

BUSINESS

# WEATHERING THE NEXT STORM: A CLOSER LOOK AT BUSINESS RESILIENCE



CENTER FOR CLIMATE  
AND ENERGY SOLUTIONS

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*September 2015*



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The Center for Climate and Energy Solutions (C2ES) is an independent, nonprofit, nonpartisan organization promoting strong policy and action to address the twin challenges of energy and climate change. Launched in November 2011, C2ES is the successor to the Pew Center on Global Climate Change. Learn more at [www.C2ES.org](http://www.C2ES.org).

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## FOREWORD

Alexandra Liftman, Global Environmental Executive, Bank of America  
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The impacts of climate change—rising sea level, more frequent and intense heat waves, flooding and drought, and other extreme weather events—are imposing significant costs on companies and communities alike. While companies continue to navigate changing business environments, today they also face changing physical environments. Climate change is affecting business facilities and operations, critical supply and distribution chains, as well as access to power and water. These physical impacts also have a human impact on companies' employees and customers.

In 2013, the Center for Climate and Energy Solutions (C2ES) and Bank of America partnered to research business resilience and better understand whether major companies were aware of these climate risks. At that time, we found that 90 percent of the Standard & Poor Global 100 Index companies identified extreme weather and climate change as a current or future business risk.

Our latest research dives deeper, exploring how large companies perceive and manage these climate change risks. It researches the challenges organizations face that may prevent them from doing more to change their operations and business practices as it relates to measuring, managing, and mitigating physical risks attributed to climate change.

While many companies are working aggressively to improve energy efficiency, invest in clean energy, and support policies to promote a low-carbon future, the reality is that understanding and managing physical risks attributed to climate change will be a critical element of corporate strategies in the future. Climate resilience is not a far-in-the-future possibility, but a right-now reality. All of us—individuals, communities, governments, planners, and businesses—need to work together to figure out how to embrace climate resilience.

It is our hope by highlighting what leading companies are doing on climate resilience—providing insights and suggestions to promote learning, collaboration and sharing of best practices—we will continue to raise awareness about the importance of planning for and effectively managing the impacts of climate change.

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## ACKNOWLEDGMENTS

The Center for Climate and Energy Solutions (C2ES) and Bank of America partnered to create this special report on business resilience to climate change. C2ES would like to acknowledge Bank of America for its collaboration and generous financial support. We would specifically like to thank Anne Finucane, Vice Chairman, Global Chief Strategy and Marketing Officer, for her commitment to this work. In addition, C2ES and Bank of America would like to thank the following individuals for their assistance in the development of this report: Roberta Barbieri at Diageo; Bill Brady at Exelon; Peter Trelenberg at Exxon; Christopher Benjamin at Pacific Gas and Electric; and Sean Mackay at Sempra. The report would not have been possible without the willingness of company and city representatives who generously volunteered their time and their input. Several C2ES staff including Joe Casola, Stephen Seidel, Laura Rehrmann, Tim Juliani, Martin Niland, and Elliot Diringier also provided very helpful comments and suggestions. Additionally, Kaj Jensen and Bonnie Benhayon, Bank of America, provided very helpful comments and insights throughout this work.

## EXECUTIVE SUMMARY

As we saw once again in 2014—the warmest year globally on record—increases in extreme weather and other climate-related impacts are imposing significant costs on society. Even as governments, companies and communities strengthen efforts to reduce emissions contributing to climate change, they are awakening to the urgent need to address growing climate impacts. Across the United States, governments at all levels are taking steps to strengthen climate resilience. Simultaneously, a growing number of companies are recognizing extreme weather and climate change as present or future business risks. For many companies, these rising risks extend well beyond the “fence line” to critical supply chains and infrastructure, and can be effectively managed only in partnership with the public sector.

In 2013, C2ES released *Weathering the Storm: Building Business Resilience to Climate Change* (hereafter *WTS 2013*), which examined how companies listed in the Standard and Poor’s (S&P) Global 100 Index were approaching climate risks. *WTS 2013* provided a baseline perspective on how major companies were assessing their climate vulnerabilities and whether and how they were working to strengthen their climate resilience. This report provides an update and takes a closer look at how companies are preparing for climate change and what is keeping them from doing more.

The report is based on several lines of research:

- A comprehensive review of the perspectives and activities of S&P Global 100 companies, based on their reporting to CDP<sup>1</sup> and their corporate sustainability reports and annual financial filings;
- Interviews with company representatives to gather more detailed information on whether and how companies are assessing climate risks and what barriers are keeping them from doing more; and
- Dialogues conducted with companies, federal and local government agencies, academics, and other stakeholders through several workshops and events focused on business resilience.

These sources provide an in-depth look at the state of climate risk assessment and resilience planning within the business community. While some companies have taken steps to assess risks and prepare their business for future climate changes, many companies face various internal and external challenges that hinder efforts toward greater climate resilience. This report identifies various approaches companies are using to address climate risks, examines challenges companies face in managing and reporting risks, and suggests strategies to overcome these challenges and strengthen climate risk management within the private sector.

## KEY FINDINGS

### ***Companies widely acknowledge climate risks, but few manage climate change as a stand-alone risk***

Whether in survey responses or individual interviews, a vast majority of very large companies across all industrial sectors identify extreme weather and climate change (such as warmer temperatures, more frequent or severe flooding, or greater water scarcity) as current or future risks to their business.<sup>2</sup> At the same time, interviews found, climate risk is often too difficult to assess in its own right because of the long timeframes involved, the lack of location-specific data, and scientific uncertainty. It is often difficult to generate the type of black-and-white data needed to drive action. One interviewee said that the notion of climate risk is too “general” and not “particularly useful” as a risk concept on its own.

Accordingly, many companies view climate change as a “threat multiplier” or as a “magnifier” of existing risks. Climate-related changes are embedded in other risks companies already manage. Treating climate change as a risk amplifier may allow companies to tackle many of the challenges it poses. However, some impacts could be overlooked, particularly the potential cumulative and indirect impacts posed by climate change.

### ***Climate vulnerability assessments have increased***

A growing number of companies report they are undertaking or have already conducted vulnerability assessments that incorporate information about future climate conditions. Of the companies interviewed, 77 percent have conducted or are in the process of conducting a vulnerability assessment of some kind. While more vulnerability assessments are being done, their scale and scope vary widely. Some companies are examining risks across their entire enterprise, while others are focused on specific facilities, parts of the business, or regions. Others examine weather and climate risks on a project-by-project or case-by-case basis, and lack an overarching strategy for considering climate across their organization. Assessing the potential climate risks to specific facilities rather than all of the business can be due to a number of factors, including limited resources or data, lack of internal issue recognition, or other operational considerations.

### ***Water supply and quality are a high priority***

Companies in various sectors, especially food and beverage, pharmaceuticals, IT equipment and mining, rely on water as a critical production input. For these companies, drought can be an important stressor, as can other events or trends affecting water supply and demand, such as flooding, changing precipitation patterns, reduced snowpack, heat waves or salt water intrusions associated with sea level rise. The dependence on water can be so important that it acts as the primary lens through which a company discusses future climate risk.

### ***Public reporting on climate risk is increasing, but assessing materiality for financial disclosures remains challenging***

Public reporting and voluntary disclosure efforts on climate risks have become increasingly important in providing transparency to investors, stakeholders, and customers. Not all companies report this climate risk and the degree of detail varies significantly among those that do. Most of the S&P Global 100 companies (84 companies) continue to discuss their climate risk concerns in their responses to the CDP questionnaire, which specifically includes questions on this topic. Substantially fewer companies address extreme weather and climate change in their financial filings (40 companies) or in their sustainability reports (47 companies), but this reporting has increased slightly since *WTS 2013*. Eleven percent more of the S&P 100 companies (a net increase of four companies) now report on climate risks in their financial filings and 34 percent more (a net increase of 12 companies) discuss these risks in their sustainability reports. Increases like these indicate that the topic of resilience is gaining more prominence.

In the context of financial disclosure, however, assessing how material climate change impacts are for a particular company remains challenging. Companies report that factors keeping them from including these risks in their financial disclosures include uncertainty about location-specific impacts, differences in timeframes between many climate risks (which may be material over many decades) and investment decisions (which may be focused on the next few quarters), and the need to place physical risks from climate impacts within the context of other risks (e.g., regulatory, reputational).

### ***Business continuity and risk management plans remain the most common ways that companies address weather and climate risks, but many plans only include historical risk and not consideration of how climate change will alter those risks***

For most companies, physical climate impacts are managed through conventional business continuity planning or risk management. Almost all companies have established business continuity and emergency management plans to address natural disasters, including extreme weather events. Most S&P Global 100 companies (80 companies) report that the methods used to manage physical climate risks are incorporated into their existing business continuity or risk management planning processes (**Figure ES-1**). This is a slight increase from the 77 companies identified in *WTS 2013*. Interviews highlighted that many may not be adjusting the risk landscape to account for climate-related changes. For example, several companies interviewed noted that while they were considering future changes in weather and climate, they were generally using historical events and data to project future risks (and were not specifically using climate projections of how these and other risks would change over time), in part because climate projections may not be

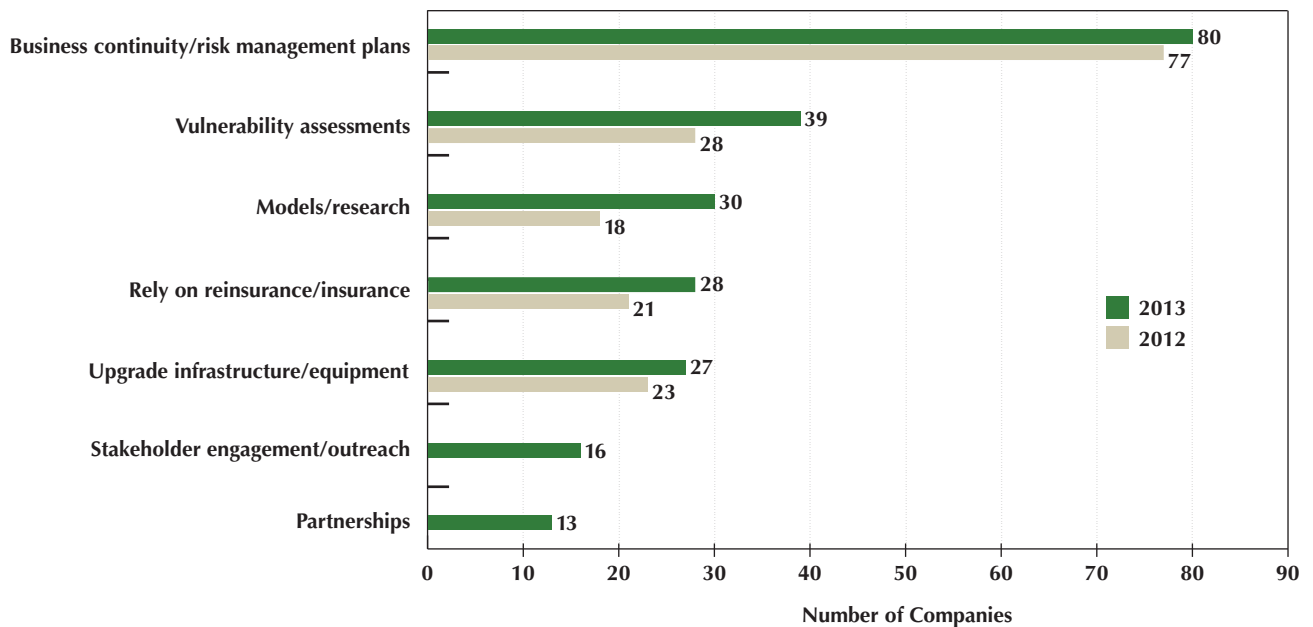


granular enough to project future risks with the same detail that historical records provide. As a result, their business continuity plans may miss certain risks and risk interactions and they may well be underinvesting in resilience.

**Methods to assess and manage climate risks vary, and there is no one-size-fits-all approach**

Companies primarily manage their climate risks through their enterprise or business continuity frameworks and often use a stepwise approach to incorporate climate into the risks they already manage. However, some companies start at different points and pursue risk management in a different order. For example, some companies are starting with a narrowly scoped vulnerability assessment that examines only one region or only one impact to raise internal awareness and assess the need for a broader vulnerability assessment, similar to the example process shown in **Figure ES-2**.

**FIGURE ES-1: Top Climate Risk Management Activities**



Note: Stakeholder engagement/outreach and partnerships were not quantified in WTS 2013.  
 Source: C2ES research based on S&P Global 100 CDP surveys.

**FIGURE ES-2: Management Framework**



\*Initial vulnerability assessments can focus on specific impacts or regions.

### ***Barriers to building resilience are decreasing but still remain***

Assessing risks is an important precursor to managing them. Some companies report they are still having difficulty understanding vulnerabilities well enough to drive internal focus. Specific barriers include:

- **Data and tools.** Significantly more climate-related data and tools exist today than when *WTS 2013* was released. Companies, however, still report that data limitations affect their ability to plan for future climate risk. Interviews suggest that much of the available climate data lacks the level of granularity needed (e.g., not location-specific enough) to assess business risks. Most climate models provide projections at global, national, or regional levels. Companies often want to know what the expected impacts will be at a specific facility or at a specific location. In other words, they want “actionable science.” The spatial resolution of climate data and tools is improving, but has yet to evolve to a level that companies can easily use to assess climate risk in their business planning.
- **Uncertainty about the expected impacts.** Companies also continue to struggle with the uncertainty associated with the nature, timing, location, or severity of climate change impacts. Although businesses are familiar with uncertainty, translating the uncertainty associated with climate projections into a corporate risk management context can be difficult. Related to this is the uncertainty about which climate scenarios should be used for risk management. Companies suggest that official regional scenarios with low, medium, and high ranges of impact would help them better manage the uncertainty.
- **Mismatch between short versus long timeframes.** One of the most frequently mentioned internal barriers was the perceived mismatch between short-term business decisions and long-term climate risks. Many companies look out five years or less when planning for risk management. While it may be relatively straightforward to identify ways that climate change will affect risks by the mid- or late-21st century, it can be difficult to show how risks over the next few years may be substantially different than those during the last few years. This can make incorporating long-term risks into management decisions difficult.
- **Out-of-date or inadequate standards and guidance.** Companies reported that engineering standards guiding how companies develop infrastructure are out of date and do not incorporate future climate risks (e.g., sea level rise, changes in 100-year floodplains). Out-of-date engineering standards and inadequate guidance can make it difficult for businesses to justify going beyond the minimum engineering standards to incorporate climate resilience.

### ***“Beyond the fence” barriers are still challenging***

Almost all companies interviewed mentioned a concern about climate-related risks outside of their control, including supply chains, infrastructure (e.g., roads, public transport, water provision, electrical grids, and communications systems), or the lack of policies and standards that can encourage or facilitate resilience investments. While companies examined in this study are large with extensive internal resources, many of their suppliers are not as large and may not have the resources to assess or manage their own climate-related risk or vulnerability. Several interviewees noted that there was also limited communication with suppliers on the issue of climate vulnerability. As one company noted, “you are only as resilient as your weakest link, so it is important to identify where that link is.”

### ***Intermediary institutions can play an important role in bringing business voices to urban resilience planning***

Given the prominent role that cities play in designing and maintaining critical infrastructure, companies and cities are beginning to collaborate to address and manage this shared risk. More than 75 percent of the cities that responded to CDP’s 2014 Cities Program questionnaire affirmed that climate impacts were likely to affect how businesses operate in their jurisdictions. For the survey respondents in the United States, nearly 80 percent indicated that climate would affect their respective businesses. And while partnerships between cities are common, explicit inclusion of companies within the resilience planning process is still rare.

When companies are involved in urban resilience planning, a third-party intermediary is typically facilitating their participation. Examples of these intermediary institutions include the Green Ribbon Commission in Boston and the

climate collaboratives that exist in a number of California cities and Washington state. These collaboratives can be effective in bringing businesses voices to resilience planning by:

1. Providing a forum through which businesses can interact with one another, as well as with other non-governmental stakeholders (e.g., academic institutions, regional land holders, faith groups).
2. Spreading the transaction costs that a public institution would otherwise bear in coordinating or replicating discussions about climate risks across a number of diverse stakeholder groups, including businesses.
3. Functioning independently of the municipal political structure, enhancing continuity through election cycles and alleviating concerns about potentially undesirable collusion between public and private institutions (e.g., that corporate engagement in resilience discussions with the city leads to the development of business opportunities that favor the companies that are involved).

### ***Recommendations for business and government***

Companies are taking a variety of approaches to incorporate resilience into their planning. There is no “right” path to follow, and applying business risk management approaches to climate change impacts is not always linear. Incorporating climate change into conventional risk management strategies can help, but companies should be aware that indirect and cumulative risks could be overlooked. While appropriate strategies will vary from company to company, recommendations for addressing climate risk include:

- Starting with a limited-scope vulnerability assessment—focusing, for example, on the most critical parts of the business—to raise internal awareness of climate risks.
- Clearly identifying who needs to be involved internally in assessing risks and implementing resilience planning.
- Facilitating regular communication across departments responsible for addressing climate issues—including sustainability, risk management, operations, and finance.
- Considering whether to change planning horizons to better incorporate climate risks.
- Exploring partnerships with governments, NGOs, and experts—particularly at the local level—to analyze data, evaluate climate risks, undertake cost-benefit studies, and implement resilience planning.

As a growing number of companies report on their climate risks through both mandatory and voluntary channels, steps can be taken to improve and streamline processes and to ensure stronger, more consistent reporting. For example, the Securities and Exchange Commission could improve its guidance by directing companies to disclose more detail about impacts they have experienced or anticipate, prescribing specific time periods and thresholds for weather and climate risks, and developing tools to enhance the quality of disclosure.

Government agencies can support private-sector resilience by contributing to existing resources such as the Climate Data Initiative, joining and establishing partnerships, and pursuing new efforts such as developing tools and guidance. A high priority is improved data and analysis that will help companies justify investments in climate resilience measures—in particular, cost-benefit analyses. Federal, state, and local government agencies can also support business resilience by improving public infrastructure and providing opportunities for the private sector to contribute to resilience investments, community upgrades, and emergency planning efforts.

## I. INTRODUCTION

Increased extreme weather and other climate-related impacts are imposing significant costs on society and on companies. In addition to affecting businesses directly, extreme weather events have economic impacts beyond the location in which they occur, posing threats to infrastructure and business continuity on national and international scales. While some companies have taken steps to assess risks and prepare their business for future climate changes, many companies face various internal and external challenges that hinder efforts to move toward greater climate resilience.

In 2013, C2ES released *Weathering the Storm: Building Business Resilience to Climate Change* (hereafter *WTS 2013*), which examined how S&P Global 100 companies were approaching climate risks and what they were doing to become more resilient. A major headline from this report was that 9 of 10 large companies said they considered climate risks in their decision-making, and 55 percent said they had already experienced or expected to experience a climate-related event within the next five years. And while this report gave an overview of whether companies viewed climate as a risk, broader questions

on *how* this risk was managed, *who* managed it, and *what* types of barriers companies faced were left for future study. Exploring these additional questions, this report provides an update to *WTS 2013* and examines in more detail how companies are preparing for climate change and what is keeping them from doing more.

### CONTEXT: THE IMPORTANCE OF BUSINESS RESILIENCE

#### *Climate change and extreme weather can be costly to business*

Numerous reports highlight the global impacts and costs associated with climate change. The [Third National Climate Assessment](#), released in 2014, confirmed that climate change is already affecting every region of the United States and key sectors of the national economy.<sup>3</sup> Companies face bottom-line cost impacts related to dealing with the consequences of extreme weather events, investor pressure, added insurance costs and ever increasing calls for more public disclosure (**Box 1**).

### Box 1. Cost Examples Related to Extreme Weather

#### *Energy*

- Hurricane Isaac damaged Entergy's distribution infrastructure, and restoration costs were estimated at about \$370 million.<sup>4</sup>
- Hurricane Sandy cost utilities in New Jersey an estimated \$1.8 billion in repair and response costs.<sup>5</sup>

#### *Oil & Gas*

- An **ExxonMobil** pipeline beneath the Yellowstone River in Montana was damaged by flood debris, spilling oil into the area and causing \$135 million in property damage.<sup>6</sup>
- **Hess** suspended production on one of its Gulf Coast platforms during Tropical Storm Karen in 2013, resulting in a production loss of approximately 130 thousand barrels of oil equivalent, with a market value of about \$9 million.<sup>7</sup>

#### *Financial*

- **Swiss Re** estimated that all natural disasters in 2013 cost the global insurance industry around \$45 billion.<sup>8</sup> Claims from large natural catastrophes in 2014 amounted to \$35 billion. The largest losses in 2014 included: a thunderstorm and hail event in the U.S. in May (\$2.9 billion), Storm Ela in Europe (\$2.4 billion), and a February snowstorm in Japan (\$2.5 billion).<sup>9</sup>

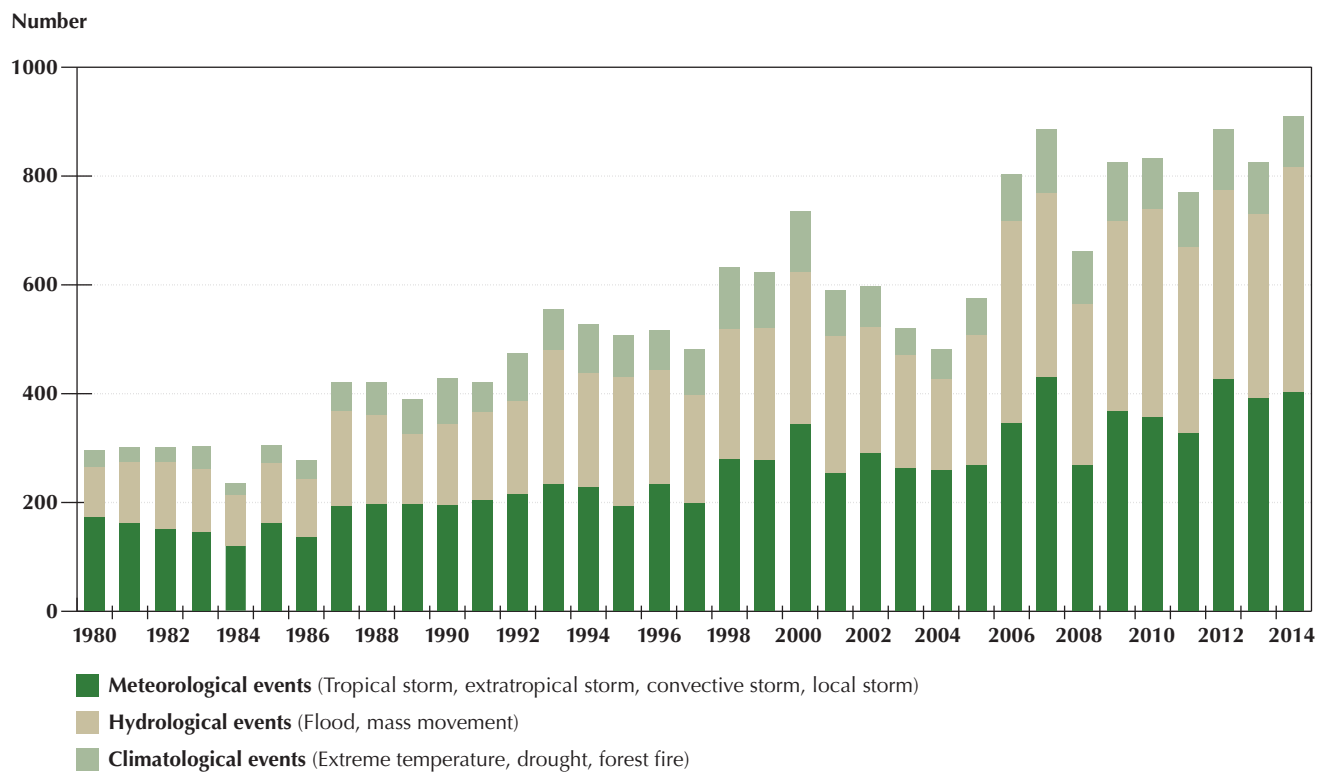
The year 2014 was the warmest year globally across land and ocean surfaces since records began in 1880, with temperatures measuring 1.24°F (0.69°C) above the 20th century average.<sup>10</sup> And while the number of weather-related extreme events and related costs vary from year to year, 2014 stands out as having among the most ever recorded (900 total).<sup>11</sup> Impacts are occurring across the globe, and an increasing trend of both the number events and their costs since 1980 is evident in **Figure 1** and **Figure 2**.<sup>12</sup> Significant climate anomalies and weather-related events around the world in 2014 are shown in **Figure 3**.

