

BUSINESS

EMERGING PRACTICES IN TCFD-ALIGNED CLIMATE RISK AND OPPORTUNITY ANALYSIS AND DISCLOSURE



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March 2022



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ACKNOWLEDGEMENTS

C2ES would like to thank Bloomberg Philanthropies for their support of this work. C2ES is also grateful to the following companies for their valuable contributions this report.

Alcoa
American Airlines
American Honda Motor Co., Inc.
BHP
Delta Airlines
CMS Energy
Pacific Gas and Electric Company (PG&E)
Southern Company

C2ES also wishes to thank the following experts for their valuable input:

Rick Alsop, WSP
Katie Eisenbrown, WSP
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EXECUTIVE SUMMARY

In 2021, the imperative for climate action became even clearer. The 6th Assessment Report from the Intergovernmental Panel on Climate Change highlighted the dangers of the rapidly changing global climate, and the 26th Conference of Parties (COP26) in Glasgow produced several new global commitments by countries and the private sector to reduce global greenhouse gas emissions and mitigate harm from climate change.

However, our climate is already changing, and it is impacting business. In 2017, the Task Force on Climate-related Financial Disclosures (TCFD) released recommendations for how business can communicate climate risks and opportunities to their investors. A key recommendation is for companies to conduct climate scenario analysis, to understand the financial consequences of climate risks and opportunities to the company under plausible climate futures.

While companies are increasingly disclosing under the TCFD framework, they are experiencing several challenges in articulating financial impact using scenario analysis. Scenario analysis is a complex exercise requiring specific climate data, as well as a technical understanding of assets and the business. Further, the lack of significant precedent toward disclosure of climate-related financial impact means that many companies are hesitant toward disclosing the detailed results of scenario analysis.

The Center for Climate and Energy Solutions (C2ES), in collaboration with member companies in its Business Environmental Leadership Council (BELC) and a few additional companies, conducted a study of current practices pertaining to climate-related scenario analysis, how companies are determining financial impact of climate-related risks and opportunities, how they are taking action on these impacts, and how they are disclosing this information. The results of the study are intended for use by companies to help them conduct more in-depth and decision-useful analysis of climate-related risks and opportunities.

We interviewed 19 companies, conducted literature reviews, and collaborative workshops. We analyzed practices under four focal areas: how are companies measuring, assessing, managing, and disclosing climate-related risks and opportunities? This report presents the in-depth results of that study. We present, aligned with the four focal areas:

- current practices companies are using to conduct climate-related financial analysis
- honest insights related to the challenges companies are facing, and how they are working to overcome the challenges
- views on future developments regarding climate risk and opportunity analysis, and keys to success
- case studies from specific BELC members.

In synthesizing the results, we developed a maturity model containing specific actions for how companies can enhance their climate-related risk and opportunity analysis and disclosure. C2ES also provides policy recommendations to improve companies' disclosure of climate-related risks and opportunities within U.S. financial markets.

I. INTRODUCTION

THE NEED FOR DISCLOSURE OF CLIMATE-RELATED RISKS AND OPPORTUNITIES

The Intergovernmental Panel on Climate Change (IPCC) released their 6th Assessment Report (AR6) in August 2021. The Panel made their findings clear: human activity is unequivocally changing the global climate and leading to higher temperatures, sea level rise, more intense storms and drought, among other climate impacts.¹ The report details how climate change has already impacted ecosystems, economies, and our society and how it will only accelerate unless significant actions are taken to reduce global greenhouse gas emissions. In November 2021, world leaders gathered in Glasgow for the 2021 Conference of Parties (COP) and established the Glasgow Climate Pact, among other commitments, that included pledges on methane emissions, steps to address loss and damage, and agreement on important rules for how emissions trading under the Paris Agreement will be implemented.²

A changing climate also poses a direct threat to businesses through impacts from extreme temperatures and storms disrupting operations, supply chains, and support services. Efforts to decarbonize business activities and transition to a low-carbon economy create both risks and opportunities to business. Risks associated with these transitions include regulatory changes, market-based incentives, and changing consumer preferences. Investments disproportionately impacted by climate change relative to the global economy create risk to investors, but investments able to thrive in a low-carbon economy create opportunities.

The Task Force on Climate-related Financial Disclosures (TCFD) was established in 2015 to determine how to produce consistent and comparable company disclosures to inform investors of the climate-related risks and opportunities that investees face. Their recommendations were released in 2017 as a framework for voluntary disclosures. Since then, thousands of companies globally have begun disclosing their climate-related risks and opportunities in alignment with the TCFD recommendations.

