



Business in a Climate-Constrained World

Catalyzing a Climate-Resilient Future through the Power of the Private Sector

Anchor Report | April 2014



About This Report

This report outlines BSR's new strategy to mobilize our formidable business network, global reach, industry insights, and issue expertise in support of sustained business action on climate change. Business and society face unprecedented risks as a consequence of climate-related impacts, including increases in temperature and sea level, increased intensity and frequency of extreme weather events, threats to biodiversity and ecosystem services, and changes in water distribution. We must pursue strategies to enhance resilience with urgency and ambition. We must both reduce our emissions to keep them consistent with a 2°C pathway and enhance adaptive capacity in the face of inevitable climate impacts.

The core of our strategy builds upon the climate “stabilization wedges” pioneered by Princeton professors Robert Socolow and Stephen Pacala in a seminal paper published in 2004. We intend to identify the appropriate stabilization wedges for emissions reductions across eight industry clusters and implement measures to reduce emissions in partnership with BSR member companies and other stakeholders, including government, philanthropies, civil society actors, academics, and multilateral organizations. In addition, we plan to develop new and innovative wedges focused on enhancing adaptive capacity—both within corporate supply chains and the climate-affected communities from which business derives its social license to operate.

We do not set out to present a comprehensive, exhaustive, or definitive inventory of measures for business to follow. Instead, we propose a framework for collaborative action that helps companies identify a menu of small steps that cumulatively add up to significant ambition to address climate change. We also offer an open invitation to collaborate on bold collective action. Identifying the right combination of interventions or wedges will require partnership, creativity, dialogue, and piloting approaches over the coming months and years. BSR will subsequently focus on this mission with our member companies and with other stakeholder partners as we advance this strategy over the coming years.

This report begins with a section on translating climate risks for business and society. We then move into a description of what companies can do to build resilience in a climate-constrained world—a combination of reducing emissions consistent with a 2°C pathway and building adaptive capacity in the face of inevitable climate impacts. We outline how BSR will partner with companies and other stakeholders to apply the climate stabilization wedges across our eight industry clusters. It details BSR's value proposition and concludes with a description of how we will leverage our network and experience in implementing this strategy by 2020.

This strategy was prepared over a six-month period from November 2013 to April 2014. It is the result of an extensive literature review, elite interviews conducted with leading practitioners across a variety of important sectors and issue areas, and discussions held within focus groups convened throughout BSR's formidable network. Moreover, it is the product of harvesting lessons from more than two decades of BSR insights and experience working with business on interrelated, complex global challenges. The content builds upon the authors' expertise, draws from BSR's climate-related work, and benefits from detailed contributions from a range of BSR colleagues, including Eric Olson, Sissel Waage, France Bourgouin, and Angie Farrag-Thibault.

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DISCLAIMER

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Working papers contain preliminary research, analysis, findings, and recommendations. They are circulated to stimulate timely discussion and critical feedback and to influence ongoing debate on emerging issues. Most working papers are eventually published in another form, and their content may be revised.

ABOUT BSR

BSR works with its global network of more than 250 member companies to build a just and sustainable world. From its offices in Asia, Europe, and North and South America, BSR develops sustainable business strategies and solutions through consulting, research, and cross-sector collaboration. Visit www.bsr.org for more information about BSR's more than 20 years of leadership in sustainability.

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Foreword: The Future of Our Climate Depends on Business

As the most recent report from the Intergovernmental Panel on Climate Change makes clear, our changing climate has already begun to reshape our world, and threatens to halt (or reverse) the remarkable gains in prosperity achieved over the past generation, which has seen 663 million people—nearly 10 percent of the population—move from poverty to at least basic levels of comfort and dignity.

With the potential for fundamental changes in our environment continuing to grow, the stakes for business could not be greater. We can no longer take for granted the relatively calm operating environment that has enabled rising prosperity over the past few decades. Vibrant enterprises and economies depend on the availability of natural resources, strong physical infrastructure, stable commodity prices, and wider access to education and economic opportunities. These and other baseline conditions for thriving communities and economies are at stake if we do not take decisive action to address climate change.

In this context, I am proud to present BSR's new report, which is part of our organization-wide Business in a Climate-Constrained World initiative. We will work with our 250-plus member companies and other partners to activate business to secure a stable climate and build the capacity of business, communities, the environment, and people to adapt to a changing climate. This effort is central to the achievement of BSR's vision of a just and sustainable world, which seeks to ensure that all the world's people can live prosperous, dignified lives within planetary boundaries.

I hope this report motivates business to redouble its efforts. Just as the stakes are clear, so, too, is the opportunity for business to act in new, unexpected, and powerful ways. Business has truly unique assets that it can bring to bear. As an engine of innovation, business creates new technologies, products, and services that will catalyze a step change in efficiency and will bring quantum leaps in the human experience. And business can take these innovations to scale to support change that will happen faster than if governments and civil society acted alone. Importantly, business also has a voice and can help shape the perspectives of citizens, consumers, and public officials alike.

Just as there is a clear and compelling human argument for action on climate, there is an equally clear argument on business grounds: Businesses that fail to prepare for changes in our world—whether economic, technological, cultural, or environmental—face existential challenges to their very survival. Happily, the opposite is also true: Business leaders who understand where the world is heading and devise strategies and investments to capitalize on these changes are positioned to lead and succeed. The companies that anticipate and create products and services for a low-carbon world will be the big winners in the decades to come, and those that don't are exposing themselves to immense risk.

At BSR, we are optimistic. History reminds us of a multitude of challenges, and our most heroic moments have come when we have applied human ingenuity to face them. The great project of the 21st century is to do exactly that: Apply the voice, creativity, and productivity of business to reorient our economy toward a low-carbon future that will truly sustain us.

Our climate depends on it. Business depends on it. And even more importantly, humanity depends on it.

—Aron Cramer, *President and CEO, BSR*

Executive Summary

BSR aspires to a just and sustainable world in which all people live prosperous, dignified lives within the boundaries of the world's natural resources. Addressing climate change with urgency and ambition is vital to securing this vision.

The science is clear—we must hold the global mean temperature rise to less than 2°C above preindustrial levels in order to avoid unprecedented climate risks to society and business from increases in temperature and sea level, increased intensity and frequency of extreme weather events, and changes in water distribution.¹

We must also recognize that climate change is already happening. The latest Intergovernmental Panel on Climate Change (IPCC) report on impacts, adaptation, and vulnerability stresses that observed impacts of climate change are widespread and consequential.² Describing climate change impacts as “severe, pervasive, and irreversible,” the report describes implications on social systems, including damage to livelihoods and homes, threats to food security and development, increased incidence of poverty and conflicts, the undermining of human rights, and heightened public health risks stemming from climate-related diseases and fatalities. Impacts on ecological systems include loss of critical habitat, heightened risk of species extinctions, and damage to ecosystem services.³

Climate Risk and Resilience

As the threat of climate change increases, so do the risks for business. These risks include disrupted supply chains, reduced availability of scarce natural resources, damage to vital infrastructure and utilities, disrupted transport and logistics routes, heightened price and market volatility, and unpredictable impacts on the workforce and consumers. Some estimates put the cumulative, global cost of climate change impacts as high as US\$4 trillion by 2030 if we continue on our current greenhouse gas (GHG) emissions pathway.⁴ These threats demand a reappraisal of climate risk and a comprehensive strategy for resilience.

The IPCC report defines resilience as “the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.”⁵ Resilience has always been understood as the ability to manage and rebound from risks, but what if some risks are so severe that they breach irreversible thresholds? Under these circumstances, resilience must include a balance between avoiding the unmanageable by aggressively reducing emissions while managing the unavoidable risks of climate change by enhancing adaptive capacity.

¹ IPCC, 2007a. At the Fifteenth Conference of Parties to the UN Framework Convention on Climate Change (UNFCCC) meeting in Copenhagen, Denmark, in December 2009, countries agreed to hold the increase in the global mean temperature below 2°C above preindustrial levels in accordance with the findings of the IPCC Fourth Assessment Report.

² IPCC, 2014.

³ Ibid.

⁴ Mercer, 2011.

⁵ IPCC, 2014, p. 5.

- » **Avoiding the unmanageable** requires ambitious reductions in GHG emissions to hold the global mean temperature rise to less than 2°C above preindustrial levels. Breaching this threshold by emitting excessive GHGs into the atmosphere would critically undermine socioecological systems beyond their points of resilience.
- » **Managing the unavoidable** recognizes that inevitable climate impacts are already locked into the system as a consequence of the rapid accumulation of GHGs in the atmosphere over many centuries and from numerous sources.

Resilience in the face of climate change, therefore, requires action on two fronts simultaneously: aggressive emissions reductions and sustained enhancement of adaptive capacity.

Business in a Climate-Constrained World

BSR's new Business in a Climate-Constrained World strategy is a three-year initiative designed to mobilize our business network, global reach, industry insights, and issue expertise to address global climate change. Our strategy consists of **translation** of climate risk; **collaboration** across business sectors and stakeholder groups in pursuit of urgent, ambitious, and sustained climate-related action; and the **stabilization** of the climate system through the implementation of *resilience wedges*.

TRANSLATION

The nature of climate risk differs across geographies and across sectors with most industries exposed to multiple, intersecting climate risks. As a consequence, a sophisticated, comprehensive reappraisal of risk is needed to ensure business success in a climate-constrained world. Moreover, the transition to a low-carbon future also holds risks. Some industries may find themselves with stranded assets as a result of climate regulation. Incentives to promote low-carbon energy could put pressure on other industries, as was the case some years ago when a rush to biofuels caused a temporary global food crisis.

Managing this transition is a critical element of managing risk. Translating these complex risks is therefore a critical part of our strategy. We intend to work with partners to better understand the full spectrum of risks and translate this knowledge into actionable strategies for resilience.

COLLABORATION

Tackling the challenge of global climate change is an enormous task—too large for any single company or organization. All stakeholders, including business, will need to commit to bold collective action to build resilience in a climate-constrained world. This need, in turn, requires a new emphasis on collaboration. We believe that collaboration across industries and with multiple stakeholder partners creates an ecosystem for climate action, allowing industries to enable each other and the communities in which they operate.

Businesses can avail themselves of the transformational power of collaboration by working across industries to share their knowledge, pioneer new approaches and technologies, and test business-to-business solutions. They can share costs and resources through partnerships with peers, as well as the public sector and civil society. These partnerships will drive effective action in the areas where businesses have the most to contribute and to lose through improvements to shared infrastructure, local capacity building, and disaster preparedness and response.

We plan to foster enhanced climate collaboration through this strategy by creating an *architecture of participation*. In practice, this participatory approach

means exploring every opportunity to build cross-industry and cross-stakeholder partnerships in pursuit of our goals. It also means finding ways to contribute to existing initiatives within the wider climate community of practice. Around the globe, new multistakeholder initiatives designed to build climate resilience are emerging rapidly. We will work to assess these initiatives, encourage them to connect, and seek out suitable opportunities for a private sector component.

STABILIZATION

The core of our strategy builds upon the climate “stabilization wedges” pioneered by Princeton professors Robert Socolow and Stephen Pacala in a seminal paper published in 2004. The great value in adopting a wedge-based approach is that it constitutes what author Clay Shirky describes as a “plausible promise”: a strategy that has sufficient ambition to be truly meaningful, while at the same time being achievable.”⁶ In the context of climate change, this means ambitious action using current technologies and operating within current political economy realities.

We intend to identify appropriate *resilience wedges* to both reduce emissions and enhance adaptive capacity across eight industry clusters. To address the former, we will seek to implement actual emissions reductions in partnership with BSR member companies and other stakeholders, including government, philanthropies, civil society actors, academics, and multilateral organizations. To enhance adaptive capacity, we will look for opportunities to strengthen corporate supply chains and increase the ability of communities directly affected by climate change to respond to and rebound from impacts with business support.

Some wedges will be unique to specific industries. For example, we already know that in order to reduce emissions the agricultural sector will need to address land-use and livestock management, increase the capacity of terrestrial carbon stocks through sequestration in soils and biomass, tackle food waste, and encourage people to change their diets. We further know that enhanced adaptive capacity in the agricultural sector will require altering cultivation and sowing times, improving crops’ tolerance to high temperatures, breeding additional drought-tolerant crop varieties, improving adaptive water management techniques, and using more suitable livestock breeds or species in regions with changing temperatures and water patterns.

Some wedges—particularly those related to energy use and mix—will be common across all industry sectors. Moreover, their application, particularly those related to efficiencies in the supply chain, will be replicable across industries.

We know that more research is needed to investigate and implement the ambitious wedges that are appropriate for each sector. Because each industry is unique, we will work with our partners to identify and act upon the spectrum of options available for emissions reductions and enhanced adaptive capacity in each sector.

A Call to Action and an Invitation to Partnership

At BSR, we believe in the transformational power of the private sector. Businesses can lead to address climate change by:

- » Developing new technologies and business models
- » Aggressively reducing their emissions and enhancing their adaptive capacity through their investments, procurement, and use of energy, land, and transportation

⁶ Shirky, 2009, p. 25.

- » Enabling climate resilience in other sectors and in the communities in which they operate through their innovations, products, services, and commitment to the social license to operate
- » Working with governments and other stakeholders to create the right policy and financial environment for a low-carbon future

The good news is that many businesses are already beginning to act. According to the Carbon Disclosure Project (CDP) in 2013, 84 percent of the Global 500—defined by CDP as the largest companies by market capitalization included in the FTSE Global Equity Index Series—companies reported that they have emissions reductions targets, and 75 percent reported that they have already reduced their emissions in some areas of their business.⁷ It is clear that many companies are already innovating and investing with the goal of building climate resilience. Moreover, more than 96 governments from developed and developing countries have initiated climate policies, ranging from domestic laws and standards to emissions trading systems and carbon pricing. The enabling environment for climate resilience is being constructed all around us.