Extreme events have significant consequences for every economy, including the United States. Since 1980, the country has experienced 178 weather and climate disasters where overall damages and costs reached or exceeded \$1 billion. The total costs for these events exceeds \$1 trillion. In 2014, there were eight extreme weather and climate events with losses exceeding \$1 billion each across the United States (**Figure 4**).<sup>16</sup> These

events included heat waves, droughts, and severe storms, all of which directly and indirectly affect business operations. In 2015, drought conditions in California have persisted, requiring water restrictions across the state. The Northeast experienced severe winter weather, affecting many businesses in the region and across the country.

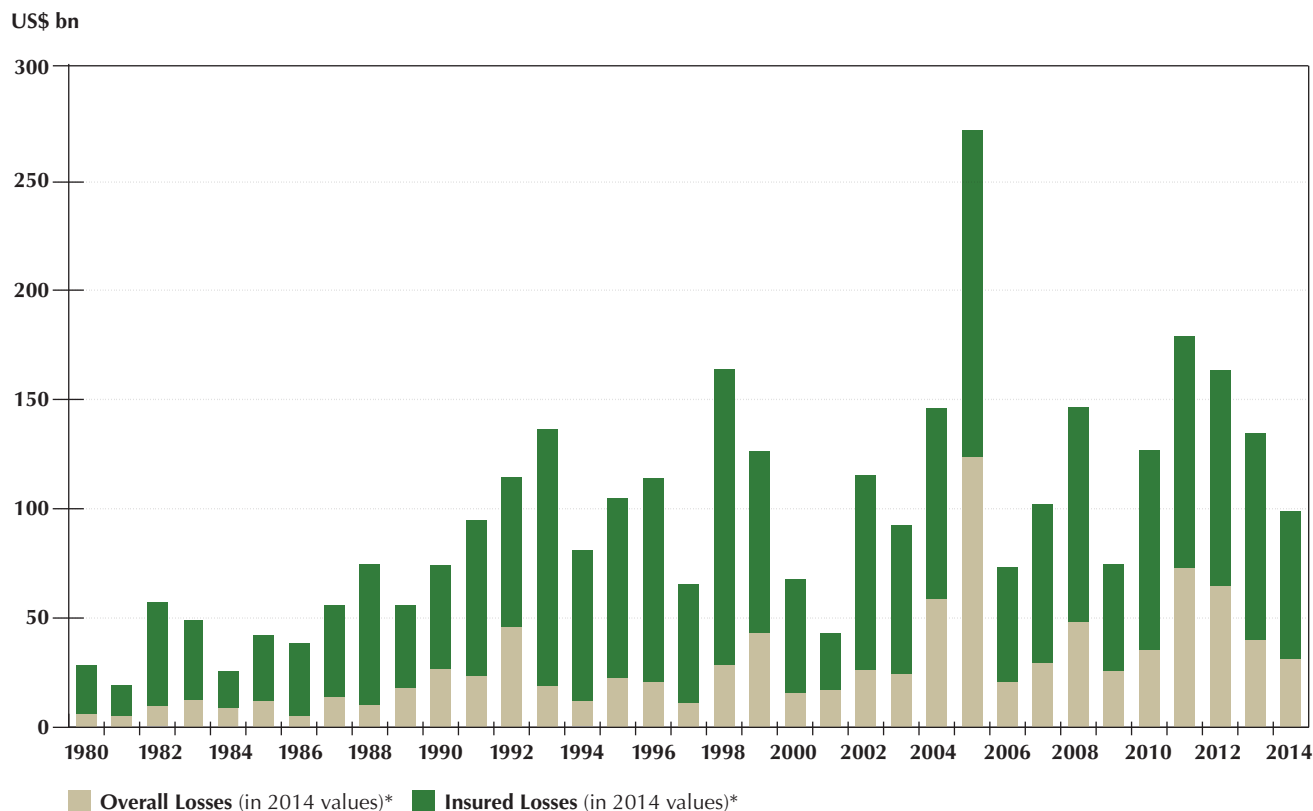
Continued climate change will have economic implications for businesses, regardless of emissions reductions. For example, within the next 15 years, higher sea levels combined with storm surge will likely increase the average annual cost of coastal storms along the Eastern Seaboard and the Gulf of Mexico by \$2 billion to \$3.5 billion. When incorporating the potential changes in hurricane activity in these regions, the likely increase in average annual losses grows to up to \$7.3 billion.<sup>18</sup> If global temperatures were to rise 3°C above preindustrial levels rather than 2°C, economic damages for the U.S. would be an additional \$150 billion (approximately 0.9 percent of global output).<sup>19</sup>

**FIGURE 1: Number of Global Weather-Related Loss Events (1980–2014)**



Source: Based on Munich Re NatCatSERVICE, 2015.<sup>13</sup>

**FIGURE 2: Global Weather-Related Losses (1980–2014)**



\*Losses adjusted to inflation based on country CPI  
 Source: Based on Munich Re NatCatSERVICE, 2015.<sup>14</sup>

***The focus on climate change and resilience has increased***

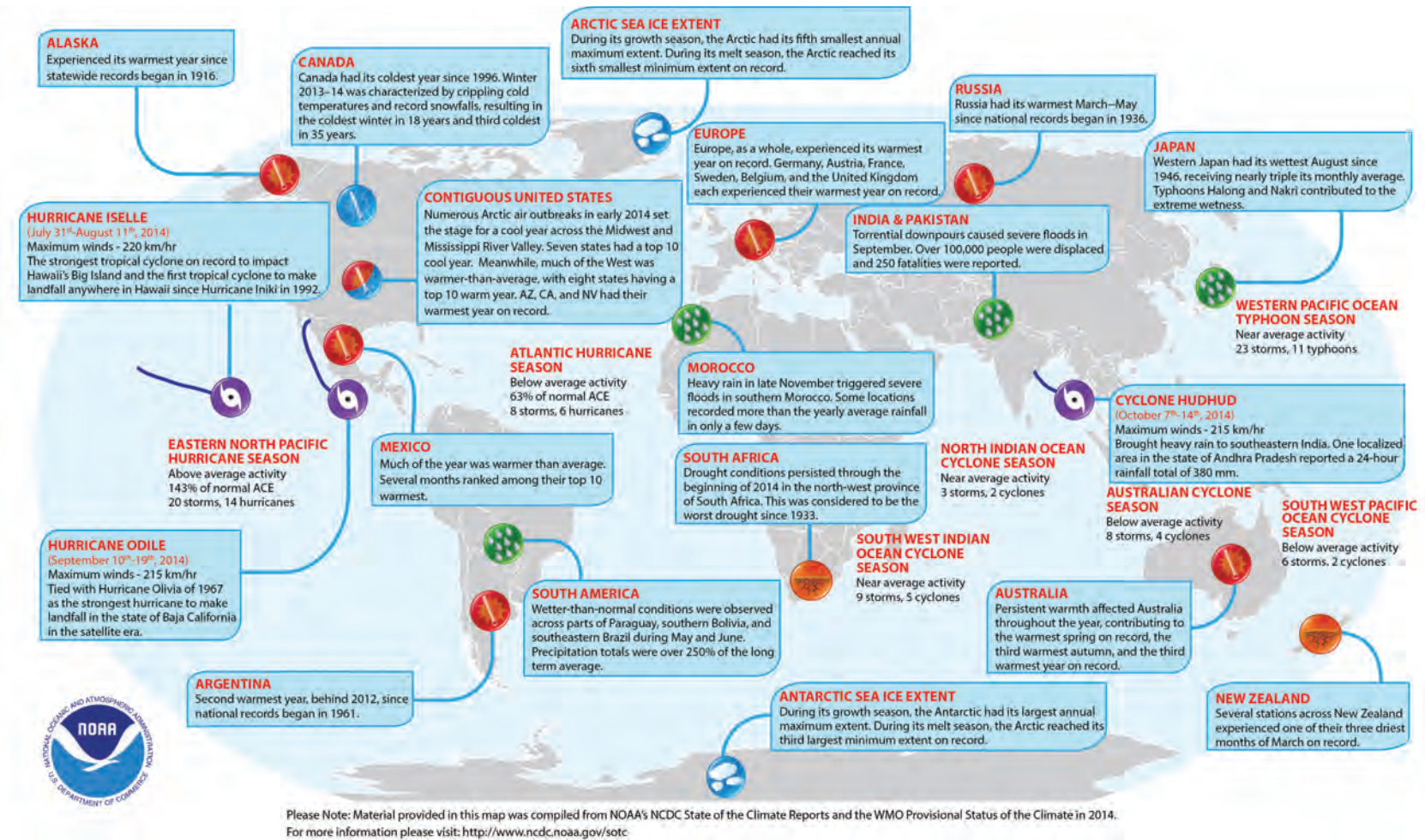
Scientists, environmentalists, politicians, business executives and military leaders have been raising concerns about the risks associated with climate change for years, and since *WTS 2013*, the number of voices expressing this concern has increased. Most recently, in 2015, Pope Francis joined the call for action by issuing a Papal Encyclical, a high-level teaching document, which highlighted the importance of protecting the planet for future generations and the need to address climate change. Additional attention to climate is also evident as nations put forward their mitigation plans as part of the effort to craft a new global climate agreement at the United Nations Conference of the Parties scheduled for December 2015 in Paris. Climate adaptation will be an important part of this agreement, particularly for developing nations.

In the United States, attention on climate resilience was amplified in June 2013 when President Obama announced his Climate Action Plan, which includes various goals focused on strengthening economy-wide resilience to climate change impacts and commits federal resources and assistance to help make communities, infrastructure, and ecosystems more climate-resilient while improving the scientific basis for future actions. In July 2015, several large companies joined President Obama in signing the “American Business Act on Climate Pledge,” highlighting actions they are taking on greenhouse gas reductions, energy efficiency, sustainability investments, and resilience.

President Obama also issued Executive Order 13653, which set up the State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience. In November 2014, the Task Force released its recommendations on how the federal government should modernize programs and policies to incorporate climate change,



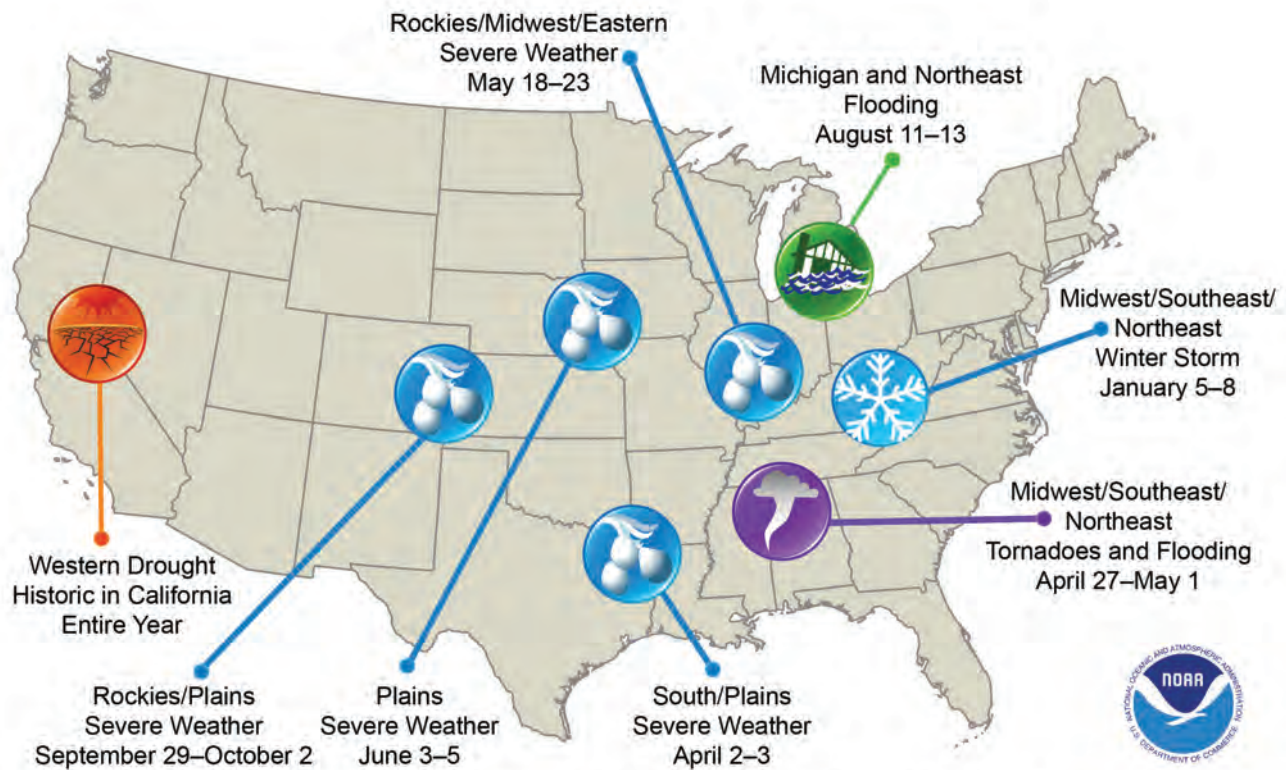
**FIGURE 3: Significant Climate Anomalies and Events in 2014**



Please Note: Material provided in this map was compiled from NOAA's NCDC State of the Climate Reports and the WMO Provisional Status of the Climate in 2014. For more information please visit: <http://www.ncdc.noaa.gov/sotc>

Source: NOAA, 2015.<sup>15</sup>

**FIGURE 4: Billion-Dollar Weather and Climate Disasters in 2014**



*This map denotes the approximate location for each of the eight billion-dollar weather and climate disasters that impacted the United States during 2014.*

Source: NOAA, 2015.<sup>17</sup>

incentivize and remove barriers to community resilience, and provide useful, actionable information and tools. Recommendations relevant to businesses include developing resilience standards for the siting and design of buildings and infrastructure, promoting private sector resilience, rewarding resilience investments, and collaborating with the insurance industry on resilience.

The Obama administration has also begun examining the specific vulnerabilities of various economic sectors. For example, the U.S. Department of Energy (DOE) released a [major study in 2013](#) on the vulnerability of critical energy and electricity infrastructure to climate change. It highlighted that electricity transmission and distribution systems carry less current and operate less efficiently when air temperatures are higher; energy infrastructure located in coastal areas is vulnerable to sea level rise, storm surges, and flooding; and changes in water availability can have implications for thermoelectric power generation and oil and gas production.<sup>20</sup>

A key role of government identified in *WTS 2013* was the provision of “credible, readily accessible scientific information, models and tools” and in March 2014, the administration took steps to increase data availability through the release of the comprehensive [Third National Climate Assessment](#) and the [Climate Data Initiative](#). The next significant step came in November 2014, when the administration released the [Climate Resilience Toolkit](#), which provides scientific tools, information, and links to experts who can help users manage their climate-related risks and opportunities and improve their resilience to extreme events.

Individual federal agencies have likewise taken steps to address private sector resilience. For example, in 2015 the U.S. DOE announced the [Partnership for Energy Sector Climate Resilience](#), which is focused on improving the resilience of energy infrastructure to extreme weather and climate change impacts. Under this partnership, owners and operators of energy assets



will develop and pursue strategies to reduce climate and weather-related vulnerabilities. The current list of 17 electricity sector partners includes National Grid, Entergy Corporation, Exelon Corporation, Pacific Gas and Electric, and Public Service Electric and Gas, among others.

Beyond the federal government, local public agencies have taken a few steps to work with the private sector on addressing climate risks. Infrastructure, supply chains and community resilience are particularly important for companies because many climate and extreme weather risks may lie beyond their “fence line” (areas outside of the company’s operations), including roads, energy distribution networks, water provisions and communication networks. Example initiatives and the potential role for cities in business resilience are discussed later in the report.

## PURPOSE AND METHODOLOGY

This report provides an update to *WTS 2013* and examines in more detail whether and how companies are preparing for the risks associated with climate change. As a more in-depth review, this report looks at how corporate perceptions have changed since *WTS 2013*, whether and how companies are assessing climate risks and what barriers keep companies from doing more. Exploring these additional questions, this report used the same three sources used in *WTS 2013* and built on these with direct company dialogues conducted between September 2013 and July 2015. Sources included:

1. Public statements made by the 100 companies in the Standard and Poor’s (S&P) Global 100 Index, including: responses to CDP’s annual Investor Survey, financial disclosure reports, and corporate sustainability reports.
2. Interviews with S&P 100 companies and companies in the C2ES Business Environmental Leadership Council.

3. A public side event at the Climate Leadership Conference on February 23, 2015.

4. Three invitation-only C2ES workshops on climate resilience held July 16, 2014; March 24, 2015; and July 15, 2015.

The companies in the S&P Global 100 Index are large-capitalization, multinational companies that are chosen for their importance to the global equity markets. For consistency, the same companies in the S&P Global 100 in 2011 were compared across 2012, 2013 and 2014 reporting periods. This cohort of companies was chosen for this study because it constitutes a random sample of companies large enough to publicly report and global enough to have experienced a variety of extreme weather events.<sup>21</sup>

To explore the extent to which companies are partnering with cities, our research included a series of discussions and interviews with select city staff involved in resilience planning (Boston, San Francisco, San Diego, Los Angeles, and Philadelphia), and staff at organizations focused on tracking cities’ efforts in building resilience (American Society of Adaptation Professionals, C40, CDP, and Urban Sustainability Directors Network). The July 2015 workshop also brought together representatives from both cities and companies to discuss our findings and develop recommendations for potential future public-private collaboration to bolster resilience.

To ensure candor, interviews were conducted on condition of anonymity and company attributions are primarily from public reports. A list of companies comprising the S&P Global 100 can be found in Appendix A, and additional notes on this study’s research methodology can be found in Appendix B.

## II. HAVE COMPANY PERCEPTIONS OF CLIMATE RISK AND RISK MANAGEMENT EFFORTS CHANGED?

### COMPANIES STILL WIDELY ACKNOWLEDGE CLIMATE RISKS

Whether in survey responses or individual interviews, a vast majority of very large companies across all industrial sectors identify extreme weather and climate change (such as warmer temperatures, more frequent or severe flooding, or greater water scarcity) as current or future risks to their business.<sup>22</sup> Compared to *WTS 2013*, more companies are now assessing their climate-related vulnerabilities. Most companies consider these risks to be relevant within the next five years and that the impacts are “likely,” “very likely,” or “virtually certain.” Many companies point to recent events—such as Hurricane Sandy or droughts in California and Africa—as examples of how extreme weather can affect business operations. In general, reporting on climate-related risks by companies the S&P Global 100 has increased, as has the level of detail in the reports.

Standard business continuity and enterprise risk management practices remain the primary method of managing these risks, but more companies are now completing specific climate vulnerability assessments to better enable them to understand how climate change will affect their business. **Table 1** provides a short comparison of how the key findings in this report have changed from *WTS 2013*.

#### ***Vulnerability assessments have increased***

Not only are companies acknowledging risk in public disclosures, but also a growing number report they are undertaking or have already conducted some type of vulnerability assessment that incorporates information about future climate conditions. Of the companies interviewed, 77 percent have conducted or are in the process of conducting a vulnerability assessment of some kind. This percentage is significantly higher than the

number of companies that publicly reported conducting an assessment (39 percent) and may reflect a number of factors, including: 1) selection bias where those companies agreeing to an interview had spent the time understanding the risks; and 2) public disclosures can be at least a year behind actual efforts, and more attention has been focused on understanding vulnerabilities over the past year (**Figure 9** illustrates the number of companies in the S&P Global 100 that publicly report performing vulnerability assessments).

While more vulnerability assessments are being done, the scale and scope of these assessments vary widely (**Box 2**). Interviews identified that some companies are examining risks across their entire enterprise, while others are focused on specific facilities or regions. Others examine weather and climate risks on a project-by-project or case-by-case basis but lack an overarching strategy for considering climate across their organization. This can be due to a number of factors, including limitation of resources or data, lack of internal recognition of the broader implications of climate risk, or because a company has prioritized specific facilities.

While for many a vulnerability assessment is a first step in understanding where to focus resilience efforts, companies tell us they often find this step very difficult because of the multitude of available climate models and scenarios. Companies may also struggle in translating uncertainty in climate model output to their respective decision-making context, or how data and projections at regional or continental spatial scales can be translated to assess vulnerability at local spatial scales or specific facilities. A concern also exists that their assumptions and scenarios may be different from others in the region and validity of their own vulnerability estimation will be questioned. Barriers are further discussed later in the report.

**TABLE 1: Comparison of Key 2015 Findings Relative to WTS 2013**

FINDINGS	RELATIVE TO WTS 2013
<b>Acknowledgement of climate risks</b>	
<i>Companies acknowledging climate change risks</i>	▲ Increase from 90 to 91/100 of S&P 100
<i>Companies reporting on climate change risks</i>	<ul style="list-style-type: none"> <li>▲ Increased public reporting across multiple sources</li> <li>▲ Increased disclosure in sustainability (increase from 35 to 47) and financial reports (increase from 36 to 40)</li> <li>+ New information on how climate risk factors into materiality</li> </ul>
<i>Companies reporting climate change risks as near-term</i>	▲ Increase in companies identifying risks as “current” (increase from 38 to 44)
<i>Types of climate change risks</i>	<ul style="list-style-type: none"> <li>+ New detailed information on physical climate risks</li> <li>+ Extreme precipitation and drought identified most frequently (48) (not quantified in WTS 2013)</li> <li>+ New details on water risks</li> </ul>
<b>Climate change impacts</b>	
<i>Top five expected impacts</i>	<ul style="list-style-type: none"> <li>↔ No change to top five expected impacts</li> <li>↔ No change in most commonly cited impacts (disruption to production and increased operational cost)</li> </ul>
<b>Approaches for risk management</b>	
<i>Companies identifying risk management activities to address climate change</i>	↔ No change in most common method of addressing risks (existing business continuity/risk management plans)
<i>Types of risk management activities</i>	<ul style="list-style-type: none"> <li>▲ More companies conducting vulnerability assessments (increase from 28 to 39)</li> <li>▲ More companies utilizing climate-specific models and research (increase from 18 to 30)</li> <li>▲ Increased importance of external partnerships and stakeholder engagement</li> <li>+ New examples of internal approaches to risk management</li> <li>+ New information on departments involved and steps taken to address risks</li> <li>+ New information on types of tools businesses are using</li> </ul>
<i>Partnerships</i>	<ul style="list-style-type: none"> <li>+ New information on types of partnerships business are involved in</li> <li>+ New information on potential role of cities in building business resilience</li> </ul>
<b>Barriers</b>	
<i>Types of barriers companies face in addressing climate risks</i>	<ul style="list-style-type: none"> <li>▲ More detailed examples</li> <li>+ New information on common challenges that companies are facing</li> </ul>
<b>Opportunities<sup>23</sup></b>	
<i>Companies acknowledging climate change opportunities</i>	↔ No change: 75/100 companies identify potential opportunities

Note: For ease of review, arrows indicate the qualitative direction of change, tan plus signs indicate new information and gray dashes indicate no change.

