From Risk to Reward

The Business Imperative to Finance Climate Adaptation and Resilience

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Foreword

Companies and entrepreneurs around the world are beginning to invest in climate adaptation. A large multinational company is working to train its farmers in Madagascar to use climate-smart techniques to grow vanilla to ensure that these valuable trees can grow in the future, thereby safeguarding the resilience of the company's global spice supply chain. Entrepreneurs based in Arizona are creating new hydropanel technologies to harvest drinking water from sunlight for water-scarce regions and working to deploy that technology in remote communities in Papua New Guinea. And cities in Southeast Asia and sub-Saharan Africa are partnering with private financiers to insure infrastructure investments in high-flood risk areas. These are just a few of many examples.

Time has proven that effective, inclusive investments in climate adaptation and resilience can minimize the impacts of the climate crisis, and in some cases, even prevent them. Nonetheless, extreme storms and weather events continue to lead to catastrophic damage to businesses and their surrounding communities, with major international trade routes recently disrupted by prolonged drought.

To respond to the scope and scale of the climate crisis, in November 2021, President Biden announced the President's Emergency Plan for Adaptation and Resilience (PREPARE). PREPARE is the cornerstone of the United States foreign policy response to addressing the increasingly devastating impacts of the global climate crisis by improving the ability of vulnerable communities around the world to confront them and, as a result, bolster stability and security. Through PREPARE, nineteen federal agencies and departments are helping to mobilize private capital and public investments in sectors impacted by climate change in developing countries.

As this important new research by Boston Consulting Group (BCG) demonstrates, now more than ever, investing in adaptation is both a business imperative and an economic opportunity. Still, most companies and private financiers have yet to understand or embrace how investments in adaptation can safeguard their operations and workforce, or strengthen their portfolios. As climate impacts intensify, the need for adaptation and resilience solutions will continue to grow—expanding both the opportunity and the demand for innovators and investors.

For these reasons and as part of their role in co-leading the implementation of PREPARE, Special Presidential Envoy for Climate John Kerry and USAID Administrator Samantha Power launched the PREPARE Call to Action to the Private Sector at COP27 in 2022, urging the private sector to draw on its unique resources, expertise, and innovation to make significant new commitments to build climate resilience in partner countries.

This report by BCG articulates a framework for how businesses can invest in adaptation and resilience, especially in emerging markets and developing economies. To protect private sector assets and the workforces they rely on, businesses can zero in on specific investments in adaptation that are producing at-market or above-market returns, and fast-track those returns by partnering with the public sector on investments across infrastructure, water, food, and more.

We commend BCG for responding to our PREPARE Call to Action with this groundbreaking new study demonstrating the business case for investment in adaptation. We invite private sector institutions to join BCG in responding to our Call to Action, and to take advantage of the blended finance opportunities that the US government is offering to tackle this challenge.

Please join us as we work to create a climate-ready world.

Sincerely,

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Chief Climate Officer
US Agency for International Development

Christina Chan
Managing Director for Adaptation
Office of the Special Presidential Envoy for Climate

Ann Vaughan
Senior Advisor and
USAID PREPARE Director
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Executive Summary

The increasing frequency and severity of extreme weather are forcing the private sector and the world to take action on adaptation and resilience.

Most business leaders and investors have long viewed proactive investment in adaptation and resilience as important but not urgent. The business case was elusive because assessments of the negative financial impacts were based on uncertain climate scenarios, and the solutions seemed unclear and often fell into the domain of public sector investment. But all of this has changed dramatically. The negative effects of the climate crisis on the global economy are no longer theoretical—they are happening now. In 2022, global climate, weather, and natural disasters resulted in billions of dollars in economic losses, affecting lives, livelihoods, and economies around the world. If climate change continues unabated, according to EDHEC Infrastructure Institute estimates, infrastructure investors risk losing over half of their portfolio globally by 2050. These effects are even worse in emerging markets and developing economies (EMDEs), where some of the most severe impacts of climate change occur. We are moving from a business case for adaptation and resilience premised on potential scenarios to one reflecting near-certain projections.

Required adaptation and resilience actions are increasingly clear to the private sector. As a result of the growing quantity and quality of companies' climate-related disclosures, we now have a robust set of data to help us see how businesses assess their exposure to climate hazards, quantify the cost of inaction, and protect against these losses. Of the more than 18,700 climate change disclosures that companies filed with the Climate Disclosure Project (CDP) in 2022, approximately 25% identified the financial materiality of physical risks, together with the actions that the companies are taking to manage them in EMDEs and advanced economies. Although the number of companies disclosing physical risks and taking action must increase significantly, companies are beginning to move in the right direction. Our analysis revealed that companies are implementing a range of levers such as flood protection and supply chain strategies—measures that strengthen the resilience of their businesses as well as broader systems such as food, water, and health.

These actions protect significant financial value for companies, especially in EMDEs. In their CDP disclosures, many businesses report benefits such as cost savings and avoided losses from adaptation and resilience investments. The benefit-to-cost ratio (BCR) for companies that implement water efficiency technologies, regenerative agriculture, and other resilience-building measures commonly ranges from 2:1 to 15:1. In some instances, measures such as water collection and storage generate BCRs as high as 53:1. Notably, interventions in EMDEs generated some of the highest BCRs in our sample, with both multinational and local companies standing to benefit from them. By enlarging traditional definitions of return on investment from a narrow focus on generating cash flow to a view that encompasses protecting value at risk, companies can set themselves up for long-term benefits and business continuity in a warming world.

Financing adaptation and resilience is becoming nonnegotiable. Investors, governments, and regulators increasingly require the private sector to disclose climate-related risks, including the financial impacts of physical risks on assets and operations. More than 40 countries already require large financial institutions operating in their jurisdiction to make climate-related financial disclosures—a movement that is setting the standard for other industries and for adoption around the world. Financial institutions are also starting to employ alternative valuation methods that price in physical risks, creating pressure for companies and investors to deploy adaptation and resilience measures not only to safeguard cash flows, but also to protect the value of their assets and firms.

Investors are capitalizing on a pipeline of diverse adaptation and resilience solutions. As governments and companies take action to build resilience, they create compelling opportunities for early-stage, growth-stage, and mature companies and financiers to invest in the market of adaptation and resilience solutions. Contrary to common perception, our analysis reveals a relatively robust pipeline of opportunities. In one transaction database, we identified hundreds of current deals that directed finance toward adaptation and resilience solution providers—and this represents only a fraction of the deals in the overall database. Moreover, although the prevailing view is that the deal pipeline is concentrated in food and agriculture (38% of tracked funding in our analysis), our research found diverse opportunities across sectors such as energy (34%), health (10%), and water (4%). But while the adaptation and resilience market is growing, it is still nascent. Efforts are underway to address investment barriers and further channel finance to develop and scale adaptation and resilience solutions, especially in EMDEs.

Valuation multiples are promising in advanced economies and EMDEs alike. In our analysis, adaptation and resilience solution providers earned a median valuation multiple of 9 times revenue (with most values ranging from 1 to 31 times revenue), and some companies generated valuations as high as 77 times revenue. Further, although investors commonly view advanced economies as prime innovation hubs, our research revealed that many promising innovators based in EMDEs are delivering similar, if not higher valuations, than peers globally. This trend occurs against a backdrop of sustained interest in climate-related technologies. Valuation multiples of venture capital and private equity transactions have more than doubled in advanced economies since 2012, outperforming the broader market since 2018.

Much of the impact happens at the intersection of public and private action. Although there are clear opportunities to bring finance into these transactions, investors note challenges in identifying viable projects. However, a pipeline of opportunities that require project finance, infrastructure finance, and associated capital markets activity is emerging and is structured in ways that can yield attractive, long-term returns for private investors. The public sector and the social sector play important roles in mobilizing capital toward these opportunities and in guiding private funds toward areas of greatest need, such as in EMDEs. Their engagement is critical because they provide the catalytic capital, enabling environment, and technical assistance needed to de-risk investments. For instance, governments are entering into public-private partnerships and providing tax breaks, rebates, and other incentives that lower the cost of capital. International financial institutions are increasingly engaging with asset managers and other institutions to develop mechanisms such as blended funds (and even overarching funds of funds) that direct larger pools of capital toward a portfolio of adaptation and resilience investments in EMDEs. More such mechanisms will be key to stimulating further investments and reducing barriers to entry for private investment in public efforts, particularly in EMDEs.

Many front-running companies and investors understand what climate change means for their bottom lines and are already benefiting from financing adaptation and resilience. They are avoiding the mounting costs of inaction, positioning themselves as providers of choice in a growing market, and igniting growth prospects for lenders and investors that deploy financial solutions. They are contributing to the resilience of the communities, economies, and ecosystems upon which their business models depend. They comprehend that their ability to prosper is inextricably linked to the survival of people and the planet.

In response to the US President's Emergency Plan for Adaptation and Resilience (PREPARE) call to action, BCG's analysis aims to inform industry-wide actions at this critical time. This report details the adaptation and resilience business case, laying out three key opportunities for the private sector to secure value and identifying the specific entry points for finance:

- **The "Protect" Opportunity.** Companies can safeguard value at risk and protect assets, supply chains, and operations by implementing and financing adaptation and resilience measures. Lenders and investors can safeguard their portfolios by deploying capital toward resilient assets and companies.

- **The "Grow" Opportunity.** Investors can finance companies that develop adaptation and resilience solutions, and companies can invest in new adaptation and resilience product lines, creating climate-resilient revenue streams and thereby expand the overall market of adaptation and resilience solutions.

- **The "Participate" Opportunity.** The private sector can collaborate with the public sector to finance and implement capital projects and deploy finance toward vehicles that support a portfolio of projects.

We close with a set of actions that different industry participants can take to begin availing themselves of these three opportunities and fostering systemic resilience to help protect the planet and its people. (See the exhibit.)

Adaptation and Resilience Financing Opportunities Framework

Increasingly certain and worsening impacts of climate change

Imperative and opportunity for private sector actors to finance adaptation and resilience in ways that benefit them and the communities, economies, and ecosystems upon which their business models depend

Opportunity	Business case	Entry points
Protect assets, supply chains, and operations	Safeguard value at risk to enhance business resilience	1 Finance measures companies take to protect against future losses 2 Align investment portfolios toward resilient companies
Grow the market of adaptation and resilience solutions	Capitalize on the growing market fueled by companies and governments that are increasingly recognizing the imperative to act	3 Finance early- and growth-stage companies developing adaptation and resilience solutions 4 Finance mature companies developing new adaptation and resilience product lines
Participate in public sector implementation	Realize the direct returns and indirect benefits of collaborating with the public sector on critical initiatives	5 Allocate capital to public adaptation and resilience projects 6 Invest in financial vehicles that direct capital to public adaptation and resilience initiatives

Mobilize the private sector

Public and social sectors catalyze and de-risk investments

Enhanced resilience of businesses and the world

Source: BCG analysis.

The “Protect” Opportunity

Protect Assets, Supply Chains, and Operations

Globally, private sector assets, supply chains, and operations are exposed to worsening climate hazards. In 2022, global climate, weather, and natural disasters resulted in economic losses of over $313 billion, affecting lives, livelihoods, and economies around the world.[1] This trend makes financing adaptation and resilience measures a business imperative. Companies that have begun to take action are finding that investments that protect the communities and natural ecosystems upon which their business models depend are a critical factor in building resilience.

Investors are starting to price in the private sector’s response to physical risks, giving an advantage to businesses that minimize their exposure. Rather than viewing adaptation and resilience as a means of warding off theoretical climate impacts, leaders should regard them as an investment in business continuity in a world that is already reeling from the negative effects of climate change.

Exhibit 1 - Two Entry Points Comprise the "Protect" Adaptation and Resilience Financing Opportunity

Opportunity	Business case	Entry points
Protect assets, supply chains, and operations	Safeguard value at risk to enhance business resilience	1 Finance measures companies take to protect against future losses 2 Align investment portfolios toward resilient companies

Source: BCG analysis.

This chapter explores two key financing actions—entry points—associated with protecting assets, supply chains, and operations. First, we examine the adaptation and resilience measures that companies can finance, the economic business case that these measures can deliver, and the types of financing and public sector engagement that companies need if they are to accelerate their investment in adaptation and resilience. Second, we detail how investors can integrate physical risk and resilience into their financing decisions and thus channel more finance into adaptation and resilience measures. (See Exhibit 1.)

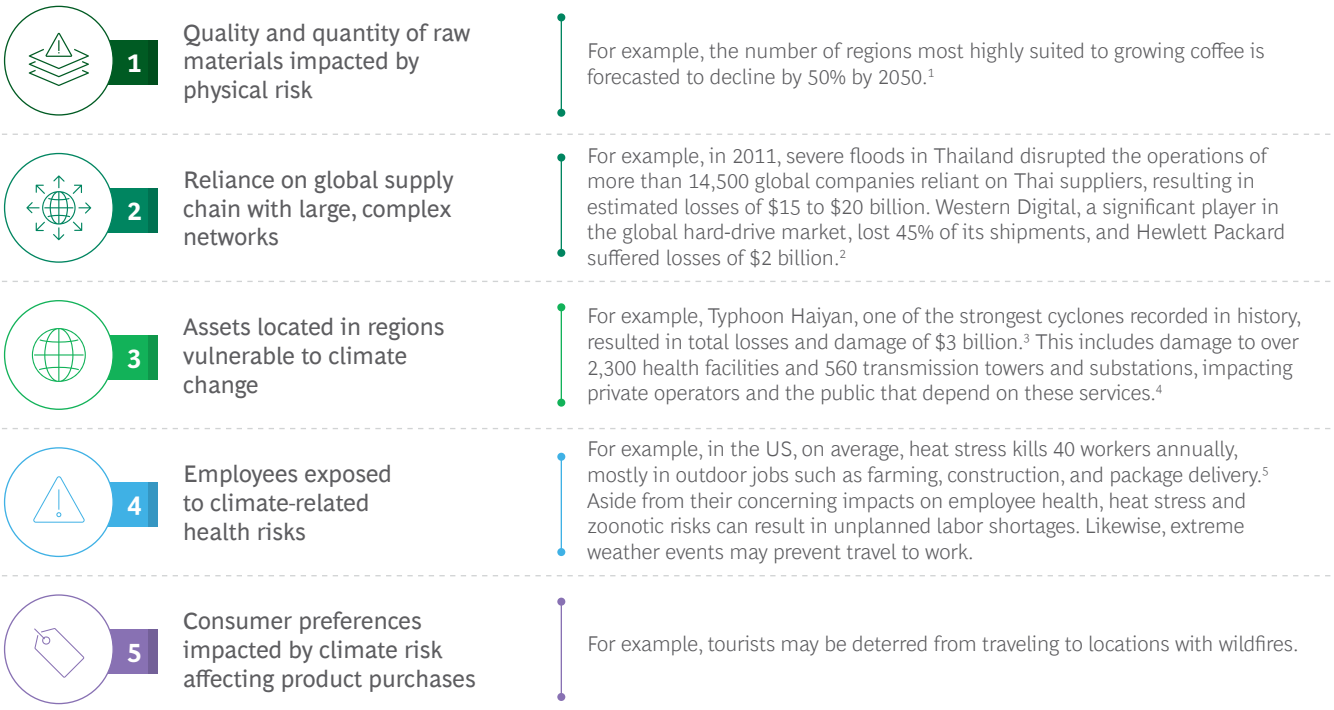
Entry Point 1: Finance Measures Companies Take to Protect Against Future Losses

Although efforts to limit further global temperature warming are critical and should remain a priority, the private sector must adapt and build resilience to climate impacts that are already occurring now and are projected to intensify exponentially. (See "Companies Should Be Investing in Mitigation and in Adaptation and Resilience.") Many companies, especially those in regions now experiencing climate impacts, such as emerging markets and developing economies (EMDEs), are taking steps to implement adaptation and resilience measures to avoid climate-related losses. Those that fail to act may face significantly higher risks.

Companies across all industries are financing adaptation and resilience measures. Physical climate risks can affect companies' business models through five main channels. (See Exhibit 2.) These risks can have material financial impacts such as increased operational costs from surges in raw material prices, diminished revenue due to decreased production efficiency, unforeseen asset damage that results in higher repair costs or devaluation, and escalating insurance premiums.

Companies are recognizing the financial materiality of these impacts and starting to finance adaptation and resilience measures to address them: 25% of the roughly 18,700 companies that completed the Climate Disclosure Project (CDP) Climate Change Questionnaire in 2022 reported acute and chronic physical risks in their disclosures. Many of these companies calculated how much climate impacts will cost them in the coming years if they do nothing—that is, the cost of inaction—and described the measures they are taking and financing to protect their value at risk. An analysis of hundreds of individual responses provides a snapshot of where private finance for adaptation and resilience implementation is flowing today. For companies that are not yet investing in adaptation and resilience, this landscape reveals the types of actions that their peers deem valuable. (See Exhibit 3.) Mapping adaptation and resilience actions against key impact areas such as food resilience, water resilience, and energy resilience illuminates the positive spillover benefits that these measures can deliver for the local communities, economies, and ecosystems in which companies operate and upon which their business models depend. (See "Adaptation and Resilience Measures Framework" in the Appendix.) Financing these actions can help fortify broader systemic resilience.

Exhibit 2 - Physical Risks Impact Business Models



Sources: See the footnotes below for sources of specific data points.