The bad news is that activity does not equal ambition. Too many businesses believe that climate-related action is impractical in an age of fiscal austerity and is incompatible with their bottom line. Others are waiting for a silver bullet—either a new technology or a policy incentive from government—to spur them to act.

This strategy therefore constitutes a call to action—to match the volume of activity on climate with a greater commitment to ambition. We believe that our strategy of translation, stabilization, and collaboration provides a menu of tangible, actionable steps that all companies and sectors can take to cut emissions, consistent with a 2°C pathway, while also enhancing their adaptive capacity in the face of the inevitable impacts. We invite BSR members and noncorporate stakeholder partners to join us in this effort—to work with us to identify the *resilience wedges* across all industry sectors and to seed the innovation necessary to build a climate-resilient world.

If we are successful, by 2020, business leadership on climate change will contribute to effective programs that promise to hold the projected global average temperature rise to less than 2°C above preindustrial levels, and BSR members across our eight industry sectors will be taking steps to reduce GHG emissions and build adaptive capacity. Our members will be revealing a greater understanding of the downside risks of runaway climate change and a heightened awareness of the upside opportunities of the transition to a low-carbon economy, and they will be implementing policies and approaches that are in line with climate-compatible development.

BSR Is Driving New Ideas and Collaboration on Climate Resilience

We believe our legacy of work on sustainability over two decades has prepared us well to lead this effort. BSR is practical and ambitious in translating good ideas into actionable strategies that deliver value for business and society. Working with more than 250 major corporations across eight industry clusters, we promote individual company leadership and innovation, collaborative change across business networks, and cross-sector solutions for systemic change.

With eight offices on four continents, we work in the key geographies that will determine success or failure on climate. We understand the social and environmental issues and how they play out across different regions. We are also collaborative. Extending from our work with individual companies, we bring business and its stakeholders together to tackle intransigent common problems. This work involves improving industry standards, sharing best practices across industries, pooling resources to develop value-chain partnerships, and hosting

⁷ CDP, 2013, p. 8.

unlikely discussions with adversaries. Our partnership development work allows us to cooperate with governments, philanthropies, multilateral organizations, and civil society actors.

BSR has earned the trust of influential companies, governments, and civil society actors during the past 20 years. Our insight and reach allows us to help companies make sense of emerging issues, while asking tough questions. Our understanding of the private sector enables noncorporate partners to engage business in meeting societal goals.

Moreover, we understand collaboration. For more than 20 years, BSR has brought companies together to address sustainability challenges that are too systemic and complex for any single company to tackle alone. Engaging nearly 200 companies, our collaborative initiatives provide a standing forum for these companies to share knowledge and insights, take action, and engage with their stakeholders as a collective, rather than as individual companies.

From this platform, we will work to multiply the size and impact of business initiatives on climate to create transformative and structural change. We will meet this challenge by scaling up our own collaborations, research, and fieldwork. We will also rally companies to join other innovative, ambitious climate initiatives organized by partners in the spirit of creating an *architecture of participation*.

Next Steps

Over the coming months, we will rapidly begin to implement this strategy. We plan to take several steps immediately to operationalize our approach to translation, collaboration, and stabilization.

First, we will produce a series of briefs translating the latest climate science into actionable insights for companies operating in the agriculture, extractives and primary industries, and transport sectors. Working in partnership with the European Climate Foundation and the University of Cambridge Judge Business School and Institute for Sustainability Leadership, we will distill key lessons on risk, adaptive capacity, and emissions reductions for each of these sectors.

Second, our new guide, “Transitioning to Low-Carbon Fuel: A Business Guide for Sustainable Trucking in North America,” will help major vehicle fleet operators and their value chain partners develop impactful yet practical strategies for fuel sustainability. These strategies will enable energy producers, vehicle manufacturers, retailers that place shipments, and investors to accelerate the transition to low-carbon fuels by developing a greater understanding of the total fuel footprint, optimizing the use of available fuel and vehicles, collaborating to enable new low-carbon solutions, and advocating for a better policy environment. This guide comes from our Future of Fuels initiative, a collaborative initiative among a group of companies, including pioneering fleet operators like Coca-Cola, PepsiCo, UPS, and Walmart, who are working together to create a transportation fuel system that is more sustainable, resilient, and, most critically, affordable.

Beyond these immediate steps, we will prioritize initiatives that are meaningful in terms of their capacity to be truly ambitious and feasible, reflecting our ability to generate corporate interest and multistakeholder partnerships in keeping with our goals.

What We Know and What We Hope to Learn

We know that this is a decisive decade for the global climate. We must have a greater sense of urgency and ambition if we are to avoid dangerous climate thresholds with potentially catastrophic implications for socioecological systems and global prosperity. We further know that catalyzing climate resilience will not

be easy. Our global economy, and with it the legitimate development aspirations of billions of people, is heavily dependent on fossil fuels and other high-carbon practices. The transition to a low-carbon future must be managed in a manner that recognizes this context, minimizes negative dislocations, and facilitates equitable access to sustainable development.

We already know enough to get started. As Ecofys points out, “. . . [E]xisting scenarios show that it is technically and economically feasible to reduce emissions to zero for roughly 90 percent of current sources of GHG emissions with technological options that are available today and in the near future.”⁸ The wedges approach does not require us to wait for breakthrough energy technologies or other technological or policy silver bullets. We can act with urgency and ambition straightaway.

We don't know everything, however. We will therefore call upon our members and other partners to work together to complete a comprehensive, definitive inventory of appropriate wedges and to develop collaborative approaches to building resilience in a climate-constrained world.

⁸ Hohne et al., 2013.

Translating Climate Risks for Business and Society

The science around climate change is clear; we must hold the global mean temperature rise to less than 2°C above preindustrial levels in order to avoid exposure to significant, potentially irreversible risks to the planet, people, and business.⁹

Understanding Climate Risks

In June 1962, *The New Yorker* began serializing Rachel Carson's *Silent Spring*. The book derived its power from its fictional "fable for tomorrow," which described a storybook town's descent from natural harmony to a "spring without voices" as ecosystems and biodiversity collapsed due to environmental pollution.¹⁰ Fifty years later, another powerful piece in a different New York magazine described Lower Manhattan as "dark, silent, and underwater." *Bloomberg Businessweek's* cover story last year, "It's Global Warming, Stupid," offered a modern "fable for tomorrow." The culprit was dangerous climate change prompted by the rapid accumulation of GHGs in the atmosphere.¹¹

As the United States marked the one-year anniversary of Hurricane Sandy, another extreme weather event devastated communities half a world away. Typhoon Yolanda (Haiyan), which struck the Philippines on November 9, 2013, killed almost six thousand people and left more than a half million people displaced and more than 2 million people in need of food aid.¹² To many observers, these events hint at a climate-constrained future.

The IPCC's Fifth Assessment Report clearly lays out the reason to focus on and work to stabilize the climate, "Since the 1950s, many of the observed changes are unprecedented over decades to millennia."¹³ These changes are driven by increasing concentrations of GHGs to levels unprecedented in at least the last 800,000 years.¹⁴ The global mean temperature has already increased 0.8°C above preindustrial levels. The IPCC projects that we are on a path to a global mean temperature rise in the range of 1.5°C to 4.5°C¹⁵ by the end of the century; to avoid dangerous climate change, we must limit this temperature rise to 2°C above preindustrial levels.¹⁶ These findings are reinforced by research conducted by the World Bank, which estimates that, based on current trends, the world is likely to warm by 4°C by the end of the century.¹⁷

⁹ IPCC, 2007a. At the Fifteenth Conference of Parties to the UN Framework Convention on Climate Change (UNFCCC) meeting in Copenhagen, Denmark, in December 2009, countries agreed to hold the increase in the global mean temperature less than 2°C above preindustrial levels in accordance with the findings of the IPCC Fourth Assessment Report.

¹⁰ Carson, 1962, p. 27.

¹¹ Barrett, 2012.

¹² National Disaster Risk Reduction and Management Council of the Republic of the Philippines, 2013.

¹³ IPCC, 2013, p. 3.

¹⁴ Ibid., p. 7.

¹⁵ Ibid., p. 11.

¹⁶ IPCC, 2007a.

¹⁷ World Bank, 2012.

As statistician Nate Silver has pointed out, “The science behind the greenhouse effect was simple enough to have been widely understood by the mid- to late 19th century, when the lightbulb, the telephone, and the automobile were being invented—and not the atomic bomb, the iPhone, and the space shuttle. The greenhouse effect is not rocket science.”¹⁸ Despite this fact, skeptics have attacked and disputed the science underpinning climate change for many decades.¹⁹ The IPCC’s Fifth Assessment Report is the most detailed examination of climate change ever. It is based on more data, contains more detailed regional projections, and is more confident about its conclusions than any other global assessment to date. As a result, the report provides us an opportunity to transform the conversation from whether climate change is happening to what can be done to build resilience in a climate-constrained world.

FIGURE 1 (Click [here](#) to enlarge)



Risks to Socioecological Systems

According to the IPCC, a new world characterized by rising temperatures, increasing frequency and intensity of extreme weather events, the inundation of coastal cities with many wet regions becoming wetter and dry regions becoming drier, an irreversible loss of biodiversity, rainforest dieback, and a rising sea level is being forged all around us.²⁰

These climate-driven impacts, in turn, lead to loss of livelihoods and homes; increased incidences of poverty and hunger; additional stresses on fragile states, particularly those prone to conflict; the undermining of human rights; and threats to health and lives caused by declining nutrition, increases in vector and waterborne diseases, and fatalities resulting from extreme weather events. These social impacts of climate change reach into every community around the globe but have a disproportionate effect on the world’s poor.²¹

The landmark Stern Review on the Economics of Climate Change prepared by Sir Nicholas Stern predicted that temperature rises in excess of 2°C will result in as many as 4 billion people experiencing growing water shortages. The most heavily impacted populations would be in Africa, the Middle East, southern Europe, and Latin America. This temperature increase would have consequences, not only for drinking water, but also for the availability of water for

¹⁸ Silver, 2012, p. 450.

¹⁹ See Hoggan and Littlemore, 2009, and Boykoff and Boykoff, 2007.

²⁰ IPCC, 2013.

²¹ Cameron, 2011.

business purposes, including those related to irrigation and urban water supplies.²² In addition, the UN predicts that temperature rises beyond 2°C could lead to 600 million additional people facing acute malnutrition by the 2080s.²³

In addition, the changing climate will affect the structure and function of ecological systems. Approximately 20 to 30 percent of plant and animal species are likely to face an increased risk of extinction if we exceed the 2°C threshold. Entire ecosystems, which are not only important in their own right, but also provide essential services to communities and business, could be destroyed;²⁴ everything from medicines and clothing to irrigation and crop pollination relies on our complex ecosystems.²⁵

For example, because of climate change, a tropical rainforest may have more variable rainfall patterns over time. With shifting conditions, tree stress would likely increase, which would lead to forests becoming more prone to insects, diseases, and fire. Changes in wildlife movement could affect natural forest regeneration because fruit-eating wildlife play a key role in dispersing seeds and continually regenerating (or replanting) forests. Therefore, as trees die off and water becomes scarcer, wildlife may have to spend more time searching for water sources, thereby blocking the pathways to natural forest regeneration. The net effect could be less forest cover over time due to both mortality and lack of natural regeneration, which, in turn, would reduce carbon sequestration and oxygen production, as well as contribute to many other issues.

In short order, surrounding communities could begin to see human health impacts associated with climate change related to the unraveling of ecosystem structure and function. Regional air quality could deteriorate because there would be fewer trees in a region to sequester carbon, and insect-borne disease could surge as natural mosquito predators (such as frogs) die off, mosquitoes propagate, and illnesses (such as malaria and dengue fever) skyrocket. Clearly, loss of green infrastructure, in the form of robust ecological structure and function, is in no one's best interest—least of all that of a company relying on stability in a particular part of the world to ensure that its business runs smoothly.

Climate Risks for Business: Financial, Operational, and Reputational

Not merely an environmental and social challenge, climate change also poses a significant, growing set of risks for business, spanning the spectrum from financial to operational. These risks include market and price volatility; rising costs of inputs, including energy, water, land, and chemicals; access to scarce natural resources that are vital for production; and damage to the infrastructure and logistics essential for a functioning supply chain. Moreover, increasing demand for action from a variety of stakeholders is imposing a variety of reputational and regulatory risks.

According to a report by Mercer, the cumulative, global cost of climate change—related impacts on the environment, health, and food security will reach between US\$2 trillion and US\$4 trillion by 2030.²⁶ The World Economic Forum (WEF) reports that Hurricane Sandy cost more than US\$70 billion in damages in New York and New Jersey alone.²⁷ The record U.S. drought in 2011 led to US\$7.62 billion in losses in Texas, and in 2012, more than 1,000 counties in 29 U.S. states were designated primary natural disaster areas by the U.S. Department of

Translating Climate Risk: Swiss Re

Swiss Re first identified climate change as a major trend that will affect the insurance industry 20 years ago. Understanding this impact is essential for the insurance company; Swiss Re estimates that the average weather-related insurance industry loss in the United States grew from US\$3 billion a year in the 1980s to approximately US\$20 billion by the end of the past decade. As an insurance company that helps customers manage risk, Swiss Re is exposed to the risks of climate change and has seized its role in minimizing the risks its consumers and investments face.