## Box 2. Vulnerability Assessments Can Take Many Forms

**Royal Dutch Shell**, a global oil company, has identified a management process for assessing its climate risks throughout its oil and gas operations, e.g. exploration, production, pipelines, communities. Shell's current (2014) adaptation management plan includes: modeling climate impacts on assets (through a collaboration with the UK Meteorological Office), management of climate risks within operating procedures and addressing impacts outside the fence line (outside Shell operations). The company utilizes modeling of future scenarios to help inform investment and design of new projects. For existing assets, Shell uses climate forecasts to conduct a screening approach and rank assets. This plan is a dynamic process, and continues to evolve.<sup>24</sup>

**HSBC** mapped the impact of rising sea levels on 318 critical locations and assessed infrastructure in critical buildings. The company is also developing a Water Risk Assessment Framework to evaluate water security.<sup>25</sup>

### *Climate impacts on water is a common concern, but companies are also alert to other climate stressors*

Companies in various sectors, but especially food and beverage, pharmaceuticals, IT equipment, and mining, rely on water as a critical production input. For these companies, drought can be an important stressor, as can other stressors that affect water supply and demand, such as flooding, changing precipitation patterns, reduced snowpack, heat waves or salt water intrusions associated with sea level rise.

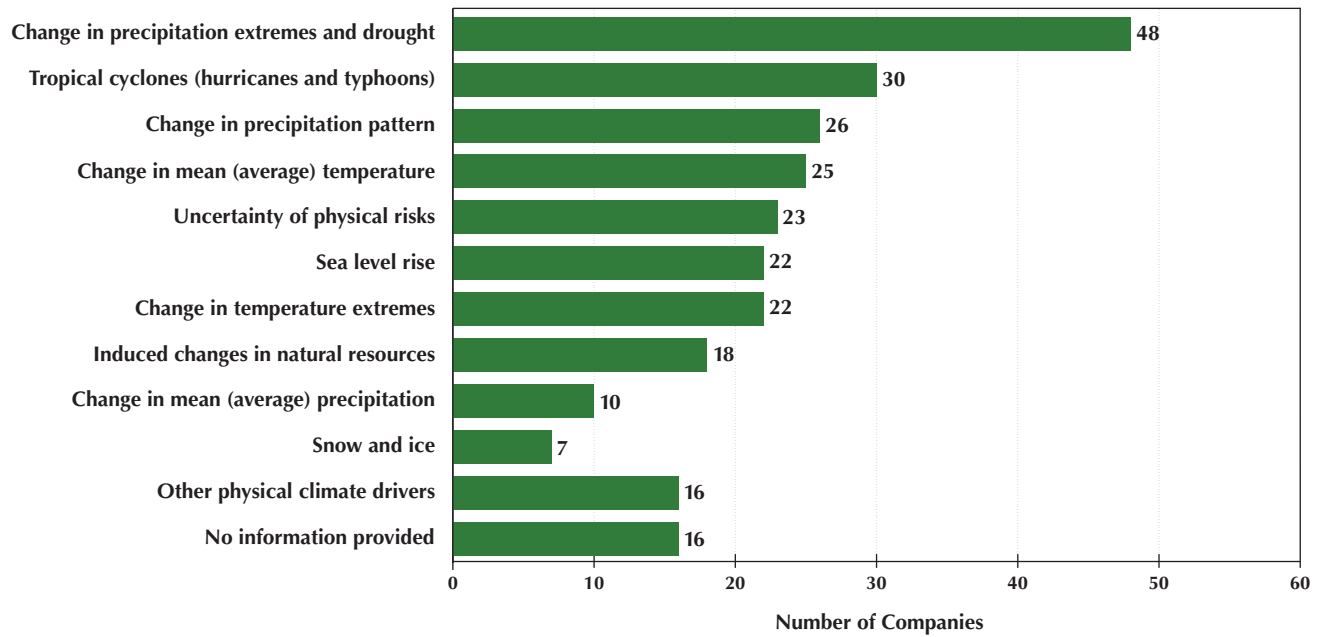
When asked to indicate the types of physical climate risk drivers<sup>26</sup> for their business, companies identified several different stressors, including changes in temperature, precipitation, sea level rise, and storms, as well as uncertainty of physical risks. Almost half of the S&P Global 100 companies identified changes in precipitation extremes and drought as a climate risk driver (48 companies). The dependence on water can be so important that it acts as the primary lens through which a company discusses and manages its future climate risk. While water concerns dominate, **Figure 5** illustrates that many companies are also alert to the more gradual changes, like changing temperatures, precipitation patterns, and

sea level rise. **Box 3** shows an example of the types of impacts that one company highlights.

### *Companies continue to be most concerned about direct impacts on production capacity and operations*

The two most commonly reported direct impacts of concern from extreme weather and climate change are impacts on production capacity (52 companies) and operational costs (46 companies) (**Figure 6**). This result was largely unchanged since *WTS 2013*. Indirect impacts—such as those on capital costs and availability, or on communities and customers—are identified far less frequently as explicit concerns. These concerns were echoed in the interviews with companies. Many identified impacts to operations, facilities, and supply chains as the most important risks. **Box 4** provides example direct and indirect impacts of concern. A number of companies also identified impacts to water supplies as a concern for their business, as water is an essential production input (for agriculture, food and beverage, and some manufacturers) or for thermoelectric cooling for a wide range of companies.

**FIGURE 5: Physical Climate Risk Drivers**

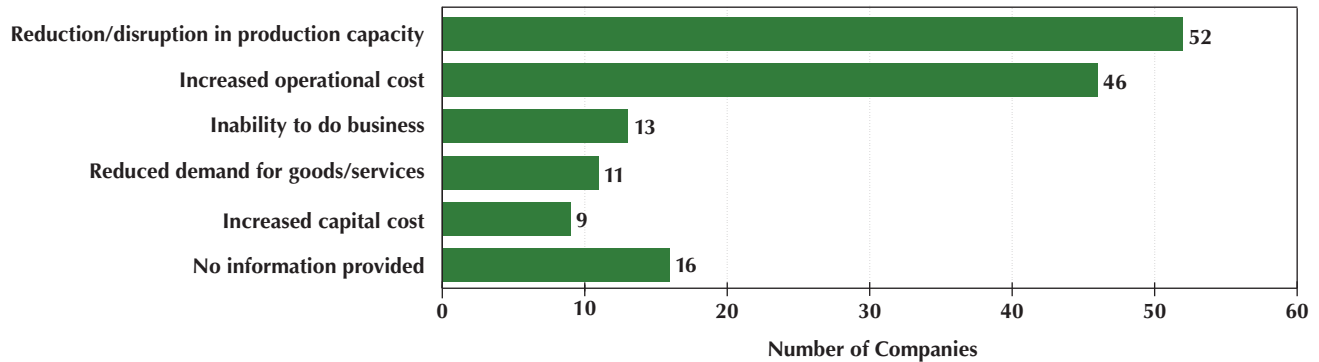


Source: C2ES research based on S&P Global 100 CDP surveys.

### Box 3. Temperature and Precipitation Impacts on Production at Canon Inc.

**Canon Inc.** identifies changes in temperature and precipitation extremes as the climate risks about which they are most concerned, particularly in the Southeast Asia region, where the company has many production facilities. Extreme temperatures could require increased cooling at operational sites, which in turn could result in more energy consumption and increased greenhouse gas emissions. Flooding from extreme precipitation could “cause damage to production facilities, interrupt production, or disrupt physical distribution.” Flooding can also affect suppliers of parts and materials, which would interrupt production, reduce sales, and affect business and management performance. “In October 2011, parts supply shortages caused by Thai floods adversely affected Canon’s production activities, lowering sales by 49.9 billion yen (about \$640 million USD).” Droughts could lead to water shortages at production facilities, “resulting in the suspension of production, sales opportunity loss, and subsequently harmful influences on the company’s business and operating results.”<sup>27</sup>

**FIGURE 6: Current or Expected Impacts from a Changing Climate**



Source: C2ES research based on S&P Global 100 CDP surveys.

#### Box 4. Examples of Direct and Indirect Impacts to Companies

Direct Impacts on Operations: **Chevron Corporation** notes that changes in snow and ice could cause “disruptions to transportation routes in the Arctic...a reduced number of ice roads in the arctic would reduce the number of days available for construction and transportation of products.” Disruption to transportation would limit production capacity and potentially increase operational costs.<sup>28</sup>

Direct Impacts on Supply Chain: Extreme events and changes in climatic variability could affect the yield and quality of crops. **Philip Morris International** is concerned about how the “frequency and severity of heat waves, drought, floods and hurricanes could affect the distribution of pests and crop predators. These could affect the yield and quality of crops and of other raw materials we use.”<sup>29</sup>

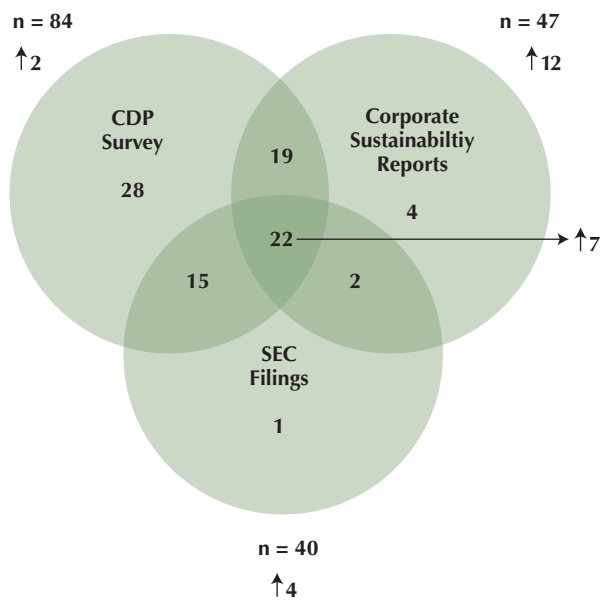
Indirect Impacts on Customers: As a pharmaceuticals company, **GlaxoSmithKline** is concerned with how changes in mean average temperatures will affect patient needs and expectations as the prevalence of some diseases changes.<sup>30</sup>

### III. DISCLOSURES ON CLIMATE RISKS

#### PUBLIC REPORTING ON CLIMATE RISK IS INCREASING

As shown in **Figure 7**, most of the S&P Global 100 companies (84 companies) continue to discuss their climate risk concerns in their responses to the CDP questionnaire, which specifically includes questions on this topic. Substantially fewer companies addressed extreme weather and climate change in their financial filings (40 companies) or in their sustainability reports (47 companies), but this reporting has increased slightly since *WTS 2013*. Eleven percent more (a net increase of four companies) of the S&P Global 100 now report on climate risks in their financial filings and 34 percent more (a net increase of 12 companies) discuss these risks in their sustainability reports. Increases like these indicate that the topic of resilience is gaining more prominence.

**FIGURE 7: Where Companies Report on Physical Impacts of Climate Change**



Source: C2ES research based on S&P Global 100 CDP surveys, sustainability reports, annual reports, and SEC filings.

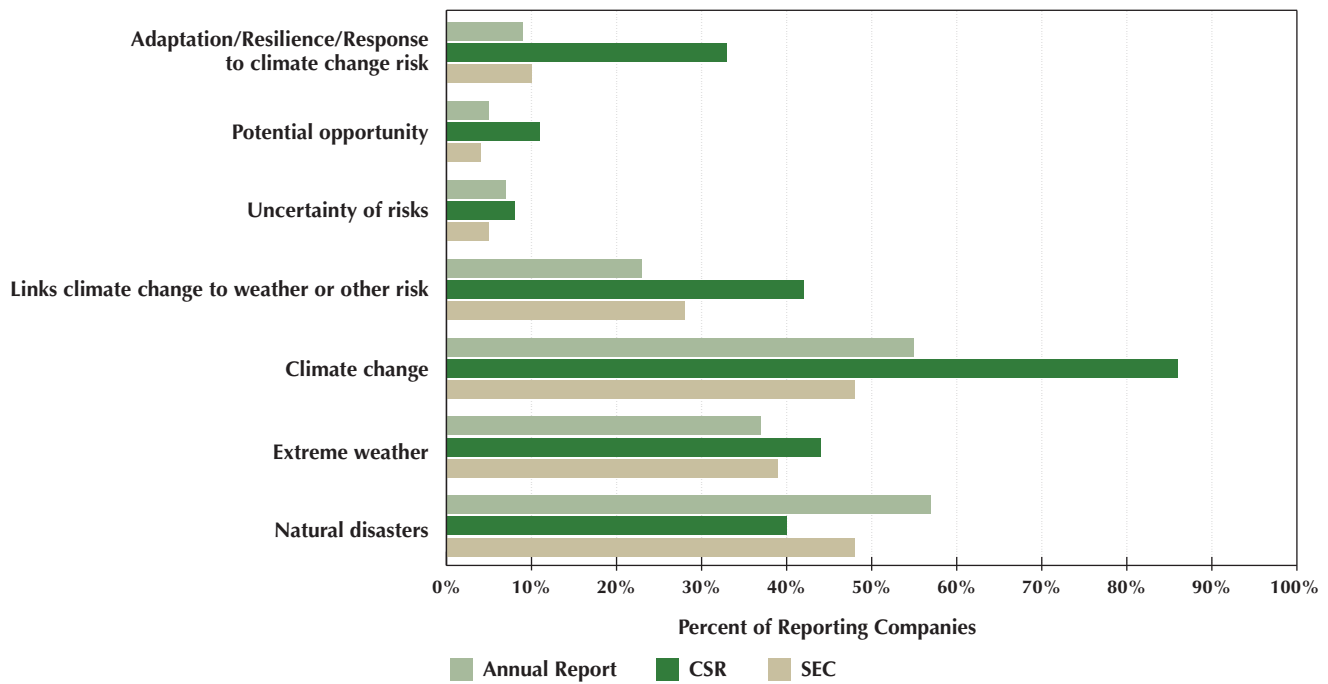
Unprompted by the CDP questionnaire, most companies identify climate change in their sustainability (85 percent) and annual reports (55 percent); 44 percent also mention extreme weather, 42 percent link extreme weather to climate change and 33 percent talk about adaptation and climate resilience. Only when discussing natural disasters did companies tend to report more to the Securities and Exchange Commission (SEC) and in their annual reports than in their sustainability materials. **Figure 8** highlights the relative frequency of various climate risk related topics discussed by companies in non-CDP reporting.

Similar to our findings in *WTS 2013*, there is a large gap between reporting on climate risk to CDP and what is included in sustainability reports or financial filings. This gap likely arises from several causes:

- CDP questions and direct guidance:** Likely the largest reason that climate risk is mentioned more in CDP responses than other reporting is because CDP is a climate-specific disclosure platform, and it has detailed guidance and clear instructions about what should be covered, including questions on climate resilience. While sustainability or financial reports may choose to include some of the same climate-related information, they are not required to do so.
- Different audiences:** While the audience for CDP responses and sustainability reports is typically the environmental/sustainability community, the audience for financial reports and filings is the financial sector and investors. Investors may review CDP responses as a secondary source, but their primary need is a focus on important near-term company specific information that could materially influence their investment decisions.
- Lack of materiality:** Materiality is a central concept in financial reporting and accounting. What constitutes material information is a subjective determination by each company and represents something that could substantially affect economic decisions by the company or investors. By not discussing climate risk in its financial filings, a company is inherently suggesting the risk is not material for near-term economic decisions.



**FIGURE 8: Climate Risk Topics Mentioned in Non-CDP Reports**



Source: C2ES research based on S&P Global 100 sustainability reports, annual reports, and SEC filings.

As discussed in further detail below, because SEC guidance does not require the inclusion of climate risks in financial filings, many companies choose not to include them. For example, 84 of the S&P Global 100 companies acknowledged climate change risks in CDP surveys, but less than half that number (40 companies) included them in financial reporting.

- **Focus on mitigation:** While company sustainability reports typically have an environmental component, the coverage of climate change in these reports generally focuses more on how the company is working to reduce greenhouse gas emissions, save energy, reduce water consumption and waste, etc. While “adaptation”/resilience issues are not as widely covered, an increasing number of companies are beginning to identify climate risks and outline resilience actions in corporate sustainability reports.
- **Organizational structure:** The staff involved in compiling and submitting information for financial filings, sustainability reports, and CDP surveys are often from different departments. The financial staff who compile SEC filings and annual reports may not have insight on climate risks, particularly due to the lack of a requirement to include them.

In addition, sustainability staff may not be directly responsible for climate risk and resilience issues, which are often embedded into risk management or business continuity functions. These organizational silos may lead to a lack of coverage of climate risks and resilience in sustainability reports.

#### DETERMINATIONS OF MATERIALITY CAN BE CHALLENGING

For all of the aforementioned reasons, companies often do not report in their financial filings that climate risk is material. Several organizations that monitor corporate disclosures (e.g., the Global Reporting Initiative, Ceres) have recommended that the SEC invest greater effort to induce more companies to disclose information about climate risks, and improve the quality of these disclosures.<sup>31</sup> Requirements for disclosure would provide an important incentive and justification for climate risk assessment, but clear guidance regarding what constitutes a material physical risk, and the timeframe over which these risks should be considered, are necessary precursors to better SEC reporting. This excerpt from the current SEC guidance reflects how it is relatively imprecise and open-ended:



*Registrants whose businesses may be vulnerable to severe weather or climate-related events should consider disclosing material risks of, or consequences from, such events in their publicly filed disclosure documents.*<sup>32</sup>

This sentence is accompanied by a list of five potential physical impacts on a business arising from severe weather or climate change (coastal damage; disruption to supply chains; increases in insurance claims; decreased agricultural production; increased cost or decreased access to insurance).<sup>33</sup> It is left to companies to

determine which details to disclose, and how they might determine materiality.

This limited SEC guidance has resulted in highly variable answers. Many include little information about risks associated with severe weather and climate change, or they discuss regulatory risks associated with reductions in greenhouse gas emissions. Others include a list of potential climate impacts without much assessment of the likelihood, consequence, or timing of these impacts, and a few draw on the same text submitted to CDP (**Box 5**).

## **Box 5. Wide Diversity of Focus Found in Financial Filings\***

### **Dow Chemical 2013 10K**

*“Climate change matters for Dow are likely to be driven by changes in regulations, public policy and physical climate parameters... Many scientific academies throughout the world have concluded that it is very likely that human activities are contributing to global warming. At this point, it is difficult to predict and assess the probability and opportunity of a global warming trend on Dow specifically. Preparedness plans are developed that detail actions needed in the event of severe weather. These measures have historically been in place and these activities and associated costs are driven by normal operational preparedness. Dow continues to study the long-term implications of changing climate parameters on water availability, plant siting issues, and impacts and opportunities for products.”*

*“As a diversified chemical manufacturing company, the Company’s operations, the transportation of products, cyber attacks, or severe weather conditions and other natural phenomena (such as drought, hurricanes, earthquakes, tsunamis, floods, etc.) could result in an unplanned event that could be significant in scale and could negatively impact operations, neighbors or the public at large, which could have a negative impact on the Company’s results of operations. Major hurricanes have caused significant disruption in Dow’s operations on the U.S. Gulf Coast, logistics across the region, and the supply of certain raw materials, which had an adverse impact on volume and cost for some of Dow’s products. Due to the Company’s substantial presence on the U.S. Gulf Coast, similar severe weather conditions or other natural phenomena in the future could negatively affect Dow’s results of operations... The Company’s ability to produce seeds can be materially impacted by weather conditions.”<sup>34</sup>*

### **Ford Motor Co. 2013 10K**

*“The worldwide automotive industry is governed by a substantial amount of government regulation, which often differs by state, region, and country. Government regulation has arisen, and proposals for additional regulation are advanced, primarily out of concern for the environment (including concerns about the possibility of global climate change and its impact), vehicle safety, and energy independence. In addition, many governments regulate local product content and/or impose import requirements as a means of creating jobs, protecting domestic producers, and influencing the balance of payments.”<sup>35</sup>*

### **Alcatel-Lucent 2013 20-F**

*“Climate Change: We have made a commitment to reduce our absolute carbon footprint (CO<sub>2</sub>e) from our Scope 1 and Scope 2 operations by 50% by 2020 (compared to our 2008 baseline). According to the 2013 operational data available at the time of this report, the reported carbon footprint associated with our operations showed approximately a 32% reduction from 2008 levels.”<sup>36</sup>*

\* Financial filings include SEC Form 10-Ks for U.S.-headquartered companies and SEC 20-F or SEC 40-F for foreign owned companies, or Annual Reports.

The research for this report suggests SEC guidance could be improved through the use of four parameters related to materiality of climate risk:

- 1. Disclosing business impacts from recent extreme weather and climate events.** Drawing on a credible list of recognizable high-impact weather and climate events (e.g., NOAA’s list of [Billion-Dollar U.S. Weather and Climate Disasters](#)<sup>37</sup>; and the lists of major international weather and climate disasters prepared by Aon Benfield’s [Impact Forecasting](#) practice<sup>38</sup> or Munich RE’s [NatCatSERVICE](#)<sup>39</sup>), companies could be required to disclose the impacts to their business associated with these events. Such disclosure would represent a relatively clear standard—in any given year, the number of billion-dollar/major events is likely to include fewer than 20 discrete events for a company to consider. Basing the risk discussion on past events also allows a distinction to be made between the consequences of such an event and the probability or likelihood of such an event recurring at some point in the future. Many current disclosures tend to downplay the former by focusing on the uncertainty of the latter; however, each type of information can be potentially useful for an investor.
- 2. Prescribing specific thresholds for weather and climate risks.** Examples might include events with an annual probability of 1 percent (the 1-in-100 year event) or 0.2 percent (the 1-in-500 year events). These could include events such as tropical storms, flooding, droughts, and heat waves, provided that there was an expected link between that event and business continuity or performance.
- 3. Prescribing specific time periods for weather and climate risks.** Disclosures could be required to differentiate between risks that could potentially affect operations and assets in the coming year, as well as those that affect multi-decade investments and infrastructure. This distinction would allow companies to identify which parts of their business are potentially exposed to long-term risks, without misconstruing these risks as immediate threats.
- 4. Developing tools to enhance the quality of disclosure.** The variability among disclosures demonstrates the difficulty companies often face when trying to determine how weather and climate impacts affect their organizations, and the types of information about future climate conditions

that should be taken into consideration. While the existing [CDP guidance](#)<sup>40</sup> offers examples pertaining to impacts and a brief description about climate change, more information is available on a sectoral or regional basis (e.g., assessments for the [energy sector](#)<sup>41</sup> or the [mining sector](#)<sup>42</sup>, the [National Climate Assessment](#)<sup>43</sup>), which could be utilized in an SEC standard.

The goal for clearer guidance about disclosing physical climate risks is to provide certainty about what should be reported and enhance the transparency of individual companies’ risk management activities. However, this desire for transparency should be balanced with a corporation’s proprietary interests. In addition, investors and SEC need to take into account the various challenges businesses face when reporting climate risks. These can include the differences in timeframes between many climate risks (which may be material over many decades) and investment decisions (which may be focused on the next few quarters); the need to place physical risks from climate impacts in the context of other risks (e.g., regulatory, reputational); and the existence of disclosures that are already widespread (e.g., CDP surveys).

More clear-cut guidance, however, may not change materiality determinations for some large companies. Most of the companies interviewed are large with a global footprint. They produce a diversity of products, on multiple continents with extensive supply chains. An extreme event in one region could cause significant damage, but because of the sheer size and scope of the company, it may be able to redirect production and supplies to compensate for a short-term outage. Siemens, for example, notes in its CDP survey, “based on a systematic risk assessment and evaluation processes... we do not expect that an increase in extreme weather events, including cyclones and hurricanes or changes in precipitation patterns due to the effects of climate change, will generate substantive change in our business operations, revenues or expenditures in the next years. Consequently and in compliance with applied financial reporting requirements, these risks are not included in Siemens Group’s risk reporting in quarterly and annual reports.”<sup>44</sup> Several interviews for this project confirmed this same perspective.