[1]Grüter, Trachsel, Laube & Jaisli (2022), "Expected global suitability of coffee, cashew and avocado due to climate change."

[2]British Broadcasting Corporation (2011), "Hard disk and camera makers hit by Thai floods."

[3]Government of the Philippines (2013), "Post-Disaster Needs Assessment of TY Yolanda Affected Areas."

[4]Asian Development Bank (2013), "Summary: Initial Disaster Needs Assessment."

[5]Time Magazine (2023), "Extreme heat is endangering America's workers—and its economy."

Our analysis shows that a sizable number of companies (roughly 40% of responses analyzed) are financing measures that directly enhance the resilience of their businesses and communities. Those investments are directed primarily toward supply chain resilience, climate analytics, disaster preparedness, and climate insurance. The demand for such protection reinforces the criticality of ensuring the availability of sufficient financing to companies.

Many businesses (roughly 20% of responses) are also enhancing infrastructure resilience through better planning, design, and development of new assets and by retrofitting and upgrading existing assets. Specific measures depend on the particular climate hazard faced, but companies in nearly all industries cite flood protection measures as essential and are investing in actions such as improved drainage and rainwater harvesting.

In addition, companies in nearly every industry are financing water security measures. They report protecting revenue by securing operations during times of water stress and achieving cost savings through increased resource efficiency. These water security measures include investments in reducing water demand through water use efficiency technologies and water recycling, increasing water supplies through desalination and other methods, and deploying technologies for alternative water use. Highly water-dependent industries such as food, beverage, and agriculture and manufacturing invested the most in building water resilience.

Although more momentum is needed, the increased financing in these core areas is encouraging. In contrast, relatively few companies disclose efforts toward ensuring the resilience of energy systems, food systems, health, and biodiversity.

Investing in Adaptation and Resilience Alongside Mitigation Is the New Climate Finance Imperative

It is imperative for companies to recognize that investing in mitigation efforts, such as striving for net-zero emissions and adapting to and building resilience against existing and impending climate impacts, are critical priorities. While mitigation measures aim to curb the future progression of climate change, adaptation is equally essential because it directly addresses climate impacts affecting businesses, communities, and ecosystems now and in the future. Business leaders should develop a comprehensive climate transition plan that covers both mitigation and adaptation—factoring in how their operations contribute to climate change and how climate change impacts their operations, their communities, and beyond.

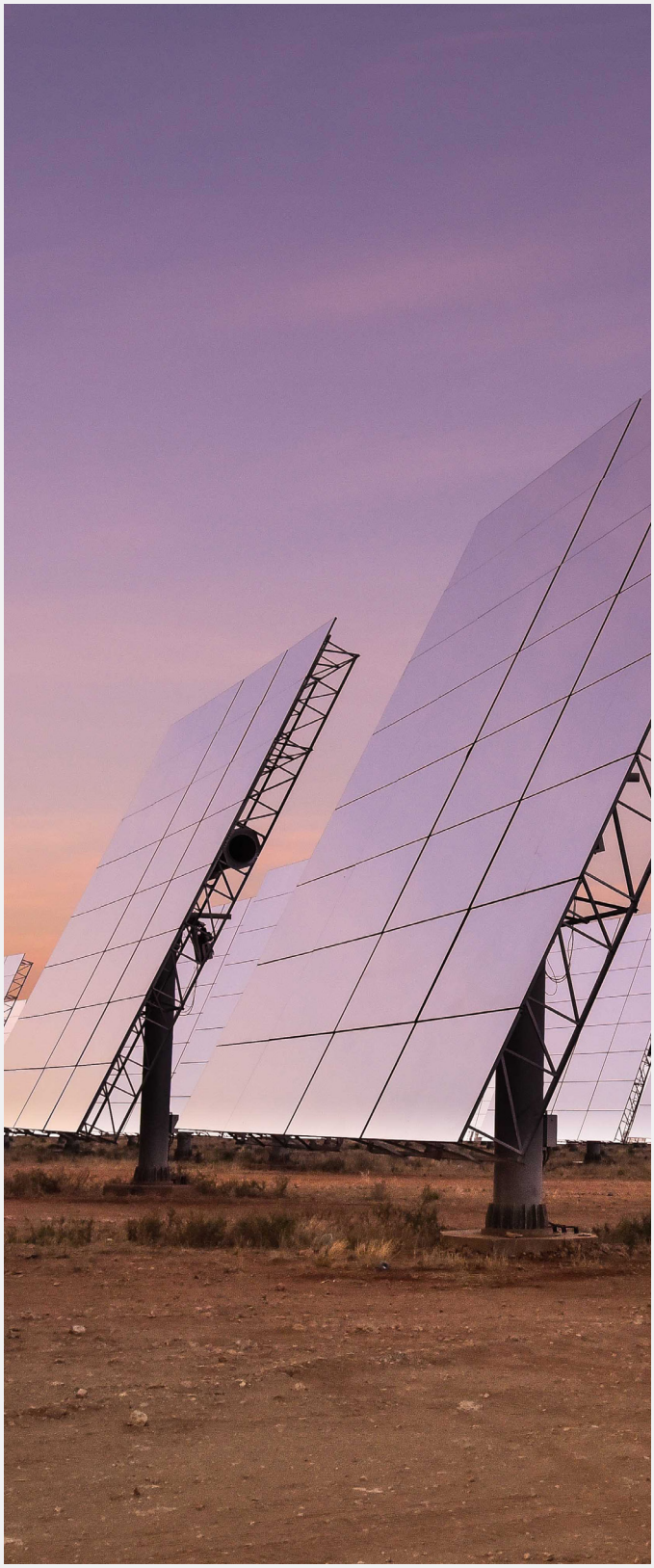
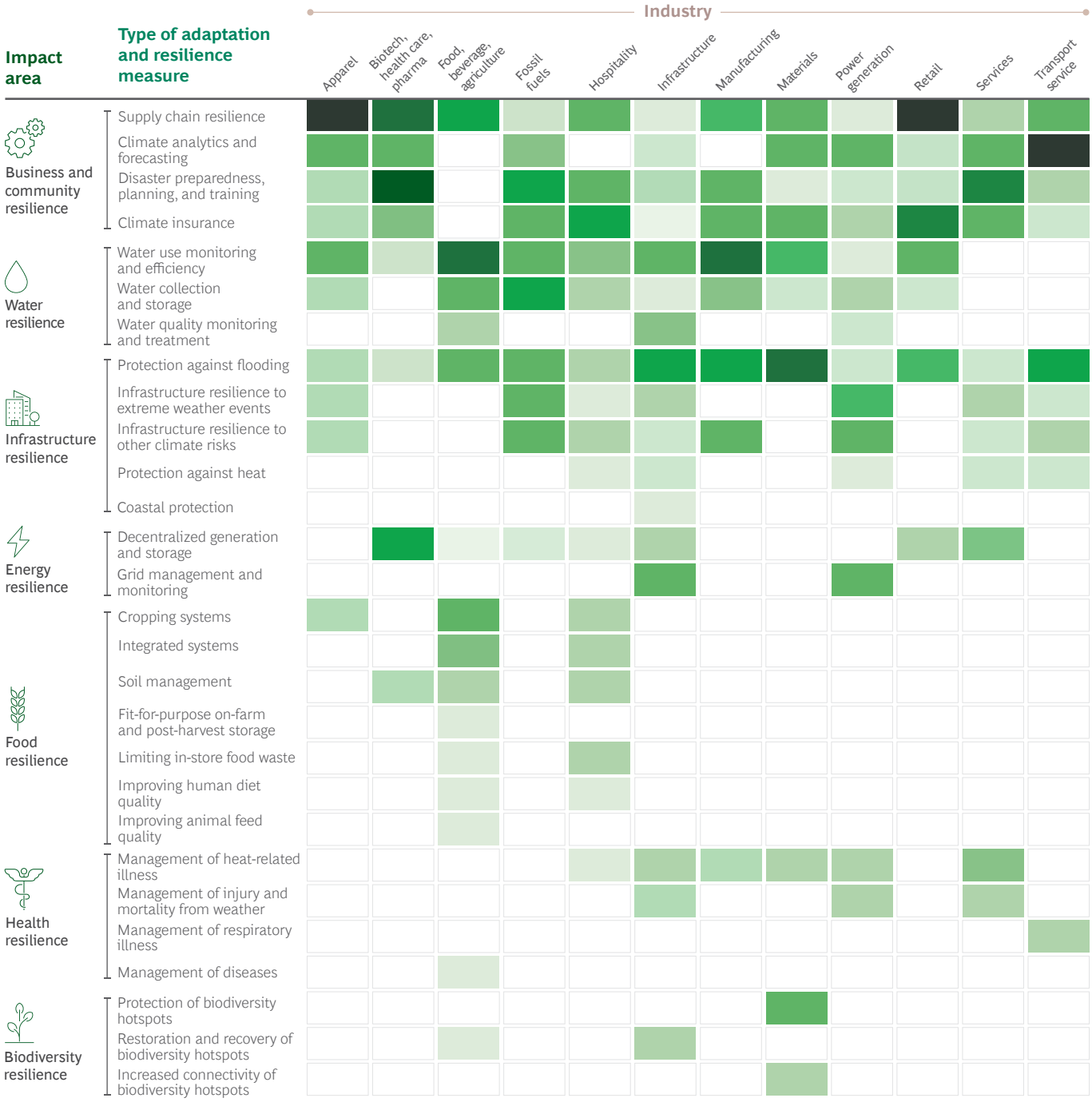


Exhibit 3 - Companies Are Financing Adaptation and Resilience Measures to Protect Value at Risk

Landscape analysis showing the frequency of adaptation and resilience measures taken by companies as cited in CDP disclosures, organized by industry and impact area



Legend: For each industry, shading indicates the number of specific adaptation and resilience measures taken, as a percentage of all adaptation and resilience measures taken by the industry

30% 0%

Source: BCG analysis based on data from the 2022 Climate Disclosure Project Climate Change Questionnaire (n = 400 responses).

Note: The landscape analysis summarizes actions that companies are disclosing to CDP; they are not representative of all actions that a company is taking or considering taking. Results are self-disclosed and may show positive bias.

We are moving from a business case for adaptation and resilience premised on potential scenarios to one based on near-certain projections.

With regard to energy, companies across industries are beginning to finance measures such as building new energy storage facilities, installing backup power sources, and generating energy on-site. These investments help ensure continued operations during climate-related disruptions, a key benefit that companies cite.

Actions to build the resilience of food systems are primarily financed by food, beverage, and agriculture companies. These companies are changing upstream production methods (for example, by investing in regenerative practices such as soil, crop, and livestock management, climate-resistant crop varieties, and precision agriculture tech) and downstream activities (for example, climate-controlled storage and transport and improved packaging to limit food loss). These efforts protect company revenue and deliver cost savings through greater resource efficiency. They also improve food security, reduce food loss and waste, and minimize biodiversity degradation and resource dependency.

Despite growing recognition of the adverse impacts of climate change on health and biodiversity, few companies have engaged in meaningful action and financing. With respect to health, only a small number of companies noted that they are financing particular interventions. Some that did so were involved in outdoor industries such as services and manufacturing. Among the health measures financed were technologies such as cooling systems and practices such as shifting work hours to protect workers from heat-related incidents and to lower health-related costs.

With respect to biodiversity, our CDP analysis revealed little action: only 2% of responses refer to measures such as peatland restoration, forest conservation, and adoption of grazing techniques that improve biodiversity. Companies that are undertaking these efforts reported positive direct impacts on their business operations (for example, through reducing forest fire risks). But more action and finance are needed. A recent report by BCG found that roughly 50% of global gross domestic product directly depends on nature and its services. Companies whose revenue-generating activities rely heavily on nature-based inputs should explicitly weigh the potential benefits of biodiversity and the potential harm of species loss.

Encouragingly, several companies are financing nature-based solutions, which generate positive outcomes across several impact areas and offer co-benefits such as increased biodiversity, carbon sequestration, ecosystem restoration, and higher quality of life for surrounding communities. For example, watershed management can help protect water quality, reduce flooding, enhance biodiversity, and support sustainable agricultural practices and livelihoods.

Companies are financing adaptation and resilience measures in EMDEs. Although most (70%) of the responses in the survey analysis reflect actions of companies headquartered in advanced economies—in part because the available data skews toward geographies that require disclosures—companies with operations in EMDEs are financing adaptation and resilience to protect value at risk, too. And because these markets are among the most vulnerable to climate change, they can protect the greatest value.

Our analysis shows that multinational corporations operating in climate-vulnerable EMDEs are investing in adaptation and resilience. These efforts play a critical role in enhancing the resilience of local micro and small enterprises (MSEs) within their value chains.[2] (See "Case Study on PepsiCo: How Implementing Regenerative Agricultural Practices Increased Yields and Resource Efficiency.")

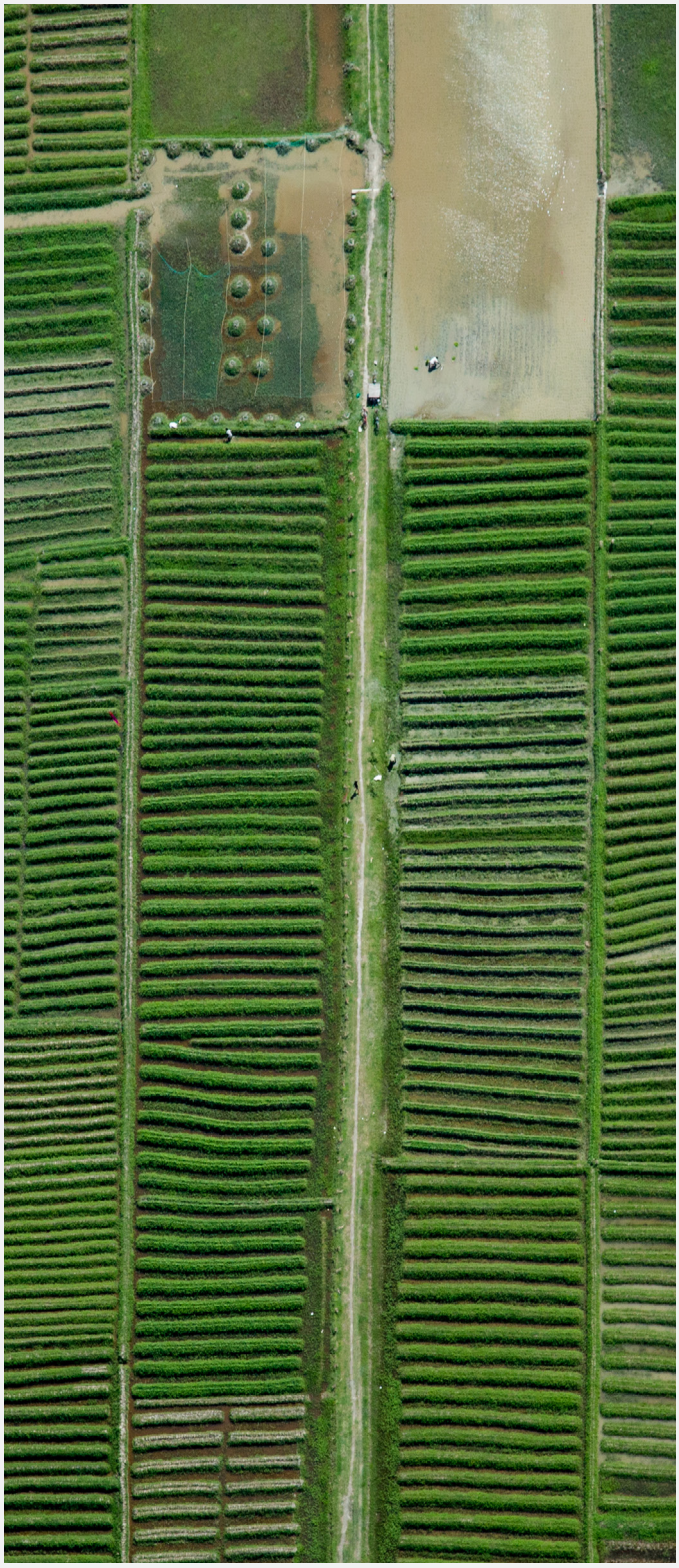
It is equally important, however, for local companies operating in EMDEs to invest in adaptation and resilience—not only to protect against harmful near-term climate impacts, but also to make use of these businesses' strong knowledge of and ties with local communities. Many individuals depend on these businesses for their livelihoods and for critical products and services. The example of the Energy Development Corporation in the Philippines illustrates how powerful the financial and societal benefits of proactive adaptation and resilience intervention can be. (See "Case Study on the Energy Development Corporation: How Building Infrastructure Resilience Protected the Company and Its Community.")

The benefits of investments in adaptation and resilience can significantly outstrip their costs. Across advanced economies and EMDEs, company data shows that efforts to protect value at risk can deliver significant returns. Overall, 80% of survey respondents reported that the benefits they achieved were at least 2 to 15 times their cost—and in one measure analyzed, the benefits climbed as high as 53 times their cost. (See Exhibit 4.)