Over the past two decades, Swiss Re's leadership in understanding and managing risk and resiliency across its products and services has continuously expanded. An ambitious approach to its climate change strategy is enabling this knowledge and aspiration to spread throughout the company's industry and customer base.

²² Stern, 2006.

²³ UNDP, 2007.

²⁴ UNDP, 2005.

²⁵ Cameron, 2013.

²⁶ Mercer, 2011.

²⁷ WEF, 2013.

Agriculture from another record drought that suppressed farming profits and drove up the price of soybeans and corn.²⁸

Beyond the financial risks from climate change impacts, businesses pursuing business as usual also face economic risks, specifically associated with failing to anticipate a climate-constrained world and the types of policy and financial incentives that will make a high-carbon economy increasingly unattractive. The current debate concerning stranded assets is a case in point. Norway's Storebrand, which holds more than US\$30 billion in assets, announced in July 2013 that it would exclude 13 coal and 6 oil sands companies from all investments "to reduce Storebrand's exposure to fossil fuels and to secure long-term, stable returns for our clients."²⁹ Storebrand is basing its decision on the idea that holding the global mean temperature rise to less than 2°C may mean that "many fossil fuel resources will become unburnable, and their financial value will be dramatically reduced."³⁰

Translating Climate Risk: Nike

In recent years, Nike has proactively pursued measures to understand climate risks. Threats to water availability and extreme weather form the bulk of Nike's risk exposure. In 2008, floods in Thailand forced four of Nike's factories to temporarily shut down. Since the majority of Nike's factories are located in Southeast Asia, a region increasingly susceptible to extreme weather events, the danger of further prolonged disruptions to production are increasingly emerging.

Water is an integral resource for Nike to be able to grow, manufacture, dye, and distribute its products; the company estimates that it takes 100 to 150 liters of water to process 1 kilogram of textiles. Water scarcity has become a major concern for Nike because many of the regions from which it sources its raw materials are becoming more susceptible to drought. In order to manage this risk, Nike has begun using more synthetic fabrics that require less water and has also developed its ColorDry process, which eliminates water and chemical use during the dyeing process.

The concept of unburnable fossil fuels is gaining traction. A 2011 Carbon Tracker report asserted that 80 percent of fossil fuel reserves must be left in the ground to avoid some of the worst effects of climate change.³¹ Other leaders in the financial services sector have also been weighing in on the matter. In January 2013, HSBC issued a report outlining the unburnable reserves on a company-by-company basis to, among other things, provide investor guidance on how to mitigate risk. According to the report's authors, "A material proportion of the world's undeveloped reserves of fossil fuels could become 'unburnable.'"³²

From an operational standpoint, climate impacts cover a broad spectrum of activities that get to the core of business practices and products. The following three examples dealing with the agriculture, extractives and primary industries, and transport sectors illustrate the growing spectrum of risks across the private sector.

AGRICULTURE

Climate-related impacts are expected to lead to increased scarcity and reduced security of freshwater resources, diminished crop production by as much as 2 percent per decade for the rest of the century, enhanced price and market volatility for agricultural commodities, amplified damage to production caused by pests, and substantial losses to the terrestrial ecosystems that facilitate agricultural production, food security, and rural livelihoods.

Agriculture requires large quantities of water for irrigation and other production processes. In many regions, changing levels and patterns of precipitation, melting snow and ice, and retreating glaciers are altering hydrological systems and affecting water resources and quality. Climate change is projected to reduce water resources significantly in most dry subtropical regions, exacerbating competition for water among sectors, with each degree of warming expected to decrease renewable water resources by at least 20 percent for an additional 7 percent of the global population. Without adaptation, local temperature increases of 1°C or more above preindustrial levels are projected to negatively impact yields for the major crops, such as wheat, rice, and maize, in tropical and temperate regions. In addition, areas suitable for the cultivation of coffee, tea, and cocoa, which support millions of smallholders in more than 60 countries, will be significantly reduced.

²⁸ *The Economist*, 2012.

²⁹ Quoted in Waage and Cameron, 2013.

³⁰ Quoted in Waage and Cameron, 2013.

³¹ Campanale and Leggett, 2012.

³² Spedding, Mehta, and Robins, 2013.

In recent years, fluctuations and trends in food production are widely believed to have played a role in price changes, with price spikes often following climate extremes that major producers have weathered. For example, studies suggest price increases of 37, 55, and 11 percent respectively for rice, maize, and wheat by 2050 from climate impacts. This volatility has negative implications for business as it heightens uncertainty, increases the costs of production, and impedes access to vital commodities.³³

EXTRACTIVES

The physical impacts of climate change on the extractives and primary industries are expected to be wide ranging. They will likely include damage to networked infrastructure and industrial capital assets, impacts on the availability of natural resources, and reduced access to water resources. Pipelines for the transport of oil and gas may be affected by secondary impacts of climate change, from a rising sea level to bushfires caused by heat waves in hot regions. The supply, transport, and transmission of energy are all likely to be affected by changes in the frequency and intensity of extreme weather events.

An increase in climate-related hazards (such as forest fires, flooding, and windstorms) may affect the viability of mining operations and increase operating, transportation, and decommissioning costs. Surface mining may be particularly affected by precipitation extremes and related floods and erosion, and temperature extremes, especially extreme cold, that may hamper extraction for quite some time.³⁴

TRANSPORT

Climate impacts in the transport sector will vary across transport modes. Extreme heat will soften paved roads, requiring resurfacing with more durable materials. More frequent flooding will require more frequent maintenance and investments in a higher, more expensive drainage standard. Bridges will be exposed to flooding, requiring upgraded design specifications in new construction and retrofitting. Estimates range from US\$140 to US\$250 billion to adapt existing bridge infrastructure in the United States over the next 50 years. Extreme heat will reduce the fuel and energy efficiency of vehicles by increasing demand for cooling in private vehicles and on public transport and energy consumption in the refrigeration of perishable freight. More frequent droughts and floods will increase the possibility of storms on certain maritime transport routes, which will translate into higher shipping costs because of the additional safety measures or longer, less storm-prone routes that carriers will need to take.

Storms may increase the number of weather-related delays and cancellations in the aviation sector. Clear-air turbulence will increase in the Atlantic corridor leading to longer, bumpier flights. More intense heat and rainfall will have impacts on runways similar to the ones they have on roads.³⁵

Coastal infrastructure, including ports, roads, rail, and airports, are vulnerable to flooding and erosion as a result of a rising sea level and extreme weather, including more intense rainfall, high winds, and storm surges. Recent events illustrating the threat include Hurricane Katrina in 2005, which caused US\$100 million in damages to Mississippi ports, and Hurricane Sandy in 2012, which led to a weeklong shutdown of the Port of New York, causing US\$50 billion in damages. According to the IPCC, port infrastructure assets worth more than US\$3 trillion in 136 cities are vulnerable to weather events.³⁶

Beyond operational concerns, both brands and their suppliers face increasing pressure to provide sustainable services and products across their value chains.

³³ Cameron, 2014.

³⁴ Bourgoignie, 2014.

³⁵ Farrag-Thibault, 2014.

³⁶ IPCC, 2014.

Consumers, investors, NGOs, and government regulations are all combining to apply pressure on multinational corporations.

Consumers are demanding greater transparency from companies about their environmental impacts, including better products and services. They are more aware of supply chain working conditions and environmental impacts, are demanding assurance that the goods they purchase are aligned with their values, and have more access to information about how goods are produced than ever before. According to Edelman Trust Barometer, in the past year, 77 percent of 25- to 64-year-olds around the world refused to buy a product or service from a distrusted company.³⁷

Meanwhile, investors have increased pressure on business to report transparent metrics on their environmental performance, investments, and risks. They see responsible, sustainable practices throughout the supply chain as a necessity to avoid business risks; are advocating for government regulations to force companies to address these issues; and are seeing a sharp rise in ethical investments, with the signatories to the Principles for Responsible Investment managing assets greater than US\$30 trillion, estimated at 20 percent of the total value of global capital markets.³⁸

NGO campaigns have become more sophisticated with big data, consumer-engagement strategies, and increased literacy on issues. They are leading the charge on holding companies responsible for their social and environmental impacts in the supply chain, are launching campaigns to target both brands and suppliers, and are digging into the deeper layers of the supply chain where brands have reduced visibility into their suppliers and risks. Moreover, they are collecting their own data for reports from a variety of sources, including primary research. And finally, public policies on climate change are emerging all the time. Regulators around the globe are becoming more proactive at initiating voluntary and mandatory standards; are receiving increased support and criticism from the general public for their decisions, obscuring the path for business; and are increasingly campaigning to win public support for new approaches to climate resilience.

The Time for Resilience Has Arrived

The risks outlined in this section are neither exhaustive nor definitive, nor are they unique to a small subset of industries. They impact the complex socioecological system upon which all businesses depend for long-term success. It is vital that business understand climate risk, develop strategies for resilience, and implement them with urgency, ambition, and effectiveness during this decisive decade.

³⁷ Edelman, 2009.

³⁸ U.S. SIF Foundation, 2013, p. 3.

TABLE 1: Climate Risks

<p>According to the IPCC, climate change impacts are likely to be “severe, pervasive, and irreversible.” They are driven by increasing concentrations of GHGs to levels not seen in the last 800,000 years. Risk of climate-related impacts for business results from the interaction between climate-related hazards (including hazardous events and trends) and the vulnerability and exposure of human and natural systems and the private sector’s own sensitivity to a range of specific risks, including those relating to raw materials, operations, and finances.</p>		
HAZARDS	IMPACTS AND VULNERABILITY	BUSINESS RISKS
<p>Temperature: The global atmosphere has already increased 0.8°C above preindustrial levels. The IPCC projects that we are on a path to a global mean temperature rise in the range of 1.5°C to 4.5°C by the end of the century. Many socioecological thresholds will be breached at 2°C above preindustrial levels.ⁱ</p> <p>Water: Changing precipitation or melting snow and ice are altering hydrological systems, affecting water resources in terms of quantity and quality.</p> <p>Extreme events: Climate change is reinforcing the intensity and frequency of extreme weather events, including floods, droughts, tornadoes, tropical storms, and heat waves.ⁱⁱ Risks are already moderate to high with 1°C additional warming, and they increase at higher temperatures.ⁱⁱⁱ</p> <p>Ocean acidification poses substantial risks to marine ecosystems, especially polar ecosystems and coral reefs.^{iv}</p> <p>Sea-level rises, flooding, and storm surges: The World Bank 4°C report warns that warming of this magnitude will likely lead to a sea-level rise of 0.5 to 1 meter (possibly more) by 2100; while limiting warming to 2°C would likely reduce sea-level rise by about 20 cm by 2100 compared to a 4°C world.^v</p> <p>Large-scale “singularities”: With increasing warming, climate impacts could lead to the melting of the Greenland and Antarctic ice shelves, the release of methane in Siberia, and the halting of the Atlantic conveyor belt.^{vi}</p>	<p>Unique and threatened systems: Some ecosystems and cultures are already at risk from climate change. The number of systems at risk of severe consequences increases as the global mean temperature rises more than 1°C.^{vii} Approximately 20 to 30 percent of plant and animal species will likely be at increased risk of extinction if the global average temperature exceeds 1.5°C to 2.5°C. Major changes in ecosystem structure and function, species ecological interactions, and species geographical ranges, with predominantly negative consequences for biodiversity and ecosystems are projected.^{viii}</p> <p>Socioeconomic impacts: Throughout the 21st century, climate-change impacts are projected to slow down economic growth, make poverty reduction more difficult, further erode food security, prolong existing and create new poverty traps, increase the risk of conflict and involuntary displacement, impact human health, and undermine the realization of human rights.^{ix}</p> <p>Distribution of impacts: Risks are unevenly distributed and are generally greater for disadvantaged people. Based on projected decreases in regional crop yields and water availability, risks of unevenly distributed impacts are high for warming beyond 2°C.^x</p>	<p>Raw materials access: Climate change could reduce the availability of raw materials vital to production of goods and services, principally with implications for agricultural and forestry commodities, water, and the loss of provisioning and regulating functions of ecosystems services. Climate change may also undermine access to these materials by damaging the infrastructure and utilities essential to resource extraction and production.</p> <p>Operational risks: Supply chains are likely to be adversely affected as a result of reduced access to raw materials; climate-induced disruption to production lines; unstable energy supply; impacts on transport, physical and other infrastructure; and increased vulnerability of the workforce, particularly in developing countries.</p> <p>Financial risks include increased insurance costs, expenses related to retrofitting and climate-proofing infrastructure, loss and damage costs incurred from extreme weather events, and/or slow onset climate changes.</p> <p>Reputational risks: Multinational corporations are increasingly subject to reputational risks for failing to act on climate change or for seeming indifferent to the plight of affected communities.</p> <p>Social risks impacting business: Many of the socioeconomic impacts, including those related to state fragility and social unrest, undermine access to and the stability of markets, as well as the stability of manufacturing hubs.</p>

References

- ⁱ IPCC, 2014.
ⁱⁱ IPCC, 2012.
ⁱⁱⁱ IPCC, 2014.
^{iv} IPCC, 2014.
^v World Bank, 2012.
^{vi} IPCC, 2014.
^{vii} Ibid.
^{viii} International Union for the Conservation of Nature, 2008.
^{ix} IPCC, 2014.
^x Ibid.

Defining Resilience in a Climate-Constrained World

Climate resilience requires aggressive GHG emissions reductions to avoid the unmanageable impacts of climate change, and it requires comprehensive approaches to enhancing adaptive capacity to manage the unavoidable impacts.