While a company may not consider climate change risks to be material to their business, this does not

mean that the issue of climate is not seen as important, or that the company is not assessing climate risks or taking action on resilience, but rather a short-term view of this risk may keep it from rising to the level as other risks disclosed to SEC. Climate risks may not be seen as material to a large company that has significant capital and enough redundancies in its supply chain and operations to absorb the costs of a particular extreme weather event. However, these companies may still consider the potential longer-term impacts of changing climatic conditions on their business through vulnerability assessments. Companies may also be monitoring the smaller-scale impacts of extreme weather events on their suppliers and the communities in which

they operate. Businesses are aware that they are only as strong as their weakest link, which requires companies to be cognizant of local-level impacts and manage operational disruptions, no matter how small.

The size and geographic diversity of S&P Global 100 companies, differences in timeframes between some climate risks and investment decisions, the inclination to place physical risks from climate impacts in the context of other risks, and the existence of disclosures that are already widespread as well as a lack of SEC guidance likely explain why so few companies report climate risks in their SEC filings.

## IV. APPROACHES FOR RISK MANAGEMENT

### WHILE CLIMATE RISK IS WIDELY ACKNOWLEDGED, METHODS TO ASSESS AND MANAGE CLIMATE RISKS VARY, AND FEW COMPANIES ACTUALLY ASSESS OR MANAGE IT AS A STANDALONE RISK

While companies broadly acknowledge climate risk in their public disclosures, many of the interviews found that climate risk was often too difficult to assess in its own right because of lack of location-specific data, long timeframes, inaccuracy or lack of location-specific information in analytical tools and models, and scientific uncertainty. One interviewee said climate risk was just too “general” and not “particularly useful” as a risk concept on its own. The interviewee further explained that the term “climate risk” often does not resonate within the company, so the key to addressing it is to translate the risk into information relevant for operations. Another explained that companies are driven by black and white data—and climate risk needs to be clearly discernable to drive the management chain to take action. Similarly, others suggested climate-related changes are embedded in other risks companies already manage. The term “threat multiplier” was often used. Along these lines, one company linked the term “hazards” to climate change and noted that hazards are not directly managed but risks are. To this end, climate change is a hazard and creates risk, and this risk is simply applied or layered into other enterprise risk management activities. For example, not having sufficient water to operate would be a hazard, and managing this risk would be part of overall business continuity efforts.

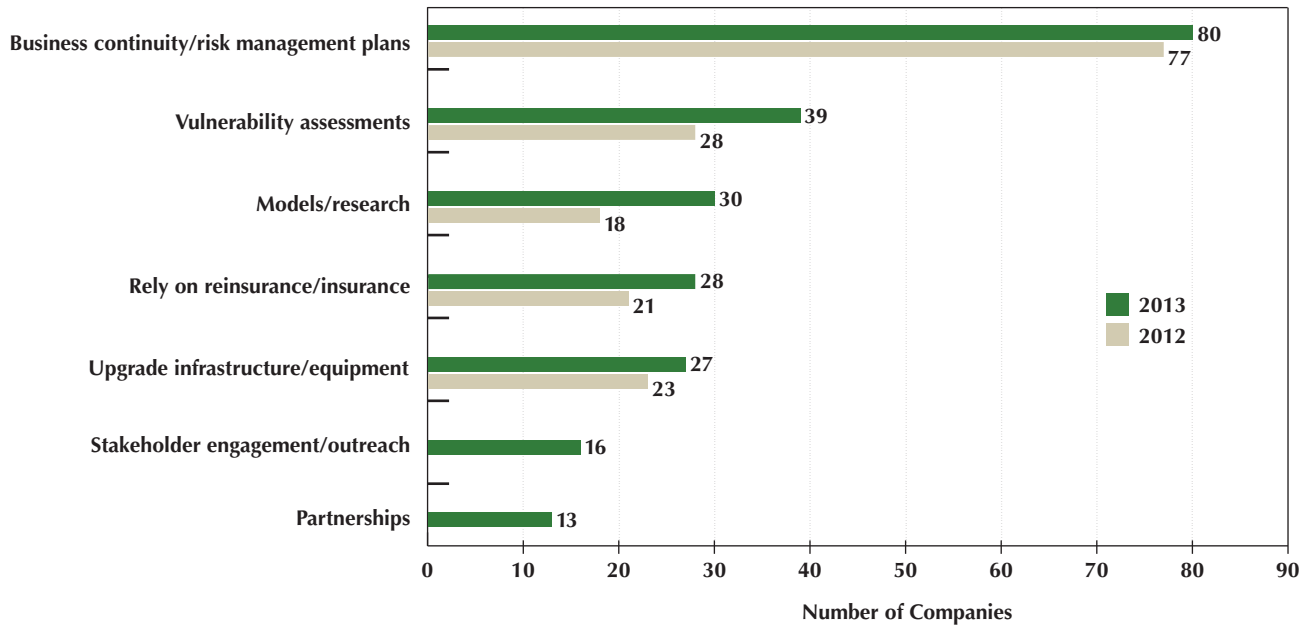
Embedding climate in other existing risks—and in particular water risk—was commonly discussed in interviews. Ensuring the availability of water is an important component of many enterprise risk management efforts, and assessing how climate change will alter this risk in a region or at a facility was mentioned by many of the companies interviewed. Risks to water supply and quality are a high priority for many businesses. Companies in various sectors, but especially food and beverage, pharmaceuticals, IT equipment, and mining, rely on water as a critical production input. For these companies, drought

can be an important stressor, as can other stressors that affect water demands and supplies, such as flooding, changing precipitation patterns, reduced snowpack, heat waves or salt water intrusion associated with sea level rise. Because water is so critical, many companies interviewed mentioned water as they discussed their risk management efforts.

One potential downside of looking at climate change only as an existing risk amplifier is that potential implications and/or potential opportunities could be missed. For example, climate change will have a broad suite of implications, including sea level rise, impacts on precipitation, species movement, melting of sea ice and opening of transportation routes, reduction and increase of demand for heating and cooling, frequency and severity of storms, etc. Assessing only how climate change will affect existing threats could miss significant risk vectors. In addition, climate change can cause cumulative and indirect effects that may not be immediately evident when examining existing risks. For example, the cumulative impacts of higher storm surges and increases in sea level may not be considered in traditional risk management when looking at potential risks from coastal flooding to facilities. In another example, it is important for companies to consider how increasing temperatures and more heat waves will affect customer health and behavior. As one interviewee put it, “a failure to comprehensively plan is a plan to fail.”

Companies that acknowledge climate risks to their business use a variety of methods to assess and manage these risks (**Figure 9**). Company interviews suggest that while a stepwise process is almost universally true, companies may choose to start at different points and pursue risk management in a different order. For example, starting with a narrowly scoped vulnerability assessment that examines only one region or only one impact is an option companies are using to raise internal awareness and assess the need for a broader more inclusive (and potentially more expensive) vulnerability assessment, similar to **Figure 10**. **Box 6** provides examples of how different sectors may approach climate risks.

**FIGURE 9: Comparison of Top Climate Risk Management Activities**



Note: Stakeholder engagement/outreach and partnerships were not quantified in WTS 2013.  
 Source: C2ES research based on S&P Global 100 CDP surveys.

**FIGURE 10: Management Framework**



\*Initial vulnerability assessments can focus on specific impacts or regions.

## Box 6. Business Sectors May Approach Climate Risk Differently

- Consumer products that rely on agricultural commodities and water supply may be more likely to assess future climate risks because of direct impacts on the supply chain and their products. For example:
  - **Pfizer** has assessed which regions and facilities are at risk of operational issues associated with water shortages.<sup>45</sup>
- IT companies are more often concerned about infrastructure (data centers) and potential disruption to operations, which may occur through extreme events. For example:
  - **EMC Corporation** notes that “extreme weather events as hurricanes, floods, droughts, ice storms, and other extreme weather conditions have potential to disrupt our supply chain either by disrupting the production capability ability of our direct or indirect suppliers, or by impacting logistics.” Flooding in Thailand in 2011 caused disruption to production.<sup>46</sup>
- Extractive industries have threats to operations from water supply, storms, sea level rise, etc., and often address climate change through existing risk management. For example:
  - **Total** utilizes its crisis management team to prepare for climate-related events. Most of their major production sites are located outside hurricane areas. In addition, the threat from larger and rougher sea waves is now taken into account in the design and maintenance of offshore installations.<sup>47</sup>
- Financial companies look at how risks will impact portfolios. For example:
  - As an insurer with a property and casualty portfolio, **Aegon** continuously monitors the risk posed by changes in physical climate and incorporates those risks into its underwriting procedures.<sup>48</sup>
- Telecommunications and utility companies have historically had to consider weather impacts on services, so many are considering upgrades and implementing changes to become more resilient. For example:
  - **E.ON** has undertaken operational and infrastructure improvements to increase the resiliency of its generating assets and transmission and distribution networks to extreme events and seasonal and weather-related fluctuations.<sup>49</sup>
  - **National Grid** is upgrading vulnerable transmission substations to be able to withstand a 1,000-year flood event.<sup>50</sup>



## **BUSINESS CONTINUITY AND RISK MANAGEMENT PLANS REMAIN THE MOST COMMON WAYS COMPANIES ADDRESS WEATHER AND CLIMATE RISKS, BUT MANY PLANS INCLUDE ONLY HISTORICAL OR STATIC RISK, AND NOT A CONSIDERATION OF HOW THIS RISK IS CHANGING**

Almost all companies have well-established business continuity and emergency management plans to address natural disasters, including extreme weather events (see **Box 7** for examples). Most S&P Global 100 companies (80 companies) report to CDP that the methods used to manage physical climate risks are incorporated into their existing business continuity or risk management planning processes. This is a slight increase (4 percent) from the 77 companies identified in *WTS 2013*.

Managing climate risk as an amplifier of existing risk and as part of conventional business continuity planning has both pluses and minuses. Interviews suggested that this approach can help put climate risk into the “language of business” which may result in greater buy-in and attention. However, interviews also suggested that many companies are assuming a static view of climate risks. They are not adjusting the risk landscape to account for future climate-related changes. For example, several companies interviewed noted they were generally using historical data about the likelihood of events and were not specifically using climate projections of how these and other risks would change over time. This was in part because climate projections may not be granular enough to project future risks with the same detail historical records provide. As a result, their business

continuity plans may miss certain risks and risk interactions, and they may well be underinvesting in resilience. Historical weather patterns in most areas of the country are no longer considered accurate, especially for future planning. For example, using the historical standard of weather extremes (e.g., a “100-year flood”) will not accurately account for these becoming more frequent or intense under climate change. As noted in the 2009 National Climate Assessment, “historical weather patterns are no longer a reliable predictor of the future.”<sup>51</sup>

A vulnerability assessment is often a first step in assessing how climate change will influence existing risks. More companies are doing some type of climate vulnerability assessment, but there is no one standard approach for conducting a business vulnerability assessment. Some companies choose to focus their vulnerability assessment on a particular region (such as Exelon, see example in **Box 8**) or stressor, such as flooding, or resource availability. Other companies may take a broader look at how changing physical conditions will affect all parts of their business.

Companies also report on specific actions aimed at reducing risks, such as upgrading equipment or infrastructure (such as Sempra, see example in **Box 9**) and transferring risk through insurance policies. For example, Wal-Mart uses an insurance strategy to address weather-related risks: “In light of the substantial premiums payable in the current insurance market for insurance coverage for losses caused by certain natural disasters, such as hurricanes, cyclones, typhoons, tropical storms, earthquakes, floods, and tsunamis, as well as the limitations on available coverage for such losses, we have

### **Box 7. Examples of Business Continuity Planning**

**3M** has incorporated extreme weather and climate changes into its business continuity planning process and crisis management program. At the top level of management, 3M’s Corporate Crisis Management Committee is responsible for addressing physical risks. In addition, each facility has “a crisis management team that implements crisis management plans that address a variety of weather-related and other potential interruptions to operations. Every year, each local crisis management team must review their plan for current conditions and must perform a tabletop or actual exercise...3M has also attempted to mitigate physical risks by maintaining appropriate stocks of critical raw materials and by entering into contingency plans with suppliers of key raw materials to ensure some allocation to 3M of available supplies following a weather-related disruption at a supplier location.”<sup>52</sup>

**Credit Suisse** has a business continuity management process that “includes procedures to back up and recover critical systems and data, strategies to sustain critical business functions using alternate local or overseas workspace facilities and capabilities to communicate with key stakeholders, including employees and customers.”<sup>53</sup>

chosen to be primarily self-insured for such losses.”<sup>54</sup> In our interviews, we asked companies whether they had adjusted insurance in response to climate change risks specifically. Most companies responded that they had not adjusted insurance to reflect climate risks to date, but that these risks may be considered through ongoing adjustments to insurance as part of conventional risk

management. One company, however, reported that their insurer actually performed the risk evaluation for them and suggested steps that would reduce the cost of coverage.

Several companies also noted their engagement in partnerships with stakeholders or technical experts aimed at reducing risks. While these management

## **Box 8. Exelon: A Closer Look at Climate Risk and Resilience**

Exelon is one of the largest electricity providers in the United States, headquartered in Chicago. Exelon serves more than 10 million customers, including more than two-thirds of the Fortune 100 companies in the United States. With an emphasis on providing safe, reliable, and affordable electricity, Exelon conducts regular assessments of infrastructure resilience by examining the ability of its system to continue operation during adverse weather events and resume as quickly as possible in the event of a disruption.

Climate change and infrastructure resilience are key parts of its overall environmental strategy. The potential climate risks of concern include extreme temperatures that can affect generation station efficiency, changing regional temperature averages that shift electricity demand, and potential disruptions to transmission and delivery systems that can result from increasing storm frequency and severity. Exelon also closely monitors drought risk and changing precipitation patterns that have the potential to affect electricity production and distribution. In 2014, Exelon-operated facilities used approximately 37.9 billion gallons of water per day (98 percent of which is directly returned to the source).

Water-related climate change risks may:

- Disrupt cooling water supplies at thermal generation stations
- Restrict cooling water discharges due to lower water levels and warmer ambient temperatures
- Limit production levels in water-scarce areas to comply with water supply and discharge permit limits

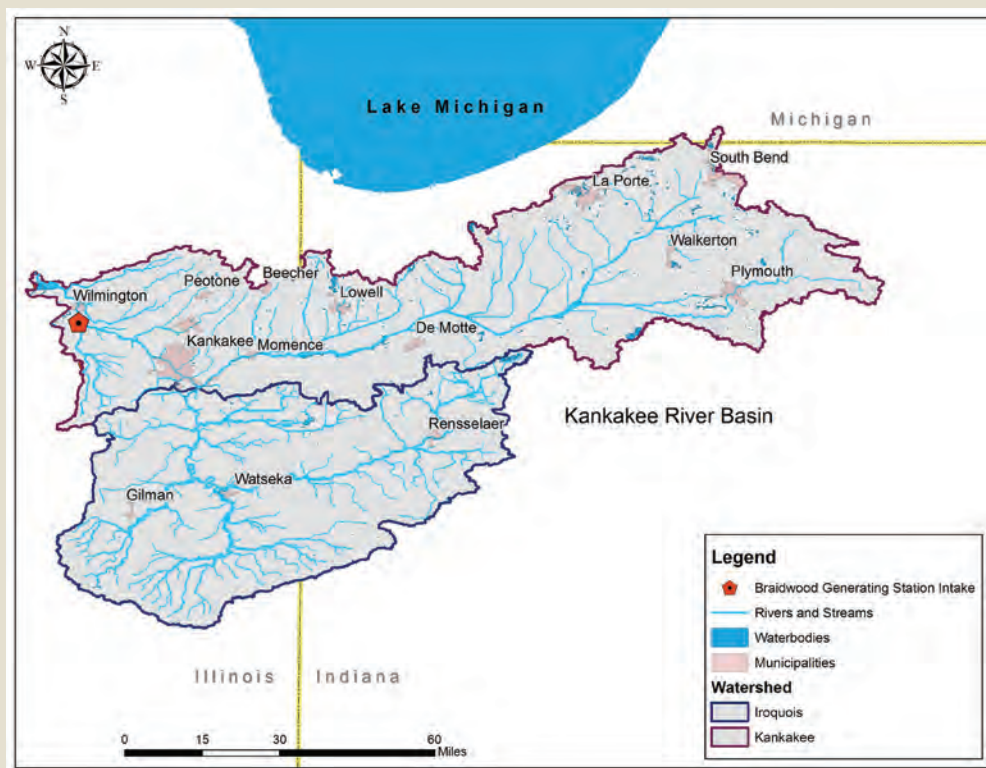
Exelon uses a number of tools to identify locations where the company’s U.S. generation fleet is vulnerable to water risks, including WRI’s Aqeduct tool. Following this identification of potentially water-stressed areas, Exelon has undertaken a stepwise approach to more fully understand its potential water vulnerabilities by conducting a comprehensive assessment of its water vulnerability in one particular region (shown in the map below). Starting with the creation of a detailed watershed model that coupled regional hydrologic and climate change forecasts, they examined how multiple stressors, including increased upstream use and lower flows correlated to temperature expectations would affect water availability. Understanding how stressors in this region affect water availability provides insights useful for other regions and for the broader water risks that could affect the business.

Understanding these risks is essential for long-term decision making. Exelon, for example, has begun integrating water scarcity projections into its investment decisions. New gas-fired, combined-cycle power plants Exelon is building in water-stressed areas have been specifically designed to be air-cooled rather than water-cooled to minimize the risk of water availability. Exelon is also working with its utilities to help customers manage and reduce energy use during heat waves.

To promote better alignment across the company and with the broader electric industry, Exelon joined the DOE Partnership for Energy Sector Climate Resilience in 2015. Through the partnership, Exelon will be identifying climate change vulnerabilities, developing and pursuing a resilience strategy, and measuring and reporting on progress. Understanding how multiple stressors affect water availability in one watershed is an important component of their step-wise approach to assessing their climate vulnerability and building enhanced resilience.



## Box 8: Exelon: A Closer Look at Climate Risk and Resilience (continued)



Source: RTI International.

statistics are taken from CDP responses, they reflect interview results which also suggest that these activities are not mutually exclusive. Companies may use some or all of these approaches to address their climate risk.

Among the sectors (**Figure 11**), we found that banking and insurance companies are most involved in conducting climate-specific research and utilizing climate models, and these companies rely on reinsurance or insurance to protect against risks. Upgrades to infrastructure and equipment are a major focus of many materials companies, while consumer goods companies are most involved in conducting vulnerability assessments. Using business continuity planning to incorporate climate risks is common across all sectors, but most frequently mentioned by financial and consumer goods companies. Engagement in stakeholder outreach and partnerships is a focus of banking, materials, and consumer goods companies.

Interviews also suggested that companies that have established institutional experience in managing past weather and climate variability have often taken more

action in addressing future climate risks. For example, companies that rely on agricultural commodities already use explicit temperature and precipitation forecasts to understand risks to water supplies and crops. Considering future impacts from climate change can often be more easily integrated into these existing business operations. However, companies that do not routinely address changing weather conditions as part of their business may have more difficulty incorporating climate change into their planning. For example, it may be difficult for a manufacturing company to make the case for investments in hardening coastal infrastructure if damaging events have not occurred often, or only occurred very recently, and coastal flood risk is not directly connected to their production process.

### A VARIETY OF TOOLS ARE AVAILABLE FOR ASSESSING CLIMATE RISKS

Companies use a variety of risk assessment tools to analyze climate stressors, including changes in temperature, precipitation, sea levels, and storms. The types of

## Box 9. Sempra Energy Responds to Water and Wildfire Risks

Sempra Energy is a Fortune 500 energy services company with more than 32 million customers worldwide. San Diego, California—where Sempra has its home base—is in the midst of a serious drought that has implications for both electricity generation and distribution of power. Power generation requires significant amounts of water for cooling, and power distribution wires cross vast expanses of land that is vulnerable to wildfire.

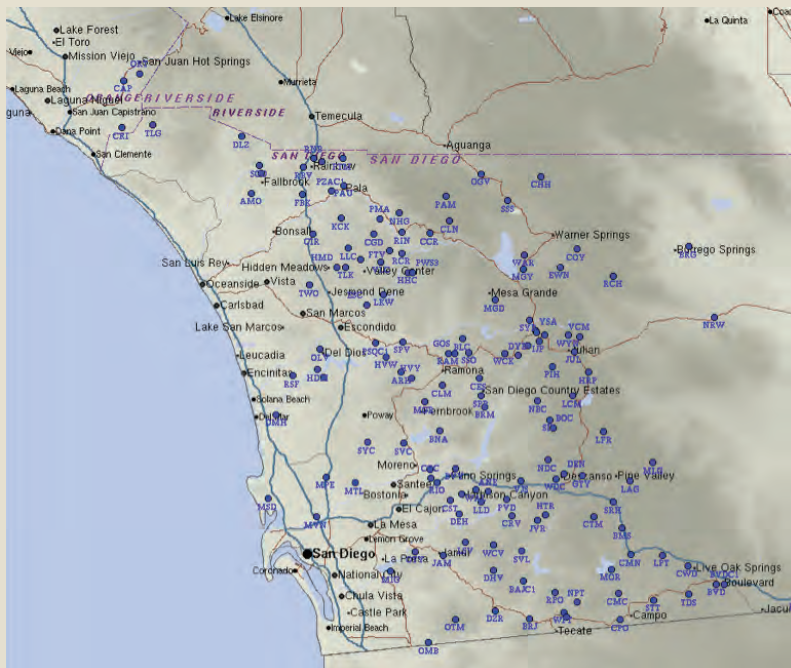
Sempra has made using less water a priority across the entire company from its operations to its facility landscaping. For example, Palomar, operated by subsidiary San Diego Gas and Electric (SDG&E) in Escondido, California, uses reclaimed and treated wastewater for cooling. Desert Star, another SDG&E-operated power plant near Boulder City, Nevada, utilizes dry-cooling, which uses 90 percent less water than a traditional power plant.

Water supply and availability, however, is not the only concern. Wildfires have been identified by Sempra as a significant threat, especially as climate projections indicate that future risk will increase. In 2003 and 2007, San Diego and its surrounding region experienced two of the largest wildfires in California history. Over 300,000 acres was burned, roughly 13 percent of SDG&E service territory was impacted, and over 300,000 people were evacuated in both firestorms.

To enhance fire preparedness, SDG&E has taken a number of actions within their own operations and has partnered with local communities, federal agencies and academic institutions. To strengthen its overhead electrical system, for example, the company has been changing out wooden power poles for steel to make the grid more resilient to the impacts of wind and fire. The company also hired in-house meteorologists and installed 150 weather stations across its service area to gather real-time information and monitor the impact of weather on utility equipment (see map below).