How Implementing Regenerative Agricultural Practices Increased Yields and Resource Efficiency

Case Study on PepsiCo

PepsiCo, a PREPARE Call to Action company, sources agricultural ingredients from approximately 60 countries, many of them EMDEs. Through pep+, the company's end-to-end transformation to fundamentally transform how it makes, moves, and sells its products, the company is collaborating with farmers in these countries to convert 7 million acres of its agricultural land footprint to regenerative practices that are more resilient to climate change. As of the end of 2022, PepsiCo has worked with 89 regenerative demonstration farms in Mexico, South Asia, Southeast Asia, and other locations to showcase new technologies and locally relevant practices. These efforts are already paying off. In demonstration farms in India, pep+ has helped farmers improve yields by an average of 3% and cut greenhouse gas emissions by 20%. In 2022, farmers in demonstration farms in Thailand have boosted yields by 18% and reduced water use in irrigation by up to 36%.



How Building Infrastructure Resilience Protected the Company and Its Community

Case Study on the Energy Development Corporation

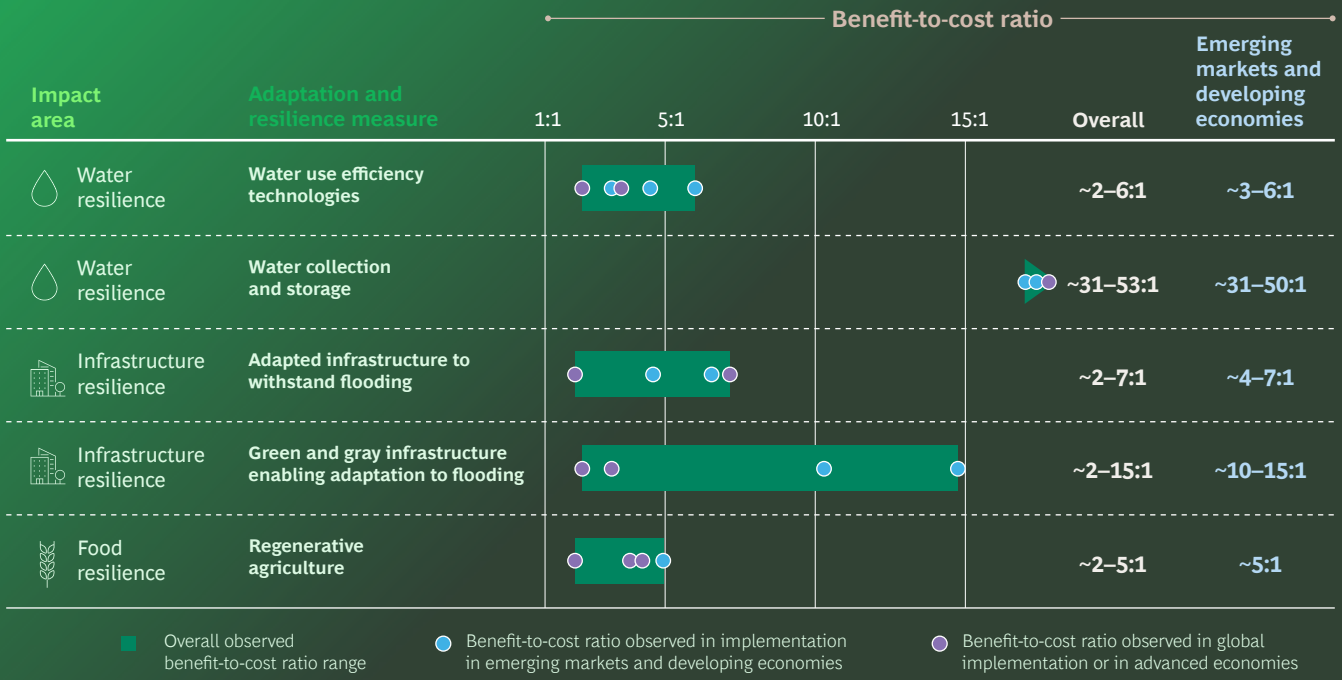
The Energy Development Corporation (EDC), based in the Philippines, is one of the world's largest producers of geothermal energy. In 2013, Super Typhoon Haiyan, one of the most powerful storms on record, struck the island nation. This caused substantial damage to more than half of EDC's 650-megawatt geothermal facilities on the island of Leyte and required four months of work for the company to recover and resume normal operations. In 2017, Tropical Storm Urduja brought 1 meter of rain in just three days, reducing capacity by 50% at the 232-megawatt Malitbog Geothermal Power Plant. These events, and the Philippines' status as one of the world's ten countries with the highest exposure to natural disasters, signaled the urgency for EDC to build infrastructure resilience.

In response, EDC implemented a variety of adaptation and resilience measures that protected its own assets and operations while also increasing the systemic resilience of the local communities and economies in which it operated. Those measures covered critical points of infrastructure in EDC's Philippine operations. For example, they reinforced or replaced cooling towers to accommodate higher wind speeds, upgraded materials from wood to fiber-reinforced plastic, and stabilized slopes to prevent impacts from landslides. Following guidance from the country's Department of Energy and in coordination with municipal stakeholders, EDC also conducted disaster relief and recovery training in surrounding communities and created a nationwide network of first responders to boost local resilience.

These initiatives were well received by the market, garnering interest from asset managers and insurers in the Philippines. To finance the continuous implementation of adaptation and resilience projects, the International Finance Corporation issued the first internationally rated triple-A Philippine peso-denominated green bond in 2018, with a back-to-back loan to EDC, at a value of about $90 million. EDC also listed $100 million worth of ASEAN Green Bonds in June 2021, the first tranche to be issued out of its $300 million shelf registration. The base $60 million issue size was oversubscribed by a factor of more than 10. This allowed EDC to exercise its oversubscription option and raise another $40 million, approximately $14 million of which it specifically allocated to enhancing natural calamity resilience. Insurance providers have also recognized and factored in the value of these adaptation and resilience initiatives, keeping EDC's premiums steady in markets where they have otherwise been rising as a result of climate-related disasters.

Exhibit 4 - Implementing Adaptation and Resilience Measures Delivers a Range of Benefit-to-Cost Ratios

Transaction analysis showing the range of benefit-to-cost ratios across five types of adaptation and resilience measures



Source: BCG analysis based on data from the 2022 CDP Climate Change Questionnaire (n = 20).

Note: This analysis focuses on the benefits gained from adaptation and resilience measures and does not consider broader social impacts or mitigation benefits that, taken together, may result in a higher benefit-to-cost ratio. The data illustrates that a positive business case can be made in financing adaptation and resilience measures, and actual returns expectations depend on appropriate implementation of adaptation and resilience solutions as well as local policy contexts, physical climate risk assessments, and the condition of assets.

To explore how companies are deriving positive benefit-to-cost ratios (BCRs), we selected five adaptation and resilience measures and analyzed self-reported company data relevant to those measures. Benefits that companies reported include cost savings gained through increased resource efficiency, revenue loss avoided through continued operations amid climate shocks, and asset damage avoided through reinforcing infrastructure. Data points at the upper end of BCR ranges refer to projects implemented in EMDEs (such as in water efficiency technologies), nature-based projects (such as in green and gray infrastructure to adapt assets to flooding), and projects funded through co-investment with the public sector (such as in regenerative agriculture). (See "Benefit-to-Cost Ratios for Five Illustrative Adaptation and Resilience Measures.")

Companies need more diverse financing solutions to implement adaptation and resilience measures. As the imperative to adapt becomes more urgent, companies will need financing for adaptation and resilience measures and more creative approaches to sourcing it—especially for interventions that provide systemic resilience in EMDEs. Financing decisions, particularly those involving debt, typically proceed on the basis of future cash flows. But that construct may not be suitable for decisions about adaptation and resilience financing, where the goal of the proposed measures is to prevent economic losses, ensure the continuity of business operations, and secure asset values over longer time horizons, rather than to create new cash flows.

A number of financing approaches are available today to fund these initiatives. Companies can deploy balance sheet financing. Commercial banks can provide commercial debt and integrate physical risks into their lending portfolios. Investors can underwrite corporate bonds. Insurers can offer indemnity and parametric insurance to cover damage from climate-related disasters. And in specific cases, public financiers can provide catalytic capital or concessional debt to de-risk adaptation and resilience investments in critical sectors.

Demonstrating the cost of inaction can support efforts to secure financing. Evidence-based, forward-looking physical climate risk assessments are becoming more common as companies employ in-house and third-party climate data across different time frames and use scenario modeling to assess their financial exposure. These insights allow them to more accurately quantify the value at risk and better develop the business case to protect.

The public sector plays a prominent role in enabling businesses to adapt. Companies globally—and particularly in EMDEs—are engaging public financiers, including governments, to fund adaptation and resilience measures that provide crucial protections and generate tangible social and economic outcomes. But more help is needed in creating instruments that incentivize private action to strengthen the systemic resilience of local communities and MSEs in EMDEs.

Many MSEs that sit at the frontlines of climate change will turn to public financiers for grants, subsidies, and guarantees to finance adaptation and resilience measures. And the more capital constrained these businesses are, the greater their need for public assistance will be. The UN Capital Development Fund employs a results-based payment model that helps MSEs in Africa undertake resilience-building activities. Using the donor agreement as collateral, the MSE can secure upfront financing through loans from local banks, with additional financing contingent on their achieving specific milestones.[3]

Governments and public financiers can also provide technical assistance and catalytic capital to improve project economics and ensure that measures are not maladaptive. (See "How a Food and Beverage Producer Employs Public-Private Partnerships to Strengthen Local Agriculture Supply Chains in East Africa.")

To facilitate investment, governments should develop and communicate climate risk assessments and adaptation and resilience plans jointly with the private sector. This can provide visibility on climate risks and ensure that measures align with local priorities. Governments can also accelerate development of regulatory frameworks that incentivize and mandate private sector action.[4] And standard setters must help formulate methodologies that improve the quality of disclosures and assist companies and their financiers in accurately sizing what's at stake and financing the measures needed to build resilience.

Benefit-to-Cost Ratios for Five Illustrative Adaptation and Resilience Measures

Water Efficiency Technologies. Cost savings from drip irrigation and other low-flow technologies delivered an economic benefit-to-cost ratio (BCR) of 2 to 6 globally and of 3 to 6 in EMDEs. Such measures are particularly critical in EMDEs in sub-Saharan Africa and Latin America, the two regions that are expected to see the highest growth in water demand by 2050.[1]

Water Collection and Storage. Rainwater harvesting systems and other alternative water collection measures that ensure continued operations during times of water stress delivered an economic BCR of 31 to 53 globally and of 31 to 50 in EMDEs. The high BCRs on this measure reflect the magnitude of value at risk that companies report from revenue loss due to water shortages.

Adapted Infrastructure to Manage Flooding.[2] Elevating, reinforcing, and retrofitting infrastructure delivered an economic BCR of 2 to 7 globally and of 4 to 7 in EMDEs. This is critical in EMDEs where expansion of urban areas and new cities requires resilient infrastructure, achieved by embedding physical risks in planning and design.[3] Although costs are front-loaded, benefits accrue over many years through reduced start-stop spending, maintenance costs, and repair costs. The BCRs in our analysis are in line with those of the Global Commission on Adaptation, which estimates a range of 2 to 10.[4]

Green and Gray Infrastructure to Adapt Other Assets to Flooding. Measures to absorb or divert floodwater delivered an economic BCR of 2 to 15 globally and of 10 to 15 in EMDEs.[5] The upper end of the BCR range reflects implementation of hybrid nature-based solutions combined with gray infrastructure solutions, which have been shown to provide lower-cost and more resilient services.[6]

Regenerative Agriculture. Combining practices such as agroforestry, cover cropping, and no-till farming can deliver an economic BCR of 2 to 5 globally, with the upper end of the range occurring in a project based in an EMDE. This project was financed through a public-private partnership in which injection of public capital lowered initial private investment.

1. World Resources Institute (2023), 25 Countries, Housing One-quarter of the Population, Face Extremely High Water Stress.
2. Based on EU taxonomy classifications of adapted investments versus investments enabling adaptation.
3. OECD (2018), Climate resilient infrastructure.
4. Global Commission on Adaptation and World Resources Institute (2019), Adapt Now: A Global Call for Leadership on Climate Resilience.
5. Based on EU taxonomy classifications of adapted investments versus investments enabling adaptation.
6. Climate Adaptation Platform (2023), "Green-Grey Infrastructure Solution for Urban Stormwater Management."

How a Food and Beverage Producer Employs Public-Private Partnerships to Strengthen Local Agricultural Supply Chains in East Africa

With drought becoming a more persistent threat to agricultural production in sub-Saharan Africa, a global food and beverage company active in the region entered into six public-private partnerships to provide farmers with new seed varietals, agricultural training, and improved access to finance. The goal was to strengthen local supply chains and help the company generate 60% of its total agricultural production in the region. The $3 billion project was 50% financed by the company, with the remainder financed by public and development financial institutions. The adaptation and resilience initiatives more than doubled current crop yields while also improving local food security. The program also expanded market access for farmers, as they sold more than half of their agricultural products in local markets.[1]

1. CDP (2022), Disclosures to the Climate Change Questionnaire 2022; acquired through BCG's institutional license.

Companies need to manage inadvertent negative impacts of adaptation and resilience measures. Some adaptation and resilience actions, if improperly executed, may lead to maladaptation. And because physical risks are systemic, they can have knock-on effects in the broader market and in the macroeconomic and natural environment. For example, applying a sustainable fertilizer could restore ecosystems in one farm while causing an algal bloom in a downstream river system. That bloom could deplete nutrients in the river system, impacting the households and firms that depend on it. Geographic diversification may also inadvertently reduce capital flows to the very communities most in need of investment to address climate vulnerabilities. Companies should therefore evaluate the impacts of their actions using indicators that extend beyond the management of risk and direct financial benefit, and they should consider whether their interventions can lead to transformational change for a wider system of actors—including the communities, customers, ecosystems, and countries that their business models depend upon. This broader evaluation is also important because of the overlap between managing market risks and building social capital in communities. Companies can use resources such as the Locally Led Principles for Adaptation, which offer a guide for engaging local communities, to craft fit-for-purpose adaptation and resilience measures that benefit their operations while preventing maladaptation and boosting broader systemic resilience.

Entry Point 2: Align Investment Portfolios Toward Resilient Companies

Traditional accounting methods often fail to take physical climate risks into account in valuations. As a result, investment portfolios are prone to underestimating their financial exposure. These blind spots can create significant losses when unanticipated vulnerabilities come to light and must be written off or retired.[5] Infrastructure investors risk losing over half of their portfolio globally by 2050.[6] In the US alone, $2.2 trillion of syndicated loans from 28 major banks could be exposed to physical risks of about $250 billion.[7] Likewise, traditional accounting methods do not quantify direct and indirect benefits such as losses avoided, which results in additional missed opportunities.

As lenders and investors increasingly recognize these vulnerabilities, alternative valuation methods that price in physical risks are gaining recognition. (See "Case Study on BNP Paribas Asset Management: How One Firm Integrates Physical Climate Risk into Its Decision Making.") Standardized methodologies that support such pricing are underway, too, as several regional and global investment groups, standards boards, insurance associations, and UN-related bodies have come together to advance these issues. One such effort is the Physical Climate Risk Assessment Methodology (PCRAM) Guidelines for Integrating Physical Climate Risks in Infrastructure Investment Appraisal.[8] Another is the Global Resilience Index Initiative's Systemic Risk Assessment Tool (SRAT).[9] Early results from the PCRAM methodology suggest that integrating physical risks in infrastructure appraisal can help investors quantify both direct and indirect benefits of incorporating adaptation and resilience in infrastructure design.[10] Similarly, the SRAT enables financiers and other decision makers to visualize physical risks to individual infrastructure assets, quantify associated direct and indirect economic impacts, and assess the effectiveness of various adaptation options in addressing the value at risk.[11]

To give investors greater surety, regulatory bodies, standards setters, and others must improve the quality and quantity of climate-related disclosures and promote the development of methodologies that integrate physical risk in investment and lending decisions. Methodologies that address the limitations of traditional accounting methods will be important for a wider range of sectors and asset classes. They are critical to unlocking more flexible and patient private financing for adaptation and resilience projects that have direct and indirect benefits to the private sector over longer time horizons.

How One Firm Integrates Physical Climate Risk into Its Decision Making

Case Study on BNP Paribas Asset Management

BNP Paribas Asset Management (BNPP AM) has implemented a proactive strategy to assess and address physical climate risk within its investment portfolio. Its methodology for risk assessment represents a holistic integration of financial, extra-financial, and climate-related asset-level information with an array of factors, including each firm's business lines, macroeconomic dynamics, financial valuation, and investor risk. One key facet of BNPP AM's strategy involves the development of a robust risk assessment framework that evaluates the potential impacts of climate scenarios on the credit quality and internal rating of its corporate clients in the future.

Undergirding this methodology are robust climate data and analytics. BNPP AM conducts asset-level and country-level analyses through internally developed climate models that are tailored to assess risks from riverine and coastal flooding as well as from chronic heat events. By harnessing these models, BNPP AM can effectively quantify potential damage to assets and firms within its portfolio across various climate scenarios. This quantification offers the firm valuable insights into sectors and regions that may face heightened risks under future climate conditions. For example, in its 2022 Climate Report, BNPP AM highlighted manufacturing, real estate, wholesale and retail trade, and loans collateralized by commercial immovable property as its primary sectors of exposure.[1]

1. BNP Paribas (2022), "2022 Climate Report: Strategy, risks & opportunities, net zero commitments."

The “Grow” Opportunity

Grow the Market of Adaptation and Resilience Solutions

As companies and countries respond to the mounting impacts of climate change, the global market for adaptation and resilience solutions will rapidly scale to meet demand. This will require technology and business model innovation, especially in EMDEs, where many consumers cannot afford to use traditional payment models to purchase high-tech products.