Enhancing Resilience through Ambition: IKEA

IKEA is demonstrating that energy efficiency, renewable energy, and sustainability are not only good investments, but that they can be affordable and accessible for consumers, thereby hastening the transition to a low-emission economy.

The company is working to help its communities and customers transition by installing renewable energy, including geothermal and wind turbines in its communities; implementing electric-vehicle-charging stations at its retail location; and selling photovoltaic systems beginning in early 2014. IKEA's energy commitments are not only driving change in its own operations, but also creating impact in its industry and for its consumers.

IKEA has made a broader commitment to more sustainable energy consumption, which also involves collecting solar energy on its rooftops to meet its goal of producing more renewable energy than it consumes by 2020. It has committed to invested €1.5 billion in renewable energy by 2015; in 2014, 34 percent of its energy was supplied from its renewable energy capacity. Seizing opportunities for efficiency improvements and cost savings is fundamental to IKEA's business model.

The IPCC defines resilience as “the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.”³⁹ Resilience has always been understood as the ability to manage and rebound from risks, but what if some risks are so severe that they breach irreversible thresholds?

In 2007, the United Nations Foundation issued a report urging action to “avoid the unmanageable warming beyond 2°C while managing the unavoidable.”⁴⁰ In recent years, this compact phrase has captured the dual approach needed to ensure resilience in a climate-constrained world.

- » **Avoiding the unmanageable** requires ambitious reductions in GHG emissions to hold the global mean temperature rise to less than 2°C above preindustrial levels. According to the best available climate science, many key socioecological thresholds will be irreversibly breached if the global mean temperature exceeds 2°C above preindustrial levels by the end of this century. Because there is a limit to the level of climate change that we can safely manage, we must pursue urgent, ambitious GHG emissions reductions as part of any sensible strategy for resilience. Breaching this 2°C threshold by releasing excessive GHGs into the atmosphere would critically undermine socioecological systems, stretching them beyond their points of resilience.
- » **Managing the unavoidable** recognizes that inevitable climate impacts are already locked into the system as a consequence of the rapid accumulation of GHGs in the atmosphere over many centuries and from numerous sources.

The IPCC further states that “adaptation and mitigation choices in the near term will affect the risks of climate change throughout the 21st century.”⁴¹ As a result, true resilience in the face of climate change requires action on two fronts simultaneously: aggressive emissions reductions and sustained enhancement of adaptive capacity.

Avoiding the Unmanageable: Urgent, Ambitious Emissions Reductions

“Avoiding the unmanageable” means taking bold action to reduce GHG emissions to avoid planetary warming of more than 2°C. According to the UN Environment Programme (UNEP), emissions reductions consistent with a 2°C pathway require global GHGs to peak on or before 2020 at around 44 gigatons of carbon dioxide equivalent (CO₂e), which is the high end of an acceptable range of 39 to 44 gigatons of CO₂e. For them to be 50 to 60 percent below their 1990

³⁹ IPCC, 2014, p. 5.

⁴⁰ UN Foundation, 2007.

⁴¹ IPCC, 2014, p. 10.

levels by 2050, CO₂ emissions would need to be reduced by around 3 percent per year between 2020 and 2050 for energy and industry.⁴²

The private sector meanwhile must understand the total climate impact of the business along its entire value chain and/or the lifecycle of its products; many of a company's most material climate impacts are indirect or outside its direct operational control. Businesses must identify and capture opportunities for radical efficiency gains—again along the entire value chain.

Enhancing Resilience through Ambition: Verizon

Extreme weather events, such as Hurricane Sandy, cause damage to infrastructure and physical assets, prompting many companies to pursue innovative solutions to mitigate future risks and disruptions in services and operations. Prior to October 2012, Verizon's telephone infrastructure depended on copper-based systems to support its landlines nationally, including in New York and New Jersey. This infrastructure could not withstand the saltwater flooding caused by Hurricane Sandy, however. As a result, thousands of Verizon customers lost service, and the company lost approximately US\$1 billion.

In response, Verizon decided not to replace the copper wiring, but rather to install its wireless Voice Link as a solution to fortify both landline and wireless systems. Unlike copper-based systems, wireless systems like Voice Link are less susceptible to extreme weather events, such as flooding, and thus are a more reliable source of phone service. The company has also identified Verizon Fios, a system based on fiber optic cables, as another reliable alternative to copper-based systems that allows the company to forego the costs associated with repairs, replacements, and interrupted service due to the inherent vulnerabilities of copper-based systems. Both solutions demonstrate Verizon's dedication to building resilience within its own operations in the face of climate risks to mitigate impacts from future storms and other extreme weather events.

Efficiencies in energy, water, and material use offer some of the most dramatic near-term wins with respect to business and climate performance, but this tactic remains underexploited by most companies and within most industries. Accelerating the adoption of low-carbon energy sources and technologies in facilities and transport by partnering with peers and suppliers could increase investment in critical research and development and contribute to efficiency. Harnessing design and innovation to reduce the lifecycle impacts of products and services could provide climate benefits, while also achieving better long-term security of supply and greater protection from energy and regulatory costs. Finally, mobilizing in support of public policies that will incentivize a range of climate-related actions (from the need for intelligent carbon pricing and regulation to the importance of sound incentives to accelerate efficiency efforts in individual companies) is a vital ingredient for action.

Although this task sounds daunting, there are at least three pieces of good news:

1. **Many of the investments and actions required will make business stronger and more profitable over time. The opportunities for businesses at the vanguard of climate action are growing rapidly.**⁴³ A calculation from Third Generation Environmentalism (E3G) suggests that climate policies and incentives around the globe collectively add up to around €3 trillion in additional low-carbon investment by 2030.⁴⁴ Beyond the policy measures, investors are already placing their own bets on the future. According to Bloomberg New Energy Finance, investments in global clean energy rose from US\$39 billion in 2004 to US\$257 billion in 2011, representing more than a sixfold increase in seven years.⁴⁵ Most importantly, as Ceres points out, this figure represents cumulative clean energy investments of more than US\$1 trillion globally.⁴⁶ Analysts at McKinsey further estimate that “if [energy efficiency measures are] executed at scale, a holistic approach would yield gross energy savings worth more than US\$1.2 trillion” annually.⁴⁷ UNEP estimates that renewable energy already generates more jobs than employment in fossil fuels and that employment in alternative energy may rise to 2.1 million in wind power and 6.3 million in solar power by 2030.⁴⁸ These typically well-paying jobs, in turn, contribute to stimulating the economy.
2. **We are not starting from scratch. Many companies have been working for years to address their climate impacts and take advantage of opportunities.** In 2005, General Electric (GE) launched ecomagination, a core business strategy designed to generate sustainable economic growth while contributing to broader social and environmental values. By 2010, there were 130 products and solutions in the ecomagination portfolio generating US\$85 billion and growing at double the rate of overall GE

⁴² UNEP, 2010.

⁴³ Ceres, 2012.

⁴⁴ E3G, 2010.

⁴⁵ McCrone and Aspinall, 2012, p. 13.

⁴⁶ Ceres, 2012, p. 1.

⁴⁷ Choi Grande et al., 2010, p. 4.

⁴⁸ UNEP, 2008, p. 8.

Enhancing Resilience through Ambition: Walmart

To reduce environmental impacts, increase women's empowerment, improve food safety, and support rural development, Walmart has committed to training more than 1 million farmers in its supply chain, half of whom are women. Walmart China partnered with BSR to implement the Green Farmer program to provide trainings in sustainable agricultural practices for farmers throughout China.

To date, the program has trained more than 2,800 farmers—1,000 of whom are women—on sustainable practices, such as soil testing, integrated pest management, composting, vegetable and pest disease diagnosis and pesticide selection and safe use. Many participants have experienced an approximately 30 percent increase in crop yields and reduced operating costs due to better disease prevention and decreased pesticide use.

Through this program, Walmart China has demonstrated its leadership in building resilience within its own operations and within its suppliers. Additionally, the program has enabled farmers to protect against climate-related impacts, such as diminished crop production and crop damage from pests, through the use of sustainable agricultural practices.

revenues.⁴⁹ In Germany, Siemens has stated that it stands behind the government's energy transition. The company already generates 40 percent of its revenue from green products and solutions.⁵⁰ Unilever's Sustainable Living Plan is helping the company decouple growth from environmental impact, while at the same time increasing its positive social impact. Since 2008, Unilever's eco-effective investments to reduce energy, water, and waste have avoided more than €300 million in cumulative supply chain costs, with €17 million in savings from water, €10 million from waste, €99 million from energy, and €186 million from materials.⁵¹ And in the energy sector, BP and Royal Dutch Shell issued an internal price on carbon of US\$40 per ton of CO₂e, and Exxon Mobil Corporation issued a price of US\$60 per ton CO₂e. In addition, Exxon Mobil has committed to publishing a report that discloses the risk that emissions limits on its operations would pose to future investments and the value of its projects.

3. **The potential for emissions reductions across key sectors is real.** The agricultural sector has enormous potential to help avoid dangerous climate change. Emissions from agriculture comprised about 10 to 12 percent of global GHG emissions in 2010. In addition, the sector is the largest contributor of non-CO₂ GHGs, including methane, accounting for 56 percent of emissions in 2005. According to the IPCC, recent studies have found that all land-related mitigation strategies from combined action on agriculture, forestry, and bioenergy could contribute 20 to 60 percent of cumulative emissions reductions by 2030, and 15 to 45 percent additionally by 2100. Industry accounts for around 30 percent of total GHG emissions. Its emissions totals include those from industrial sector energy consumption, the total global production of materials, the stock of products created from these materials, and services rendered through the use of those products. Broad deployment of the best available technologies could reduce the emissions intensity of industry by approximately 25 percent, with innovation reducing it by up to another 20 percent, before technological limits are approached in some energy-intensive sectors.⁵²

Managing the Unavoidable: Enhancing Adaptive Capacity in Business and Communities

Several climate impacts from extreme weather events to changes in water distribution are already evident and locked into the climate system. Their intensity and frequency are now likely to increase irrespective of emissions reductions over the short term, threatening socioecological systems around the globe and, therefore, requiring immediate action to manage the unavoidable impacts.⁵³ These growing threats, in turn, require business to take action to enhance its adaptive capacity.

"Enhancing adaptive capacity" is defined as changes in processes, practices, or structures to moderate or offset potential damages or to take advantage of opportunities associated with changes in climate. There are two main approaches to enhancing adaptive capacity: First, generation adaptation is often referred to as "climate-proofing" and typically refers to interventions in infrastructure that attempt to minimize the consequences of exposure to climate

⁴⁹ GE, 2011.

⁵⁰ Siemens, 2013.

⁵¹ Unilever, 2013.

⁵² IPCC, 2014.

⁵³ Adger, 2001; IPCC, 2007b.

change risks (e.g., flood defenses or seawalls). This approach may address the symptoms rather than the root causes of vulnerability.

“Second-generation adaptation” is a more development-oriented approach that tackles the underlying drivers of vulnerability, including factors that make populations sensitive to climate change impacts. In addition, this type of adaptation helps build resilience not only to climate change but also to other stressors. These adaptation measures include investments in local early warning systems, health care and education, governance and legal reform, institutional capacity building, gender initiatives, biodiversity and ecosystem services, and social safety nets.

Business can enhance its own adaptive capacity in multiple meaningful ways:

- » Understand the total climate exposure and risk to the business from the direct and operational to the furthest reaches of the supply chain and customer communities.
- » Map material risks and opportunities by engaging internal and external stakeholders. Senior management will need to review and be part of the team assessing which risks and opportunities are most material and most addressable, both now and in the future.
- » Provide leadership (and share costs and resources) through partnerships with peers, as well as the public sector and civil society. These partnerships will drive effective action in the areas where the business has the most to contribute (and to lose) via improvements to shared infrastructure, local capacity building, and disaster preparedness and response.

A report titled “Value Chain Climate Resilience” prepared by BSR with Oxfam and Acclimatise highlights the many examples of businesses embracing resilience, including financial leaders who are developing innovative climate-insurance products for communities at increased risk of weather-related natural disasters, engineers working on more resilient construction materials and design standards, information and communications technology (ICT) companies starting to offer equipment and smart networks to monitor and manage climate-related impacts, and new technologies being developed and deployed to address increased water stress.⁵⁴

The Transition to a Low-Carbon Future Is Underway: We Must Act with Greater Ambition

This is a decisive decade for the global climate, in part because we are running out of time to reduce emissions at the scale and rate needed to avoid passing the 2°C goal; and also because a moment for collective action is emerging and converging around 2015.⁵⁵ The so-called “2015 moment” brings together the latest science from the IPCC,⁵⁶ the development of a new international climate agreement under the auspices of the UN,⁵⁷ and the preparation of sustainable development goals to replace the Millennium Development Goals, which expire in 2015.⁵⁸

GOVERNMENTS ARE ACTING

There is a misconception that climate action is stalled and that too few governments are interested in implementing policies to catalyze climate resilience. Looking deeper at the national and international political landscape

⁵⁴ Ardo et al., 2012, p. 3.

⁵⁵ Cameron et al., 2013.

⁵⁶ University of Cambridge Judge Business School and Institute for Sustainability Leadership, 2013.

⁵⁷ Bodansky, 2012.

⁵⁸ Bapna, 2012.

reveals a different picture entirely—one of growing climate policy development, innovation, and increasing incentives.