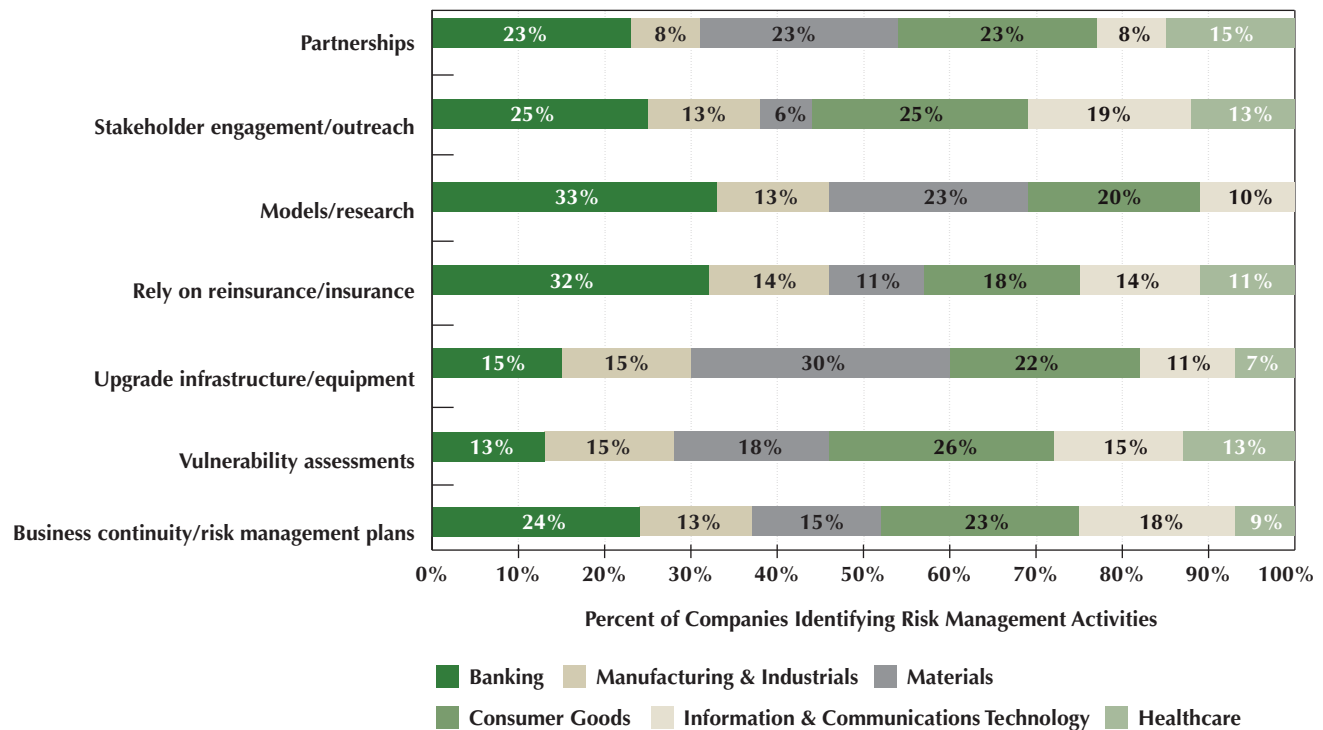
SDG&E also partnered with the U.S. Forest Service and the University of California, Los Angeles, to develop a web-based tool to classify the fire threat potential during Santa Ana winds. The [Santa Ana Wildfire Threat Index](#) will be used to help fire agencies, other first-responders and the public determine the appropriate actions to take based on the likelihood of a catastrophic wildfire fueled by high winds.

### SDG&E Weather Station Network



Source: SDG&E, <http://50.23.1.31/maps/stations.gif>

**FIGURE 11: Breakdown of Sector-Specific Findings on Risk Management Activities**



Source: C2ES research based on S&P Global 100 CDP surveys.

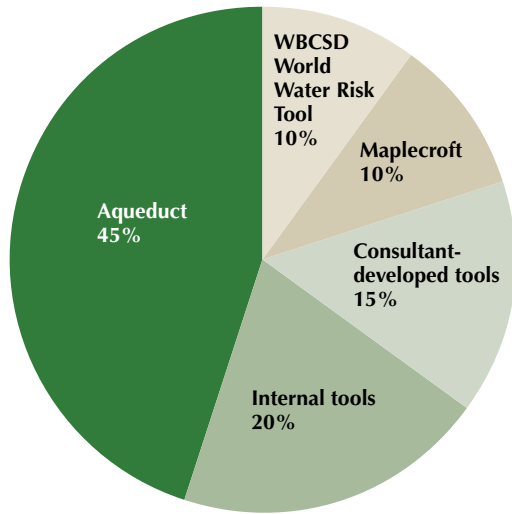
tools identified by companies interviewed are shown in **Figure 12**. These types of tools have been developed by a variety of groups, including other private companies, industry trade groups, consultants, non-governmental organizations (NGOs), and academics. Some risk assessment tools focus on a particular risk, such as water or storms, while others focus on a wider set of risks for a particular sector (e.g., agriculture) or aspect of business (e.g., supply chain management).

The important role of water in climate risk management is indicated by the common use of water-risk tools. Of the companies interviewed, 45 percent indicated they had used the World Resource Institute’s (WRI) Aqueduct tool to assess water risks to their business, with the remainder using the World Business Council on Sustainable Development’s (WBCSD) Global Water Tool, Maplecroft’s global risk and resilience indices, or other proprietary consultant or internally (or industry association) developed tools.

**HOW AND WHO MANAGES CLIMATE RISK IS VARIED**

Companies take a variety of different approaches to address climate risks and resilience, usually basing internal management strategies on how the company is structured and organized, the types of services or products they provide, resources available, and geographic considerations. In many cases, several departments or groups within a company are involved in addressing climate risks (**Figure 13**). Within the group of companies interviewed, the departments most frequently involved in addressing climate risks included risk management (26 percent) and environmental or sustainability departments (26 percent). Companies also mentioned the involvement of business continuity planning, operations, engineering, facilities and asset management, and emergency and disaster management. A few companies noted that departments responsible for water issues were heavily involved in addressing climate risks, because of the importance of water to their business. It is clear from these results that there is no one department across all businesses that is solely responsible for addressing

**FIGURE 12: Tools used by Companies for Assessing Climate Risks**



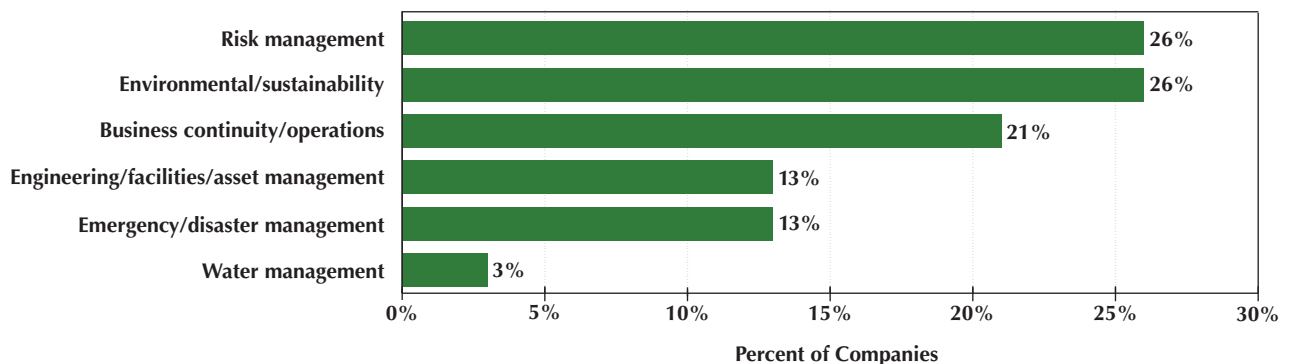
Source: C2ES research based on interviews with companies.

climate risks. In many cases, various departments within a company may be involved in evaluating and addressing climate change risks to the business. Various interviewees noted that there can be challenges in having multiple departments involved in these activities, particularly if approaches and strategies are not communicated effectively across groups. For example, sustainability departments at the corporate level may not be aware of risks facility managers are already dealing with on the ground.

When assessing climate risks and implementing resilience planning, companies seemed to use two different approaches: top-down and bottom-up. Top-down approaches involve companies conducting an assessment of risks across the enterprise. This type of approach generally allows a company to examine the potential risks to core operations (e.g., facilities, production processes, maintenance) and the value chain (e.g., production inputs, suppliers, employees, customers) at a higher level. This approach can serve as a first step in screening which types of vulnerabilities, and which aspects of the corporation, should be prioritized or further evaluated through in-depth assessments. Companies may use this approach when their operations are geographically widespread, or when a consistent approach is required across diverse business units. Diageo is one such company that used a top-down approach in evaluating climate risks (Box 10).

Bottom-up approaches involve companies choosing to focus on specific areas of their core operations or value chain for assessments of risk or resilience planning. For example, a company may choose to conduct a vulnerability assessment on a particular facility because it is essential for operations or because it has historically experienced exposure to risk (Box 11). This type of approach allows a company to focus resources on an essential or highly exposed part of its operations, and to experiment or learn more about the process of assessing vulnerability (e.g., the types of data required, the types of partnerships that are most helpful, or how to conduct research or communications with internal staff, suppliers, or customers). If desired, these small-scale efforts can be replicated to other facilities, regions, or business units.

**FIGURE 13: Departments Involved in Addressing Climate Risks**



Source: C2ES research based on interviews with companies.



## Box 10. Addressing Climate Risk and Resilience at Diageo

**Diageo** is a global leader in beverage alcohol with an outstanding collection of brands across spirits, beer and wine categories. These brands include Johnnie Walker, Crown Royal, J&B, Windsor and Buchanan’s whiskies, Smirnoff, Cîroc and Ketel One vodkas, Captain Morgan, Baileys, Don Julio, Tanqueray and Guinness. Operating production and distribution facilities in over 30 countries, including Australia, Canada, Cameroon, Ghana, Ireland, Jamaica, Kenya, Nigeria, Uganda, the United Kingdom, and the USA, they use a variety of agricultural commodities in their products, and water is always a primary ingredient.

This dependence on agriculture and water supply makes Diageo particularly aware of climate change impacts, including changes in temperature or precipitation and sea level rise. For example, drought has disrupted production in Kenya, Ghana, and the Seychelles, and flooding has affected production in Ireland and Australia.

To better understand and manage these risks, Diageo conducts annual company-wide evaluations of the potential risks to water in its own operations as well as in key agricultural sourcing areas. Using the Aqueduct tool looking out to 2025, combined with other tools and site assessments, the company identified 45 potentially water-stressed production locations that produce over one-third of Diageo’s packaged volume. Many of these sites are in Africa and India where water shortages can not only impact production, but also local communities and the availability of key agricultural commodities. To help address this scarcity, Diageo has an integrated water strategy—Water Blueprint—which adopts a four-platform approach including raw materials, production, advocacy, and investing in community infrastructure and sanitation programs through its *Water of Life Program* (which helps provide community access to safe water and sanitation, primarily in Africa). As part of the production element, the Water Blueprint includes aggressive targets for improvements in water efficiency as well as wastewater treatment. Moving beyond its own four walls, the company also has a target, specific to its water stressed locations, to replenish the water used in finished products. This target will be achieved through community projects in stressed watersheds and will be aimed at watershed protection, increasing the productive use of water in agricultural sourcing, and improving access to clean water and sanitation.

Because water scarcity in combination with temperature change has significant implications for agriculture, Diageo has assessed the top six most critical agricultural commodities (cream, sorghum, barley, grapes, agave, and sugar) for current and future risk factors. With these factors in mind, the company can assess, manage and strategically source the longer-term acquisition of these products. For example, the company recently modelled the potential impacts of rising temperatures on the amount of land suitable for growing barley in Kenya, a key beer market for Diageo. The results of the analysis will be used to inform medium-to-long term sourcing strategies in the area. Diageo is also working to develop and expand the local market and supply of sorghum and cassava in Africa as both crops can grow in semi-arid regions with poor soil and are more drought-tolerant.



Source: Diageo.



### Box 11. Anglo American Selection of High-Risk Facilities

Anglo American assessed the potential climate change impacts on selected high-risk operational facilities, including their Minas-Rio iron ore project in Brazil and coal and platinum operations in the Olifants River catchment in South Africa.

The company also conducted a study on incorporating climate and weather model data into project design. The study focused on Anglo American’s Michiquillay copper project in Peru, which was identified as an area of potentially high risk from the physical impacts of climate change. The outcomes of this research influenced an internal best practice guide on implementing climate adaptation within new projects across the company.<sup>55</sup>

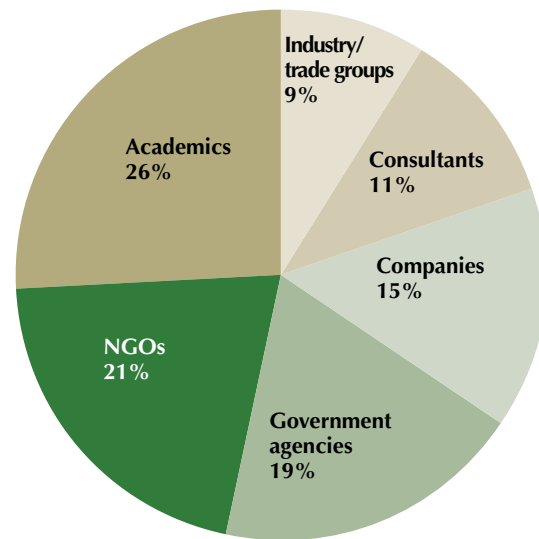
A number of companies use a hybrid of these two approaches. For example, a company may conduct a vulnerability assessment and implement resilience at one facility and then choose to replicate this approach for other facilities. The approach used by a company will be determined by the structure of the organization, and what makes sense for the business as a whole.

#### PARTNERSHIPS CAN BE HELPFUL

Companies form partnerships with various types of groups, including academics, NGOs, government agencies, other companies, industry and trade groups, and external consultants. Of the companies interviewed, the most common partnerships were with academics (26 percent), NGOs (21 percent), and government agencies (19 percent) (Figure 14). Many of these partnerships are developed to get access to data, tools, or other services, particularly in the case of partnerships with academic institutions. But many partnerships also serve the purpose of leveraging efforts and engaging with stakeholders within the community to address climate issues (Box 12). Companies and communities increasingly recognize the need to integrate their respective resilience planning (see Box 13 for Exxon’s work in this area). Company and city interviews both highlighted the need to consider regional impacts and coordinated efforts. Public-private partnerships focused on climate resilience are growing as businesses work together with local, state, and federal agencies to address climate risks (Box 14 for how Pacific Gas and Electric has worked with government agencies).

For example, Allianz partnered with the World Wildlife Fund to evaluate the risks of climate change on the financial services industry. This partnership led to the report, *Major Tipping Points in the Earth’s Climate System and Consequences for the Insurance Sector*, which focuses on the consequences of four tipping points (sea level rise, droughts, shifts in monsoons, and rainforest dieback) for insurers.

FIGURE 14: Partnerships Companies are Involved In



Source: C2ES research based on interviews with companies.

### Box 12. Companies Engaging with Stakeholders

Nestlé provides support, training and technical assistance to local farmers who are part of their supplier network in order to ensure long-term sustainability of resources. As part of their NESCAFÉ Plan, the company works with the Sustainable Agriculture Network to encourage farmers to implement adaptation to enhance farms’ resilience to climate change. Nestlé also engages with various stakeholders to address water conservation issues. For example, 128 milk producers in Nicaragua have received training on protection of local water resources.<sup>56</sup>

### **Box 13. ExxonMobil: Managing Climate Risk and Engineering for Resilience**

As the world's largest publicly traded international oil and gas company, ExxonMobil conducts business in a wide range of challenging physical environments across the globe, and has done so for many decades. The company's extensive design, construction and operating experience makes it very familiar with the risks associated with different physical environments. It is particularly aware of the risks posed by extreme weather events. The company also recognizes the risks climate change could potentially introduce for any facilities that are sufficiently long-lived to be exposed to slowly changing average physical conditions.

When considering the potential risks from climate change, ExxonMobil evaluates the type and location of its current and future facilities. As an example, offshore facilities could be impacted by changes in wave and wind intensity as well as ice flow patterns, while onshore facilities could be vulnerable to sea level rise and changes in storm surge. In the Arctic, long-term changes in ice and permafrost could impact the design of structural foundations.

Understanding these risks enables the company to design, build, and operate its facilities to withstand a variety of extreme climatic and other conditions. Safety factors in design and construction cover a number of engineering uncertainties, including those associated with potential climate change impacts. After construction, ongoing facility integrity is monitored and managed, for example through periodic checks on key aspects of structures. In addition, the company regularly participates with major engineering societies and industry groups to assess and update engineering standards to manage the risks of extreme weather.

Once in operation, the risks of extreme weather are also addressed by emergency management planning. Detailed, well-practiced, and continuously improved emergency response plans at each facility help the company prepare for extreme weather events. Regular emergency drills are practiced in partnership with appropriate government agencies to help ensure readiness and minimize the impacts of extreme weather events.

In short, resilience to extreme physical environments is embedded in ExxonMobil's risk management framework. While the current scientific understanding of the likelihood, magnitude, frequency or geographic distribution of weather events resulting from climate change presents planning challenges, ExxonMobil's systems enable the company to manage a wide variety of possible outcomes over the coming decades.



*Source: ExxonMobil.*

## Box 14. Pacific Gas and Electric's Multi-Faceted Approach to Addressing Climate Risks

Based in San Francisco, Pacific Gas and Electric Company (PG&E) provides natural gas and electric service to nearly 16 million people throughout Northern and Central California. As part of its broader climate change commitment, the company is working in a variety of ways to address the need to adapt to changing climate conditions.

As an energy provider, PG&E has identified a range of potential risks to its business, including sea level rise, temperature changes, rainfall and runoff patterns, wildfire risk, and storm frequency and intensity.

To address these risks, PG&E is taking a multi-faceted approach:

- Robust emergency response plans and procedures to address near-term risks, including more extreme storms, heat, and wildfires.
- A multi-year, comprehensive risk assessment process to prioritize infrastructure investments for longer-term risks.
- An in-house climate change science team that regularly reviews the most relevant science and integrates its research into PG&E's risk assessment process.
- Active engagement at the federal, state, and local level on climate change adaptation and resilience, including joining DOE's Partnership for Energy Sector Climate Resilience as a forum to share best practices on reducing vulnerabilities to climate impacts.

As the drought continues in California, PG&E is working proactively to ease its impact on customers, communities and its operations. This includes strategically managing water supplies to optimize its hydropower operations, coordinating with key partners like local Fire Safe Councils to prevent and respond to wildfires, and helping its agricultural and other customers reduce water and energy consumption. In fact, through its energy efficiency measures that promote water conservation, PG&E achieved water use savings of about 1.8 billion gallons in 2014. Another area of focus is making substantial investments to build a more modern and resilient gas and electric system that can better withstand extreme weather and natural disasters.



Source: Pacific Gas and Electric Company.



## V. PERSISTENT BARRIERS TO BUILDING RESILIENCE

*WTS 2013* identified a variety of barriers that limited a company's ability to develop comprehensive forward-looking climate resilience plans. These included:

1. The inherently uncertain nature and long-term horizon of the changes involved
2. The absence of easily accessible, scientifically credible, location-specific, and user-friendly information on the changes in weather related risks
3. Limitations of current climate change modeling
4. Low levels of awareness and expertise within a company
5. A context of multiple stresses
6. Competition for company resources

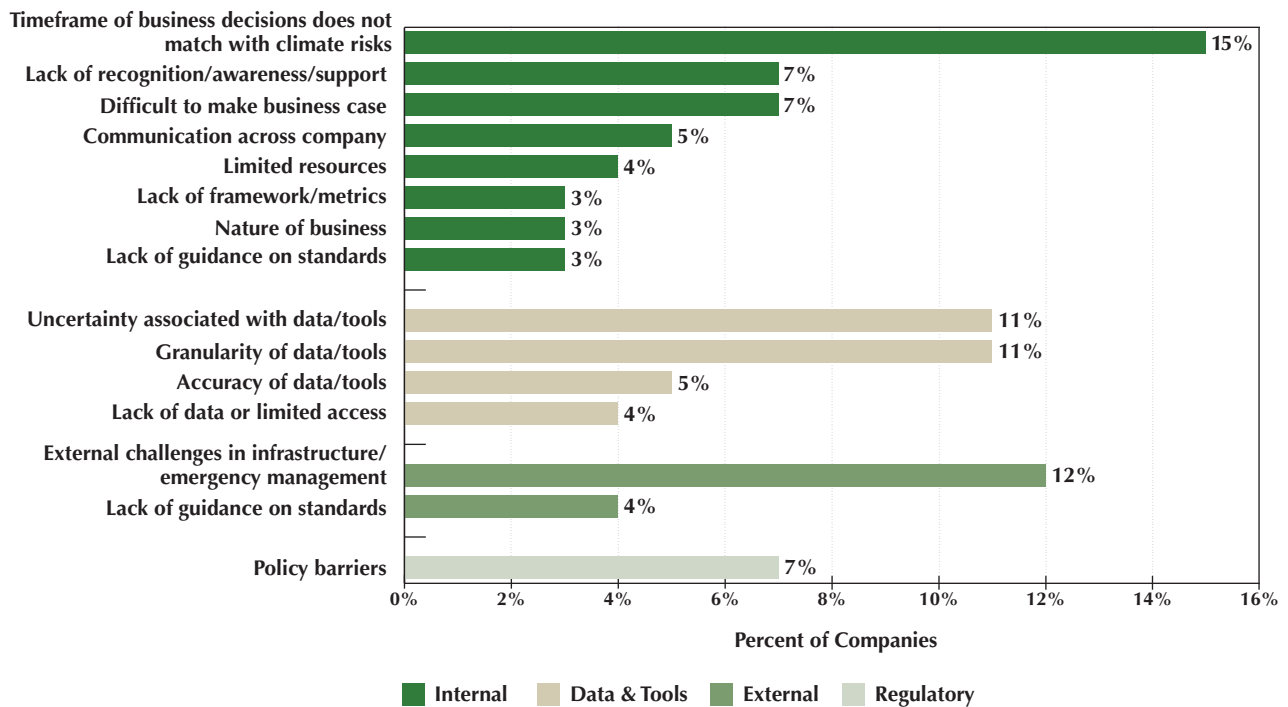
7. Lack of investment by governments in public infrastructure

Since the release of the *WTS 2013*, some barriers are beginning to be addressed but others remain (**Figure 15**).

### CLIMATE DATA AND TOOLS HAVE IMPROVED, BUT STILL PRESENT CHALLENGES

While more climate-related data and tools exist today, companies still report that data limitations affect their ability to plan for future climate risk. Interviews suggest that much of the available climate data lacks the level of granularity needed to assess business risks. Most climate

**FIGURE 15: Types of Barriers**



Source: C2ES research based on interviews with companies.

models provide projections at global, national, or regional levels. Companies, however, often want to know what the expected impacts will be at a specific facility or at a specific location. In other words, they want “actionable science.” The spatial resolution of climate data and tools is improving, but has yet to evolve to a level that companies can easily use to assess climate risk in their business planning. The lack of granularity (e.g., not location-specific enough) in some tools could be the reason why some interviewees noted that many of the outputs from the tools available did not match with actual data. For example, one interviewee noted that a water risk tool used by their company failed to identify the critical future water risks for a particular facility in an area with significant droughts. Another noted that “getting the right information in the appropriate format to make decisions can be difficult.”

### **MANAGING UNCERTAINTY OF CLIMATE IMPACTS CAN BE CHALLENGING**

Companies also continue to struggle with the uncertainty associated with the nature, timing, location, or severity of climate change impacts. Although businesses are familiar with uncertainty, translating the uncertainty associated with climate projections into a corporate risk management context can be difficult. One interviewee suggested that an assessment commissioned from a contractor was so complex, full of uncertainties, and expensive that they had difficulty using this to make a case to senior management about the need for managing the risks or conducting a broader corporate-wide vulnerability assessment. Companies have to consider not only direct risks, but also cumulative risks and risk interactions that may affect operations (e.g., impacts to suppliers, customers and energy providers). For example, a storm event may cause damage to water and energy systems, which a company relies on for production and operations. Without energy supply, the company may not be able to transport products to an alternate location. In addition, the company’s employees could be without water and power in their homes and unable to work.

Supply chain risks were also associated with information and awareness barriers. While companies examined in this study are large with extensive internal resources, many of their suppliers are neither large nor have the resources to assess or manage their own climate-related risk or vulnerability. Redundancy in the supply chain and requests for vendor risk assessments were two options mentioned for addressing this type of information

barrier. These strategies may help large businesses, but small ones can still be severely affected or even put out of business by extreme weather events and climate changes. There are more than 28 million small businesses throughout the country, which account for 54 percent of sales and provide 55 percent of jobs in the U.S.<sup>57</sup> For these types of businesses, localized weather events and changes in climate over time can have significant impacts on operations and employees, and can lead to service and production delays.