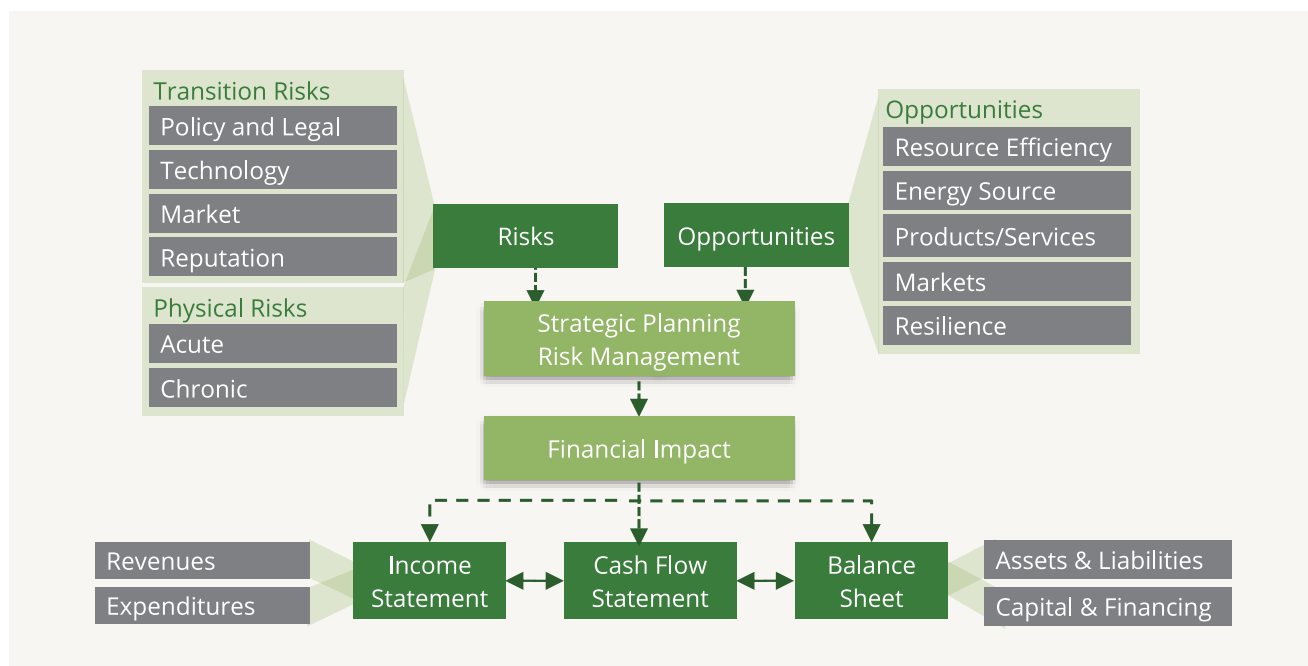
Recently, financial regulators have shown greater interest in mandating climate-related disclosures for publicly listed entities. Recent regulation has been introduced in jurisdictions such as the United Kingdom, New Zealand, Singapore, and the Netherlands.³ A draft proposal has been introduced by the Canadian Securities Administrators (CSA) in Canada.⁴ In the United States, the Securities and Exchange Commission (SEC) issued a request for information in 2021 to inform the development of a regulation to require companies to disclose climate-related data in financial filings,⁵ building off their guidance issued approximately a decade earlier that introduced the need to disclose climate-related risks that were deemed material.

The TCFD recommendations are designed to provide a holistic view to investors of how a company is assessing and managing its climate-related risks and opportunities. It contains recommendations organized into four core elements: governance, strategy, risk management and metrics and targets.

A notable recommendation of the TCFD is for companies and investors to evaluate climate-related risks and opportunities using forward-looking analysis. The TCFD recommends using scenario analysis to evaluate the resilience of the organization under different warming models deemed “scenarios.” The intent of the disclosure recommendation is to help investors understand the direction and magnitude of impacts that climate-related risks and opportunities may have on their investees, by explicitly incorporating forward-looking data and analysis. Specifically, the TCFD recommends how the impacts of a changing climate and a low-carbon transition will impact the company under each chosen scenario, considering the financial impact to revenue, operating expense, capital expense, and assets and liabilities. See **Figure 1** for a representation from the TCFD.

There is an increasing need for companies to use scenario analysis to evaluate the relevance of business models in the transition to a low-carbon economy. Scenario analysis enables companies to “road-test”

FIGURE 1: Climate-Related Risks, Opportunities and Financial Impact



Source: Recommendations of the Task Force on Climate-related Financial Disclosures, 2017

different climate strategies, and to test resilience to climate-related risks.