At the international level, the negotiations under the UN Framework Convention on Climate Change (UNFCCC) are moving toward a decisive summit in Paris in December 2015. Meeting in Warsaw in December 2013, 198 countries confirmed their longstanding commitment to hold the increase in global average temperature below 2°C above preindustrial levels⁵⁹ and have expressed their determination to capture this commitment in a comprehensive global climate agreement at a Paris summit in December 2015.⁶⁰

Although much maligned, the UNFCCC has already led to significant actions by governments. More than 90 countries have submitted formal pledges to reduce their GHG emissions by 2020. Many have initiated domestic actions to make good on these pledges, and as a result, different policy innovations and financial incentives are being tested around the world.⁶¹ A report produced by the Global Legislators Organisation (GLOBE) International reveals significant climate action in 33 countries, including many developing countries. It includes 17 of the top 20 emitters of GHGs and 24 of the top 50, representing more than 85 percent of global emissions. Overall, they report substantial legislative progress in 18 of the 33 study countries and limited developments in 14 others.⁶² From emissions-trading systems in the European Union, China, and California to energy transformations in Germany and the United States, we are seeing important steps toward a low-carbon future.⁶³

Finance is flowing as a result of these processes. In 2009, developed countries committed to mobilizing US\$30 billion in “fast-start financing” between 2010 and 2012 as a stepping stone toward providing US\$100 billion per year in support of emissions reductions and resilience building. As of November 2013, these same countries have reported that they mobilized US\$35 billion. However, with governments now joining insurers and institutional investors in developing financial products in support of low-carbon development, an important trend is being set.⁶⁴

⁵⁹ UNFCCC, 2012, p. 2.

⁶⁰ UNFCCC, 2013.

⁶¹ UNEP, 2012.

⁶² Townshend et al., 2013.

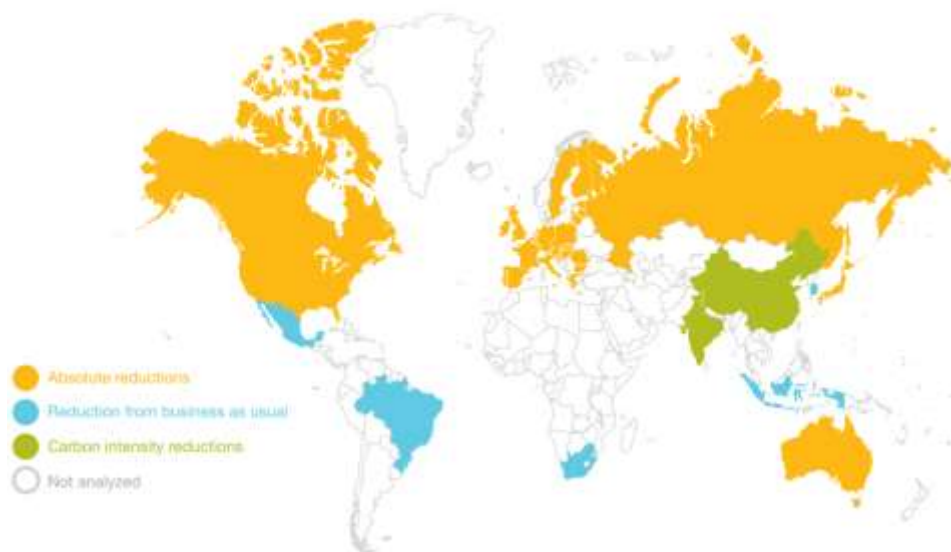
⁶³ Cameron, 2013.

⁶⁴ Fransen et al., 2013.

FIGURE 2 (Click [here](#) to enlarge)

Countries Are Acting

More than 96 governments from developed and developing countries have begun to implement climate policies, ranging from domestic laws and standards to emissions trading systems and carbon pricing. Some are working on absolute emissions reductions, others are attempting to deviate from business as usual projects, and a third group is tackling emissions intensity. The enabling environment for climate resilience is being constructed all around us and is likely to gather pace over the coming years.



Source: WRI, 2013; This analysis is from unpublished assessments from the World Resources Institute.

THE PRIVATE SECTOR IS ACTING

The private sector is also rising to meet the challenge of climate change. Key companies in a variety of sectors are engaging in activities to reduce and mitigate climate risk and bolster resilience. These include senior management or board-level oversight of climate-related issues, monetary incentives tied to emission reduction targets, and the integration of climate change within the overall business strategy.

According to the 2013 “CDP Global 500 Climate Change Report,” which examines the largest companies by market capitalization included in the FTSE Global Equity Index Series as of January 2013, 332 companies have incorporated some form of climate action into their overall business strategies. Of those 332 companies, 232 either met or exceeded their emissions reduction targets, and 269 experienced overall emission reductions as a result of successfully implementing various emission reduction activities. Overall, the number of Global 500 companies undertaking initiatives to mitigate climate risk has increased over the past few years, indicating an increasing trend within the global business community to pursue greater climate resilience and recognize climate change as a formidable risk.⁶⁵

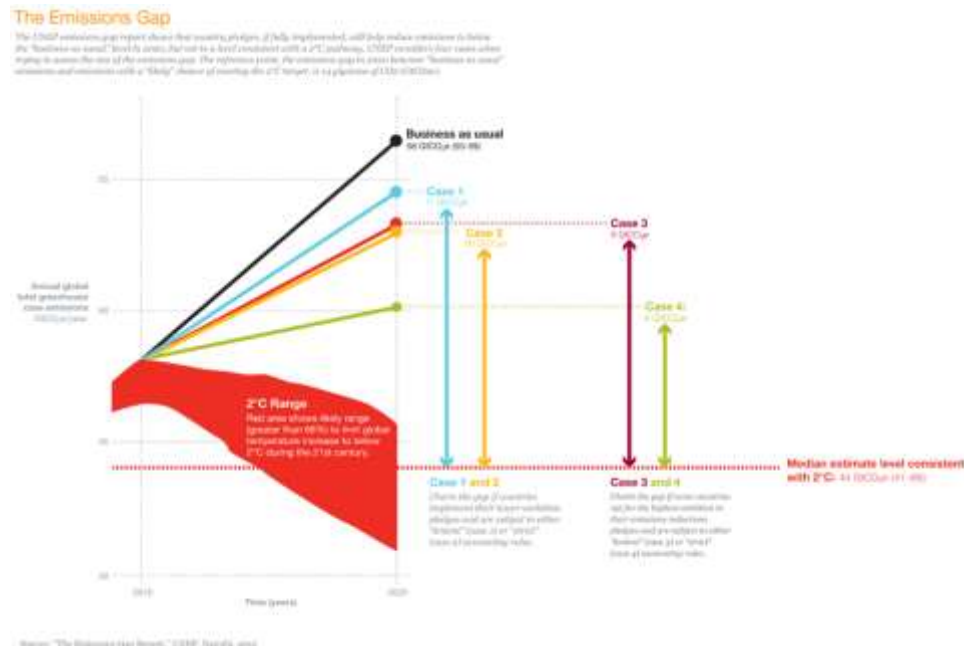
ACTIONS NEED TO BE SUPPORTED BY MORE AMBITION

While climate activity is increasing, climate ambition still lags far behind. As successive UNEP reports have illustrated, current climate initiatives by governments and corporate leaders, while important, remain insufficient to close the gap between current emissions trajectories and a 2°C pathway. The key message from the 2012 “Emissions Gap Report” is that, even if countries deliver on their current actions, they will still fall short of where we need to be in 2020 by 6 gigatons of CO₂e.⁶⁶

⁶⁵ CDP, 2013.

⁶⁶ UNEP, 2012.

Figure 3 (Click [here](#) to enlarge)



There are numerous legitimate reasons fueling this lack of action. Many businesses believe that climate action is impractical in an age of fiscal austerity and is incompatible with their bottom line. Others are waiting for a silver bullet—either a new technology or a policy incentive from government before they act. The International Energy Agency has astutely pointed out that high-emissions fossil fuels are likely to remain a critical part of our energy mix over the coming decades until and unless we can find suitable ways to reduce their carbon intensity and substitute low-emissions alternatives.⁶⁷

The transition to a low-carbon future also puts increasing pressure on scarce resources. As Vidal and his colleagues point out, if the contribution from wind turbines and solar energy to global energy production is to increase in line with a 2°C pathway, “About 3,200 million tons of steel, 310 million tons of aluminum, and 40 million tons of copper will be required to build the latest generations of wind and solar facilities. This corresponds to a 5 to 18 percent annual increase in the global production of these metals for the next 40 years and will be on top of existing rising demand absent climate change of about 5 percent per year.”⁶⁸

Despite these constraints, the risks of inaction greatly outweigh the barriers to action. The risks outlined above undermine business prospects and societal stability around the globe and across industries. A single company or government acting in isolation will be unable to change our current trajectory. However, bold collective action by all, working at the upper limits of ambition, could build climate resilience in a manner consistent with prosperity and profitability.

BSR’s strategy for climate resilience combines meaningful climate action with practical and manageable steps across industries.

⁶⁷ International Energy Agency, 2013.

⁶⁸ Vidal et al., 2013, p. 895.

Catalyzing Business Resilience in a Climate-Constrained World

Business can build climate resilience by reducing emissions and enhancing its adaptive capacity. Climate stabilization wedges provide an effective means of meaningful and practical action.

BSR's new Business in a Climate-Constrained World strategy is a three-year initiative designed to mobilize BSR's business network, global reach, industry insights, and issue expertise to address global climate change. Our strategy consists of **translation** of climate risk, **collaboration** across business sectors and stakeholder groups in pursuit of urgent, ambitious, and sustained climate action; and **stabilization** of the climate system through *resilience wedges*.

Translation

The nature of climate risk differs across geographies and across sectors with most industries exposed to multiple, intersecting climate risks. As a consequence, a sophisticated, comprehensive reappraisal of risk is needed to ensure business success in a climate-constrained world.

Part of the problem with the current debate on climate and business is that the "translation" focuses on aggregate, cumulative risks and consequences that few businesses can relate to. Our translation addresses this problem by downscaling climate risks for specific industries and individual companies in a manner that highlights concrete impacts on business operations and strategy. The case studies in this report indicate how some companies are beginning the process of understanding their specific risks.

The transition to a low-carbon future also holds risks. Some industries may find themselves with stranded assets as a result of climate regulation. To prevent the global mean temperature from rising more than 2°C, some estimates suggest that 60 to 80 percent of the current reserves of the world's publicly listed oil, gas, and coal companies must not be consumed, which raises the possibility of establishing carbon pricing and taxes to ensure that these reserves remain underground, thus making them "stranded." This approach could lead to a "carbon bubble," an overvaluation of oil, gas, and coal reserves that could cause massive losses within the financial system.⁶⁹ Incentives to promote low-carbon energy could put pressure on other industries, as was the case some years ago when a rush to biofuels caused a temporary global food crisis.

Managing this transition is a critical element of managing risk. Translating these complex risks is therefore a critical part of our strategy. We intend to work with partners to better understand the full spectrum of risks and translate this knowledge into actionable strategies for resilience.

Collaboration

Tackling the challenge of global climate change is an enormous task—too much for any single company or organization. All stakeholders, including business, must take bold collective action to build resilience in a climate-constrained world. This need, in turn, requires a new emphasis on collaboration. We believe that collaboration across industries and with multiple stakeholder partners creates an

⁶⁹ Carbon Tracker, 2013; Carrington, 2013.

ecosystem for climate action, allowing industries to enable each other and the communities in which they operate.

Business can avail itself of the transformational power of collaboration by working across industries to share knowledge, pioneer new approaches and technologies, and test business-to-business solutions. Companies can share costs and resources through partnerships with peers, as well as the public sector and civil society. These partnerships will drive effective action in the areas where business has the most to contribute and to lose through improvements to shared infrastructure, local capacity building, and disaster preparedness and response.

We plan to foster enhanced climate collaboration through this strategy by creating an *architecture of participation*. In practice, this strategy means exploring every opportunity to build cross-industry and cross-stakeholder partnerships in pursuit of our goals. It also means finding ways to contribute to existing initiatives within the wider climate community of practice. Around the globe, new multistakeholder initiatives designed to build climate resilience are emerging rapidly. We will work to assess these initiatives, encourage them to collaborate, and seek out suitable opportunities for a private sector component.

Stabilization

The core of our strategy builds upon the climate “stabilization wedges” pioneered by Princeton professors Robert Socolow and Stephen Pacala. We intend to identify appropriate *resilience wedges* that combine emissions reductions and enhanced adaptive capacity across eight industry clusters. They will be implemented in partnership with BSR member companies and other stakeholders, including government, philanthropies, civil society actors, academics, and multilateral organizations. The climate-smart businesses that emerge will not only be resilient in a climate-constrained world, but also positive agents of resilience within the communities from which they derive their social license to operate, their production inputs, and their markets.

The Core of the Strategy: Climate Stabilization Wedges

The climate stabilization wedges approach was initially developed by Socolow and Pacala in 2004. They argued that a portfolio of technological, scientific, and industrial knowledge already existed and consequently provided a platform for solving the climate challenge.⁷⁰ At the heart of their approach was the view that while no single strategy or intervention could achieve sufficient emissions reduction in isolation, the portfolio as a whole, when looked at as cumulative steps, would constitute significant ambition.

Pacala and Socolow argued that it was “important not to become beguiled by the possibility of revolutionary technology but instead to scale up what we already know.”⁷¹ To illustrate their point, they created a “stabilization triangle,” depicting the total amount of emissions reductions they assessed as commensurate with climate stabilization. They divided this triangle into wedges, totaling 25 gigatons of CO₂e of reduced GHGs over 50 years.⁷² The Princeton model advocates for 15 economy-wide wedges, dealing with energy efficiency and conservation, shifting toward renewable energy, and altering land-use patterns.