### **A NUMBER OF COMPANIES REPORTED THAT THEY FOUND IT DIFFICULT TO MATCH THE TIMEFRAME OF BUSINESS DECISIONS TO THE TIMEFRAME AND MATERIALITY OF PERCEIVED CLIMATE RISKS**

One of the most frequently mentioned internal barriers was the perceived mismatch between short-term business decisions and long-term climate risks. Many companies look out five years or less when planning for risk management. While it may be relatively straightforward to identify ways climate change would affect risks by the mid- or late-21st century, it can be difficult to show and make the business case regarding how risks over the next few years would be substantially different than those during the last few years. This can make incorporating long-term changes into management decisions difficult. For example, insurance companies noted that insurance packages are changed yearly to reflect changes in price; this makes it difficult to incorporate any risk that goes beyond the next year. In contrast, mining and forest product companies are both investing in assets that are likely to be around for several decades and therefore longer-term risks associated with climate change are more likely to be factored into investment and planning decisions.

Timing and uncertainty also affect resilience investments. Longer-term potential impacts can be difficult to assign a dollar value and include in the net present value necessary for decision-making. Larger investments that improved resilience were thus more difficult to justify than low- or no-cost investments that only marginally improved resilience. A scenario analysis of potential impacts was one method used to overcome this challenge, but determining which scenarios to use was highlighted as yet another challenge.

Companies that mentioned experiencing a recent severe physical impact seem to be more motivated to upgrade their planning and response strategies to enhance resilience. Companies that have had recent

experience with extreme events also seem to be more likely to depart from using historical assumptions and adopt a perspective that reflects the current reality of intensifying climate change.

### **INTERNAL UNDERSTANDING, AWARENESS, AND SUPPORT IMPACT HOW CLIMATE RISK IS PRIORITIZED**

Data and uncertainty are not the only barriers that hinder resilience efforts; internal competition for resources and attention are other barriers that interviews suggested were pervasive among businesses. One interviewee suggested that climate change was “intangible” and difficult to explain to upper management. Several interviewees suggested that uncertainties made it difficult to prioritize climate risk in comparison to risks the company has historically faced. Another suggested that because climate was not a risk unto itself but instead a “threat multiplier” across the organization, each business unit approached the materiality of these risks according to their own understanding. As a consequence, risk management approaches were not always consistent—especially between regions.

Companies also described challenges with building awareness internally within their company and obtaining buy-in from senior management for investing time and resources on climate risk and resilience. One interviewee noted that climate change was not one of the issues “built into their job description”, and therefore was seen as lower priority as compared to other issues they were required to address. When there is a perception that resilience planning is not a foundational task for an employee or department, it is also likely that there is a lack of guidance, expertise, time, or resources devoted to evaluate climate risks and implement resilience actions. Even when internal knowledge is available, the importance of sharing this knowledge more broadly was highlighted. Having a broader base of institutional knowledge ensures continuity when the person with expertise on climate risk and resilience moves to another position, perhaps through a transfer, promotion, retirement, or move to a new company.

Approaches for addressing barriers vary, and there is no “one size fits all” approach. Assessing just one type of vulnerability or vulnerabilities in just one region was an approach suggested by some companies as a way to get started. Scenario analysis, hiring outside

contractors or partnering with NGOs or a university were other suggestions.

### **BEYOND THE FENCE BARRIERS ARE STILL CHALLENGING**

While some barriers are internal to businesses, and stem from the ways they are organized and the timeframes over which they make decisions, others are external, and involve supply chains, infrastructure (including roads, public transportation, water provision, electrical grids), and communications systems, or the lack of policies and standards that can encourage or facilitate resilience investments. Almost all interviewees mentioned a concern about climate-related risks outside of their control.

While companies examined in this study are large with extensive internal resources (such as experts, data, and modeling), many of their suppliers are not as large and many may not have the resources to assess or manage their own climate-related risk or vulnerability. Several interviewees noted that there was also limited communications with suppliers on the issue of climate vulnerability. Unidentified risks can be a significant barrier to building resilience.

Also critical to the operation of a business is the surrounding infrastructure, and the design and management of that infrastructure is often controlled by local and state government agencies. This can pose problems for businesses, particularly during extreme events, when business operations are affected by infrastructure that is damaged or inaccessible (e.g., employees are unable to get to work, operations are suspended because routes are blocked). Many companies find it difficult to adequately plan for extreme events when the management of infrastructure is out of their control.

Companies also highlighted the need for updated federal engineering standards and additional guidance on how to incorporate climate risks into new buildings and upgrades to existing infrastructure that companies control. Companies reported that engineering standards defining how companies build and develop infrastructure are out-of-date and do not incorporate future climate risks (e.g., sea level rise, changes in 100-year floodplains). Out-of-date engineering standards can make it difficult for businesses to justify going beyond the minimum engineering standards to incorporate climate resilience.

Policy and regulatory barriers were a less common

concern among companies, but several interviewees did mention them. Electricity generators, water utilities, communication providers, and insurers for example, are often required to provide justification to their regulators or utility commissioners before investing in resilient measures. Obtaining these approvals, however, can sometimes be challenging. One interviewee relayed an example of attempting to upgrade an area with communications technology that could withstand stronger storms, be more reliable and cost almost the same or less than old technology. Approval for this change, however, was denied because the technology would be “new” for local residents, and they would be less familiar with it.

Fortunately, resilience planning is gaining momentum and is a topic that many different groups including public agencies, NGOs, universities, and consultants are now addressing. Almost 50 percent of U.S. states have adaptation plans or strategies finalized or in-process.<sup>58</sup> There are many lessons that can be shared by those who have taken the first steps of assessing risks, identifying priorities, and implementing resilience changes.

Partnerships offer an opportunity to bring various stakeholders together to share guidance, standards, benchmarks and lessons learned on climate risk and resilience. For example, government agencies can provide guidance on engineering standards, building codes, scenario planning, and emergency management. Addressing “beyond the fence” risks that lie with cities is clearly important to business and to city residents.

Interviews with various city leaders identified potential opportunities for private-public partnerships. Businesses have opportunities to work with local government agencies and other organizations to address resilience in the communities where they operate. Some companies work with third-party intermediaries that bring together public institutions, businesses, and non-governmental stakeholders to leverage efforts and facilitate engagement on urban resilience issues. Many companies highlighted the value in coordinating with localities on emergency planning and infrastructure resilience.

## VI. THE POTENTIAL ROLE OF CITIES IN BUILDING BUSINESS RESILIENCE

### BUSINESSES FACE RISKS BEYOND THEIR FENCE LINES, AND CITIES RECOGNIZE THIS RISK

In *WTS 2013* and company interviews, risks beyond the “fence line” associated with public infrastructure were mentioned. Given the prominent role cities play in designing and maintaining much of this infrastructure, the following section explores how companies and cities are collaborating to address and manage this shared risk. More than 75 percent of the 207 cities that responded to the CDP’s 2014 Cities Program questionnaire affirmed that climate impacts were likely to affect how businesses operate in their jurisdictions. For the survey respondents in the United States, nearly 80 percent indicated climate would affect their respective businesses (Figure 16).

### URBAN RESILIENCE PLANNING IS STILL IN ITS EARLY STAGES

Even in cities that have been examining their climate risks for several years, the implementation of efforts on resilience is not widespread. An earlier survey among cities shows that fewer than 20 percent of respondents had begun implementing adaptation measures; nearly

half of the cities involved in the survey indicated they were in the “preparatory stage” or “initial planning.”<sup>60</sup>

Many actions cities are pursuing are focused on a specific risk or the deployment of a specific resilience solution (e.g., new standards for shoreline development or storm water management designed to combat flood risks; cool roof or tree-planting programs intended to manage extreme heat). Development of new institutions that potentially establish the capacity to address resilience in a broader, more coordinated fashion is only just beginning.

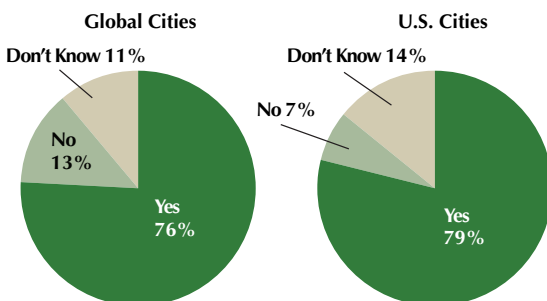
### PARTNERSHIPS ARE COMMON, BUT EXPLICIT INCLUSION OF COMPANIES WITHIN THE PLANNING PROCESS IS RARE

Several leading U.S. cities that have made progress in issuing a climate adaptation plan had engaged with university or academic institutions, consultancies, and non-profit organizations. These groups may provide technical assistance in identifying relevant climate information, synthesizing data or experiential knowledge across city departments, or facilitating discussions among city staff or relevant stakeholders in the community. However, it is less common for private sector businesses to be directly involved in the assessment of local impacts and the prioritization of risks.

Inter-departmental coordination has typically taken a higher priority than external collaboration. Many cities have made it a priority to assess their respective climate risks, develop a list of key vulnerabilities, and disseminate this information across city departments and among leadership. Engaging with external stakeholders, including the business community, is often viewed as a “next step” that can be better pursued once some of the “foundational” information about risks and vulnerability has been compiled and vetted.

**FIGURE 16: Cities Acknowledging Risks in CDP Cities Program 2014 Survey**

Do you consider that the physical impacts of climate change could threaten the ability of businesses to operate successfully in your city? (CDP Q 2.2)



Source: CDP 2014.<sup>59</sup>

## INTERMEDIARY INSTITUTIONS CAN PLAY AN IMPORTANT ROLE IN BRINGING BUSINESS VOICES TO URBAN RESILIENCE PLANNING

When companies are involved in urban resilience planning, a third-party intermediary is typically facilitating their participation. Examples of these intermediary institutions include the Green Ribbon Commission in Boston (**Box 15**) and the climate collaboratives that exist in a number of California cities and Washington state. These collaboratives can be effective in bringing businesses voices to resilience planning by:

- 1) Providing a forum through which businesses can interact with one another, as well as with other non-governmental stakeholders (e.g., academic institutions, regional land holders, faith groups).
- 2) Spreading the transaction costs that a public institution would otherwise bear in coordinating or replicating discussions about climate risks across a number of diverse stakeholder groups, including businesses.
- 3) Functioning independently of the municipal political structure, enhancing continuity through election cycles and alleviating concerns about potentially undesirable collusion between public and private institutions (e.g., that corporate engagement in resilience discussions with the city leads to the development of business opportunities that favor the companies that are involved).

## CITIES CAN PROVIDE VALUABLE GUIDANCE IN DEFINING WEATHER AND CLIMATE RISKS

Cities that have examined their weather and climate risks have often made selections about which data sets and model projections provide appropriate information for future planning decisions. In many cases, this information has been transformed into displays and tools that can effectively communicate the location and severity of risks to decision-makers, both within and outside of municipal government. The availability and user-friendly packaging of this weather and climate information can provide a useful starting point for companies beginning to consider their risks, especially since many companies lack the internal expertise to execute such work. Examples include flood risk maps for the city of London and estimates of the frequency and intensity of past and future extreme weather events in New York City.

The City of London has conducted a Strategic Flood Risk Assessment that includes high resolution maps of areas currently at risk of flooding in a 1-in-100 year event taking into account climate change.<sup>61</sup>

New York City has established a Panel on Climate Change to develop city-level information about climate variables that can be used in planning. The Panel has now issued three reports since 2008 on future changes in climate that could affect New York City. An example of these variables is shown in **Figure 17**, which includes information about average and extreme temperatures and heavy rainfall.

### Box 15. Boston Green Ribbon Commission

Launched in 2010 following Boston's initial release of a Climate Action Plan, the Green Ribbon Commission (GRC) seeks to bring together leaders from a variety of Boston's leading business, academic, philanthropic, and faith organizations to provide "advice and counsel to the city on the design and implementation of its Climate Action Plan." The group currently includes 34 member organizations. The GRC helps to encourage and implement efforts to reduce greenhouse gas mitigation and build resilience, and it provided substantial input to the updated Climate Action Plan in 2014.

Supported largely through philanthropic contributions, the GRC has been able to assist and amplify the city's efforts to address climate issues, and to establish continuity in the city's approach to climate challenges across the Menino and Walsh mayoral administrations. Through a number of working groups, including a working group devoted to climate preparedness, the GRC has explored risks posed from sea level rise and storm surge; opportunities for infusing private capital into resilience projects; and ways to establish consistency in addressing critical infrastructure (e.g., transportation, electricity water, waste) when the oversight for such systems may involve numerous city, regional, state, and federal agencies.



**FIGURE 17: Extreme Events Projections for New York City**

	BASELINE (1971–2000)	LOW ESTIMATE (10TH PERCENTILE)	MIDDLE RANGE (25TH TO 75TH PERCENTILE)	HIGH ESTIMATE (90TH PERCENTILE)
<b>a. 2020s</b>				
<i>Numbers of heat waves per year</i>	2	3	3–4	4
<i>Average heat wave duration (days)</i>	4	5	5	5
<i>Number of days per year with</i>				
<i>Maximum temperature at or above 90°F</i>	18	24	26–31	33
<i>Maximum temperature at or above 100°F</i>	0.4	0.7	1–2	2
<i>Minimum temperature at or below 32°F</i>	71	50	52–58	60
<i>Rainfall at or above 1 inch</i>	13	13	14–15	16
<i>Rainfall at or above 2 inches</i>	3	3	3–4	5
<i>Rainfall at or above 4 inches</i>	0.3	0.2	0.3–0.4	0.5
<b>b. 2050s</b>				
<i>Numbers of heat waves per year</i>	2	4	5–7	7
<i>Average heat wave duration (days)</i>	4	5	5–6	6
<i>Number of days per year with</i>				
<i>Maximum temperature at or above 90°F</i>	18	32	39–52	57
<i>Maximum temperature at or above 100°F</i>	0.4	2	3–5	7
<i>Minimum temperature at or below 32°F</i>	71	37	42–48	52
<i>Rainfall at or above 1 inch</i>	13	13	14–16	17
<i>Rainfall at or above 2 inches</i>	3	3	4–4	5
<i>Rainfall at or above 4 inches</i>	0.3	0.3	0.3–0.4	0.5
<b>c. 2070s</b>				
<i>Numbers of heat waves per year</i>	2	5	6–9	9
<i>Average heat wave duration (days)</i>	4	5	5–7	8
<i>Number of days per year with</i>				
<i>Maximum temperature at or above 90°F</i>	18	38	44–76	87
<i>Maximum temperature at or above 100°F</i>	0.4	2	4–14	20
<i>Minimum temperature at or below 32°F</i>	71	25	30–42	49
<i>Rainfall at or above 1 inch</i>	13	14	15–17	18
<i>Rainfall at or above 2 inches</i>	3	3	4–5	5
<i>Rainfall at or above 4 inches</i>	0.3	0.2	0.3–0.5	0.7

Source: Based on Horton et al., 2015.<sup>62</sup>

**TO DATE, ATTRACTING PRIVATE CAPITAL TO URBAN RESILIENCE PROJECTS HAS BEEN A CHALLENGE**

City and departmental budgets are often constrained, and it is unlikely the resilience needs in many cities can be met with purely public sources of funding (**Box 16**). Challenges related to securing funding was the most frequently noted barrier in a survey of global cities pursuing adaptation conducted by the Massachusetts Institute of Technology. For U.S. cities, nearly 90 percent

of survey respondents indicated that securing funding was a “major challenge.”<sup>63</sup> While cities would like to obtain additional public funding, they are increasingly looking for ways to leverage public dollars to get private investment.

While novel institutions like “green banks” have emerged to help raise capital or provide financing for a variety of greenhouse gas reduction projects, only one similar institution for resilience has emerged—New Jersey’s Energy Resilience Bank. Launched in October of

## Box 16. PlaNYC and Challenges in Financing Resilience

PlaNYC's detailed plan for bolstering resilience in the wake of Hurricane Sandy has an estimated price of nearly \$20 billion. It was estimated only \$15 billion was currently available or could be expected through a variety of city, state, and federal sources; insurance payouts; and philanthropic contributions. The funding gap could grow over time, since the \$20 billion estimate accounted for only the first decade of rebuilding activities, and did not include funds for the actual completion of many infrastructure projects, just their planning.

Corporate sources of financing were not mentioned in the PlaNYC funding strategy. Given that many global companies have important operations located in New York City, there is an apparent incentive for these companies to invest in the city's resilience efforts, presuming an appropriate funding mechanism is available.

2014, the Energy Resilience Bank is a public institution that provides grants and loans for rebuilding in critical sectors after an extreme weather event (e.g., water, wastewater treatment facilities, healthcare, education and transit). Several other potential models (e.g., brownfield and other urban redevelopment programs,<sup>64</sup> insurance incentives) have also been suggested for attracting capital to support resilience efforts, but few have been implemented. These types of funding efforts are likely to

rely on resilience strategies that go beyond risk reduction and provide broad co-benefits—for example, resilience efforts that enhance local access to recreation opportunities, contribute to air or water quality, provide opportunities for commercial enterprises, or enhance community connectivity. These co-benefits are perceived as more immediate, while benefits associated with risk reduction are less tangible or, when based on future climate conditions or weather events, can be subject to discounting.



## VII. CONCLUSIONS

The analysis of public disclosures from S&P Global 100 companies, in combination with interviews and group discussions, confirm that companies widely acknowledge the risks posed by climate change and extreme weather. While the number of companies reporting climate change risks and describing resilience activities in their CDP responses did not change significantly between 2011 and 2014, more companies are now identifying climate resilience activities in their sustainability and financial filings. In speaking with companies, it is clear these initiatives take significant time to discuss, implement, and evaluate. Looking at the state of business resilience, it is evident that there is an increasing trend of companies taking steps to assess their potential risks from climate change and implement resilience planning activities. In other words, this work is evolving and moving beyond basic reporting and on to the next level.

It is also clear that the preferred strategy for most companies is to embed climate risk into the other risks they already manage. While this can help climate risk to resonate more specifically with risk managers, there is also a danger that new and emerging risks may be overlooked, as well as potential opportunities.

Public reporting and voluntary disclosure efforts have become increasingly important in providing transparency to investors, stakeholders, and customers. Not all companies report on climate risks, and the degree of detail is significantly different among those that do. Disclosure about physical climate risks enhances the transparency of potential risks to companies from climate change, and helps to improve information on corporate climate risks and actions being taken to manage these risks. Having businesses disclose this type of information allows individual companies to evaluate how climate change may affect different parts of their business and explore what actions are necessary to take in the short and long term. However, this desire for transparency must be balanced with a corporation's proprietary interests. In addition, mandates need to take into account the differences in timeframes between many climate risks (which may be material over many decades) and investment decisions (which may be focused on

the next few quarters); the need to place physical risks from climate impacts in the context of other risks (e.g., regulatory, reputational); and the existence of already widespread disclosures (e.g., CDP surveys). Because of the growing number of mandatory and voluntary reporting channels, many companies suffer from "survey fatigue." As discussed in previous sections, steps can be taken to improve and streamline these processes and ensure stronger, more consistent reporting.

Risk is a concept all large companies manage, and ensuring that the ever-changing nature of climate risk is evaluated should be a high priority. Again, as one interviewee stated, not doing a comprehensive risk assessment is a plan to fail.

### RECOMMENDATIONS FOR BUSINESSES

There is no one-size-fits-all solution or framework for evaluating and managing risks. Companies take a variety of approaches to incorporate resilience into their planning, and there is no "right" path to follow. *WTS 2013* provided a framework for applying business risk management approaches to climate change impacts. This report suggests that this framework is not always linear. Companies may want to start with a limited-scope vulnerability assessment as part of their efforts to raise awareness of the issue. In addition to this framework, we have identified a number of key questions for companies to consider in incorporating climate change into risk management.

#### *Who will be involved?*

It is important to identify who needs to be involved internally within a company in both assessing risks and implementing resilience planning. This may include departments, business areas, site-level managers, as well as key individuals or leaders. As companies increasingly become involved in resilience planning, they may want to build climate change into the responsibilities of positions across departments. It is also important to facilitate regular communication across departments responsible for addressing climate issues—including sustainability, risk management, operations, and financial

departments. Improving internal understanding and building institutional support and capacity for the issue is also important. It is likely that internal staff will need to “make the case” for investing in climate risk assessments and resilience activities to other departments and external actors (such as regulators). Crafting these messages and providing information to support these decisions will be crucial.

In addressing climate change internally, it is important to consider the framing of the issue. The framing of climate risks is very important within the business community. Many companies are implicitly addressing future climate risks to their business, but do not consider these actions as being specifically as a result of climate change. Future climate impacts are often considered as part of conventional risk management, as far as a company addresses changing weather conditions in their business operations. As noted in previous sections, there are potential dangers in this approach. Looking at climate change only as a “magnifier” of existing risks can miss other potential implications (such as indirect and cumulative risks posed by climate change) and/or potential opportunities. In addition, conventional risk management may rely on historical data and event probabilities in future planning. For businesses that want to begin the process of addressing climate risks, it can be important to have internal discussions about these topics in a manner that is most appropriate and relevant to the existing risk management activities while taking into account the additional considerations that climate change may require.

Companies also may choose to involve external participants in data collection, analysis, and planning—including academic researchers, consultants, public agencies, and organizations. For example, public-private partnerships are an opportunity to share knowledge and make maximum use of efforts for risk assessment and resilience planning by companies and city, state and federal agencies. Businesses and public agencies have mutual interests in managing energy, water, and transportation infrastructure, and protecting communities. The U.S. Department of Energy’s [Partnership for Energy Sector Climate Resilience](#) is one such example of a public-private partnership working to act on resilience, develop resources to facilitate risk-based decision making, and pursue cost-effective strategies for a more climate-resilient U.S. energy infrastructure. To address climate risks and resilience at the local level, businesses can partner with cities to pursue enhanced mechanisms that build stronger joint planning for resilience.

### ***What is the timeframe?***

Companies often make decisions based on the timeframe of their planning horizons—for example, the lifetime of key assets, product supply chains, or service offerings. These timeframes will be important to consider when examining climate risks. If business decisions look only five years into the future, for example, a company can focus on collecting data and modeling of climate risks for the near term. In addition, companies may want to consider whether the timeframe of their planning horizons should be changed given the potential for more frequent and/or intense weather events. For example, some companies may choose to pursue near-term, lower-cost resilience improvements or actions to take a more progressive approach in risk management.

### ***What is the spatial scale?***

As described in previous sections, companies can take a variety of approaches in assessing climate risks. Some companies examine risks business-wide, while others choose to focus on specific facilities or regions. When beginning an assessment of risks, businesses will need to decide what spatial scale they are interested in evaluating. If resources are limited, companies may consider prioritizing risks to focus on identifying the parts of the business that are most critical and need of attention in the near term.

### ***What data is necessary?***

To assess climate risks on a business, it is important to have both climate data and internal data. In terms of climate data, companies will want to determine what types of risks they want to examine. Many companies have climate data available in-house, but in some cases external data and models are necessary to examine future risks. Academic institutions, consultants, organizations, and public agencies can help provide appropriate data and modelling to assist in this analysis. Necessary internal data will likely include the location of assets and their historic exposure to weather events.

## **RECOMMENDATIONS FOR GOVERNMENT**

*WTS 2013* highlighted the role of the government in furthering resilience within the private sector. The Obama administration has made some progress on making communities and infrastructure more resilient.

A November 2013 [executive order](#) directed federal agencies to begin integrating climate resilience in a number of

policy areas that, if carried through to completion, would fulfill many of the president's commitments. In October 2014, 38 federal agencies released final [Climate Change Adaptation Plans](#), which identify how climate change is expected to affect their missions and operations, outline steps to address these issues, and incorporate climate change considerations into decision-making. A January 2015 [executive order](#) established a new federal flood risk management standard, requiring all future federal investments in and affecting floodplains to meet a defined level of resilience and consider current and future risks.