Supporting adaptation and resilience solutions requires diverse sources of funding, creating high-growth prospects for investors, particularly in EMDEs, which have seen some of the highest company valuation multiples.

This chapter details the pipeline of adaptation and resilience solutions that are receiving financing today, the entry opportunities for private finance, and the role of public and social actors in de-risking and catalyzing private investments. We break our commentary into two entry points, one pertaining to early-stage and growth-stage companies and the other to mature companies. (See Exhibit 5.)

Exhibit 5 - Two Entry Points Comprise the "Grow" Adaptation and Resilience Financing Opportunity

Opportunity	Business case	Entry points
Grow the market of adaptation and resilience solutions	Capitalize on the growing market fueled by companies and governments that are increasingly recognizing the imperative to act	3 Finance early- and growth-stage companies developing adaptation and resilience solutions 4 Finance mature companies developing new adaptation and resilience product lines

Source: BCG analysis.

Entry Point 3: Finance Early-Stage and Growth-Stage Companies Developing Adaptation and Resilience Solutions

Businesses and governments need solutions that cover the entire adaption journey, from assessing physical climate risks to reducing those risks and their associated impacts. Interventions need to be tailored to specific industry and geographic characteristics. Some solutions, such as cooling systems, are well established, but other high-tech innovations, such as robotic appliances for precision agriculture, are still emerging. New business models are evolving, too. One example is credit-based payments designed to help subsistence farmers afford solutions such as solar-powered irrigation systems.[12] Business model innovation is particularly important in EMDEs, where companies must navigate multiple socioeconomic challenges to reach scale.

Helping early- and growth-stage companies foster these offerings to maturity and make them commercially viable can deliver attractive returns for investors. Avenues for financing these companies include accelerator programs that provide seed capital, formal venture capital (VC) and private equity (PE) funding rounds, debt financing, and emerging blended equity funds. Financial vehicles dedicated to meeting the burgeoning need for adaptation solutions are emerging as well.

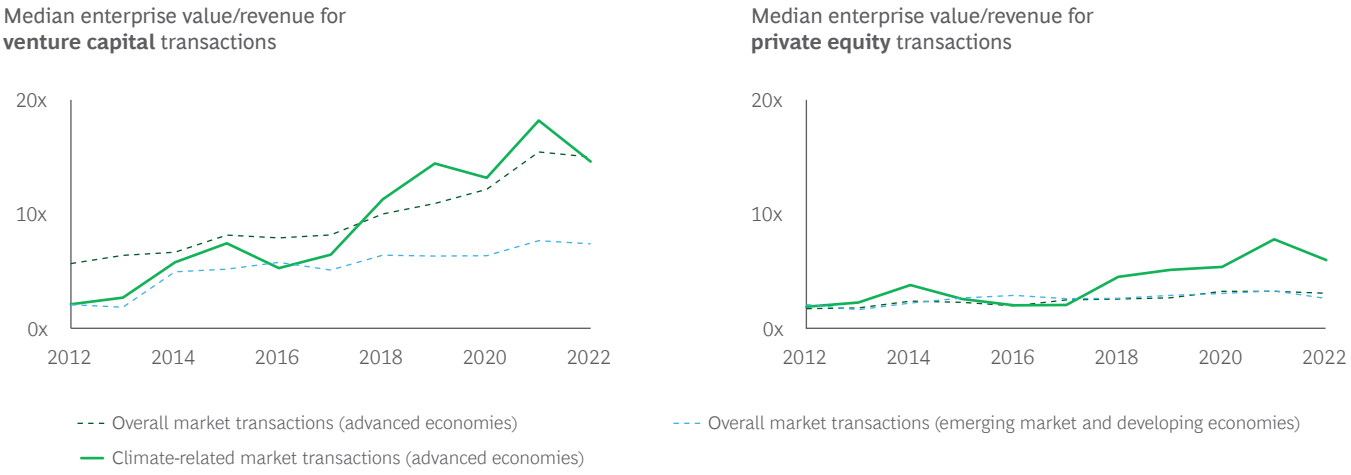
Leading investment firms consider this to be an important and high-growth space. J.P. Morgan Asset Management stated in its January 2023 Portfolio Insights issue that, "early moving investors can potentially benefit from gaining an awareness of the current adaptation landscape and then allocating capital towards promising emerging solutions."[13]

Adaptation and resilience financing is gaining traction as a distinct asset class, buoyed by efforts such as the Lightsmith Group's Adaptation SME Accelerator Project, which facilitates greater investment by providing a clearer taxonomy for adaptation and resilience solutions, with a focus on EMDEs.

Demand for adaptation and resilience solutions is occurring within the overall climate tech market. Between 2012 and 2022, VC and PE transactions in companies that engage in climate mitigation and adaptation and resilience saw their median valuation multiples more than double. From 2018 to 2022, these transactions also outperformed the overall market. (See Exhibit 6.) Although those particular assessments pertain to companies and markets in advanced economies (because there was too little data to assess transaction values across EMDEs as a whole), individual country data suggests that climate transactions in many EMDEs are generating strong multiples. For example, median valuation multiples for climate-related VC transactions increased in India by more than 13 times from 2013 through 2022, and in China by more than 1.5 times from 2021 through 2023. In 2023, VC and PE investment in climate tech is down by about 40% from 2022 levels, but that decline reflects a softening in overall deal flow across industries and is not a reflection on climate tech per se.[14]

Exhibit 6 - Valuation Multiples for Climate-Related Venture Capital and Private Equity Transactions Have Increased in the Past Decade

Year-on-year trends of median enterprise values/revenue multiples for transactions relating to climate mitigation and adaptation companies from 2012 to 2022, for advanced economies and EMDEs



Sources: PitchBook Data, Inc. (data not reviewed by PitchBook analysts); BCG analysis.

It is difficult to identify precisely how much climate tech funding goes to adaptation and resilience rather than to mitigation because not enough global data is available, but the general understanding—from VC and PE investor interviews—is that mitigation has received the larger share to date. Those investments, however, have laid the foundation for the adaptation and resilience solution market to grow, particularly as many climate technologies offer dual mitigation and adaptation benefits. And the share of funding going toward adaptation and resilience innovation is likely to rise. Over the past few years, several dedicated VCs, PEs, and equity funds that focus on adaptation technologies have emerged. A number of these funding sources emphasize EMDEs, recognizing the heightened need and potential markets in such countries. The Climate Resilience and Adaptation Finance and Technology Transfer Facility is one example.

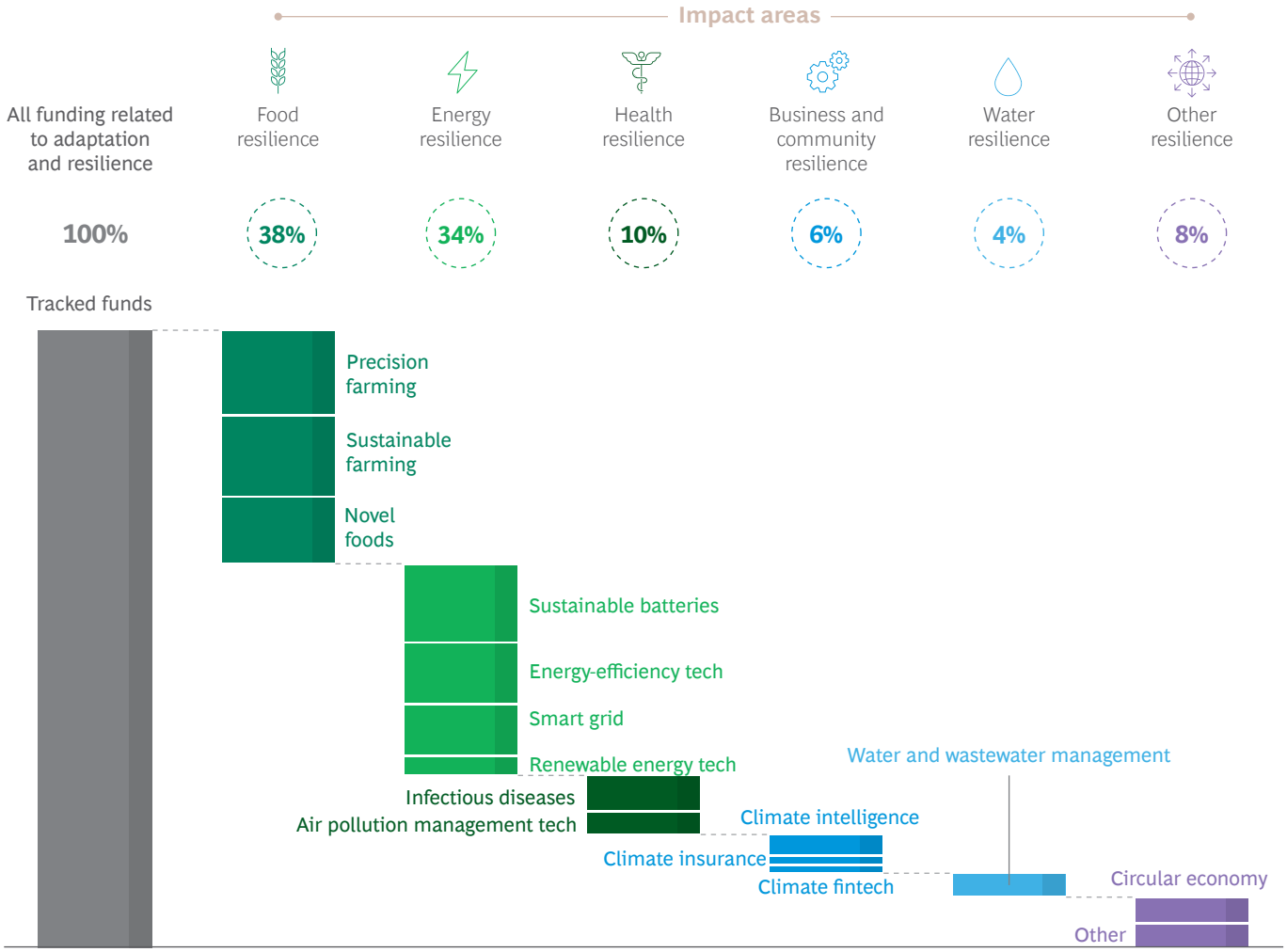
A global pipeline of adaptation and resilience transactions already exists. Contrary to a common perception among investors, an ample pipeline of adaptation and resilience transactions exists today, and that pipeline is poised for growth.

Our analysis of 295 recent sustainability tech deals involving adaptation and resilience solution companies in the investor database Tracxn indicates that the largest proportion of finance flowed into subsectors related to food and agriculture. (See Exhibit 7.) The portfolios of many adaptation-focused VCs show a similar concentration, and conversations with fund managers suggest that many investors view adaptation and resilience solutions as being synonymous with food and agriculture.

Nevertheless, there are many opportunities for investors in other impact areas. Energy, for instance, represents over one-third of tracked funds flowing into companies that provide adaptation and resilience solutions, including smart grid management and sustainable batteries. And health-related solutions that build resilience to threats such as infectious diseases and air pollution account for about 10% of tracked funds.

Exhibit 7 - Pipeline Is Available and Finance Is Flowing into Companies That Provide Adaptation and Resilience Solutions

Landscape analysis showing the proportion of tracked funds flowing into companies that provide adaptation and resilience solutions



Sources: PitchBook Data, Inc. (data not reviewed by PitchBook analysts); BCG analysis.

Note: Percentages are rounded to the nearest whole number. Boxes reflect Tracxn "sustainability tech" categories. These are mapped to BCG's adaptation and resilience measures framework, based on the impact area that is most relevant to most companies in the sustainability tech area. Percentage of sustainability tech deals involving adaptation and resilience solution companies in the Tracxn investor database.

Our analysis demonstrates that technologies receiving the most financing generally deliver cross-cutting benefits across adaptation and resilience, mitigation, and other sustainable development goals. For example, the five subsectors of adaptation and resilience solutions that attracted the most financing (precision farming, sustainable farming, sustainable batteries, novel foods, and energy efficiency tech) also promise climate mitigation benefits—reducing the carbon footprint compared to conventional farming methods and energy usage.

Founders of adaptation and resilience companies also cite their ability to satisfy multiple impact themes and investment mandates as an advantage in attracting finance. Mitigation co-benefits can generate alternative revenue streams through carbon markets, too. For example, Sand to Green, a French startup currently operating in Morocco, transforms deserts into cultivable land by using climate-smart agroforestry methodologies and solar-powered desalination systems. In addition to selling the food and fodder that the farms produce—which builds local resilience to food-related climate shocks—Sand to Green also sells carbon credits earned from capturing carbon within biomass.[15]

Although still nascent, the adaptation and resilience solutions market in EMDEs has significant potential. The sample data from Tracxn that we studied shows that a fairly low percentage of finance (just 13%) flowed to companies headquartered in EMDEs. In order of amount of finance, from largest to smallest, they are India, China, Chile, Argentina, Malaysia, Brazil, South Africa, Poland, and Turkey. That finding may be an artifact of the limited sample size and the absence of comprehensive global data, but it more likely reflects the modest level of current adaptation and resilience financing for EMDE-based companies. However, signals point towards growth. In interviews, leading climate investors told us that growth in EMDEs is inevitable, given the rising climate impacts in these countries and the resulting high demand for adaptation and resilience solutions.

Interviews also highlighted the progress that early- and growth-stage companies in EMDEs are making in developing local solutions that have tremendous market potential. Often this is due to their use of innovative business models tailored to the specific demands of local markets, making them highly accessible and scalable within those markets. In-depth interviews conducted by the organization Support Entrepreneurs for Environment and Development (SEED) with companies in Southern Africa reveal that smaller local companies have key advantages in filling the adaptation and resilience solution gap because they are aware of household- and individual-level pain points and can tailor solutions and payment schemes to large and often underserved customer bases. In economic environments where large corporations and nongovernmental organizations may not meet the needs and demand of rural communities, these local businesses may face limited competition.[16]

Demonstration projects that prove the viability and scalability of specific adaptation and resilience solutions can help these businesses grow. Investors that are willing to invest early in demonstration projects for adaptation solutions can benefit from helping companies gain scale. For example, the precision agriculture company Solinftec began as a self-funded small enterprise in Brazil. By piloting new products with its existing customer base and refining payment structures, Solinftec unlocked external funding from private equity capital and debt capital markets, enabling it to expand internationally. (See "Case Study on Solinftec: How a Scale-Up Company Is Advancing Precision Agriculture Solutions.")

Although most investor frameworks classify adaptation and resilience as a subtheme within the broader "green investing" category, some financial instruments that have emerged over the past five years specifically catalyze private investments into adaptation and resilience in early- and growth-stage companies in EMDEs. (See Table 1.) These include blended equity funds and accelerator programs that aim to mobilize larger pools of private capital into multiple local companies to help scale solutions. The emergence of such funds and programs, and particularly those that focus on EMDEs, counters the perception of adaptation and resilience as being too high-risk or as being limited to ticket sizes that are too small to attract investor interest.

Companies developing adaptation and resilience solutions have attracted strong valuation multiples. In our sample, companies engaged in developing adaptation and resilience solutions attracted a median valuation multiple of 9 times revenue, with most values ranging from 1 to 31 times their revenue. And some solutions had much higher multiples. Internet of Things solutions developed for agriculture fields (field IoT), for example, saw enterprise valuation multiples of 3 to 77 times revenue. Other solutions, such as crop nutrition and disease management, have a narrower spread, with valuation multiples ranging between 1 and 5 times revenue in most of our sample, albeit with a few notable exceptions. (See Exhibit 8 and "Evaluation of Valuation Multiples for Adaptation and Resilience Solution Companies.") Many of the companies with the highest valuation multiples are based in EMDEs, underscoring the market potential of adaptation and resilience solutions in these geographies.

Private financiers can help adaptation and resilience solutions companies succeed in EMDEs. For companies engaged in developing adaptation and resilience solutions, as for any early- or growth-stage company, finance is critical to scale their solutions. For early-stage companies, accelerator programs and angel investors can provide seed equity to complement the founders' equity, and VC firms can purchase a majority share in a formal funding round. For growth-stage companies, higher-risk investors such as PE firms may dominate funding rounds, potentially alongside debt finance providers. Some financiers (or groups of financiers) may offer blended finance, bringing together multiple sources of finance.

But private investors can do far more than simply provide liquidity for early-stage companies. They can also share valuable expertise on optimizing business models, shaping financial structures for future funding rounds (such as leveraging local insurance, underwriting foreign exchange risk, and offering affordable sources of long-tenure finance) and introducing founders to a network of potential future investors. Financiers with local investment experience are particularly valuable for EMDE-based companies, which often face numerous, interlinked challenges when raising finance, such as foreign exchange risks, terminally high interest rates, and liquidity issues in national stock exchanges.

How a Scale-Up Company Is Advancing Precision Agriculture Solutions

Case Study on Solinftec

Solinftec, headquartered in Brazil, provides farmers with hardware and software to digitize their operations. By collecting and processing data from agricultural fields in real time through technology such as sensors and weather stations, Solinftec empowers farmers to make informed decisions on a per-plant level. Those insights have increased farmers' yields and reduced their use of chemicals, fertilizer, and fuel.