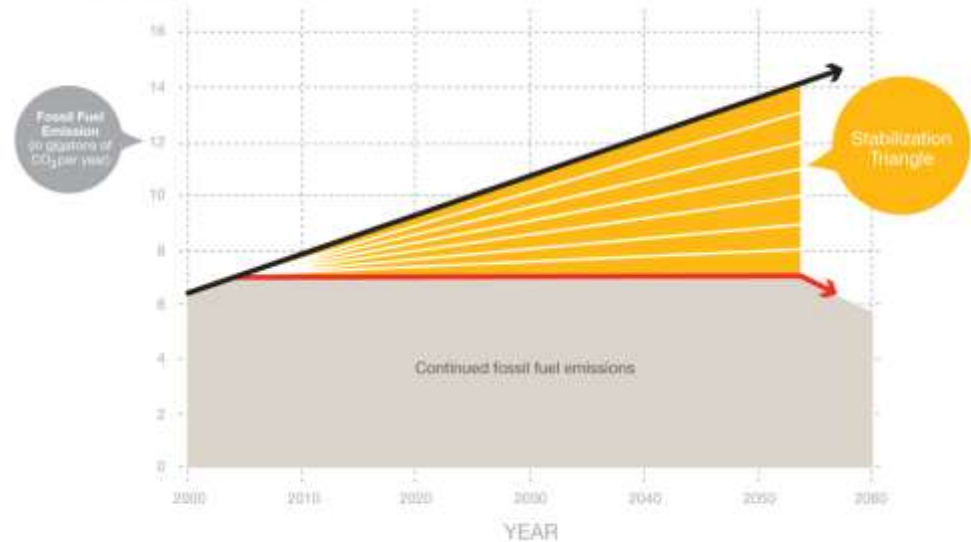
⁷⁰ Pacala and Socolow, 2004.

⁷¹ Ibid., p. 968.

⁷² Ibid.

FIGURE 4 (Click [here](#) to enlarge)

The Stabilization Triangle



Source: Science Magazine, Vol. 305, August 12, 2004.

Emissions Wedges: Future of Fuels

Between 2013 and 2030, world energy use is set to rise about 40 percent, with transportation fuels comprising about one-third of all energy consumption. Future of Fuels, a BSR-led multistakeholder initiative, catalyzes partnerships and advances best practices and policies for fuel production, consumption, and distribution. Participants include CSX, Coca-Cola, the GE Foundation, Nike, PepsiCo, Shell, Suncor, UPS, Volvo Group, Walmart, and Westport Innovations. Together, these organizations aim to promote a total lifecycle framework to understand the sustainability impacts of transportation fuels and advance a common roadmap for identifying improvement opportunities within the transportation fuels sector and its supply chain.

Future of Fuels is a leadership initiative that brings together experts from the private, nonprofit, public, and academic sectors to help companies understand the greatest impacts of their transportation fuel and what they can do to mitigate those impacts. Through a series of research papers, facilitated discussions, and innovative technology partnerships, Future of Fuels explores and addresses key impacts from the “well-to-wheel” lifecycle of fuels, while bringing better transportation fuels to scale. The initiative is identifying opportunities for industry players within the transportation fuels sector to diversify their energy mixes, particularly in terms of low-carbon alternatives and renewable energy, and to incorporate low-carbon technologies throughout their value chain. Through this work, the group promotes a transition to low-carbon fuels, while simultaneously creating jobs and other economic benefits, enhancing energy security, and facilitating local and rural development.

Socolow and Pacala’s findings have been challenged in recent years in part because their stabilization target was deemed too high and because the number of wedges they identified was deemed to be too few. Some critics also suggested that they were too quick to discount the importance of breakthrough energy technologies.⁷³ However, their method has inspired countless other climate initiatives.

In 2006, McKinsey and the Vattenfall Institute of Economic Research created a global analysis of the microeconomic changes required to reduce GHG emissions using a model building on the wedges. Their resulting cost curve shows the full range of actions that are possible with technologies that are either available today or are likely to be available in the short term. The cost curve offers a scenario in which 27 gigatons of emissions reductions compared to business as usual is achievable by 2030—a quantity that could lead to CO₂ peaking at 500 parts per million. While this figure is higher than the target deemed consistent with a 2°C pathway, it again shows that cumulative technically and economically feasible steps could add up to great ambition.⁷⁴

In 2012, analysts working at Utrecht University and Ecofys proposed an approach called “wedging the gap,” designed to bridge the gap between current emissions trends and the level needed to secure a 2°C pathway. This approach would consist of 21 major initiatives that together would trigger GHG emissions reductions of around 10 gigatons of CO₂e by 2020.⁷⁵ Blok and his colleagues reasoned that action by an individual stakeholder could seem insufficient; however, cumulative action scaled across interventions and in collaboration with multiple stakeholders could make bold action by all more attractive and with enough participation could bridge the overall emissions gap.⁷⁶

⁷³ Kintisch, 2013.

⁷⁴ Beinhocker and Oppenheim, 2008.

⁷⁵ Blok et al., 2012, p. 1.

⁷⁶ Blok et al., 2012, p. 2.

Variations on the wedges approach have also been used by UNEP,⁷⁷ by the World Wildlife Fund (WWF),⁷⁸ and by the Global e-Sustainability Initiative (GeSI) in its preparation of the SMARTer 2020 report on the ICT sector's potential to contribute to emissions reductions.⁷⁹

From our perspective, the wedges approach constitutes what author Clay Shirky describes as a “plausible promise,” a strategy that has sufficient ambition to be truly meaningful, while at the same time being achievable using current technologies and operating within current political economy realities.⁸⁰ BSR finds this approach appealing as a conceptual framework for four main reasons:

1. **Difficult but achievable:** As Ecofys points out, “Existing scenarios show that it is technically and economically feasible to reduce emissions to zero for roughly 90 percent of current sources of GHG emissions with technological options that are available today and in the near future.” They go on to report that a net phaseout of GHGs by 2050 would ensure a very high likelihood of meeting the agreed-upon 2°C goal.⁸¹ Of course, this approach would still require the right policies and incentives to overcome inertia and provide mutual benefits to action; however, the main message is that the wedges approach does not require us to wait for breakthrough energy technologies or other technological or policy silver bullets.
2. **Scalable and manageable:** As McKinsey points out, a significant portion of the costs associated with GHG reductions based on the wedges approach would be at a negative cost to society; in other words, these actions would earn a positive economic return derived largely from savings in energy costs.⁸² Moreover, McKinsey also argues that the total annual cost to society would be between €500 billion and €1,100 billion in 2030 or 0.6 to 1.4 percent of expected GDP in 2030. Compare that figure to global spending on insurance in 2005 of 3.3 percent of the GDP.⁸³ Climate action is a cost-effective way of investing in a low-carbon future while ensuring that we do not find ourselves in a climate-constrained world.
3. **Comprehensive and iterative menu for action:** In their original thesis, Pacala and Socolow noted that the portfolio of potential intervention points is large enough that not every component will need to be used.⁸⁴ Subsequent studies have noted that the original research significantly underestimated the number of potential wedges. Companies may choose from a broad spectrum of interventions and do not need to slavishly follow any single approach.
4. **Builds from a position of business strength:** Many of the possible wedges involve doing what business already does best—applying a laserlike focus to innovation, efficiencies, and systemic approaches. Saving energy, making changes across the supply chain, and being innovative with products and services can drive emissions reductions and enhance adaptive capacity.

MEASURES TO REDUCE EMISSIONS

BSR will identify and apply stabilization wedges for ambitious emissions reductions across eight industry clusters:

⁷⁷ UNEP, 2012.

⁷⁸ WWF and CDP, 2012.

⁷⁹ Global e-Sustainability Initiative, 2012.

⁸⁰ Shirky, 2009, p. 25.

⁸¹ Hohne et al., 2013.

⁸² Beinhocker and Oppenheim, 2008, p. 15.

⁸³ Ibid., p. 16.

⁸⁴ Pacala and Socolow, 2004, p. 968.

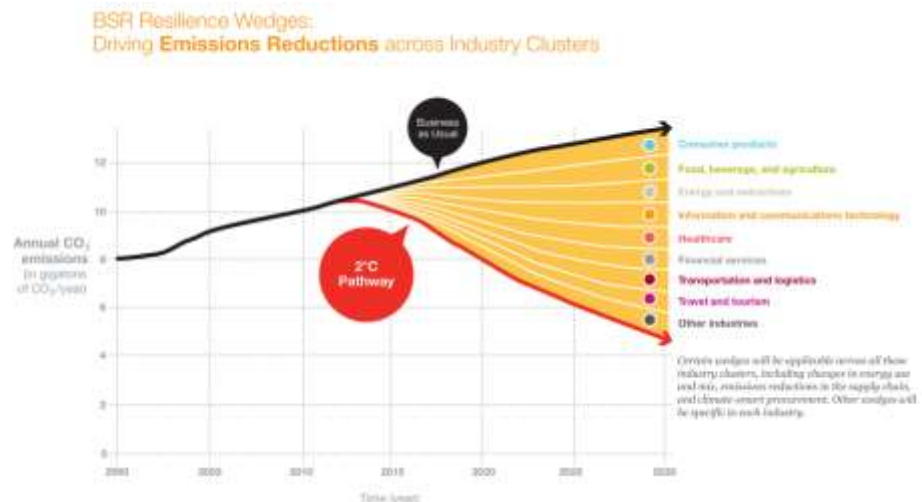
- » Consumer products
- » Food, beverage, and agriculture
- » Energy and extractives
- » Information and communications technology
- » Health care
- » Financial services
- » Transportation and logistics
- » Travel and tourism

Adaptation Wedges: HERfinance

More than 2.5 billion adults, or 75 percent of the world's poor, do not use formal financial services to save or borrow money. Helping vulnerable populations—particularly women, who are often hit first and hardest by the effects of climate change—build the financial resources they need to invest in natural, physical, and other types of assets is essential to building their adaptive capacity in the face of climate impacts.

In 2012, with a founding grant from the Walt Disney Company, BSR piloted HERfinance in India with participation from Ann Inc., Levi Strauss Foundation, Nordstrom, Primark, and Timberland. The mission of HERfinance is to build the financial capability of low-income workers in global supply chains by providing workplace-based financial education and connecting factory employees to appropriate financial services. HERfinance is part of BSR's broader efforts to empower women in the global economy, known as HERproject. To date, HERfinance has reached more than 10,000 workers through a pilot program in India, with plans under way to expand to Indonesia, Brazil, and Mexico.

FIGURE 5 (Click [here](#) to enlarge)



We intend to identify the wedges that are unique to clusters, as well as those that are common across all these industries. We already anticipate that energy use and mix in facilities and vehicles will loom large across all industries. Many options exist for energy efficiency improvements, and implementing such options could reduce the gap between actual energy use and what could become best practice in many industries. Energy intensity could be reduced by up to 25 percent through the wide-scale deployment of the best available technologies.⁸⁵ In addition, one of the top drivers of climate change is transportation fuel, which is responsible for more than 40 percent of global GHG emissions when considering the whole system of production and use.⁸⁶

We further anticipate that all sectors will need to develop a comprehensive understanding of the full scope of emissions throughout their value chains.

Moreover, companies have the opportunity to leverage their considerable financial power as investors and procurers of goods and services in driving low-carbon development.

Some wedges will be unique to specific industries. For example, we already know that GHGs from the transport sector have more than doubled since 1970 to 7 billion metric tons in 2010, increasing at a rate faster than that of any other energy end-use sector. Around 80 percent of this increase came from road vehicles. The sector produces both CO₂ and non-CO₂ emissions, including black carbon. Mitigation strategies for the transport sector will therefore draw from the

⁸⁵ Bourgoignie, 2014.

⁸⁶ Cowart et al., 2003.

following four categories of wedges: modal shifts, demand reduction, improving vehicle efficiency, and lower carbon intensity of fuels.

We have provided a snapshot of wedges across three industry clusters below for illustrative purposes. They are neither definitive nor exhaustive, and further research will be needed to identify the full suite of wedges and each one's mitigation potential.

Adaptation Wedges: ADAPT Tool

To help companies manage climate-related risks and build resilience, BSR partnered with Acclimatise and Oxfam America to create the ADAPT (analyze, develop, assess, prioritize, and tackle) tool. The tool encourages businesses to build comprehensive climate resilience approaches across their entire value chains by considering community and ecosystem vulnerability and adaptation needs. It uses a five-step approach to identify emerging market opportunities, develop integrated plans, and build community support.

ADAPT also contains sector-specific modules for three sectors that are especially vulnerable to climate impacts: food, beverage, and agriculture; water and energy utilities; and general manufacturing. The tool includes a business primer and sample questions businesses can refer to when creating effective, inclusive climate resilience plans. It encourages companies to assess the climate vulnerability for each link within the value chain, identify opportunities for new markets to increase the adaptive capacity of communities, appraise the full lifecycle economic benefit-to-cost ratio, and implement climate resilience actions in partnership with key value chain participants and stakeholders, such as communities and governments.

MEASURES TO ENHANCE ADAPTIVE CAPACITY

One of this strategy's key innovations is the proposal to develop stabilization wedges for adaptive capacity. While it has long been recognized that business needs to aggressively reduce emissions, the need for adaptive capacity in business has been less evident, and the enormous potential for business to foster greater adaptive capacity in the communities in which it operates has often been overlooked.

