to tackle the uncertainty of climate impacts, ensuring resilient strategies provide long-term success.</p> <p>This will help you understand how impacts in one part of your organisation can cascade and impact other aspects of your business. Developing a sequence of potential adaptation actions based on plausible future conditions is key.</p>
3. Community and stakeholders	<p>Effectively considering CARR relies on collective action that involves stakeholders with common and differing values, interests and capabilities.</p> <p>Collaborating with diverse stakeholders at community, government and sectoral levels deepens understanding of systemic causes and effects, addressing gaps and misalignments, and avoiding maladaptation.</p>
4. Vulnerability	<p>Climate change impacts and adaptation abilities differ among individuals, communities and nations.</p> <p>Effective adaptation efforts recognise the human dimension of vulnerability and understand that adaptation responses have the potential to amplify inequality by disrupting vital societal systems, including energy, water, food, health, education and transport. Detailed understanding of vulnerability is essential for robust adaptation plans or strategies.</p>
5. Continual improvement	<p>Climate change risks evolve, demanding adaptation measures that continually improve over time. Effectively engaging with CARR requires ongoing learning through robust monitoring and evaluation processes.</p> <p>Monitoring tracks adaptation implementation, facilitating corrective action, while evaluation systematically gauges effectiveness against objectives.[37] Taken together, the process of reflection and learning reduces the risks of maladaptation occurring, and provides a baseline against which to measure progress. It also informs future stages of iterative CARR processes.</p>

Looking to the future

Significant global change is underway. CARR is not an option: it is an imperative.

The need to integrate CARR into organisational strategy, risk management and operations is undeniable. While curtailing greenhouse gas emissions remains fundamental, building resilience to climate-related risk needs to happen now.

Investing in CARR will not only provide comprehensive insights into the current resilience of an organisation but also facilitates the identification of targeted, cost-effective measures for the betterment of industries, economies and society. Industries must navigate operational adjustments, integrate smart technologies and adapt to evolving climate conditions, all while addressing evolving regulatory requirements and changing consumer behaviours and preferences.

Effectively harnessing CARR is a dynamic, tailored process that strategically improves policies, systems and practices. CARR preparedness minimises the negative impacts of climate change, while capitalising on opportunities for sustainable and commercial development.[38]

At Deloitte, we understand the risks and opportunities you face in this era of climate change disruption. While there are significant financial costs associated with a failure to invest in CARR, there are also immense social, reputational and environmental costs.

For many, this task will be daunting and complex. However, this should not be a barrier to transformation. Ultimately, CARR transformation will differentiate organisations in the market. The costs of remaining on the business-as-usual path will dwarf the costs of this (r)evolution.

So, what's your CARR move? Stand tall or sit this one out – your call.

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