Solinftec has since scaled operations to the US and Canada, aided by funding from four PE firms over the past five years. The company's subscription-based business model ensures strong recurring revenues (and an annual average CAGR of 60%), that have enabled it to access debt funding, supported by a receivables facility. Solinftec hopes to secure additional equity and debt capital, bolstered by government grants, to extend its reach to farming communities that have significant untapped potential for yield improvement.

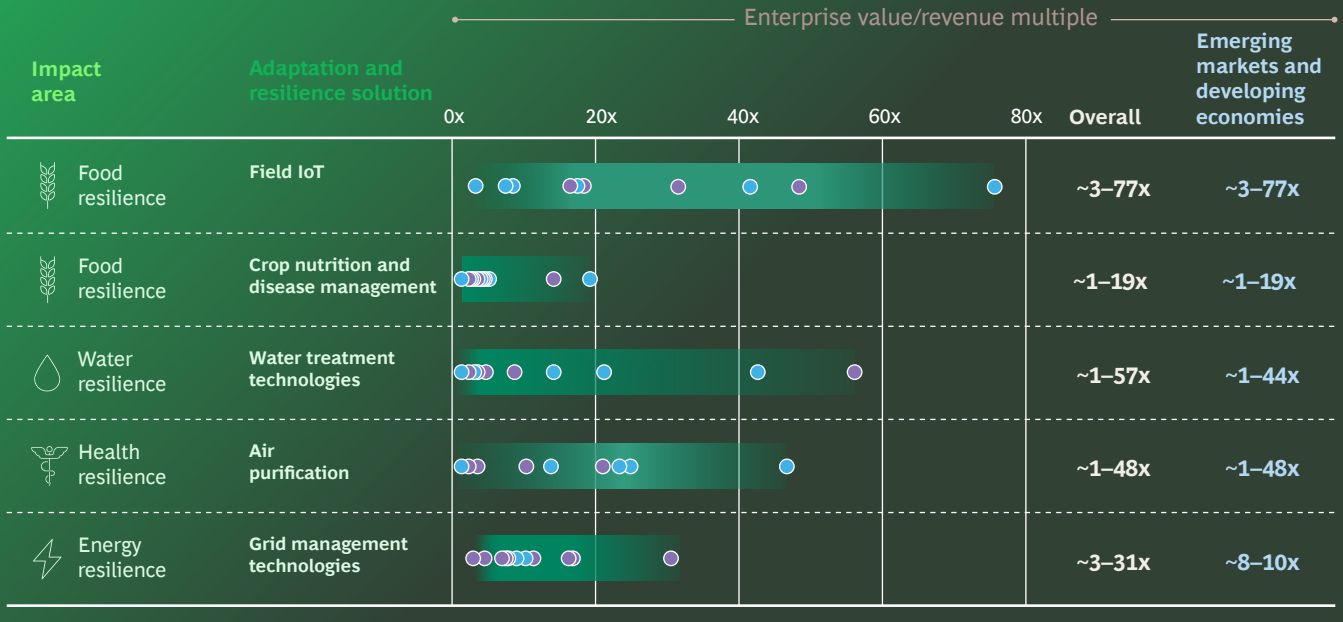
Table 1 - Case Studies of Financial Entities Investing in Scaling Adaptation and Resilience Innovation

Case study	Financing model
Climate Resilience and Adaptation Finance and Technology Transfer Facility (CRAFT) Led by Lightsmith Group	Closed in 2022 at $185 million, CRAFT is a private equity fund with a blended structure, consisting of concessional and commercial equity and a technical assistance facility.[1] The first commercial investment vehicle dedicated to expanding adaptation and resilience technologies globally, it focuses on growth-stage companies. In addition, Lightsmith Group, a private equity firm, supports small and medium-scale enterprises that develop adaptation and resilience solutions in developing countries through the Adaptation SME Accelerator Project.
Catalyst Climate Resilience Fund Led by Catalyst Fund	This early-stage fund and accelerator aims to invest in tech entrepreneurs that are scaling solutions for a climate-resilient future in Africa. They will invest $200,000 into 40 pre-seed adaptation and resilience startups across Africa and follow this through Series A on the highest performers. The fund blends capital from concessional and commercial equity investors. It reached its first close in August 2023. The target is to raise $40 million.
Global Innovation Lab for Climate Finance Secretariat: Climate Policy Initiative (CPI)	This is an investor-led, public-private initiative that accelerates innovative, well-designed, early-stage climate finance solutions and instruments. Since 2014, the Lab has launched 68 solutions (including CRAFT and the Catalyst Climate Resilience Fund), which have mobilized more than $3.5 billion for climate action in emerging economies.[2]
Innovating for Climate Resilience Fund led by Global Innovation Fund	Launched in 2021 at COP26, this fund invests grant, debt, and equity instruments into innovations that help low-income communities adapt to climate-related risks, aiming to benefit tens of millions of people.[3]
TECA Ventures for Climate Resilience led by BFA Global and FSD Africa	Launched in 2022 with $3.3 million in funding from Financial Sector Deepening (FSD) Africa, TECA is a venture builder with a mission to launch 100 ventures by 2026 (including at least 60 in Africa) to help build the climate resilience of vulnerable communities.[4]
Mazarine Climate Adaptation Tech Fund III by Mazarine Ventures	Launched in 2023, this venture capital fund is targeting roughly 15 Series A investments in technology innovations that help industry and society adapt to water risks in our new climate reality. These solutions aim to aid industry and society in monitoring, analyzing, and addressing climate-related risks.

1. Nordic Development Fund, Climate Resilience and Adaptation Finance and Technology Transfer Facility (CRAFT) [C114].
2. Climate Policy Initiative, The Global Innovation Lab for Climate Finance.
3. Global Resilience Fund (2021), Innovating for Climate Resilience Fund; Global Innovation Fund, Applying to the Global Innovating for Climate Resilience Fund.
4. Knowdys Consulting Group, BFA Global, FSD Africa partner, creates $3.3 million fintech venture capital launcher; TECA - Launching Ventures for Climate Resilience.

Exhibit 8 - Adaptation and Resilience Solution Providers Earn a Range of Valuation Multiples

Transaction analysis showing the range of enterprise value/revenue multiples for a sample of companies across five types of adaptation and resilience solutions



Source: BCG analysis based on data from PitchBook Data, Inc. and Tracxn (data not reviewed by PitchBook analysts).

Note: The revenue data covers a 12-month period. All financial information is post-2020. Data illustrates the ranges of valuation multiples observed in this analysis and does not imply expectations of future valuation multiples.

Evaluation of Valuation Multiples for Adaptation and Resilience Solution Companies

Field IoT. This adaptation and resilience solution includes the widest range of company valuations in the analysis (3 to 77 times revenue), with around half of the sample exceeding 20 times revenue. It encompasses technologies that optimize crop yields by monitoring and tailoring the conditions of crop growth, harvest, processing, and sale—for example, AI-based sensors and farm robotics, soil monitoring devices, and AI-based scouting systems that monitor crop health and deficiencies. Companies creating IoT technologies for precision agriculture have potential in EMDE regions such as sub-Saharan Africa, which has one of the world's lowest agricultural productivity rates per worker, despite having 52% of its workforce in agriculture.[1]

Crop Nutrition and Disease Management. Valuation multiples for this solution are clustered between 1 and 5 times revenue, with two standout examples at 19 times revenue (based in India) and 13 times revenue (based in the US) that develop high-tech solutions for large agricultural markets. Solutions focus on producing sustainable crop inputs to increase yield (such as high-yield seed varieties, sustainable fertilizers, and pest control solutions). Companies that develop sustainable crop inputs to increase yields similarly offer a cost-effective, scalable adaptation and resilience solution for many EMDEs.

Water Treatment Technologies. Valuation multiples in this measure cluster between 1 and 9 times revenue, with four higher multiples reaching as much as 57 times revenue (maximum 44 times revenue for EMDE companies). Relevant technologies include those that purify wastewater or manage the purification process (for example, an industrial wastewater purification and management platform for sewage treatment). Developing countries are most affected by poor water infrastructure and stand to gain significantly from these technologies: up to 80% of all environment-related diseases in the developing world are linked to inadequate water and sanitation.[2]

Air Purification. This measure, with valuation multiples of 1 to 48 times revenue, demonstrates promising valuation multiples for EMDEs companies, with the top three companies (at 48, 25, and 24 times revenue, respectively) based in India. Technologies include those that monitor and manage the quality of indoor and outdoor air, such as a hyperlocal air quality data platform. Air purification tech is important in many EMDEs, which often face higher health risks due to poor baseline air quality: 14 of the world's 20 most polluted cities are based in EMDEs.

Grid Management Technologies. These companies demonstrate a cluster of multiples at 3 to 16 times revenue, with one notably high multiple at 31 times revenue for a US-based technology platform. Technologies include software and hardware to improve the operation and resilience of the electricity grid by connecting distributed energy production assets, and efficiently routing energy production and distribution in times of extreme grid stress. We see a smaller range for companies in EMDEs (8 to 10 times revenue). This may be due to the company sample used, but it may also signal challenges in creating attractive business cases in regions that have weakened, limited, or no-grid infrastructure. Electricity access is a key enabler for economic growth, particularly in EMDE regions such as sub-Saharan Africa, which accounts for 80% of people globally who lack electrification (600 million in 2022).[3]

1. International Labour Organization ILOSTAT (2023), ILO modeled estimates database; accessed via World Bank.
2. UNEP, Water and sanitation.
3. International Energy Agency (2023), SDG 7 Data and Progress: Access to Electricity.

The public and social sectors play a vital role in catalyzing the market for adaptation and resilience solutions. Government and social sector engagement can help channel investment opportunities toward adaptation and resilience solutions in settings where the need is greatest. This is particularly critical in EMDEs. Such interventions can create conditions that unlock greater private investment. (See Table 2.) Public and social sector actors employ various methods to accomplish this.

One way in which public and social sector actors can help is by increasing awareness of the financial materiality of climate risk and the need for adaptation and resilience technologies. Our interviews with climate VC investors active in EMDEs indicate that a lack of awareness of climate risks can lead investors to underestimate the value of adaptation and resilience technologies. Publishing evidence-based research on national technology needs to build resilience, through national adaptation plans and technical needs assessments, can help raise understanding.[17]

Table 2 - Case Studies for Sistema.bio and Mobility for Africa

How Public and Social Sector Finance Can Catalyze Social Enterprises

Case study	Sistema.bio, Latin America, East Africa, India	Mobility for Africa (MfA), Zimbabwe
Key sources of funding	• Public sector: ElectriFi, the Dutch Entrepreneurial Development Bank (FMO) • Social sector: Shell Foundation • Private and impact investors: DILA Capital, Eco-Enterprises Fund, Endeavor Catalyst Fund, ENGIE RDE, Factor[e] Ventures, Triodos Bank, AXA Investment Managers, KawiSafi Ventures	• Public sector: InfraCo Africa, EEP Africa, PIDG • Social sector: Toyota Mobility Foundation, Africa Enterprise Challenge Fund
Context and adaptation and resilience impact	Sistema.bio is a social enterprise that manufactures, sells, and installs biodigesters for family and smallholder farmers. Biodigesters convert animal waste into clean energy (biogas) and organic fertilizer. These solutions increase farmer resilience to climate-related weather events by improving crop yields, increasing long-term soil health, and strengthening energy resilience. Sistema.bio provides farmers with in-house financing, capacity building, and long-term service and monitoring.	MfA provides last-mile mobility solutions to rural communities in Southern Africa. Its custom-built, three-wheeled vehicle helps rural farmers bring a larger proportion of their produce to market, increasing farmer incomes and reducing the quantity of food spoilage. By increasing farmer productivity, MfA's services directly improve local and national resilience to climate-related yield disruptions, such as droughts.
Financing model	Sistema.bio has grown from a regional enterprise based in Mexico to a global company with subsidiaries in Latin America, East Africa, and India and with projects in over 30 countries. The company has used various types of blended capital, including carbon credit sales, grants, concessional financing, commercial debt, and equity to support its expansion.	Following a capital-intensive business model, MfA's operations began with grant-funded demonstration projects in Zimbabwe. These enabled MfA and its donors to gain an in-depth understanding of these rural markets. A recent $2 million equity investment will support expansion into four to six additional locations.

Public financiers can also provide concessional capital (financing offered at below-market rates) and guarantees for demonstration projects. These projects are critical to building investor confidence with regard to wider adoption of adaptation and resilience solutions. Further, public and social investors can share crucial expertise on the opportunities and risks associated with technologies and their markets.

Finally, public financiers can help reduce development costs. Scaling adaptation and resilience solutions such as field IoT is often capital intensive. Interventions such as grants, market-shaping mechanisms (for example, bulk purchasing agreements), and guarantees can support companies through the funding "valley of death"—the period from when an early-stage company receives initial capital flows to when it produces revenues to fund its own expenses. For example, the Catalytic Climate Finance Facility, launched in May 2023 by Convergence and the Climate Policy Initiative, provides grant funding and acceleration support for early-stage adaptation and resilience companies to overcome initial funding needs and scale the rollout of solutions. The fund's anchor donors are the Bill & Melinda Gates Foundation and the Canadian and Australian governments.[18]

Entry Point 4: Finance Mature Companies Developing New Adaptation and Resilience Product Lines

Developing new adaptation and resilience product lines can help a company create new, climate-resilient revenue streams. These in turn can catalyze additional demand across the company's existing portfolio by enhancing their customers' climate resilience.

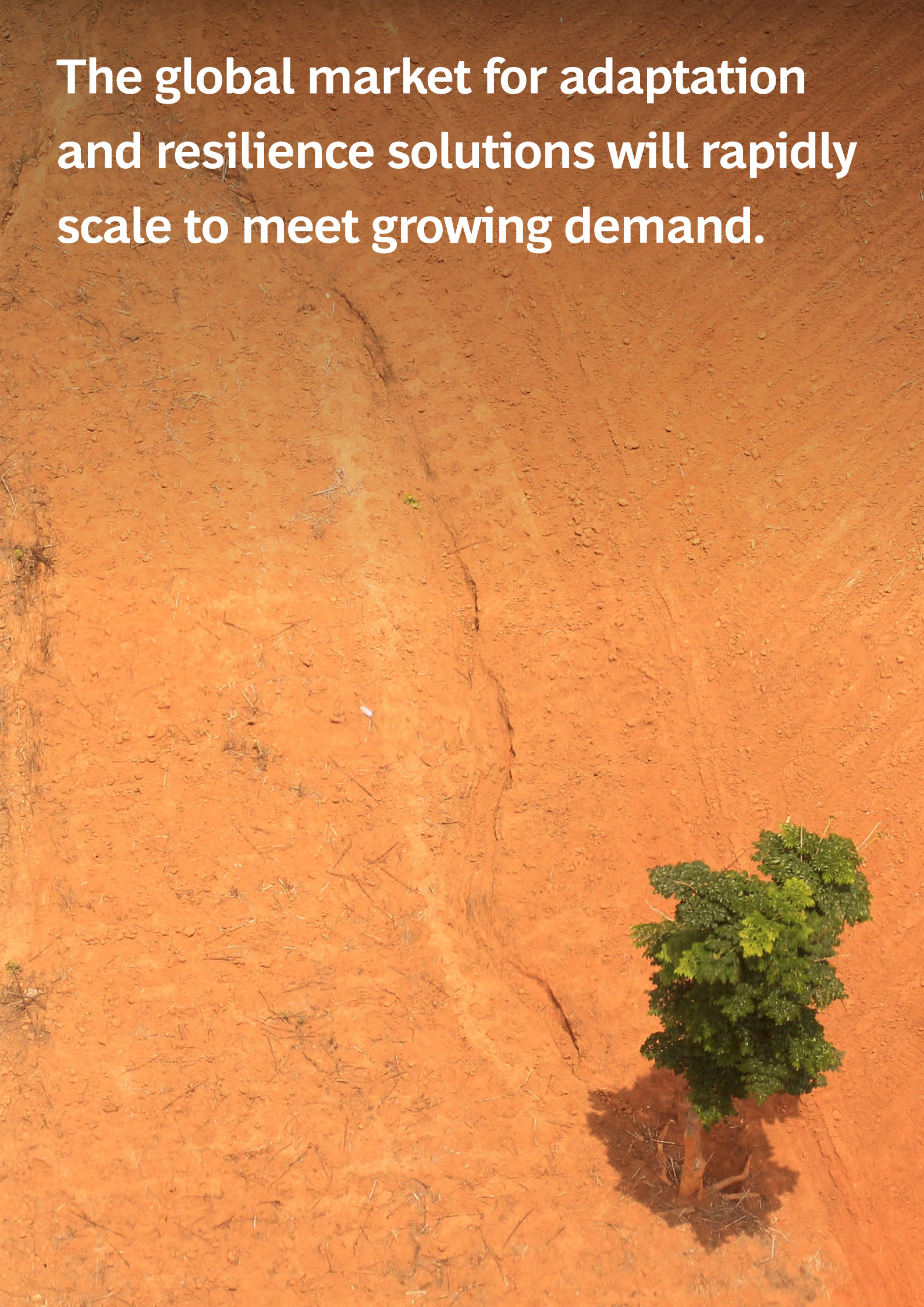
For example, a multinational agriculture company with a global offering of seeds identified food protection and security as a major climate-related challenge facing smallholder farmers. In response, the company developed a portfolio of new seed varieties with greater resilience against various climate-related threats (including flooding, drought, and high winds), and the potential for higher yields. Their greater resilience to evolving local weather conditions enabled these products to build food and financial resilience for vulnerable communities, as well as generating long-term commercial value.[19] A second example is Climate Impact AI. Developed by BCG, this analytics platform performs a comprehensive evaluation of physical and transition climate risks and calculates the potential damage that can be prevented by implementing appropriate adaptation and resilience measures. Combined with end-to-end strategy, planning, and project pipeline support, it helps public and corporate decision makers allocate resources more effectively and deploy them toward capabilities to safeguard their economies, societies, ecosystems, and businesses.