As with emissions reductions, we know that there are specific wedges for each industry cluster that can enhance adaptive capacity. In the agricultural sector, enhancing this capacity will require altering cultivation and sowing times, improving the tolerance of crops to high temperatures, breeding additional drought-tolerant crop varieties, improving adaptive water management techniques, and using more suitable livestock breeds or species in regions with changing temperatures and water patterns.

There will also be wedges for adaptive capacity that are common across all industries. BSR believes that investments in biodiversity and ecosystem services, policies to promote women's empowerment, and adherence to human rights principles will be significant wedges for building resilience. Our work on maintaining biologically diverse natural systems is critically important in strengthening the resilience of the areas in which businesses operate in an era of climate change as they face extreme weather events. For example, research has shown that offshore coral reefs and coastal mangroves or wetlands can buffer coastal areas from the effects of hurricanes, as well as a minor rise in the sea level.

Companies have the opportunity to assess and act on the reality that all businesses and supply chains are embedded within complex systems, which are not merely organizational, economic, or sociocultural. But perhaps most invisible to business people, corporate systems are embedded within ecological systems, which serve as key green infrastructure. If companies want essential infrastructure (both human built and natural, or gray and green) to be present and functioning over time, then they must invest in restoring and maintaining it. Businesses acknowledge this reality in terms of built (or gray) infrastructure, as they pay fees to use the Panama Canal, Long Beach Harbor, or any airport landing strip around the world.

Yet, there is little recognition that a similar approach to financing is essential to maintaining robust and resilient green infrastructure. And few businesses actively consider their reliance on well-functioning ecosystems that provide green infrastructure. Therefore, as one pillar of a corporate climate resilience strategy, BSR recommends that the private sector invest in the maintenance and restoration of robust, biologically diverse, ecological structures around key supply sourcing sites, manufacturing plants, essential transport hubs (or corridors), and other important business infrastructure. It is critical to understand where and how a company relies on a particular landscape—which may be the site of key raw material sourcing, manufacturing, warehousing, or any other purpose—and the “ecosystem malfunction risks” that exist in that area as a function of climate change pressures. If the risk that an ecosystem will malfunction is high, then businesses must identify an appropriate green infrastructure, or ecosystem investment approach, to mitigate or even eliminate that risk.

Women are disproportionately impacted by extreme weather events and the health and poverty impacts caused by climate change. By providing women with access to information, steady livelihoods, and financial services, policies that promote women's empowerment can build their resilience. The bulk of the evidence suggests that climate change is hardest on women, as they are often constrained by social and cultural norms that prevent them from acquiring appropriate skill sets, restrict their access to assets (including land), prevent them from having adequate access to governance (including access to decision-making and information), place them in inferior social positions, and prevent them from acquiring education and appropriate health care.⁸⁷ The results of the 1991 cyclone in Bangladesh illustrate many of these issues. More than 90 percent of the estimated 140,000 fatalities were women; their limited mobility, skill set, and social status exacerbated their vulnerability to this extreme weather event.⁸⁸

A forward-looking approach to human rights will also enable resilience building. The interface between climate change and human rights has become a prominent area of study in recent years.⁸⁹ In January 2009, the Office of the UN High Commissioner for Human Rights (UN-OHCHR) published a report on climate change and human rights. The report was based on written and oral submissions by more than 30 states and 35 international agencies, as well as national human rights institutions, NGOs, and academic bodies.

The UN-OHCHR's report clearly asserted that there is an important relationship between climate change and human rights and delineated and defined the nature of that relationship. In particular, the UN-OHCHR outlined the many ways in which climate change undermines a range of internationally protected human rights, particularly the rights of vulnerable populations.⁹⁰ Subsequent work by the Human Rights Council and a range of international scholars have highlighted how the application of human rights, particularly those associated with access to information, decision-making, and justice, can build resilience to climate impacts.⁹¹

⁸⁷ Cameron, 2010.

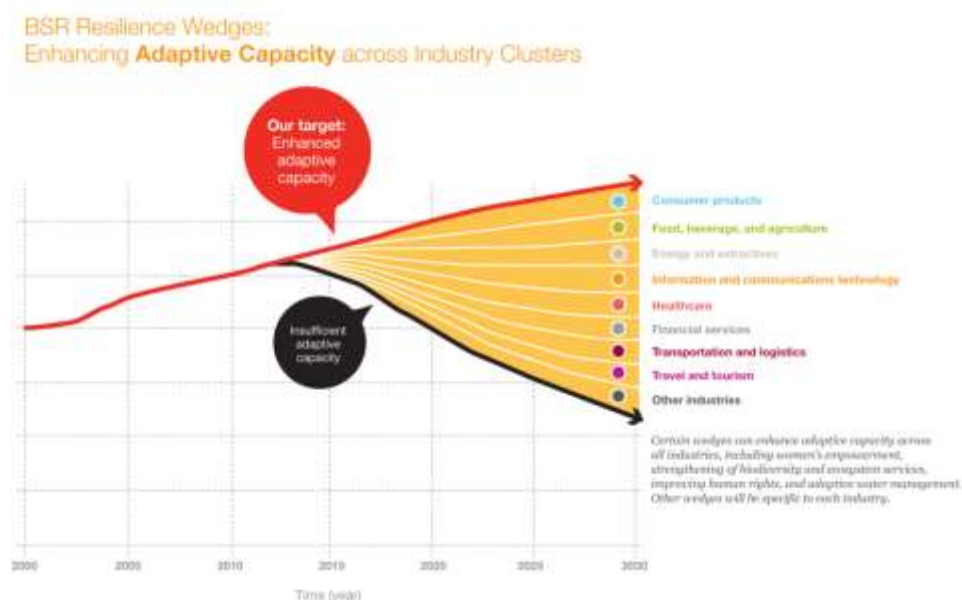
⁸⁸ Ibid.

⁸⁹ Ibid.

⁹⁰ UN OHCHR, 2009.

⁹¹ Cameron and Limon, 2012.

FIGURE 6 (Click [here](#) to enlarge)



The Wedges in Action: Illustrations from Industry Clusters

The snapshot of wedges across two industry clusters below is for illustrative purposes. They are neither definitive nor exhaustive; further research will be needed to identify the full suite of wedges and each one's mitigation potential.

AGRICULTURE

The agricultural sector has enormous potential to contribute to avoiding dangerous climate change. GHG emissions from agriculture comprised about 10 to 12 percent of global GHG emissions in 2010. In addition, the sector is the largest contributor of non-CO₂ GHGs, including methane, accounting for 56 percent of emissions in 2005. According to the IPCC, recent studies have found that all land-related mitigation strategies from combined action on agriculture, forestry, and bioenergy could contribute 20 to 60 percent of total cumulative emissions reductions by 2030, and 15 to 45 percent additionally by 2100. Consequently, agricultural companies can draw from a range of stabilization wedges when looking to reduce emissions, including the following on the supply side and the demand side.⁹²

On the supply side:

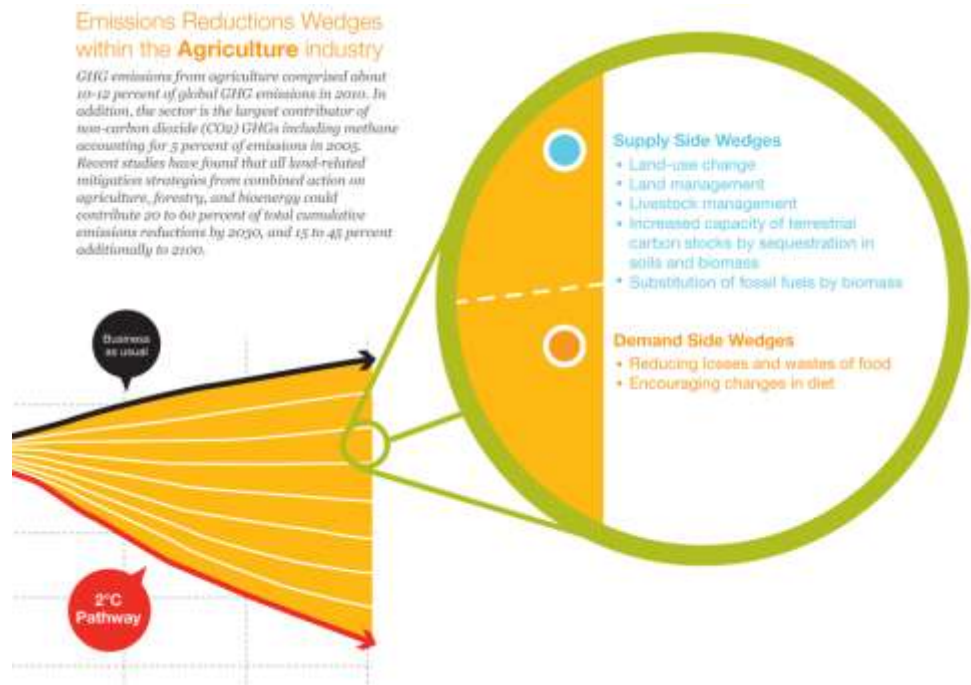
- » Land-use change
- » Land management
- » Livestock management
- » Increased capacity of terrestrial carbon stocks by sequestration in soil and biomass
- » Substitution of biomass for fossil fuels

On the demand side:

- » Reducing the loss and waste of food
- » Encouraging changes in diet

⁹² IPCC, 2014.

FIGURE 7 (Click [here](#) to enlarge)



Enhancing adaptive capacity in the agricultural sector is complex, as adaptation is highly context specific, with no single approach for reducing risk appropriate across all regions, subsectors, and settings. Consequently, food, beverage, and agricultural companies will need to draw from a range of stabilization wedges when looking to enhance adaptive capacity, including the following:

For those concerned primarily with crop production:

- » Altering cultivation and sowing times
- » Improving crops' tolerance to high temperatures
- » Breeding additional drought-tolerant crop varieties
- » Employing adaptive water management techniques

For those concerned primarily with livestock:

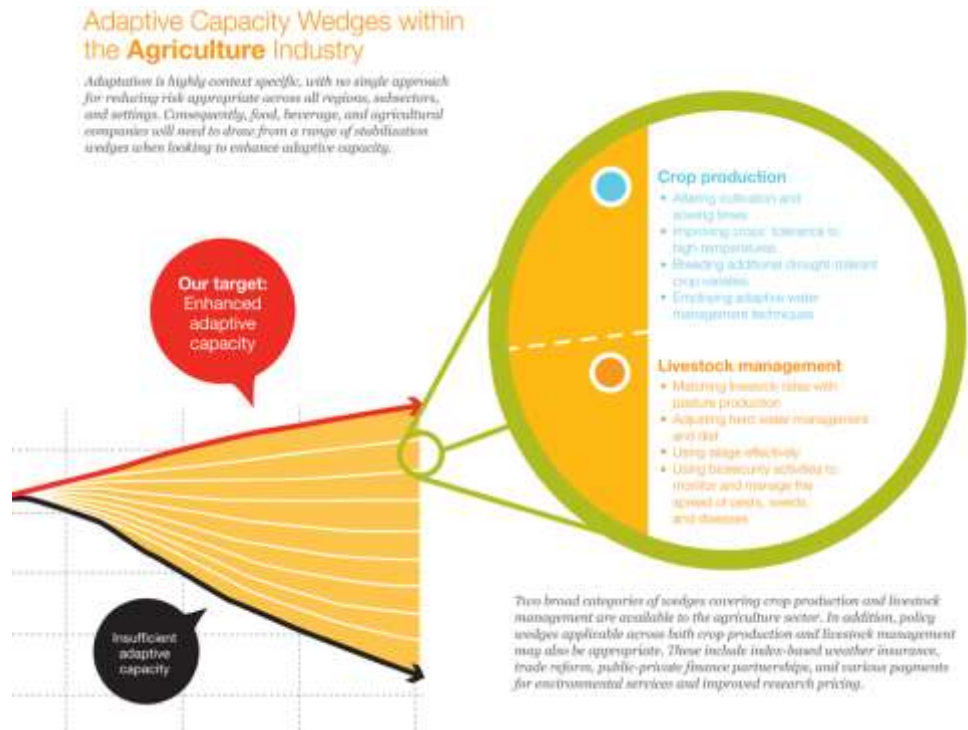
- » Matching livestock rates with pasture production
- » Adjusting herd and water point management
- » Managing livestock diet quality
- » Using silage effectively
- » Employing pasture spelling and rotation
- » Using more suitable livestock breeds or species
- » Using biosecurity activities to monitor and manage the spread of pests, weeds, and diseases

Policy wedges applicable across agricultural sectors:

- » Index-based weather insurance
- » Trade reform

- » Risk sharing and transfer mechanisms
- » Public-private finance partnerships
- » Payments for environmental services
- » Improved resource pricing

FIGURE 8 (Click [here](#) to enlarge)



EXTRACTIVES AND PRIMARY INDUSTRIES

Mitigation strategies for the extractives and primary industries sector fall into two categories: supply side and demand side. Supply-side strategies are mainly geared toward improving industrial process efficiencies. There are three main strategies:

- » Emissions efficiency
- » Energy efficiency
- » Material efficiency

Demand-side strategies are focused on reducing the overall use of product materials by changing the demand for industrial products through increased reuse and recycling, through substitution of less energy- and GHG-intensive materials, and by using materials more efficiently. There are two main strategies:

- » Product-service efficiency
- » Demand reduction

Numerous approaches to adaptation could contribute to enhanced resilience in the extractives and primary industry sectors:

- » **Adaptive water-management techniques**, including scenario planning, learning-based approaches, and flexible, low-regret solutions, could address uncertainty due to climate change.
- » **Efficient rationing of electricity** could help limit losses, where power generation is a limiting factor and a risk to the reliability of the energy supply.
- » **Improving extraction methods and increasing recycling rates** could address the depletion of certain materials, including those used in mitigation technologies.
- » **Insurance** is linked to disaster risk reduction and climate change adaptation, because it enables recovery, reduces vulnerability, and provides knowledge and incentives for reducing risk.
- » **Technical and political options for infrastructure** include upgraded design specifications during new construction, retrofitting structures, and modified land-use planning in coastal areas.