*WTS 2013* highlighted the role of government agencies in providing credible, readily accessible scientific information, models, and tools related to climate change impacts. In 2014, the Obama administration launched the [Climate Data Initiative](#) (**Box 17**), a broad effort to leverage the federal government's extensive, freely-available climate-relevant data resources to stimulate innovation and private-sector entrepreneurship in support of national climate change preparedness. The site currently provides data and resources related to coastal flooding, food resilience, water, ecosystem vulnerability, human health, energy infrastructure, and transportation. The administration also released the [Climate Resilience Toolkit](#), which provides resources to help communities address coastal flooding, food resilience, human health, ecosystem vulnerability, water security, energy, and transportation risks. Government agencies can continue to support private-sector resilience by contributing to these resources and others that assist businesses in assessing risks and implementing resilience.

Federal, state, and local government agencies can also support business resilience by improving public infrastructure. Upgrades to critical infrastructure, including roads, bridges, ports, and water systems will ensure the safety and economic functioning of businesses and communities as the climate continues to change. Federal agencies can also assist state and local governments by providing funding opportunities for resilience investments, community upgrades, and emergency planning. Public agencies at the federal, state, and local level can also partner with the private sector on climate risk and resilience initiatives. These types of partnerships can help to better understand local-level climate risks, enhance engagement and cooperation, and build community resilience.

In interviews with various companies that are regulated by commissions, we found that challenges continue to persist in making the case for resilience investments. Companies highlighted the need for data and analysis that will support their arguments for investing in climate resilience measures. Cost-benefit analyses are particularly useful to present to commissions, and many companies would benefit from these types of studies. As some interviewees noted, cost-benefit studies often require significant effort and financial resources companies may not have. Partnering with academic institutions, consultants, or NGOs could help companies in undertaking cost-benefit studies. In addition, regulators should be forward-looking and open to companies making the case for increased spending on resilience.

### **Box 17. Climate Data Initiative**

In 2014, the Obama administration launched the [Climate Data Initiative](#), a broad effort to leverage the federal government's extensive, publicly-available, climate-relevant data resources to stimulate innovation and private-sector entrepreneurship in support of national climate-change preparedness. The site currently provides data and resources related to coastal flooding, food resilience, water, ecosystem vulnerability, human health, energy infrastructure, and transportation. Various businesses are contributing to the resources available. For example, Google has donated significant cloud computing and storage and is working with partners to create a near real-time system to monitor drought. Companies such as Amazon, HP, IBM Intel, Microsoft, and Esri are creating various maps, applications, and other tools and programs to help local officials and other stakeholders understand the climate risks specific to their communities.

As part of the Climate Data Initiative, the administration also released the [Climate Resilience Toolkit](#), which provides resources to help communities address coastal flooding, food resilience, human health, ecosystem vulnerability, water security, energy, and transportation risks. One of the resources available is the Climate Explorer, a visualization tool that offers detailed maps of climate stressors and impacts, as well as interactive graphs showing daily observations and long-term averages from weather stations across the country.

## APPENDICES

### APPENDIX A. COMPANIES IN THE STANDARD & POOR'S (S&P) GLOBAL 100 INDEX (ON MAY 30, 2012)

3M Co.  
ABB Ltd.  
Aegon NV  
Alcatel-Lucent SA  
Allianz SE  
Anglo American Plc  
AstraZeneca Plc  
Aviva  
AXA  
Banco Bilbao Vizcaya Argentaria SA  
Banco Santander SA  
Barclays  
BASF SE  
Bayer AG  
BHP Billiton Ltd.  
BP  
Bridgestone Corp  
Bristol-Myer Squibb  
Canon Inc.  
Carrefour SA  
Caterpillar Inc.  
Chevron Corp.  
Citigroup Inc.  
Coca-Cola Co.  
Colgate-Palmolive Co.  
Credit Suisse Group AG  
Daimler AG  
Dell Inc.  
Deutsche Bank AG  
Deutsche Telekom  
Diageo Plc  
Dow Chemical  
DuPont, E.I. de Nemours  
E.ON AG  
EMC Corp.  
Ericsson, L.M. Telefonaktie  
Exxon Mobil Corp.  
Ford Motor Co.  
France Telecom SA  
Fujifilm Holdings Corp.  
GDF Suez  
GE  
GlaxoSmithKline  
Goldman Sachs Group Inc.  
Honda Motor Co.  
HP  
HSBC Holdings Plc  
IBM Corp.  
ING Groep NV  
Intel Corp.  
Johnson & Johnson  
JP Morgan Chase & Co.  
Kimberly-Clark  
Koninklijke Philips Electronics NV (Royal Philips Electronics)  
L'Oreal  
LVMH-Moet Vuitton  
McDonald's Corp.  
Merck & Co. Inc.  
Microsoft Corp.  
Morgan Stanley  
Munich Re AG  
National Grid PLC  
Nestle SA  
News Corporation  
Nike Inc.  
Nissan Motor Co.

Nokia OYJ  
Novartis AG  
Panasonic Corp.  
PepsiCo Inc.  
Pfizer Inc.  
Philip Morris International  
Procter & Gamble  
Repsol-YPF SA  
Rio Tinto Plc  
Royal Dutch Shell PLC  
RWE AG  
Saint-Gobain, Cie de  
Samsung Electronics Co.  
Sanofi-Aventis  
Schneider Electric SA  
Seven & I Holdings Co. Ltd.  
Siemens AG

Societe Generale  
Sony Corp.  
Standard Chartered  
Swiss Re  
Telefonica SA  
Texas Instruments Inc.  
Toshiba Corp.  
TOTAL SA  
Toyota Motor Corp.  
UBS AG  
Unilever NV  
United Technologies Corp.  
Vivendi  
Vodafone  
Volkswagen  
Wal-Mart  
Xstrata

## APPENDIX B: NOTES ON METHODOLOGY

C2ES undertook a three-part research effort to understand how companies are addressing the physical risks of extreme weather and climate change.

### I. Assessment of public statements by the companies comprising the S&P Global 100 Index.

(We used the same list from *WTS 2013* to maintain consistency—companies are listed in Appendix A.) C2ES did a systematic review of these 100 companies' statements about climate change and its predicted risks to their operations, using three publicly available sources.

#### 1. Responses to the Carbon Disclosure Project (CDP) 2013

*Investor Survey*. Completed by 84 of the S&P Global 100 Index companies, Questions 5 and 6 of this survey ask companies whether they have acted to address the physical impacts of climate change.

2. *Financial Disclosure Forms from 2013*. In their financial filings, publicly traded companies are required to identify the risks that could have a "material adverse effect" on their businesses.<sup>65</sup> Some jurisdictions (e.g., the UK) require a greater level of corporate disclosure on climate-related impacts in financial filings than other countries (e.g., the United States). C2ES assessed whether S&P Global 100 Index companies discussed physical climate change risks in their 2013 annual financial filing reporting on year 2012 activities (i.e., SEC Form 10-Ks for U.S.-headquartered companies and SEC 20-F (foreign), SEC 40-F (Canadian based), or annual reports for foreign companies) and ranked them on a scale of 1 to 5. A score of 1 or 2 indicated that the company did not substantially identify risks from climate change impacts. These companies either did not mention climate impacts or extreme weather risk at all (beyond a standard sentence about catastrophic risks) or mentioned extreme weather or water scarcity as a risk without describing the increases in those risks from climate change. A score of 3, 4, or 5 was considered an adequate discussion of risks. These companies reported the physical effects of climate change as a business risk (though often noted that the precise effects were uncertain), some companies described a specific physical impact (such as floods or warmer temperatures) as a concerning business risk, and a few described a specific action they were taking to better understand or mitigate the risk.

3. *Company Sustainability Reports from 2013*. We reviewed 2013 corporate sustainability reports (available for 47 of the 100 companies) to identify any statements related to impacts or actions associated with the physical effects of extreme weather and climate change.

II. **Interviews.** To delve more deeply into specific ways that companies address the physical impacts of climate change, C2ES conducted in-depth interviews with more than 50 companies representing a wide diversity of sectors. This process involved a review of public information on the company and telephone interviews with multiple staff involved with corporate climate change issues.

To explore the extent to which companies are partnering with cities, research included a series of discussions and interviews with select city staff involved in resilience planning (Boston, San Francisco, San Diego, Los Angeles, and Philadelphia), and staff at organizations focused on tracking cities' efforts in building resilience (American Society of Adaptation Professionals, C40, CDP, and Urban Sustainability Directors Network). The July 2015 workshop also brought together representatives from both cities and companies to discuss our findings and develop recommendations for potential future public-private collaboration to bolster resilience.

### III. Workshops on Business Resilience.

- In July 2014, C2ES organized a Climate Impacts and Resilience Workshop with the Cooperative Institute for Climate and Satellites—North Carolina (CICS-NC) (which is largely supported through a grant from NOAA's National Climatic Data Center) involving 35 participants representing 14 companies and 9 other organizations. The workshop focused on types of climate-related risks and opportunities for the private sector. The workshop featured presentations from the climate science community, companies actively working to address risks and develop solutions to build resilience, and agency representatives looking to partner with private sector companies to pursue resilience in a sustained manner.
- In February 2015, C2ES hosted a side event at the Climate Leadership Conference on "Emerging

Best Practices for Identifying Climate Risk and Increasing Resilience.” More than 80 individuals from companies, cities, and nonprofits shared their climate resilience ideas and experiences at the event.

- In March 2015, C2ES organized a Business Resilience Workshop involving 40 participants representing 15 companies and 15 other organizations, including experts from the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Global Change Research Program (USGCRP), to explore particular challenges and opportunities for building business resilience. The workshop included a scenario exercise where participants discussed important considerations for business resilience planning.
- In July 2015, C2ES organized a City-Business Resilience Workshop involving 35 participants representing 13 companies, 3 cities, 5 convening organizations, and 3 other organizations to explore strategies for public-private collaboration that build resilience to climate impacts. The workshop featured examples of resilience activities being undertaken by cities and companies; the mechanisms and institutions through which urban-corporate collaboration can be pursued; and the ways in which informational, policy, and financial barriers can be overcome.



## APPENDIX C: CDP QUESTIONS

### 5. Climate Change Risk

Q5.1 Have you identified any climate change risks (current or future) that have the potential to generate a substantive change in your business operations, revenue or expenditure? (Tick all that apply)

Please identify the relevant categories:

- Risks driven by changes in regulation
- Risks driven by changes in physical climate parameters
- Risks driven by changes in other climate-related developments

Q5.1c: Please describe your risks that are driven by change in physical climate parameters

ID	RISK DRIVER	DESCRIPTION	POTENTIAL IMPACT	TIMEFRAME	DIRECT / INDIRECT	LIKELIHOOD	MAGNITUDE OF IMPACT
<i>Text Field</i>	Select from: <ul style="list-style-type: none"> <li>• Changes in mean (average) temperature</li> <li>• Changes in temperature extremes</li> <li>• Change in mean (average) precipitation</li> <li>• Change in precipitation pattern</li> <li>• Changes in precipitation extremes and droughts</li> <li>• Snow and ice</li> <li>• Sea level rise</li> <li>• Tropical cyclones (hurricanes and typhoons)</li> <li>• Induced changes in natural resources</li> <li>• Uncertainty of physical risks</li> <li>• Other physical climate drivers</li> </ul>	Text Field	Select from: <ul style="list-style-type: none"> <li>• Increased operational cost</li> <li>• Increased capital cost</li> <li>• Reduced demand for goods/service</li> <li>• Reduction/ disruption in production capacity</li> <li>• Reduction in capital availability</li> <li>• Reduced stock price (market valuation)</li> <li>• Inability to do business</li> <li>• Wider social disadvantage</li> <li>• Other, please specify</li> </ul>	Select from: <ul style="list-style-type: none"> <li>• Current</li> <li>• 1–5 years</li> <li>• 6–10 years</li> <li>• &gt;10 years</li> <li>• Unknown</li> </ul>	Select from: <ul style="list-style-type: none"> <li>• Direct</li> <li>• Indirect (Supply chain)</li> <li>• Indirect (Client)</li> </ul>	Select from: <ul style="list-style-type: none"> <li>• Virtually certain</li> <li>• Very likely</li> <li>• Likely</li> <li>• More likely than not</li> <li>• About as likely as not</li> <li>• Unlikely</li> <li>• Very unlikely</li> <li>• Exceptionally unlikely</li> <li>• Unknown</li> </ul>	Select from: <ul style="list-style-type: none"> <li>• High</li> <li>• Medium-high</li> <li>• Medium</li> <li>• Low-medium</li> <li>• Low</li> <li>• Unknown</li> </ul>

Q5.1d: Please describe (i) the potential financial implications of the risk before taking action; (ii) the methods you are using to manage this risk and (iii) the costs associated with these actions



## 6. Climate Change Opportunities

Q6.1 Have you identified any climate change opportunities (current or future) that have the potential to generate a substantive change in your business operations, revenue or expenditure? (Tick all that apply)

Please identify the relevant categories:

- Opportunities driven by changes in regulation
- Opportunities driven by changes in physical climate parameters
- Opportunities driven by changes in other climate-related developments

Q6.1c: Please describe the opportunities that are driven by changes in physical climate parameters

ID	OPPORTUNITY DRIVER	DESCRIPTION	POTENTIAL IMPACT	TIMEFRAME	DIRECT / INDIRECT	LIKELIHOOD	MAGNITUDE OF IMPACT
<i>Text Field</i>	Select from: <ul style="list-style-type: none"> <li>• Change in mean (average) temperature</li> <li>• Change in temperature extremes</li> <li>• Change in mean (average) precipitation</li> <li>• Change in precipitation pattern</li> <li>• Change in precipitation extremes and droughts</li> <li>• Snow and ice</li> <li>• Induced changes in natural resources</li> <li>• Other physical climate opportunities</li> </ul>	Text Field	Select from: <ul style="list-style-type: none"> <li>• Reduced operational costs</li> <li>• Reduced capital costs</li> <li>• Increased demand for existing products/ services</li> <li>• Premium price opportunities</li> <li>• Increased production capacity</li> <li>• Increase in capital availability</li> <li>• Increased stock price (market valuation)</li> <li>• New product/ business services</li> <li>• Investment opportunities</li> <li>• Wider social benefits</li> <li>• Other, please specify</li> </ul>	Select from: <ul style="list-style-type: none"> <li>• Current</li> <li>• 1–5 years</li> <li>• 6–10 years</li> <li>• &gt;10 years</li> <li>• Unknown</li> </ul>	Select from: <ul style="list-style-type: none"> <li>• Direct</li> <li>• Indirect (Supply chain)</li> <li>• Indirect (Client)</li> </ul>	Select from: <ul style="list-style-type: none"> <li>• Virtually certain</li> <li>• Very likely</li> <li>• Likely</li> <li>• More likely than not</li> <li>• About as likely as not</li> <li>• Unlikely</li> <li>• Very unlikely</li> <li>• Exceptionally unlikely</li> <li>• Unknown</li> </ul>	Select from: <ul style="list-style-type: none"> <li>• High</li> <li>• Medium-high</li> <li>• Medium</li> <li>• Low-medium</li> <li>• Low</li> <li>• Unknown</li> </ul>

Q6.1d: Please describe (i) the potential financial implications of the opportunity; (ii) the methods you are using to manage this opportunity and (iii) the costs associated with these actions

Where risks and/or opportunities have not been identified for any of the categories:

Please explain why you do not consider your company to be exposed to these risks/opportunities that have the potential to generate a substantive change in your business operations, revenue or expenditure

## APPENDIX D: ADDITIONAL RESOURCES

TITLE	AUTHOR	DESCRIPTION	LINK
<i>PREP Value Chain Climate Resilience: A guide to managing climate impacts in companies and communities</i>	Acclimatise, Oxfam America, BSR	This guide introduces the Business ADAPT (analyze, develop, assess, prioritize, and tackle) tool. The tool follows a step-by-step climate resilience framework inspired by existing good practice risk management models.	<a href="http://www.oxfamamerica.org/explore/research-publications/prep-value-chain-climate-resilience/">http://www.oxfamamerica.org/explore/research-publications/prep-value-chain-climate-resilience/</a>
<i>Climate Action and Profitability: CDP S&amp;P 500 Climate Change Report 2014</i>	CDP	This report presents the progress achieved by S&P 500 companies in integrating climate change risk management into strategic planning, taking action towards emissions reductions and demonstrating a long-term view of how to best manage the assets of shareholders. Focuses broadly on all of CDP surveys, no specific information on physical climate risks and resilience activities.	<a href="https://www.cdp.net/CDPResults/CDP-SP500-leaders-report-2014.pdf">https://www.cdp.net/CDPResults/CDP-SP500-leaders-report-2014.pdf</a>
<i>Cool Response: The SEC &amp; Corporate Climate Change Reporting</i>	Ceres	This report examines the state of S&P 500 reporting on climate disclosure and SEC comment letters addressing climate disclosure from 2010 to the end of 2013.	<a href="https://www.ceres.org/resources/reports/cool-response-the-sec-corporate-climate-change-reporting/view">https://www.ceres.org/resources/reports/cool-response-the-sec-corporate-climate-change-reporting/view</a>

TITLE	AUTHOR	DESCRIPTION	LINK
<i>Gaining Ground: Corporate Progress on the Ceres Roadmap for Sustainability</i>	Ceres	This report evaluates how over 600 of the largest publicly traded U.S. companies are integrating sustainability into their business systems and decision-making. The analysis focuses mostly on broad sustainability issues, including climate mitigation, energy, water, etc., and less on climate resilience.	<a href="http://www.ceres.org/roadmap-assessment/progress-report/progress-report">http://www.ceres.org/roadmap-assessment/progress-report/progress-report</a>
<i>Major Public Companies Describe Climate-Related Risks and Costs: A Review of Findings from CDP 2011–2013 Disclosures</i>	CDP	This white paper presents key findings and responses provided by S&P 500 companies across economic sectors to the risk-related questions in CDP’s annual disclosure requests from 2011 to 2013. The paper includes example responses from various companies to the CDP survey.	<a href="https://www.cdp.net/CDPResults/review-2011-2013-USA-disclosures.pdf">https://www.cdp.net/CDPResults/review-2011-2013-USA-disclosures.pdf</a>
<i>The Economic Risks of Climate Change in the United States</i>	The Risky Business Project	This report uses a standard risk-assessment approach to determine the potential economic impacts of climate change for each region of the U.S.—as well as for selected sectors of the economy. These sectors included coastal property and infrastructure, agricultural production, energy demand, labor productivity, and public health.	<a href="http://riskybusiness.org">http://riskybusiness.org</a>
<i>Business in a Climate-Constrained World: Catalyzing a Climate-Resilient Future through the Power of the Private Sector</i>	Business for Social Responsibility (BSR)	This report provides several examples of how some businesses have enhanced resilience to extreme weather and climate change (including Verizon and Wal-Mart).	<a href="http://www.bsr.org/reports/BSR_Business_in_a_Climate_Constrained_World_Report.pdf">http://www.bsr.org/reports/BSR_Business_in_a_Climate_Constrained_World_Report.pdf</a>

TITLE	AUTHOR	DESCRIPTION	LINK
<b>SECTOR-SPECIFIC REPORTS</b>			
<p><i>Insurer Climate Risk Disclosure Survey Report &amp; Scorecard: 2014 Findings &amp; Recommendations</i></p>	<p>Ceres</p>	<p>This report summarizes responses from insurance companies to a survey on climate change risks developed by the National Association of Insurance Commissioners (NAIC). The aim of the survey is to provide regulators, insurers, investors and other stakeholders with substantive information about the risks insurers face from climate change and the steps insurers are taking—or are not taking—to respond to those risks. The report distills key findings and industry trends, and includes company specific scores based on disclosed actions taken to manage climate risks. It also offers recommendations for insurers and regulators to improve the insurance sectors’ overall management of climate change risks.</p>	<p><a href="http://www.ceres.org/resources/reports/insurer-climate-risk-disclosure-survey-report-scorecard-2014-findings-recommendations/view">http://www.ceres.org/resources/reports/insurer-climate-risk-disclosure-survey-report-scorecard-2014-findings-recommendations/view</a></p>
<p><i>Climate Information Needs for Financial Decision Making</i></p>	<p>American Meteorological Society</p>	<p>This report examines the role of climate science in financial analysis. The study explores how climate information is used financial analysis, barriers, and research needs to improve the analytic capability of financial decision makers with respect to weather and climate risks.</p>	<p><a href="http://www.ametsoc.org/atmospolicy/cin/CIN_Report.pdf">http://www.ametsoc.org/atmospolicy/cin/CIN_Report.pdf</a></p>

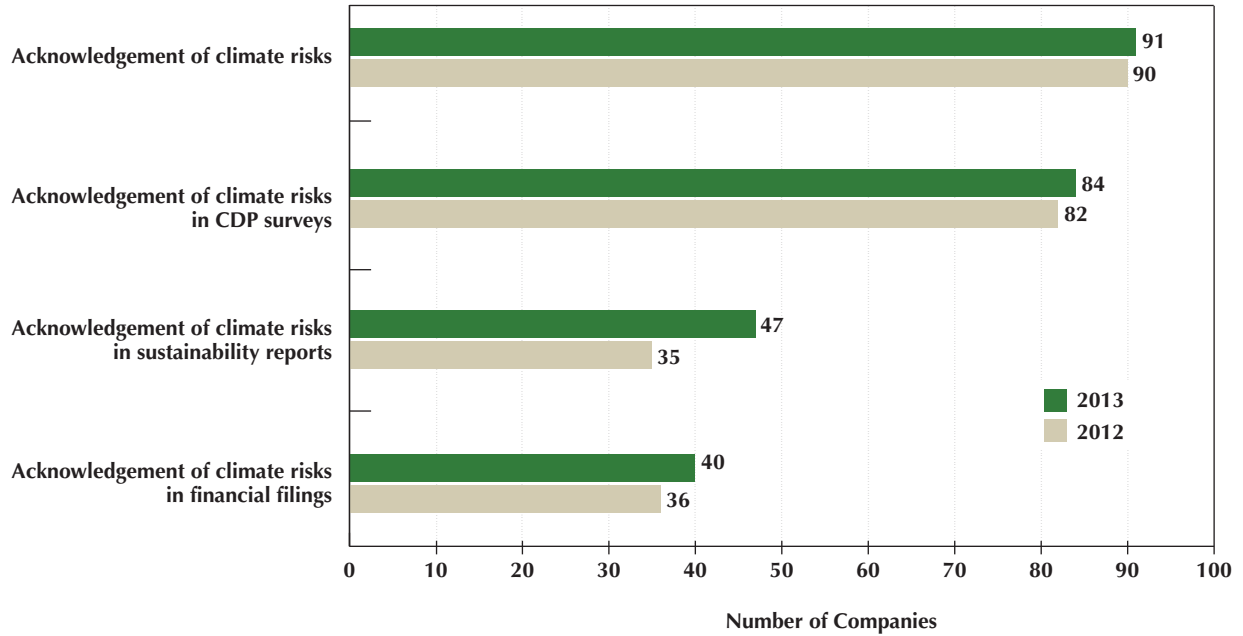
TITLE	AUTHOR	DESCRIPTION	LINK
<i>Adapting to a changing climate: implications for the mining and metals industry</i>	International Council on Mining and Metals	This report explains why it is important for the mining and metals sector to understand the impacts from a changing climate and to develop strategies to adapt. It then looks at relevant climate impacts and how mining and metals companies can evaluate risks and opportunities associated with those impacts. And finally, it examines the available options for adapting to climate change impacts.	<a href="https://www.icmm.com/document/5173">https://www.icmm.com/document/5173</a>
<i>Stormy Seas, Rising Risks What Investors Should Know About Climate Change Impacts at Oil Refineries</i>	Union of Concerned Scientists	This report examines the potential climate change risks for oil refineries from five of the largest U.S. energy companies (Valero, Phillips 66, Exxon Mobil, Marathon Petroleum, and Chevron), and looks at what each company has disclosed on climate change risks.	<a href="http://www.ucsusa.org/sites/default/files/attach/2015/02/stormy-seas-rising-risks-ucs-2015.pdf">http://www.ucsusa.org/sites/default/files/attach/2015/02/stormy-seas-rising-risks-ucs-2015.pdf</a>
<i>Addressing adaptation in the oil and gas industry</i>	IPIECA	This report examines oil and gas industry awareness of climate change-related risks, and identifies appropriate responses and ways in which these responses are being integrated into broad risk management frameworks. Provides an overview of the adaptation planning process, and includes: examples of climate risks identified by the oil and gas industry; an outline of risk evaluation processes related to specific potential impacts, and in-use examples of risk adaptation and management.	<a href="http://www.ipieca.org/publication/addressing-adaptation-oil-and-gas-industry">http://www.ipieca.org/publication/addressing-adaptation-oil-and-gas-industry</a>