CHALLENGES TO EVALUATING CLIMATE-RELATED RISKS AND OPPORTUNITIES

Companies face significant challenges in the process of measuring, assessing, managing, and disclosing climate-related risks and opportunities using forward looking data and analysis. In the TCFD’s 2021 status report, results from scenario analysis showed a notable gap in reporting, only 13% of reporting companies (of 1651 total) included an evaluation of climate-related financial risks and opportunities using scenario analysis.⁶ The TCFD status report indicated several barriers to evaluating climate-related risks and opportunities and disclosing decision-useful results, including:

- **Coordinating and gathering broad stakeholder input:** An effective climate-related analysis requires detailed, cross-organizational engagement, input, and data to inform the potential impacts. Obtaining the information needed to inform this type of scenario analysis is a challenge due to the complexity of the request, the scale of information

needed, the lack of data availability, and the time commitment required to gather the data. Few companies have the resources to dedicate to this effort.

- **Accessing and understanding relevant and useful data.** Few companies have trained climate experts on staff. Obtaining a working knowledge of climate data, asking the right questions, selecting the appropriate data, and applying this to a scenario analysis is a challenge, even with input from external consultants.
- **Discomfort with disclosure of financial metrics.** Most companies prefer to only disclose financial values produced using standard accounting or industry-standard methods. There are no standards for financial scenario analysis output, creating hesitancy to disclose financial impacts from climate risks and opportunities. Further, there is a lack of prescriptive guidance on metrics leading to potential for inconsistent analyses and reporting. The TCFD provides some suggestions for scenarios and metrics, but not explicit guidelines for financial metrics. Investors are becoming more sophisticated and are considering inherent financial risk values

(those that represent unmitigated risk) as well as residual financial risk values (those that also include the costs associated with risk management and mitigation measures). In addition, if a company does not deem the risk to be financially material, it may not disclose any risks, thus prompting investors to validate and verify the evidence to confirm this conclusion.

Some companies and investors already disclose the results of some form of climate-related scenario analysis of climate impacts, and their adaptive responses. Although companies face several challenges to disclosure, some companies have established an approach to evaluating risks and opportunities through scenario analysis that they consider robust enough for public disclosure. Further, several companies have conducted a climate-related financial scenario analysis (or are conducting analysis) that are not at a stage where disclosure is appropriate.

OVERVIEW: C2ES STUDY

C2ES has been engaging companies on climate related risks for several years. Building off C2ES' previous work on corporate climate resilience—including the reports, *Weathering the Storm: Building Business Resilience to Climate Change* (2013) and *Weathering the Next Storm: A Closer Look at Business Resilience* (2015)⁷—C2ES formed a workgroup among its Business Environmental Leadership Council (BELC) in 2016 to facilitate discussion and generate corporate input to support the TCFD. Since 1998, C2ES has convened its BELC as a roundtable to inform climate strategies and policies among climate leaders

in industry. The BELC continues to represent climate change leadership among large companies across diverse industry sectors, and its members commit to follow leading practices for addressing climate-related risks and opportunities.

Shortly after the publication of recommendations by the TCFD in June 2017, C2ES issued its report, *Beyond the Horizon: Corporate Reporting on Climate Change*,⁸ which identified where companies needed support in implementing the TCFD's recommendations, including the use of scenario analysis to assess climate-related risks and opportunities. In 2018, C2ES issued another report, *Using Scenarios to Assess and Report Climate-Related Financial Risk*,⁹ which included a discussion of best practices to date and key challenges, including how companies are navigating a more complex disclosure landscape, addressing legal concerns related to disclosure, and taking a holistic look at both transition and the physical risks of climate change.

Since then, many of the BELC members have evaluated, or are currently evaluating, their climate-related risk and opportunities, using scenario analysis. Some have begun publicly disclosing details of the analysis (e.g., methodology or results).

C2ES continues to strive to enhance the quality and quantity of climate-related risk and opportunity disclosures from leading companies if it can lead to reducing emissions and strengthening climate resilience. Further, C2ES encourages companies to assess the impact of a transition to a low-carbon economy on their businesses, as many leading companies could find new ways where they could benefit from it.

BOX 1: Sectors of focus

This study focused on sectors that are high greenhouse gas emitters, and highly exposed to impacts of climate change: utilities, some industrials, commercial real estate, and automotive and airline transportation. C2ES selected these sectors due to the significant climate-related financial risks and opportunities they face, as they often experience the most pressure from investors and the public to address climate-related risks and opportunities. Pending federal and state regulations will only increase pressure. Therefore, companies in these sectors typically have had, or are in the process of developing, more experience conducting climate-related scenario analysis when compared to other sectors. Further, they will have the greatest pressure to critically understand how their company will perform throughout the transition to a low-carbon economy.