Businesses Are Both Actors and Enablers

At BSR, we believe in the transformational power of progressive business leadership on climate change. We are convinced that businesses can catalyze a prosperous transition to a low-carbon future through their investments, procurement, and energy mix and use and by how they develop products and supply chains that meet their customers' changing needs in ways that are effective, sustainable, and stable in a rapidly changing operating environment.

Businesses are both actors and enablers of climate action. They can act to reduce their own emissions and enhance adaptive capacity in their own operations. They also have the capacity to enable other industries to reduce emissions and build adaptive capacity through the products and services they provide. All businesses can build community resilience by empowering their workforce, providing access to goods and services, integrating small businesses into global supply chains, and engaging in public-private partnerships for climate-resilient investments. And businesses can avail themselves of the transformational power of collaboration by working across industries to share their knowledge, pioneer new approaches and technologies, and test business-to-business solutions.

INFORMATION AND COMMUNICATIONS TECHNOLOGY

The ICT industry is an actor when it comes to climate change; its footprint is projected to increase at a rate faster than that of the total global footprint between 2011 and 2020—with its GHG emissions rising 3.8 percent per year in that period. Despite expected efficiency gains, the ICT industry's footprint is projected to rise to 1.3 gigatons of CO₂e (2.3 percent of global emissions) by 2020. The emissions from all three ICT categories—end-user devices, telecommunication networks, and data centers—are expected to increase.⁹³ However, it is important to note that the growth rate will decrease over time due to innovation in end-user devices.⁹⁴ Like all other industries, the ICT industry will not only need to reduce its GHG emissions, but it will also need to become a demander—and consumer—of low-carbon energy sources.

In addition to being an actor, however, the ICT sector is also an *enabler* of low-carbon development, as ICT-enabled solutions deployed in the transport, agriculture and land use, buildings, manufacturing and power, and consumer and service sectors could reduce annual total GHG emissions by an estimated 9.1 gigatons of CO₂e by 2020, representing 16.5 percent of the projected total in that

⁹³ GeSI, 2012, pp. 21–22.

⁹⁴ Ibid.

year.⁹⁵ This potential reduction is more than three times the size of the ICT industry's own emissions.⁹⁶

For ICT companies, climate change is first and foremost an opportunity to launch new products and services for climate mitigation and adaptation and enable the creation of a low-carbon economy. BSR's member network includes global companies from the energy, mining, retail, financial services, health care, manufacturing, transportation, media, and hospitality industries—all of them significant users of ICT. As a result, we are able to provide significant insights into the sustainability and corporate responsibility priorities of the ICT companies' key enterprise customers and connect the dots as to how ICT can be leveraged as a climate solution.

EXTRACTIVES

Within the extractives industry, the mining sector has an important role to play in reducing its own emissions while enabling the transition to low-carbon alternatives. Currently, 10 percent of the energy consumed worldwide is used for the extraction and processing of mineral resources. Without extraordinary advances in mining and refining technology, this fraction is set to rise as poorer, more remote deposits are tapped.⁹⁷

On the enabling side, building the wind turbines, solar power stations, and other facilities necessary for a low-carbon economy will require vast amounts of metals and other raw materials, including selenium, neodymium, iron, copper, and aluminum, which will then be sequestered for several decades.⁹⁸ As Vidal and his colleagues outline, solar and wind facilities require up to 15 times more concrete, 90 times more aluminum, and 50 times more iron, copper, and glass than a facility with an equivalent capacity that is run by fossil fuels or nuclear energy.⁹⁹ If the contribution from wind turbines and solar energy to global energy production is to rise to 5 to 18 percent annually, the global production of these vital metals must increase over the next 40 years.¹⁰⁰

Recognizing the twin roles of business as enabler and actor is critical to catalyzing private sector action. As we work toward climate resilience, all sectors must have a stake in and feel welcome in the transition to a low-carbon future. Ensuring that business sees this transition as both an opportunity and an obligation will therefore be important.

The Road Ahead

While our framework is still in development, we already know that some wedges will be common across all industries. Over the coming months, we will conduct research to identify appropriate wedges for all industry clusters and execute collaborative work where our expertise can contribute to ambition. Like Socolow and Pacala's wedges, BSR's approach will provide options that are significant but also feasible in terms of existing technologies, conceivable financial boundaries, and the timeline necessary to avoid dangerous climate change.

⁹⁵ Ibid., pp. 9–10.

⁹⁶ Ibid.

⁹⁷ U.S. Energy Information Administration, 2013.

⁹⁸ Vidal et al., 2013, p. 894.

⁹⁹ Ibid., p. 895.

¹⁰⁰ Ibid.

Driving New Ideas and Collaboration on Climate Resilience

BSR works with its global network of more than 250 member companies to build a just and sustainable world. From its offices in Asia, Europe, and North and South America, BSR develops sustainable business strategies and solutions through consulting, research, and cross-sector collaboration. Our existing skills honed over 20 years will drive this strategy forward.

Translating Good Ideas around the Globe

Working from farm to factory to the boardroom, we engage with more than 250 major corporations across eight industry clusters, integrating sustainability into strategy and operations, and promoting collaboration with business and stakeholders to produce systemic progress. We promote individual company leadership and innovation, collaborative change across business networks, and cross-sector solutions for systemic change. We understand the connections among social and environmental issues, as well as the need to integrate social expectations and business implementation.

The race to secure the global climate will be won or lost in emerging economies in Asia and South America and in the historical emitters of North America and Europe. These places are where the bulk of GHG emissions will be produced over the coming decades and/or have been produced historically. They are also the regions where the majority of consumers are based, the largest volume of investment decisions are reached, and in the case of Asia, where the most vulnerable populations to climate impacts are based. BSR's presence in each of these markets means that we have access to the key stakeholders and corporate decision-makers in these vital regions.

We have specialized expertise on climate change, energy, supply chains, finance, human rights, women's empowerment, biodiversity and ecosystem services, as well as experts and member companies spanning the eight industry clusters we propose in the *resilience wedges*. We work with business to redefine productivity in the value chain by improving use of resources and demanding low-carbon options from suppliers.

Driving Collaboration

Tackling the challenge of global climate change is an enormous task—too large for any single company or organization. In light of this challenge, BSR will lead in three ways that we hope will both simplify and amplify the efforts of our member companies. We will:

- » Provide tangible industry guidance on climate priorities and approaches via the wedges approach.
- » Integrate new tools and content into our core sustainability services from strategy to stakeholder engagement and reporting.
- » Expand our collaborative initiatives to help our members work with one another—and with partners across sectors—in areas ranging from energy and transportation to supply chain practices and public policy engagement.

For more than 20 years, BSR has brought companies together to address sustainability challenges that are too systemic and complex for any single company to tackle alone. Engaging nearly 200 companies, BSR's collaborative initiatives provide a standing forum for them to share knowledge and insights, take action, and engage with their stakeholders as a collective, rather than as individual companies.

Companies participating in collaborative initiatives benefit from BSR's commitment to driving best practices, leveraging the strengths and skills of different participants and functions, and fostering transparency, trust, and mutual learning. BSR's collaborative initiatives continue to establish industrywide and cross-sector tools, standards, and approaches for companies to, among other things, improve sustainability performance in supply chains and drive progress on frontier issues, such as the future of fuels, ecosystem services, and other complex global challenges.

Many of these initiatives have an important role to play in catalyzing emissions reductions. For example, the Clean Cargo initiative creates practical tools for measuring, evaluating, and reporting the environmental impacts of global goods transportation. Ocean freight carriers track and benchmark their performance and can therefore easily report to their customers in a standard format. This standardization allows shipping customers to review and compare carriers' environmental performance when reporting and making informed buying decisions. As a result of this work, we are now providing reliable annual emissions performance data for 23 of the world's leading ocean carriers, representing approximately 85 percent of global ocean container ship capacity.¹⁰¹ Moreover, 95 percent of cargo transport buyers participating in the initiative use our data and tools in procurement decisions and in supplier relationships with cargo carriers.¹⁰² In practical terms, the participating carriers have reduced their CO₂ emissions per kilometer an average of 16 percent since 2009. From 2014, data reported from ocean cargo carriers will represent more than 80 percent of the global container ship capacity, as more carriers join the initiative.

Similarly, the Future of Fuels initiative aspires to a sustainable, resilient, and affordable transportation fuel system in which companies can account for and effectively improve the impacts of fuel. Our work aims to identify and promote transportation fuel pathways that enhance the sustainability of available and emerging fuel choices. Our achievements to date include publishing a comprehensive study on the sustainability impacts of fuel in 2012 and a roadmap for sustainable fuel in 2013. We have also convened a series of forums that brought members together with more than 300 thought leaders and practitioners to discuss enhancing public dialogue on fuels, promoting better fuels and practices, and supporting market development.

We have also developed a number of collaborative initiatives with considerable scope for enhancing adaptive capacity in the face of climate change.

Our work on biodiversity and ecosystem services is critically important as ecosystems can help to mitigate climate by strengthening existing carbon sinks and sequestering increasing amounts of GHG emissions. They can also serve an important adaptation function by strengthening natural defenses in the face of climate-related extreme weather events.

The HERproject aims to empower low-income women workers through workplace-based programs that improve knowledge and access to services. To date, we have trained more than 200,000 women on matters related to health and access to services, including increasing access to health clinics, knowledge

¹⁰¹ According to the AlphaLiner Top 100 index, www.alphaliner.com/top100/.

¹⁰² Farrag-Thibault and Morris, 2013.

of maternal health, increased knowledge of HIV prevention, and improvements to women's financial literacy. HERproject could be transformative by helping strengthen the adaptive capacity of women—by far the most vulnerable population to climate impacts, particularly in Asia and Africa.

And our Human Rights Working Group seeks to implement the UN Guiding Principles on Business and Human Rights across all industries. The goal is to create a safe space for a cross-sector group of companies to openly share their best practices, challenges, questions, and experiences implementing the Guiding Principles. Together, participants have tackled a range of human rights issues, including human rights risk assessments, training, reporting, grievance mechanisms, and supply chain, among others—which is particularly relevant as the interface between climate change and human rights has become a prominent area of study in recent years.¹⁰³

Creating an Architecture of Participation

We plan to foster enhanced climate collaboration through this strategy by creating an *architecture of participation*. In practice, this strategy means exploring every opportunity to build cross-industry and cross-stakeholder partnerships in pursuit of our goals. It also means finding ways to contribute to existing initiatives within the wider climate community of practice. Around the globe, new multistakeholder initiatives designed to build climate resilience are emerging rapidly. Some of these are private sector in focus and link existing business networks with exciting climate portfolios. Others are issue specific (i.e., dealing with climate-smart agriculture and/or short-lived climate pollutants) and in need of a private sector component to enhance ambition, strength, and innovation and bring them to scale.

In the past, the climate community has been fragmented, with too many worthy initiatives that were working in silos, duplicating each other's efforts, and lacking in coherence, all leading to a lack of scale. We will work to build support for and participation in our strategy. We will also assess other initiatives, encourage them to connect to act together, and seek out suitable opportunities for private sector engagement.

¹⁰³ Cameron, 2010.

The Road Ahead

The strategy we have outlined in these pages is about being better, smarter businesses. We believe business future success depends on limiting the global mean temperature rise to 2°C above preindustrial levels, while also meeting societal development needs and exercising adaptive capacity in the face of expected changes in climate.

Our approach is to clarify and reappraise climate risk, emphasize that smart business requires climate resilience, and highlight that climate resilience can be achieved through our approach to translation, stabilization, and collaboration.

Creating the conditions to succeed requires us to look beyond the status quo. Business leaders must create a unified voice that cannot be ignored—that proactively and collaboratively takes part in shaping solutions to the challenges posed by global climate change into opportunities for all.

Stakeholders around the world, including businesses, are acting on climate change. The time has come to become more ambitious and increase the volume of activities. Concerted action based on a menu of appropriate stabilization wedges provides the best options for meaningful action through manageable steps. We further believe that collaboration across industries and with multiple stakeholder partners creates an ecosystem for climate action, allowing industries to support each other and the communities in which they operate.

While our framework is still in development, we already know that some wedges will be common across all industries. They include reducing emissions in the supply chain, changing the use and mix of energy that fuels industry and transportation, and shifting corporate finance toward low-carbon goods, services, and technologies through procurement and investments related to energy and resource efficiency. Over the coming months, we will conduct research where we find gaps and work collaboratively where our expertise can fuel ambition.

A low-carbon, climate-resilient future requires bold collective action by all stakeholders: government, civil society, and business. If we are successful, by 2020, business leadership on climate change will contribute to effective programs that promise to hold the projected global average temperature rise to less than 2°C above preindustrial levels. BSR members across our eight industry sectors will be taking steps to reduce GHG emissions and build adaptive capacity. Our members will be revealing a greater understanding of the downside risks of runaway climate change and a heightened awareness of the upside opportunities of the transition to a low-carbon economy, and they will be implementing policies and approaches that are in line with climate-compatible development.

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