With established credibility, financing, and customer bases, mature companies have enormous potential to drive the systemic adaptation and resilience of vulnerable communities. For example, Mastercard has begun integrating adaptation and resilience into some of its solutions and initiatives, recognizing the importance of local resilience to safeguard against climate-induced macroeconomic shocks. (See "Case Study on Mastercard: How a Mature Company Is Investing in Adaptation and Resilience Initiatives.")

Companies can use internal or external sources of corporate finance to launch or expand adaptation and resilience solutions. Often, attracting finance for these investments depends on the certainty of market demand and on the willingness and ability of customers to pay for these solutions. Here, partnerships with other companies or the public sector can play a key role. By providing guarantees, access to market, and other risk-reduction or risk-sharing instruments, they can reinforce a company's efforts to pursue these new lines of business.

Governments can further catalyze investment in adaptation and resilience solutions through incentives such as tax breaks and direct subsidies, ensuring that mature companies offer these products and that services are accessible to the communities most in need of them.

The global market for adaptation and resilience solutions will rapidly scale to meet growing demand.



How a Mature Company Is Investing in Adaptation and Resilience Initiatives

Case Study on Mastercard

Mastercard, a leading global technology company in the payments industry and a PREPARE Call to Action company, is incorporating adaptation and resilience into both its commercial products and its social impact initiatives, helping to build the resilience of vulnerable communities and small enterprises in the Global South. Mastercard is leveraging its strength in enabling financial inclusion and fostering inclusive economic growth in the face of climate change through climate-smart financial inclusion products and programs that strengthen adaptation and resilience for small businesses, farmholders, and communities. By directing financial resources to adaptation and resilience initiatives, Mastercard ensures a stable, long-term macroeconomic environment that will help protect all businesses from climate-induced economic shocks and stressors.

Mastercard also invests in philanthropic adaptation and resilience efforts, such as Climate Smart Innovations for Adaptation and Resilience Alliance to accelerate entrepreneurial fintech-enabled solutions in the Global South, and the establishment of the Priceless Planet Coalition, a global consumer-facing campaign to restore 100 million trees. As it builds systemic resilience, Mastercard also benefits from stronger business partnerships, impactful promotional campaigns, and the innovation of adaptation and resilience financial solutions.

The "Participate" Opportunity

Participate in Public Sector Implementation

Allocating capital toward public adaptation and resilience initiatives is an essential but often overlooked opportunity for private sector financing. Examples of projects around the world show that financing public initiatives can deliver significant benefits for companies and investors, creating a virtuous cycle that can build collective, systemic resilience.

To date, however, the initiatives undertaken meet only a small fraction of the total need. Uncertainty about the most effective ways to invest capital in public sector adaptation and resilience and to create arrangements that satisfy their organization's risk and return mandate has held some private sector companies back.

This chapter seeks to bring greater clarity to the issue of how the private sector can engage successfully. (See Exhibit 9.)

Entry Point 5: Allocate Capital to Public Adaptation and Resilience Projects

Private sector co-investment in public sector projects can be value accretive, protecting companies from the physical risks of climate change and providing companies and investors with new and stable sources of revenue. The combination of a typically long-term horizon and public sector backing also lowers investment risk. Public-private partnership (PPP) arrangements hold particular promise for adaptation and resilience, and a number of recent infrastructure projects illustrate the benefits.[20]

Exhibit 9 - Two Entry Points Comprise the "Participate" Adaptation and Resilience Financing Opportunity

Opportunity	Business case	Entry points
Participate in public sector implementation	Realize the direct returns and indirect benefits of collaborating with the public sector on critical initiatives	5 Allocate capital to public adaptation and resilience projects 6 Invest in financial vehicles that direct capital to public adaptation and resilience initiatives

Source: BCG analysis.

For example, as major flooding of its capital, Kuala Lumpur, became a persistent annual event, the Malaysian government sought proposals for constructing a tunnel to store and divert water. Through engagement with private sector partners, the idea evolved into a multiuse tunnel that included a motorway. Adding the motorway unlocked additional value to the project in several ways. Notably, it eased congestion in an often gridlocked city, and it introduced a revenue stream in the form of toll fees that could entice private companies to co-invest, thereby defraying government costs. The arrangement was structured as a 40-year concession agreement with SMART Sdn Bhd, a joint venture of two private sector Malaysian companies.

PPP co-investment structures can take multiple forms. (See Table 3.) Some, such as the Malaysian project, are lease-based and concession-based PPPs that enable the private entity (often medium-size to large companies and investors) to generate new revenue streams while simultaneously providing capital and expertise that are critical to delivering on public adaptation and resilience priorities.

Other options follow a build-own-operate-and-transfer (BOOT) model. For example, the government of Victoria in Australia sought a private partner to construct a large-scale desalination facility to protect against water shortages, awarding the contract to the Aquasure Consortium. Under the arrangement, Aquasure agreed to finance, design, build, operate, and maintain the desalination plant for 30 years at a fixed price of $3.5 billion. The Victorian government provides Aquasure with an annual payment, even if the backup water source is not used, and it agrees to enable refinancing support in the event of a market dislocation event. These conditions reduced future refinancing risk and resulted in the debt syndication being 53% oversubscribed across 30 institutions.

Scalable financing models for adaptation and resilience are another possibility. These models democratize access to PPPs at the project level. For example, SOURCE, a company that specializes in distributed renewable drinking water technology, focuses on areas where conventional water solutions are expensive, insufficient, or nonexistent. The company currently serves over 20,000 people in Australia, Colombia, East Timor, India, Marshall Islands, Papua New Guinea, Puerto Rico, Saudi Arabia, South Africa, Timor-Leste, the US, Vanuatu, and Zambia. It structures its projects as upfront government investments or concession- or lease-based PPPs; SOURCE builds, operates, and maintains water infrastructure with local partners and governments, and users pay fees. For example, in the Marshall Islands, SOURCE worked with the government to co-finance and build a $5 million distributed water project. Investors can also finance SOURCE directly, and several climate-focused VC funds are among its backers.

In addition to infrastructure PPPs, other mature forms of financing used in adaptation and resilience projects include payments for ecosystem services (PES) and tax increment financing. The private sector participants that finance these measures win by collaboratively safeguarding value at risk. (See Table 4.)

Table 3 - Case Studies on Project-Level Opportunities That Generate New Revenue Streams

Case study	Stormwater Management and Road Tunnel (SMART), Malaysia[1]	Victorian Desalination Project, Australia[2]	SOURCE, Global
Key financing sources	Private ($170 million): SMART Sdn Bhd (SPV), a joint venture between a local engineering, procurement, and construction company and a local mining company Public ($340 million): Government	Private: UniSuper, GDF Suez, Samsung, Itochu Group, Macquarie, HSBC, Theiss ($646 million equity) Public: Victoria state government ($3.3 billion in commercial debt) Project developer: Aquasure	Investors finance in two ways: • At the project level through private and public sources, including concessions, grants, and equity funding. • At the company level, SOURCE is backed by Blackrock, Breakthrough Energy Ventures, Microsoft Climate Fund, Lightsmith Group
Financing model	40-year concession agreement	30-year BOOT agreement, with the government providing security payments	Upfront government investments or concession- or lease-based public-private partnerships

Table 4 - Case Studies on Public, Project-Level Opportunities That Protect Private Assets and Supply Chains

Case study	Private consortium for flood protection infrastructure, Germany[3]	Aquafondo, Peru[4]
Key financing sources	Private sector consortium	Private: 50 service providing entities Public: Lima city government
Financing model	Private players each contribute approximately $32,000 annually to maintain dams and levees that protect the peninsula. The consortium will also contribute capital toward a dam to be built in the late 2020s.	The government created a modified tariff structure with 50 utilities investing a percentage of their revenue into a reserve fund. The capital is used to finance adaptation and resilience measures that protect the utilities' water supply and quality.

1. Stormwater Management and Road Tunnel (SMART); Kuala Lumpur, Malaysia Case Study (Mixed Use Tunnel).
2. Aquasure, The Victorian Desalination Project; Essential Services Commission (2013), Paying for the Victorian desalination plant: A case study in regulatory ambiguity.
3. CDP (2022), Disclosures to the Climate Change Questionnaire 2022, as acquired through BCG's institutional license.
4. The Nature Conservancy, Lima Water Fund.

In EMDEs, these projects often receive support from public funds to aid beneficiaries with limited financial capacity. For example, to finance critical improvements to the city's watershed, the housing ministry in Lima, Peru, established an environmental compensation mechanism linked to watershed management and planning. The framework created a reserve fund, called Aquafondo, into which 50 local utilities invest 1.5% of revenue for natural infrastructure projects and 3.5% of revenue for adaptation projects, totaling $117 million over five years. This capital will be used to finance projects that protect the utilities' water supply and quality by implementing water adaptation and resilience measures such as slope stabilization, lagoon recovery, and watershed reforestation.

Entry Point 6: Invest in Financial Vehicles That Direct Capital to Public Adaptation and Resilience Initiatives

The private sector can also structure and invest in financing vehicles that direct capital toward a portfolio of projects. These initiatives blend capital at the fund level as opposed to the project level.

The capital is critical because financial institutions and private investors must surmount multiple barriers to participation in adaptation and resilience projects, including a lack of clarity on what to classify as adaptation and resilience investing, a shortage of relevant projects in the investment pipeline, and uncertain financial returns. These challenges make it especially hard for EMDEs that suffer from low credit ratings to attract adaptation and resilience investment—and many of these countries are already climate vulnerable.

Increasingly, multilateral development banks, bilateral donors, and international organizations such as the Green Climate Fund engage with asset managers and other institutions to develop mechanisms that attract and direct larger pools of capital toward a portfolio of adaptation and resilience projects in EMDEs at scale. They also provide the catalytic finance needed to de-risk investments through guarantees or first-loss capital.

However, technical assistance is a critical and often missing piece of the puzzle in mobilizing private pools of capital. Deal originators often need grant funding to structure projects that align with investor expectations and to assure investors that implementation will be managed well. Technical assistance can also help issuers showcase the way green, sustainable, and social debt instruments operate in practice, including guidance on how issuers evaluate and select eligible adaptation projects, and on the role of external reviewers in meeting investors' standards. For example, by innovating an investment strategy that elevates the role of technical assistance, Invesco EMEA is exploring opportunities to scale adaptation and resilience debt investments in climate vulnerable regions that include least-developed countries, small-island developing states, and Africa.

The critical need for private adaptation and resilience capital is giving rise to new mechanisms to help remove barriers to investment. (See Table 5.)

The private sector can also invest in a fund of funds to channel even larger pools of capital to multiple underlying funds. Such pooled investments create critical mass for capital deployment of adaptation and resilience initiatives at scale, and they appeal to investors who prefer standardized financial instruments and larger ticket sizes.

Although fund of funds constructs remain nascent in adaptation and resilience, this is an area of innovation. Evolving mechanisms that mobilize larger pools of private capital have the potential to reduce the risk associated with any single investment strategy or asset class. (See Table 6.)

Table 5 - Case Studies on Funds That Aim to Mobilize Private Capital for a Portfolio of Adaptation and Resilience Projects

Case study	Global Fund for Coral Reefs (GFCR)[1]	Climate Insurance-Linked Resilient Infrastructure Facility (CILRIF)[2]	Atlanta Green Infrastructure Environmental Impact Bond[3]
Key financing sources	Private: Banks, corporate investors, family offices, high net worth individuals, institutional investors, philanthropies (fund manager: Pegasus Capital Advisors) Public: Green Climate Fund, development financial institutions (DFIs), sovereign investors	To be launched: The development of CILRIF to date has been driven by a working group of individuals representing multiple stakeholders, convened by the UN Capital Development Fund	Private: Various investment firms Philanthropic: Rockefeller
Context and adaptation and resilience impact	The GFCR is the first and only blended finance vehicle dedicated to coastal ecosystems, communities, and coral reefs globally. A coalition consisting of both a grant fund and an investment fund, the GFCR is designed to scale financial solutions and bolster the resilience of coral reefs and the communities that depend on them. GFCR focuses on supporting investments in enterprises that address local drivers of coral reef degradation, unlock conservation funding flows, and increase communities' adaptive capacities.	CILRIF is a long-term insurance solution for cities, deployed in tandem with a financing facility, that creates financial incentives and capacity for municipalities to invest in resilient infrastructure. CILRIF aims to enable cities to access affordable, 10- to 20-year climate insurance with prearranged premiums contingent on the cities' commitment to invest in climate resiliency. Pilots are under development in EMDE cities in Africa and Asia, focusing on riverine flood risk, with further pilots expected to focus on extreme heat and other climate hazards.	Urbanization, increasing total rainfall, and extreme storm events have led to concentrated stormwater impacts in low-income neighborhoods downstream from Proctor Creek in Atlanta. A $14 million environmental impact bond (EIB) was created to finance six green infrastructure projects to improve water equity and remediate the polluted waterway.
Financing model	Green Climate Fund committed up to $125 million of first-loss equity to mobilize four times this amount in additional investment from other private and public investors through a de-risking structure. In turn, the fund will provide critical growth equity or project financing to entrepreneurs and project developers. The dedicated grant fund provides technical assistance, capacity development, emergency grants, and monitoring and evaluation.	CILRIF will operate a climate risk insurance facility and an infrastructure finance facility. In addition to structuring long-term coverage with pre-arranged premiums, CILRIF will incentivize resilience building (through results-based premium pricing) and funding (through the financing facility).	The ten-year outcome-based EIB has a two-tiered performance structure, with an estimated base rate of 3.55%. The estimated effective interest rate increases to 4.67% if performance exceeds the threshold, in which case Atlanta will pay investors an additional $1 million.

1. Global Fund for Coral Reefs.
2. Climate Finance Lab, Climate Insurance-Linked Resilient Infrastructure Financing (CILRIF).
3. CDP, Project Profile: Environmental Impact Bonds for Green Infrastructure.

Table 6 - Case Study on Funds of Funds

Case study	Emerging Market Climate Action Fund (EMCAF)[1]
Key financing sources	Private: Allianz Global, Folksam Group Public: European Investment Bank, KfW, Nordic Development Fund, and the government of Luxembourg
Context and adaptation and resilience impact	EMCAF is a fund of funds with a target size of $534 million that catalyzes private capital in climate-focused investment funds and projects active in EMDEs. For example, it committed $15 million to the ARCH Cold Chain Solutions East Africa Fund, which finances greenfield development, construction, and operation of temperature-controlled storage and distribution facilities in East Africa to reduce food spoilage from lack of refrigeration.
Financing model	EMCAF is structured as a risk-layered fund vehicle that combines public and private capital. A junior tranche is funded by public investors and serves to attract private investors into the senior tranche. EMCAF primarily invests in fund structures, but it may also selectively invest in corporate structures or co-investments. It backs experienced local investment teams that develop bankable projects through highly catalytic early-stage equity financing.

1. Allianz Global Investors, Emerging Market Climate Action Fund.

Now, companies and investors must rise to the challenge—and the opportunity—to build an adapted and resilient world.

Conclusion

There is no time to waste. The levers for building resilience are understood. The solutions underpinning adaptation are ready to scale. The business case is clear. Now, companies and investors must rise to the challenge—and the opportunity—to build an adapted and resilient world.

We hope that this report invites rethinking about private financing for adaptation and resilience and spurs new capital flows, continued conversation and committed action. All leaders should consider climate change impacts and steps they can take to mobilize private finance for adaptation and resilience.

Here are a few recommendations.

For business leaders:

- Start quantifying the organization's financial exposure to the physical risks of climate change.
- Develop a roadmap to shift operations to a climate-resilient state, taking into account financial requirements, the risk of maladaptation, and broader societal, natural, and economic systems.
- Initiate or accelerate engagement with the broader ecosystem of adaptation and resilience actors across public, private, and social sectors to deliver the roadmap.
- Recognize the adaptation and resilience benefits of products, integrate these benefits into the overall value proposition, and explore high-impact avenues (such as local partnerships) to bring the products to markets.

For government leaders:

- Provide more and targeted catalytic capital and concessional finance to de-risk private investment in adaptation and resilience.
- Develop national adaptation plans and technology needs assessments that take physical climate risks and opportunities into consideration, identify and prioritize projects that signal the national market's projected need for adaptation and resilience solutions, and define the private sector's role in the process.
- Create an enabling environment for adaptation and resilience action by accelerating requirements for climate risk assessments and disclosures and ensuring that these requirements take physical climate risks into account.

For financiers:

- Integrate physical risk assessments into portfolios, and explore bespoke adaptation and resilience approaches (such as engaging with the public sector) to mitigate these risks.
- Recognize adaptation and resilience as an emerging and high-growth theme, and incorporate it into investment strategies.