TITLE	AUTHOR	DESCRIPTION	LINK
<i>Building a Resilient Power Sector</i>	World Business Council on Sustainable Development	This report analyzes climate impacts on power systems, explores how to better forecast weather and long-term climate risk, and shares best practices from companies around the world.	<a href="http://www.wbcsd.org/resilience.aspx">http://www.wbcsd.org/resilience.aspx</a>
<i>Water and Climate Risks Facing U.S. Corn Production: How Companies and Investors Can Cultivate Sustainability</i>	Ceres	This report provides new data and interactive maps on the risks facing U.S. corn production, as well as detailed recommendations for how corn-buying companies and their investors can catalyze more sustainable agricultural practices that will reduce these risks, preserve and enhance yields, and protect water resources.	<a href="http://www.ceres.org/resources/reports/water-and-climate-risks-facing-u.s.-corn-production-how-companies-and-investors-can-cultivate-sustainability/view">http://www.ceres.org/resources/reports/water-and-climate-risks-facing-u.s.-corn-production-how-companies-and-investors-can-cultivate-sustainability/view</a>
<i>A Prescription for the 21st Century: Improving Resilience to High-Impact Weather for Healthcare Facilities and Services</i>	American Meteorological Society	This report examines the vulnerabilities of health facilities and discusses resilience options to maintain the continuity of health services during extreme events.	<a href="http://www2.ametsoc.org/ams/assets/File/health_workshop_report.pdf">http://www2.ametsoc.org/ams/assets/File/health_workshop_report.pdf</a>
<i>Green Resilience: Climate Adaptation + Mitigation Synergies</i>	Center for Clean Air Policy (CCAP)	This report includes sector-specific examples on how best to integrate climate adaptation in four areas: buildings, energy, water, and cities.	<a href="http://ccap.org/assets/CCAP-Green-Resilience-Climate-Adaptation-Mitigation-Synergies_April-2014.pdf">http://ccap.org/assets/CCAP-Green-Resilience-Climate-Adaptation-Mitigation-Synergies_April-2014.pdf</a>
<b>Region-specific reports</b>			
<i>Climate Change Resilience in Europe: A Snapshot of the Private Sector</i>	CDP	This report shares key findings from data on climate risk and resilience collected by CDP from the FTSEurofirst 300 Index (the 300 largest companies ranked by market capitalization in the FTSE Developed Europe Index) as well as the largest 100 listed companies in Central & Eastern Europe.	<a href="https://www.cdp.net/CDPResults/climate-change-resilience-europe.pdf">https://www.cdp.net/CDPResults/climate-change-resilience-europe.pdf</a>



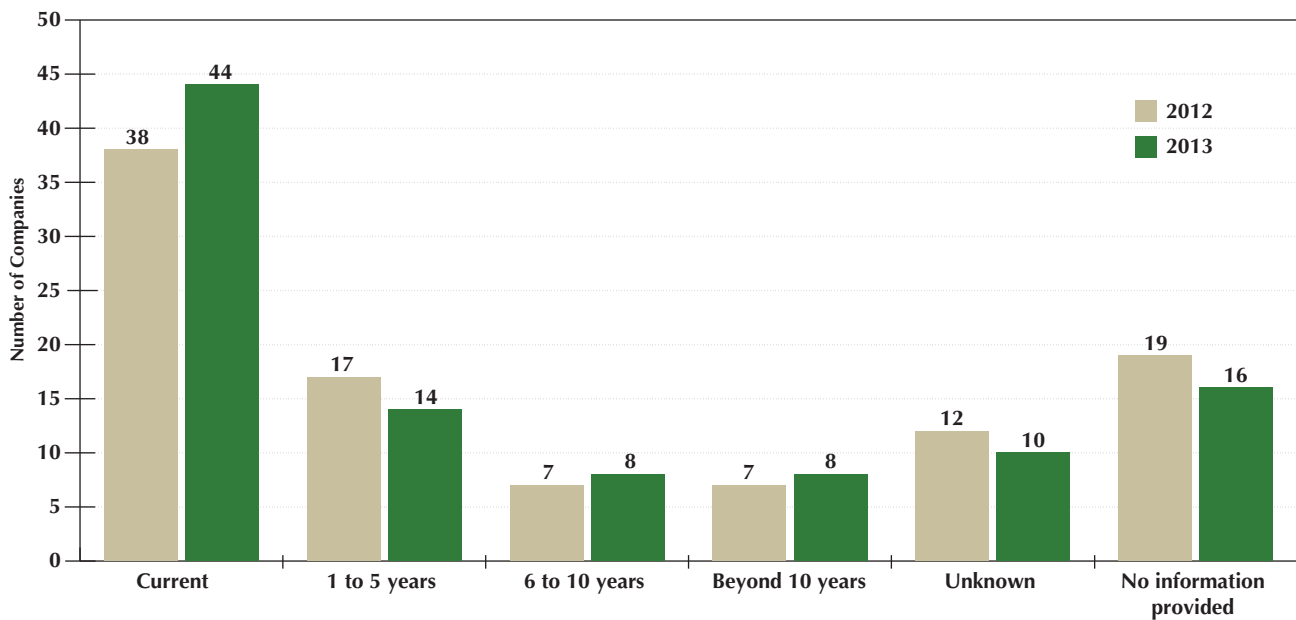
TITLE	AUTHOR	DESCRIPTION	LINK
<i>State by State: The business response to climate change across America</i>	CDP	This report examines the business response to climate change from companies in nine US states. It provides a state-by-state breakdown of key statistics from responses to CDP's 2013 survey and descriptions of the current state of action among US businesses on climate change.	<a href="https://www.cdp.net/CDPResults/CDP-state-by-state-report-2014.pdf">https://www.cdp.net/CDPResults/CDP-state-by-state-report-2014.pdf</a>
<i>Supply Chain Sustainability Revealed: A Country Comparison</i>	CDP	This CDP report analyzes the responses from almost 3,400 suppliers on how they are approaching climate and water risks. In addition to the analysis at the global level, the report also summarizes key findings on supply chain data at the country level.	<a href="https://www.cdp.net/CDPResults/CDP-Supply-Chain-Report-2015.pdf">https://www.cdp.net/CDPResults/CDP-Supply-Chain-Report-2015.pdf</a>
<i>Business and Climate Change Adaptation: Toward Resilient Companies and Communities</i>	United Nations Environment Programme (UNEP)	This report presents case studies to illustrate how businesses are responding to address climate change opportunities, risks, and impacts in developing countries and emerging economies	<a href="https://www.unglobalcompact.org/docs/issues_doc/Environment/climate/Business_and_Climate_Change_Adaptation.pdf">https://www.unglobalcompact.org/docs/issues_doc/Environment/climate/Business_and_Climate_Change_Adaptation.pdf</a>

**FIGURE A1: Comparison of Reporting on Climate Change Risks**



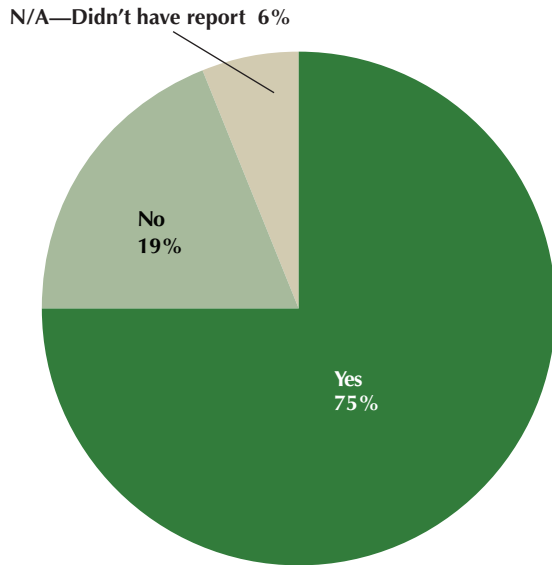
Source: C2ES research based on S&P Global 100 CDP surveys, sustainability reports, annual reports, and SEC filings.

**FIGURE A2: Comparison of Earliest Estimates for When Impacts Will Occur**



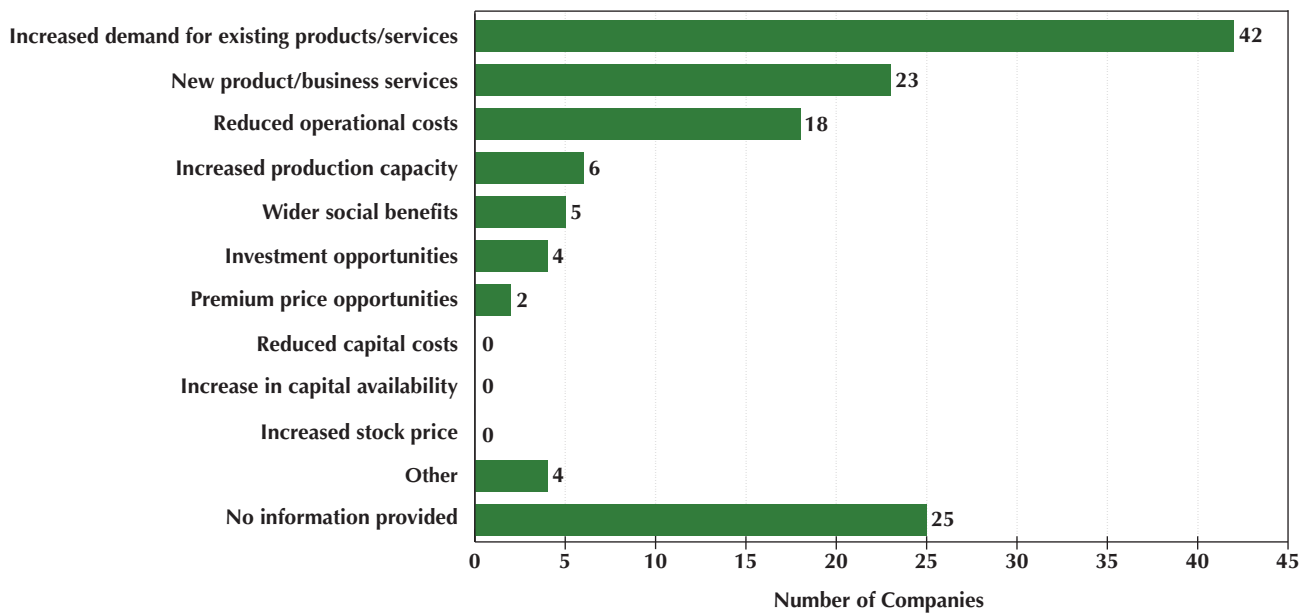
Source: C2ES research based on S&P Global 100 CDP surveys.

**FIGURE A3: Companies Acknowledging Climate Opportunities in 2013 CDP Surveys**



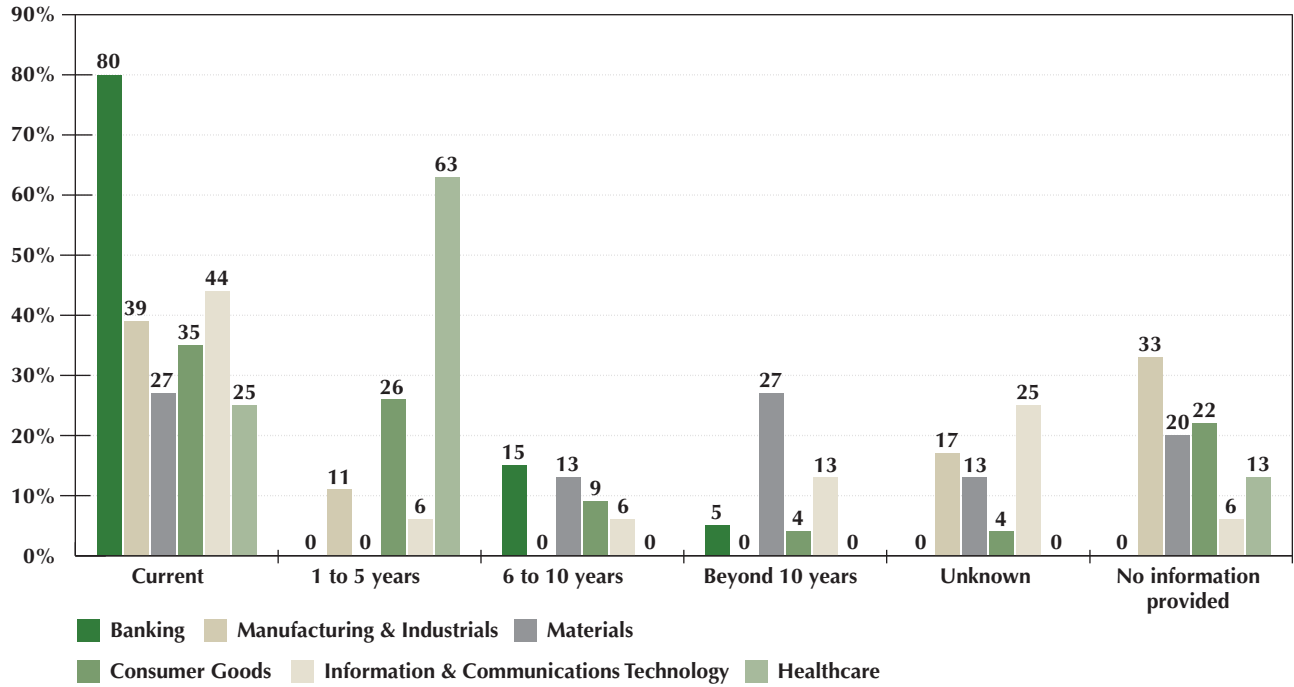
Source: C2ES research based on S&P Global 100 CDP surveys.

**FIGURE A4: Types of Opportunities Identified in 2013 CDP Surveys**



Source: C2ES research based on S&P Global 100 CDP surveys.

**FIGURE A5: Breakdown of Sector-Specific Findings on Timeframe of Climate Risks**



Source: C2ES research based on S&P Global 100 CDP surveys.

## ENDNOTES

- 1 CDP requests voluntary disclosures from the world's largest companies on their climate risks and opportunities on behalf of institutional investor signatories to increase transparency around climate-related investment risk and commercial opportunity, and drive investments toward a low carbon economy.
- 2 S&P Global 100 company CDP responses for years 2011, 2012, 2013 and 2014 and interview questions had very consistent answers to questions about risk and resilience.
- 3 Melillo, J.M., T.C. Richmond, and G.W. Yohe (Eds.), "Climate Change Impacts in the United States: The Third National Climate Assessment," U.S. Global Change Research Program, 2014, <http://nca2014.globalchange.gov/>.
- 4 Entergy response to the CDP 2014 Climate Survey.
- 5 U.S. Department of Commerce, "Economic Impact of Hurricane Sandy: Potential Economic Activity Lost and Gained in New Jersey and New York," September 2013, <http://www.esa.doc.gov/sites/default/files/sandyfinal101713.pdf>.
- 6 U.S. Department of Energy (DOE), "U.S. Energy Sector Vulnerabilities to Climate Change and Extreme Weather," July 2013, <http://energy.gov/sites/prod/files/2013/07/f2/20130710-Energy-Sector-Vulnerabilities-Report.pdf>.
- 7 Hess response to the CDP 2014 Climate Survey.
- 8 JP Morgan response to the CDP 2014 Climate Survey.
- 9 Swiss Re Annual Financial Report 2014.
- 10 National Oceanic and Atmospheric Administration (NOAA), National Climatic Data Center, "State of the Climate: Global Analysis for Annual 2014," Issued January 2015, <http://www.ncdc.noaa.gov/sotc/global/201413>.
- 11 Swiss Re, "Sigma No 02/2015," February 2015, [http://media.swissre.com/documents/sigma2\\_2015\\_en\\_final.pdf](http://media.swissre.com/documents/sigma2_2015_en_final.pdf).
- 12 Swiss Re Annual Financial Report 2014.
- 13 Munich Re NatCatSERVICE, "Loss Events Worldwide 1980-2014," January 2015.
- 14 Munich Re NatCatSERVICE, "Loss Events Worldwide 1980-2014," January 2015.
- 15 NOAA, National Centers for Environmental Information, "State of the Climate: Global Analysis for Annual 2014," January 2015, <http://www.ncdc.noaa.gov/sotc/global/201413>.
- 16 NOAA, National Climatic Data Center, "Billion-Dollar Weather and Climate Disasters," 2015, <http://www.ncdc.noaa.gov/billions/>.
- 17 NOAA, National Climatic Data Center, "Billion-Dollar Weather and Climate Disasters," 2015, <http://www.ncdc.noaa.gov/billions/>.
- 18 Houser, T., R. Kopp, S. Hsiang, M. Delgado, A. Jina, K. Larsen, M. Mastrandrea, S. Mohan, R. Muir-Wood, D.J. Rasmussen, J. Rising, and P. Wilson, "American Climate Prospectus: Economic Risks in the United States," June 2014, [http://rhg.com/wp-content/uploads/2014/10/AmericanClimateProspectus\\_v1.2.pdf](http://rhg.com/wp-content/uploads/2014/10/AmericanClimateProspectus_v1.2.pdf).
- 19 White House, "The Cost of Delaying Action to stem Climate Change," July 2014, [https://www.whitehouse.gov/sites/default/files/docs/the\\_cost\\_of\\_delaying\\_action\\_to\\_stem\\_climate\\_change.pdf](https://www.whitehouse.gov/sites/default/files/docs/the_cost_of_delaying_action_to_stem_climate_change.pdf).

20 U.S. DOE, “U.S. Energy Sector Vulnerabilities to Climate Change and Extreme Weather,” July 2013, <http://energy.gov/sites/prod/files/2013/07/f2/20130710-Energy-Sector-Vulnerabilities-Report.pdf>.

21 Unfortunately, a complete CDP data set for 2014 could not be obtained but a select comparison of 2014 data indicated answers were extremely similar to 2013. Where 2014 data were available it was used.

22 S&P Global 100 company CDP responses for years 2011, 2012, 2013 and 2014 and interview questions had very consistent answers to questions about risk and resilience.

23 Because perceptions about climate change opportunity did not change, this issue was not pursued in the current report.

24 Royal Dutch Shell presentation at the 5th Nexus Forum on the Climate-Energy Security Nexus: Policies and Practices to Enhance Energy Sector Resilience, Djamila Amimer, November 4, 2014.

25 HSBC Holdings response to the CDP 2013 Climate Survey.

26 In the CDP survey, respondents are given a list of physical climate risk drivers to choose from. Companies can select multiple drivers and also write in their own by selecting “other.” See the Appendix for the CDP questions.

27 Canon Inc. response to the CDP 2013 Climate Survey.

28 Chevron Corporation response to the CDP 2013 Climate Survey.

29 Philip Morris International response to the CDP 2013 Climate Survey.

30 GlaxoSmithKline response to the CDP 2013 Climate Survey.

31 Ceres, Cool Response: The SEC and Corporate Climate Change Reporting, 2014, <http://www.ceres.org/resources/reports/cool-response-the-sec-corporate-climate-change-reporting>.

32 U.S. Securities and Exchange Commission (SEC), “Commission Guidance Regarding Disclosure Related to Climate Change,” 2010, <https://www.sec.gov/rules/interp/2010/33-9106.pdf>.

33 Guidance suggests, but does not require disclosure on these types of risks: “Registrants whose businesses may be vulnerable to severe weather or climate related events should consider disclosing material risks of, or consequences from, such events in their publicly filed disclosure documents.”

34 Dow Chemical 10-K filing for 2013.

35 Ford Motor Co. 10-K filing for 2013.

36 Alcatel-Lucent 20-F filing for 2013.

37 <https://www.ncdc.noaa.gov/billions/>

38 <http://www.aon.com/impactforecasting/impact-forecasting.jsp>

39 <http://www.munichre.com/en/reinsurance/business/non-life/natcatservice/index.html>

40 <https://www.cdp.net/Documents/Guidance/2015/Climate-change-reporting-guidance-2015.pdf>

41 <http://energy.gov/sites/prod/files/2013/07/f2/20130716-Energy%20Sector%20Vulnerabilities%20Report.pdf>

42 <https://www.icmm.com/document/5173>

43 <http://nca2014.globalchange.gov/>

44 Siemens Group response to the CDP 2013 Climate Survey.

45 Pfizer response to the CDP 2013 Climate Survey.

46 EMC Corporation response to the CDP 2013 Climate Survey.



- 47 Total SA response to the CDP 2013 Climate Survey.
- 48 Aegon response to the CDP 2013 Climate Survey.
- 49 E.ON response to the CDP 2013 Climate Survey.
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- 51 T.R. Karl, J.M. Melillo, and T.C. Peterson, (eds.), “Global Climate Change Impacts in the United States,” Cambridge University Press, 2009, <http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf>.
- 52 3M Co. response to the CDP 2013 Climate Survey.
- 53 Credit Suisse Group AG response to the CDP 2013 Climate Survey.
- 54 Wal-Mart response to the CDP 2013 Climate Survey.
- 55 Anglo American Sustainable Development Report 2013.
- 56 Nestlé response to the CDP 2013 Climate Survey.
- 57 Small Business Association, “Small Business Trends,” <https://www.sba.gov/content/small-business-trends-impact>.
- 58 Center for Climate and Energy Solutions (C2ES), “State and Local Climate Adaptation,” <http://www.c2es.org/us-states-regions/policy-maps/adaptation>.
- 59 CDP, “Protecting Our Capital: How climate adaptation in cities creates a resilient place for business,” July 2014, <https://www.cdp.net/CDPResults/CDP-global-cities-report-2014.pdf>.
- 60 Carmin, J., N. Nadkarni, and C. Rhie, “Progress and Challenges in Urban Adaptation Planning: Results of a Global Survey,” 2012, <http://www.icleiusa.org/action-center/learn-from-others/progress-and-challenges-in-urban-climate-adaptation-planning-results-of-a-global-survey>.
- 61 Halcrow Group, “City of London Strategic Flood Risk Assessment,” May 2012, <https://www.cityoflondon.gov.uk/services/environment-and-planning/planning/design/Pages/flood-risk.aspx>.
- 62 Horton, R., D. Bader, Y. Kushnir, C. Little, R. Blake, and C. Rosenzweig, “New York City Panel on Climate Change 2015 Report Chapter 1: Climate Observations and Projections,” *Ann. N.Y. Acad. Sci.* 1336 (2015) 18–35, <http://onlinelibrary.wiley.com/doi/10.1111/nyas.12586/epdf>.
- 63 Carmin, J., N. Nadkarni, and C. Rhie, “Progress and Challenges in Urban Adaptation Planning: Results of a Global Survey,” 2012, <http://www.icleiusa.org/action-center/learn-from-others/progress-and-challenges-in-urban-climate-adaptation-planning-results-of-a-global-survey>.
- 64 Ceres, “Building Resilience Cities: From Risk Assessment to Redevelopment,” November 2013, <http://www.ceres.org/resources/reports/building-resilient-cities-from-risk-assessment-to-redevelopment/view>.
- 65 U.S. SEC, “Commission Guidance Regarding Disclosure Related to Climate Change,” 17 CFR Parts 211, 231, and 241, effective date February 8, 2010, <http://www.sec.gov/rules/interp/2010/33-9106.pdf>

The Center for Climate and Energy Solutions (C2ES) is an independent non-profit, non-partisan organization promoting strong policy and action to address the twin challenges of energy and climate change. Launched in 2011, C2ES is the successor to the Pew Center on Global Climate Change.



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