Appendix

Adaptation and Resilience Measures Framework

We classified adaptation and resilience measures into seven impact areas to arrive at a mutually exclusive framework for assessing how adaptation and resilience measures contribute to systemic resilience when implemented. Because there is no consensus on a global taxonomy for adaptation and resilience, we conducted a literature review for each sector. (See the exhibit.)

Owing to the cross-cutting nature of adaptation and resilience, some measures fall into multiple sectors. We defined the following guardrails to provide a mutually exhaustive framework so that each measure maps to only one impact area:

- Measures for agricultural water efficiency (for example, irrigation) sit in "water."
- Measures to address food- and water-borne disease (for example, WASH training) sit in "health."
- Retrofitting and upgrading of existing health, water, and energy assets sit in "infrastructure."
- Nature-based solutions for water security (for example, watershed management) sit in "water."
- Nature-based solutions for infrastructure resilience (for example, mangrove restoration) sits in "infrastructure."
- Climate hazard monitoring and warning sits in "business and community resilience"; resource-specific monitoring sits in the relevant subsector (for example, "water use monitoring and efficiency").
- Resilience of distribution, processing, and retail assets sits in "infrastructure."

Methodology: "Protect" Opportunity Analysis

This section details the materials we used in scoping the "protect" opportunity.

Literature Review for the Adaptation and Resilience Measures Framework

No single taxonomy has an exhaustive sectoral view for classifying adaptation and resilience measures. Consequently, for each sector, we reviewed key pieces of literature and supplemented them with expert interviews to arrive at a classification system for this report.

Adaptation and Resilience Measures Framework

NON-EXHAUSTIVE

Food resilience

Ensuring food security through resilient production practices
- Soil management
- Cropping systems
- Livestock and fishery management
- Integrated systems
- Precision agriculture and digital tools

Minimizing food loss and waste
- Fit-for-purpose on-farm and post-harvest storage
- Climate-controlled transport
- Improved packaging
- Limiting in-store food waste

Improving diet quality and minimizing food loss/waste in consumption
- Improving human diet quality
- Improving animal feed quality

Health resilience

Addressing climate-related impacts to human health
- Management of injury and mortality from extreme weather events
- Management of heat-related illness
- Management of respiratory illness
- Management of diseases, including vector-, food-, and water-borne diseases, non-communicable diseases, and zoonoses
- Management of mental and psychosocial health

Safeguarding health systems and facilities
- Health-care facilities
- Essential medical products and technologies
- Health workforce

Water resilience

Securing adequate water supply
- Water collection and storage

Ensuring water quality
- Water quality monitoring and treatment

Managing water resources and use
- Water use monitoring and efficiency
- Water use alternatives

Infrastructure resilience

Ensuring structural/physical resilience of assets against physical risk
- Coastal protection
- Protection against flooding
- Infrastructure resilience to extreme wind, storms, and cyclones
- Protection against heat
- Infrastructure resilience to other climate risks

Energy resilience

Securing energy system resilience during climate-related disruption
- Decentralized generation and storage
- Grid management and monitoring

Biodiversity resilience

Safeguarding biodiversity of terrestrial, marine, and groundwater ecosystems
- Protection of biodiversity hotspots
- Increased connectivity of biodiversity hotspots
- Restoration and recovery of biodiversity hotspots

Business and community resilience

- Supply chain resilience
- Climate information services
- Disaster preparedness, planning, and training
- Insurance

Source: BCG analysis.

Food Resilience

Source	Description	Classification of adaptation and resilience measures
Chapter on food security from an IPCC special report	The Intergovernmental Panel on Climate Change (IPCC) is an intergovernmental body of the UN tasked with providing governments at all levels with scientific information to use in developing climate policies. This classification is drawn from the IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems.	According to the chapter, demand for food and supply of food are interlinked and need to be jointly assessed to identify adaptation measures to climate change. • Supply: crop production, livestock production, aquaculture, transport, storage, trade, and processing • Demand: consumption practices, diets, reducing food loss and waste
BCG Food Systems Framework	Classification is drawn from the Sharm el-Sheikh Adaptation Deep Dive report for food and agriculture. The analysis was formulated by BCG and UN Climate Change High-Level Champions	According to the report, building food resilience depends on considering the entire food system across the value chain. Adaptation and resilience measures along the food value chain—including shifts in food production, processing and consumption—are essential. • Production: land, water, energy, soil nutrients, pests, animal feeding and grazing • Processing: storage, packaging, formulation and recipe, processing • Distribution and retail: distribution, marketing, retailing • Consumption: human consumption, animal consumption
UNEP Taxonomy of Adaptation Technology for Country Technology Needs Assessments (TNAs)	The Technology Needs Assessments (TNA) taxonomy was led by the UN Environment Programme and the UNEP Copenhagen Climate Centre on behalf of the Global Environment Facility. Working through the UNEP DTU Partnership, UNEP supports developing countries in preparing their TNAs and Technology Action Plans (TAPs). This classification is an attempt to enable the development of TAPs and TNA.	The TNA seeks to promote the transfer of environment-friendly technologies and include the perspectives of both soft and hard technology for mitigation and adaptation. • Climate-resilient farming measures • Crop management and climate-resilient crops • Climate-resilient livestock management • Agricultural water management • Agricultural soil management • Agricultural environment monitoring
High-yielding, resilient, and adaptive practices (HYRAP) framework	A joint effort between BCG and the UN Climate Change High Level Champions, the African Food Systems Transformation Initiative accelerates the adoption of high-yielding, adaptive, and resilient practices in Africa through an ecosystem approach.	The framework classifies regenerative agriculture practices as follows, applied on a case-by-case basis depending on crop, weather, and other farming factors. • Soil systems: No and low tilling, water harvesting and irrigation, organic and synthetic soil nutrients and biochar, optimal soil infiltration • Cropping systems: Rotating crops; drought-, heat-, and flood-resistant crops; nitrogen-efficient crop varieties; cover crops • Integrated systems: Integrated pest management, wildlife cohabitation, natural grazing patterns, agroforestry • Precision agriculture and digital tools (enabler)

Health Resilience

Source	Description	Classification of adaptation and resilience measures
WHO operational framework for building climate-resilient health systems	The World Health Organization is a specialized agency of the UN responsible for international public health. This classification is drawn from WHO's report on an operational framework for building climate-resilient health systems	Framework views how health systems can systematically address the challenges presented by climate variability and change. The adaptation and resilience measures focus on increasing their capacity for protecting health. • Leadership and governance • Climate and health financing • Service delivery: Emergency preparedness and management, climate-informed health programs, management of environmental determinants of health • Health workforce • Health information systems: Vulnerability capacity and adaptation assessment, integrated risk monitoring and early warning, health and climate research • Essential medical products and technologies: Climate-resilient and sustainable technologies and infrastructure
WHO framework for Climate Sensitive Health Risks	The framework is drawn from WHO's Climate Sensitive Health Risks framework	Climate change is impacting health in myriad ways, including by leading to death and illness from increasingly frequent extreme weather events. Climate change is also undermining many of the social determinants for good health, such as livelihoods, equality, and access to health care and social support structures. The framework views the impact of climate on health and health systems. • Health: Injury and mortality from extreme weather events, heat-related illness, respiratory illness, water-borne diseases and other water-related health impacts, zoonoses, vector-borne diseases, malnutrition and food-borne diseases, noncommunicable diseases (NCDs), mental and psychosocial health • Health systems and facilities: impacts on health-care facilities, effects on health systems
Chapter on Human Health: Impacts, Adaptation, and Co-Benefits from IPCC	Framework is drawn from IPCC's Fifth Assessment Report (WGII AR5) chapter on human health	There are three basic pathways by which climate change affects health: Direct impacts, which relate primarily to changes in the frequency of extreme weather, including heat, drought, and heavy rain; effects mediated through natural systems (for example, disease vectors, water-borne diseases, and air pollution); and effects heavily mediated by human systems (for example, occupational impacts, undernutrition, and mental stress). The IPCC report classifies examples of solutions as follows. • Health policies and programs • Vector-borne, water-borne, and food-borne diseases • Heat-related morbidity and mortality • Air-pollution-related health effects • Risks to mental health • Facilitating early-warning and response systems • Incorporating disaster risk reduction into health adaptation

UNEP Taxonomy of Adaptation Technology for Country Technology Needs Assessments (TNAs)	As discussed above	• Medical and public health infrastructure • Prevention and control of infectious disease • Food safety, food security, and nutrition • Health policy consulting, enabling environment, health education, health system strengthening

Water Resilience

Source	Description	Classification of adaptation and resilience measures
UNEP Taxonomy of Adaptation Technology for Country Technology Needs Assessments (TNAs)	As discussed above	• Maintaining a sustainable water supply • Monitoring and early warning of water resources • Securing water quality • Integrated water resource management • Water-related disaster risk management • Water ecosystem service management • Water education and consulting
Climate Bonds Taxonomy	The taxonomy was established by the Climate Bonds Initiative to determine whether assets or projects are eligible for green bonds	Substantial infrastructure will be required to ensure clean and secure water supplies as the climate changes. • Water monitoring • Water storage and management • Water treatment • Stormwater management • Water use efficiency products
Academic study on climate change and water resources	Academic study on climate change and water resources in Lebanon and the Middle East by E. Bou-Zeid and M. El-Fadel	The classification focuses on the expected biophysical and socioeconomic impacts of climate change on water resources. • Water security and supply • Water quality • Water management system
Representative NAP measures adapted from IPCC	Framework is drawn from Chapter 4: Water of IPCC Sixth Assessment Report	The classification is based on the principle that water-related adaptation includes water-related hazards (such as floods and droughts) and water-related adaptation intervention (such as irrigation, rainwater harvesting, and soil and moisture conservation). Further, adaptation responses have benefits in terms of water outcomes and environmental and ecological parameters. • Structural and physical: alternative water supply, improved existing infrastructure and distribution systems, water-efficient industry technology and design • Social: consumer awareness, monitoring and maintenance of water systems, industrial water management training • Institutional: water quality management, economic support, water supply management and regulation

Infrastructure Resilience

Source	Description	Classification of adaptation and resilience measures
Climate Bonds Initiative and UNDRR Resilience Taxonomy Whitepaper (organized by outcome)	The Climate Bonds Initiative is an investor-focused, not-for-profit organization working to accelerate a global transition to a low-carbon, climate-resilient economy. The Resilience Taxonomy Whitepaper presents a blueprint for developing a climate resilience classification framework to promote and facilitate investments in adaptation and resilience through capital markets.	In October 2018, the Climate Bonds Initiative convened the Adaptation and Resilience Expert Group (AREG) to design a set of principles to guide the integration of criteria for climate adaptation and resilience into the Climate Bonds Standard. This includes illustrative examples of solutions under "infrastructure" (organized by outcome): • Infrastructure more resilient to hazards: construction, expansion, and operation upgrade; reinforcement; structural strengthening; relocation and raising; redundancy; monitoring and warning systems; drainage; nature-based solutions • Other sectors more resilient to flooding: increased flood drainage capacity, overflow reservoirs, infiltration ponds, flood monitoring and warning, levees, floodgates, sand dams, surge barriers, pumps
Climate Bonds Initiative and UNDRR Resilience Taxonomy Whitepaper (organized by sector)	As discussed above	The Resilience Taxonomy also gives examples of infrastructure that needs to be resilient (organized by sector): • Information, communication, technology: telecoms, broadband, other connectivity services • Energy: power generation, power transmission and distribution • Water: desalination, flood management, wastewater treatment, water storage, water supply • Transport: roads, ports
C40 Infrastructure Interdependencies and Climate Risks report	C40 is a global network of nearly 100 mayors of the world's leading cities who are united in action to confront the climate crisis. The framework is drawn from C40's Interdependencies and Climate Risks report	The scope of the framework is based on approaches that select city governments use to identify their infrastructure interdependencies and climate impacts on these systems, as a first step in reducing systemic risks: • Infrastructure resilience to sea level rise • Infrastructure resilience to floods • Infrastructure resilience to extreme heat • Infrastructure resilience to geohazards (including subsidence and landslides) • Infrastructure resilience to other climate hazards

Business and Community Resilience

Source	Description	Classification of adaptation and resilience measures
Marrakech Partnership Global Climate Action resilience pathways	Marrakech Partnership for Global Climate Action supports implementation of the Paris Agreement by enabling collaboration between governments and the cities, regions, businesses, and investors that must act on climate change	Suite of solutions applicable to all sectors. • Climate risk and vulnerability assessments, disclosure and monitoring actions • Access to early warning systems and development of early actions • Preparedness with contingency plans and emergency response • Establishment of effective governance to manage climate risks accompanied by human and institutional capacity-building • Using nature-based solutions to reduce risk • Climate-proofing infrastructure and services • Risk transfer: insurance and social protection instruments • Sharing knowledge and best practices on climate risk management • Increased volume, quality, and access of public and private finance to invest in resilience
World Bank Business Continuity Planning for Climate Resilient Industries	This is drawn from the World Bank's report on Resilient Industries in Japan: Lessons learned in Japan on enhancing competitive industries in the face of disasters caused by natural hazards	Four steps in ensuring business continuity amid climate change. • Understand risk • Planning and prioritization • Mitigation and preparedness • Response and recovery

Energy Resilience

Source	Description	Classification of adaptation and resilience measures
Climate Bonds Initiative and UNDRR Resilience Taxonomy Whitepaper	As discussed above	Illustrative measures that enhance the climate resilience of assets over their design lifespan include: • Power generation more resilient to flooding and extreme weather: adjusted capacity, mechanical strengthening, relocation, flood defenses, cooling systems, weather and energy use monitoring, forecasting, and modeling systems, safety and emergency systems • Power transmission and distribution (T&D): mechanical strengthening, underground T&D lines, vegetation management, flood defenses, strengthening grid configuration, automated grid controls, mini- and micro-grids, energy storage, weather and energy use monitoring, forecasting, and modeling systems, safety and emergency systems
International Energy Agency	The International Energy Agency is an autonomous intergovernmental organization that provides policy recommendations, analysis, and data on the global energy sector. The framework is drawn from Electricity Security 2021 Report	The framework is based on the idea that a climate-resilient electricity system, which has the ability to anticipate, absorb, accommodate and recover from adverse climate impacts, brings multiple benefits to electricity security. • Supply side: Conduct climate risk and impact assessment, implement physical system improvement, switch to water-efficient and heat-resilient production process, diversify energy supply chain, improve monitoring for early warning and emergency response. • Demand side: Ensure climate-proofing in design and performance, increase awareness and promote behavioral changes, improve energy efficiency, use smart and advanced technologies for better management, adopt nature-based solutions, and switch to climate-resilient materials.

Biodiversity Resilience

Source	Description	Classification of adaptation and resilience measures
Chapter on Biodiversity Hotspots from IPCC Sixth Assessment Report	Framework is drawn from Biodiversity Hotspots of IPCC Sixth Assessment Report	In this report, terrestrial, freshwater, and coastal marine ecosystems are seen as the major biodiversity hotspots. The suite of adaptation options for biodiversity is as applicable to all three ecosystems. • Protection of biodiversity hotspots • Increased connectivity of hotspots • Outside hotspots • Environmentally sustainable agriculture, tourism, and other uses • Restoration and recovery of old ecosystems • Reduced erosion, soil loss, and flooding • Urban development
UNEP Taxonomy of Adaptation Technology for Country Technology Needs Assessments (TNAs)	As discussed above	Forestry and land • Climate-resilient forest resources production • Forest disaster risk management • Forest carbon sink management • Forestry and land ecosystem service management • Forestry and land ecosystem restoration • Forest and land ecosystem change detection and prediction • Forestry and land education and consulting • Marine fisheries and coastal zone • Coastal zone risk retention—soft structure • Coastal zone risk retention—hard structure • Coastal environment monitoring and risk assessment and prediction • Disease management of marine resources • Marine production promotion • Marine ecosystem service management • Marine fisheries and coastal zones education and consulting

Methodology: "Protect" Landscape Analysis

In gaining a perspective on specific measures that companies are taking to adapt and build resilience to physical climate risks and to protect broader communities, we reviewed and examined 400 responses to the Climate Disclosure Project (CDP) 2022 Climate Change Questionnaire and classified these according to the adaptation and resilience measures framework. The analysis covers companies headquartered in advanced economies and EMDEs. Some companies headquartered in advanced economies also implement measures in EMDEs where they have operations.

Actions presented in the landscape are not representative of all actions that an industry is taking or considering taking. Rather, they represent actions that are voluntarily disclosed to CDP and, therefore, have positive bias. Nevertheless, this analysis illustrates that funding is being mobilized and that corporates are taking adaptation and resilience action today.

Steps in the "Protect" Landscape Analysis

Step	Approach
1. Identify and sample companies for consideration	Of the 8,000 companies in the CDP 2022 Climate Change Disclosures data set that BCG acquired through an institutional license, approximately 2,800 contained responses on physical risk. For the 2,800 companies that have responses on physical risk, we used a total random sampling technique to pull a sample of 384 companies (33 companies for each of the 12 CDP industries) for consideration.

2. Filter responses for analysis	Of the 384 companies from the random sample set, we identified company responses appropriate for analysis based on the following filters.
	
	• **Physical Risk Scenarios.** The analysis excluded responses from companies with no disclosed physical climate scenario analysis to select for responses that demonstrate a scientific basis for quantifying the value at risk and selecting, prioritizing, and implementing appropriate adaptation and resilience measures.
	• **Type of Risk and Opportunity.** Within the remaining companies, the analysis excluded responses on transition-related risks and opportunities that are solely mitigation focused (for example, "Participation in carbon market"), to focus the analysis on adaptation and resilience actions.
	  • In instances with opportunities for potential adaptation co-benefits, (for example, "Use of new technologies"), we analyzed responses case-by-case, excluding those where the specific action described was not sufficiently adaptation related, based on the adaptation and resilience measures framework.
	  • We did not differentiate between "risk" and "opportunity" categories, given the variation in how companies disclose (for example, duplicated responses on both risk and opportunities, listing of identical actions under varying categories).
	  • We excluded the development of new products, (for example, climate-resilient seed varieties), to focus analysis on implementation of adaptation and resilience measures that companies themselves are taking to address the value at risk (for example, increased cost, lost revenues), rather than the development of adaptation and resilience solutions that will be sold for other organizations to implement.

3. Tag responses with adaptation and resilience measures	We evaluated textual descriptions to understand and extract the appropriate adaptation and resilience measure that was implemented. Each response was then tagged with an adaptation and resilience measure under the adaptation and resilience measures framework. We observed that companies either disclosed adaptation and resilience actions in multiple responses (that is, in multiple line items) or bundled them into one response. In cases of bundled actions, we evaluated adaptation and resilience actions individually to account for unique instances of a company taking an adaptation and resilience action. For example, where a company disclosed both a water efficiency action and a climate insurance action within a single bundled response, we divided the response into two distinct responses. This analysis resulted in a total analyzed response count of 399.
4. Calculate and summarize the results	To determine the frequency of actions that a particular industry (according to CDP classifications) is taking in adaptation and resilience, we determined (A) the count of responses tagged to a particular adaptation and resilience measure, and (B) the total analyzed response count for that industry. There may be potential undercounting of water-related adaptation and resilience actions due to CDP's separate "Water questionnaire." Frequency of adaptation and resilience actions was summarized in a heatmap with color grading corresponding to the frequency of a specific adaptation and resilience measure taken in an industry as a percentage of the overall analyzed responses in the same industry (A/B).

Methodology: "Protect" Transactions Analysis

To understand the business case for investments in implementing adaptation and resilience measures that protect private assets and supply chains against future losses due to climate impacts, we analyzed corporate disclosures on the financial impacts of physical risks and the costs and actions taken to respond to them, as disclosed in the CDP Climate Change Questionnaire 2022. CDP's Climate Change Disclosure database contains the world's most comprehensive collection of self-reported data that aligns with the Task Force on Climate-related Financial Disclosure (TCFD) recommendations. This is the first study ever to analyze adaptation measures from CDP data. Appropriate implementation of adaptation and resilience solutions and actual return expectations depend on local, physical climate risk assessments. The five measures in this analysis were selected on the basis of data availability and quality and the sample size of companies implementing a specific measure.

Because we rely on companies' self-reported data, a key limitation of this analysis is that we can capture economic and financial data only for the time horizons disclosed (that is, the timeframe when economic impacts will be experienced by the company). Therefore, the benefits disclosed may exclude revenue and/or cost savings that usually accrue over the lifetime of the asset, social benefits, or mitigation co-benefits.

Steps in the "Protect" Transactions Analysis

Step	Approach
1. Select responses for analysis	For each selected adaptation and resilience measure, we used the responses that were tagged with the adaptation and resilience measure from the landscape analysis. We manually checked each response to decide whether to include it in the transactions analysis. Using our best judgment, we selected responses based on several factors. • The clarity and specificity of the exact adaptation and resilience measure implemented, and how actions respond to the impacts identified • Breakdown of financial impacts and costs of response in textual descriptions that can be attributed to the specific measure implemented • For example, this may remove single bundled responses (as outlined in Step 2 of the methodology on landscape analysis), where costs to implement each adaptation and resilience measure are not broken down in the textual description. • Type of financial impact disclosed, to ensure that parallel comparisons can be made across the resulting analysis. We focused on financial impacts on revenue and/or cost, given that the benefits realized from implementing adaptation and resilience measures are predicated on addressing the value at risk through recovered cash flows (for example, avoided increased costs, avoided loss in revenue).

2. Calculate the benefit-to-cost ratio	The following formula was used to calculate the benefit-to-cost ratio (BCR) for transactions. $$BCR = \frac{|PV\ [Benefits]|}{|PV[Cost]|} = \frac{\sum_{t=0}^{N} \frac{|CF_t[Benefits]|}{(1+i_t)^t}}{\sum_{t=0}^{N} \frac{|CF_t[Costs]|}{(1+i_t)^t}}$$ (A) Benefits = Information disclosed. Where a range was given, the average was used. (B) Costs = Information disclosed. (C) t = Upper range of the time horizon disclosed. (D) i = Discount rate based on the equity risk premium in the geographies of implementation from New York University's Stern School of Business. Geographies of implementation were extracted from text descriptions. Where there are no disclosed geographies, we assumed implementation in the operating countries disclosed. Where implementation was done across multiple geographies or the companies operate in multiple countries, we used the appropriate median (for example, Global = approximately 10%, EMDEs = approximately 15%). We revised some of the responses on the basis of the textual descriptions that the company provided. We also took into consideration probabilities of climate shocks and stresses, where the company had not already done so.
3. Summarize the results	At the measure level, we summarized data in a bar chart containing the observed range of BCRs. At the aggregate level, we summarized data in a range, representing data points within one standard deviation of the mean.

About the CDP Climate Change Questionnaire 2022 Data Set

CDP runs the global disclosure system that enables companies, cities, states, and regions to measure and manage their environmental impacts. Its Climate Change Disclosure database contains the world's most comprehensive collection of self-reported data that aligns with the Task Force on Climate-related Financial Disclosure (TCFD) recommendations. Over 18,700 companies disclosed in 2022.

Methodology: "Grow" Opportunity Analysis

The methodology for the "Grow" opportunity analysis can be separated into two main sections: landscape analysis and transactions analysis.

"Grow" Landscape Analysis

To gain a perspective on the sectors into which most finance for adaptation and resilience solutions flows, we sampled and compared investment deals in companies developing adaptation and resilience solutions from the Tracxn investor database.

Steps in the "Grow" Landscape Analysis

Step	Approach
1. Identify the source of investment deals	We compared a range of recognized investor databases to identify which one was best positioned to offer information about a wide range of companies providing climate adaptation and resilience solutions, across geographies and sectors. We selected the Tracxn database, which focuses primarily on earlier-stage companies. Tracxn has a dedicated category of Sustainability Tech companies, which has a global spread and covers a range of 40 subsectors. Among the 40 subsectors, we identified the following 23 that are likely to contain deals pertaining to adaptation and resilience solutions, based on expert perspectives on adaptation and resilience. • Affordable housing • Agri fintech • Air pollution management tech • Circular building materials • Circular economy • Climate fintech • Climate insurance • Climate intelligence • Energy efficiency tech • Green buildings • Green chemicals • Infectious diseases • Microfinance • Novel foods • Precision farming • Renewable energy tech • Smart grid • Sustainable batteries • Sustainable farming • Sustainable forestry management • Sustainable supply chain • Water and wastewater management tech • Water bodies conservation
2. Sample investment deals for consideration	Next, we sampled 627 deals from the identified subsectors. To ensure the relevance of the data, we selected only investment deals made since 2018. Information on these deals was downloaded from the Tracxn platform. Within each subsector, the number of deals sampled reflected the subsector's size as a proportion of the total the population of deals, and the deals were sampled around the average of the annual median financial values of the deals in the total population. In the infrequent instances in which deals were duplicated across different subsectors of Sustainability Tech, and both were selected in the samples, we split the quantity of finance associated with the specific deal equally across the subsectors during analysis.

3. Tag responses with adaptation and resilience measures	Even within the chosen subsectors, many deals detailed the flow of finance into companies unrelated to adaptation and resilience (for example, mitigation companies or those with an indirect adaptation and resilience benefit). For this reason, we individually assessed whether each company developed a solution that directly enabled climate adaptation and resilience. We used the Adaptation SME Accelerator Project (ASAP) qualification as a general guide, which specifies that a company's technology, product, or service offering must meet at least one of three criteria. • Enable a user to identify, evaluate, manage, or monitor physical climate risks and impacts, preventing and reducing contextual and location-specific climate risk or adverse impacts. • Enable a user to address systemic barriers to adaptation, such as access to information, capacity, technology, or finance. • Make a measurable and defined contribution to adaptation outcomes. The ASAP criteria specifically apply to SMEs and developing countries, but we also applied the definition to developed countries and companies of all scales. This stems from our recognition that nascent technologies originating in developed countries and/or in larger companies might be scaled in developing nations, where similar challenges exist. Activities that build resilience are included in the ASAP qualification under the concept of "system adaptation" in alignment with the EU Taxonomy. However, activities that only indirectly impact adaptation and resilience solutions (for example, upstream or downstream of a direct adaptation and resilience solution) or contribute to broad community resilience are excluded. In complex cases, we leveraged the ASAP classification of adaptation and resilience solutions to establish whether a company's focus relates to a recognized adaptation and resilience solution.
4. Calculate and summarize the results	Across each subsector, we summarized the proportion of finance flowing into companies that directly enable adaptation and resilience solutions. We color-coded the results on the basis of the primary impact area that the subsector addresses. For example, "precision agriculture" was colored under "Food resilience."

"Grow" Transactions Analysis

To understand the market's growth potential as perceived by companies that develop adaptation and resilience solutions, we analyzed valuation multiples of a sample of companies across five selected adaptation and resilience solutions. EV/revenue was selected as the valuation multiple. This widely recognized metric remains relevant in the case of early-stage companies that are not yet profitable (for example, in comparison with the EV/EBITDA multiple).

This analysis illustrates that companies developing adaptation and resilience solutions can attract high valuation multiples both in EMDEs and advanced economies.

Steps in the "Grow" Transaction Analysis

Step	Approach
1. Select adaptation and resilience solutions for analysis	We chose five categories of adaptation and resilience solutions, considering factors such as the maturity of the adaptation and resilience solutions (for example, as evidenced in the landscape analysis), direct adaptation and resilience impact, and the solution's scalability in EMDEs.
2. Select companies within each solution	Next, we selected approximately ten companies under each adaptation and resilience solution. To expand the database of possible companies to use in our analysis, we leveraged both Tracxn (as in the landscape analysis) and PitchBook Data, Inc., a widely recognized independent research firm and one of the largest available databases of company financial data. PitchBook analysts have not reviewed the data. • We selected companies based on several criteria. • A significant majority of the business model that match the relevant adaptation and resilience solution • The availability of recent (post-2020) enterprise value (EV) and revenue values • A diverse representation of companies across EMDEs and AEs
3. Calculate the EV/revenue multiple	We divided the post-money EV of each company by its revenue (earnings obtained over a 12-month period). To improve the accuracy of the metric, we ensured that the EV and revenue values taken from the databases were obtained within the same 12-month period.
4. Summarize the results	At the measure level, we summarized data in a bar chart containing the observed range of EV/revenue multiples per solution, with darker shading representing a higher concentration of data points. At the aggregate level, we summarized data in a range, representing datapoints within one standard deviation of the mean.

PREPARE and the Private Sector Call to Action

This section describes PREPARE's goals, its aspirations for the private sector, and BCG's response.

Overview of PREPARE

The climate is changing, bringing with it rising temperatures, elevated sea levels, and more catastrophic storms, fires, floods, droughts, and extreme heat. On November 1, 2021, the US government launched the President's Emergency Plan for Adaptation and Resilience (PREPARE) as the cornerstone of US foreign policy responses to the increasingly devastating impacts of the global climate crisis, in order to improve the ability of vulnerable communities around the world to confront them, and thereby to bolster stability and security. PREPARE aims to help more than half a billion people in developing countries adapt to and manage the impacts of climate change by 2030. PREPARE activates a whole-of-government effort that brings the force of 19 US federal agencies to accelerate adaptation action and support in countries and communities vulnerable to the impacts of climate change.

Overview of PREPARE Private Sector Call to Action

In their roles leading the implementation of PREPARE, Special Presidential Envoy for Climate John Kerry and the Administrator for the US Agency for International Development (USAID) Samantha Power launched a global call to action for businesses at COP27 to make new, significant commitments to signal the critical importance of building climate resilience in partner countries.

This call to action recognizes the urgent need for both private and public sector action to address long-standing gaps in climate adaptation. It also acknowledges that progress on reducing emissions resulted, in part, from more than a decade of public and private sector collaboration, and that strong collaboration coupled with attention to the needs of local communities can drive further action on global climate adaptation.

For these reasons, Secretary Kerry and Administrator Power call on private sector actors to draw on their unique resources, expertise, and innovation to support inclusive approaches to climate adaptation. Together, we can remove barriers to investment in adaptation and, operating in a 1.5°C future, build a world in which communities can thrive, even in the face of climate change.

The Global Resilience Partnership, through the support it receives from USAID, will manage the call to action, with input from the Office of the Special Presidential Envoy on Climate.

BCG's Response to the PREPARE Private Sector Call to Action

Boston Consulting Group's mission is to unlock the potential of those who advance the world. As a global consulting firm, BCG partners with leaders in business and society to tackle their most important challenges and capture their greatest opportunities. The firm works with thousands of companies, governments, and civil society organizations on their societal and planetary impact, including work on net zero journeys, critical needs of investing in adaptation and resilience, and a just transition to a green global economy. Today, there is a massive and persistent gap in adaptation and resilience funding, delaying the implementation of actions and the scaling of solutions needed to protect the most vulnerable communities in developing countries. BCG's contribution to the PREPARE Call to Action aims to provide a compelling business case based on rigorous new analysis to galvanize the private sector to advance climate adaptation and resilience across critical sectors of the global economy. BCG will focus resources and expertise to develop the analytical foundations, evaluate transactions, demystify the benefits, and identify pathways for the private sector to invest in this important space. BCG is delivering a flagship report at COP28 that articulates the imperatives and opportunities for private sector investment in adaptation and resilience.

Endnotes

1. AON (2023), Weather, Climate, and Catastrophe Insight.
2. World Resources Institute and UN Development Programme (2016), Adapting from the Ground Up: Enabling Small Businesses in Developing Countries to Adapt to Climate Change.
3. African Development Bank (2018), Engaging private sector in financing local climate adaptation: What lessons can we learn from Africa and how to scale them up?
4. World Bank (2021), Enabling Private Investment in Climate Adaptation and Resilience.
5. Carbon Tracker (2023), Loading the DICE Against Pensions.
6. EDHEC Private Assets and Infrastructure Research Institute (2023). It's getting physical.
7. Ceres (2021), The Consequences of Physical Climate Risk for Banks.
8. Coalition for Climate Resilient Investment (2022), Physical Climate Risk Assessment Methodology Guidelines for Integrating Physical Climate Risks in Infrastructure Investment Appraisal. Note: CCRI is now a legacy programme. The PCRAM is now led by the Institutional Investors Group on Climate Change.
9. Global Resilience Index Initiative, Resilience Metrics for Infrastructure Investment.
10. Sharm Adaptation Agenda Implementation Report.
11. Global Resilience Index Initiative, Resilience Metrics for Infrastructure Investment.
12. AICCRA (2023), "Pay-as-you-go-model makes solar-powered irrigation affordable for farmers in Mali."
13. J.P. Morgan Portfolio Insights (2023), Adapting to a warmer planet.
14. GreenBiz (2023), "Climate tech investment fell by 40%, but there's a silver lining."
15. Sand to Green.
16. SEED (2022), SMEs as Key Drivers of Climate Change Adaptation in Southern Africa.
17. UNFCCC (2021), National Adaptation Plans; UNFCC (2022), Technology Needs Assessment: Pathways for climate tech implementation.
18. Convergence (2023), Catalytic Climate Finance Facility.
19. CDP (2022), Disclosures to the Climate Change Questionnaire 2022; acquired through BCG's institutional license.
20. PPPs are a model for facilitating private investment for public development often used in infrastructure. In this model, a private entity and the government co-invest in a project with shared risks and financial returns, which can be particularly effective in large-scale infrastructure projects where public oversight ensures societal benefits while private efficiencies can drive down cost.

When citing the present report, please use the following form:

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Global Resilience Partnership

The Global Resilience Partnership (GRP) advances resilience through identifying and scaling on-the-ground innovation, generating and sharing knowledge, and shaping policy. Resilience underpins sustainable development in an increasingly unpredictable world. We envisage an inclusive world in harmony with nature, that is better prepared to cope with shocks, adapt to change, and transform—all within planetary boundaries. GRP is made up of 80+ organizations that have joined forces to work together toward this vision. GRP is registered as a nonprofit organization in South Africa and co-hosted by the Stockholm Resilience Centre at Stockholm University.

US Agency for International Development

The US Agency for International Development (USAID) is the world's premier international development agency and a catalytic actor driving development results. USAID's work advances US national security and economic prosperity, demonstrates American generosity, and promotes a path to recipient self-reliance and resilience. The purpose of foreign aid should be ending the need for its existence, and we provide development assistance to help partner countries on their own development journey to self-reliance—looking at ways to help lift lives, build communities, and establish self-sufficiency. Our efforts are both from and for the American people. USAID demonstrates America's good will around the world; increases global stability by addressing the root causes of violence; opens new markets and generates opportunity for trade; creates innovative solutions for once unsolvable development challenges; saves lives; and advances democracy, governance, and peace.


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