Methodology

C2ES undertook a new study with 19 large companies, mostly BELC members, to examine how they are measuring, assessing, addressing, and disclosing climate-related risks and opportunities. We conducted virtual interviews and workshops to understand the activities, techniques, and tools, how they obtained organizational buy-in for conducting detailed and robust analysis, and how they have approached climate-related financial disclosure. Our study was further supplemented by a review of available literature discussing climate-related risk and opportunity evaluation and scenario analysis.

The study's intent is not to evaluate the strength or comprehensiveness of the disclosures or the outputs of the analysis, but to understand the process across different companies so that other companies can consider lessons learned and apply them to their own internal processes to better manage climate-related financial risks and opportunities.

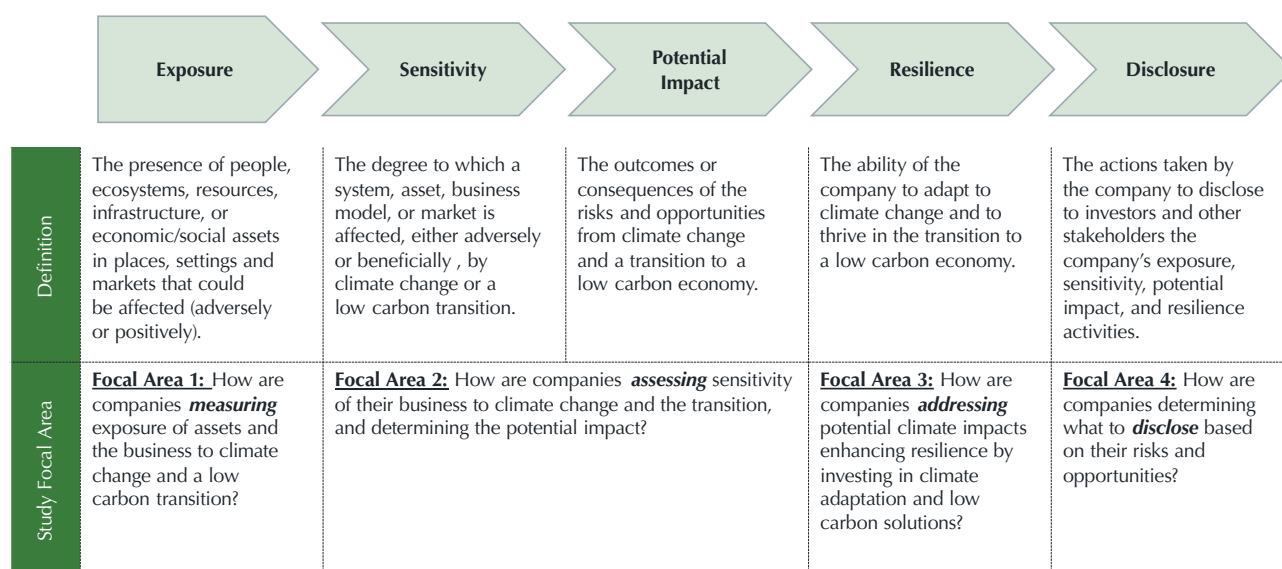
STUDY FOCAL AREAS

The study focused on four main topics as they pertain to climate-related transition and physical risks and opportunities for companies. The four focal areas are established by C2ES to help add clarity to the practices

of evaluating and disclosing climate-related financial risks and opportunities. C2ES selected the focal areas based on the key components for determining climate risks and opportunities as laid out by the IPCC. Note that throughout the remainder of the document we will occasionally refer to climate-related financial risks and opportunities as climate-related impacts or impacts.

1. **Measuring exposure:** Identifying and measuring a company's exposure to a changing climate or the transition to a low-carbon economy.
 - **Method:** We reviewed the methodologies and tools used for identifying impacts, gathering data, and measuring exposure to climate-related risks and opportunities.
2. **Assessing sensitivity to climate-related risks and opportunities:** Assessing the sensitivity of a company's business model, its revenue base and its operating and capital costs to climate change or a low-carbon transition, and determine potential financial impacts.
 - **Method:** We reviewed how companies currently assess the sensitivity of the company's businesses, strategy, financial planning, and assets to physical and transition risks and opportunities, and how companies use the information to determine the potential impact.

FIGURE 2: Defining terms within the study¹⁰



Source: Adapted from the IPCC's 5th Assessment Report

3. **Addressing climate-related risks and opportunities:**

Addressing climate-related risks and opportunities through actions and investments to reduce climate-related physical and transition risks, enhance resilience, and capitalize on opportunities.

- **Method:** We reviewed what actions and investments companies are making to capitalize on opportunities and build resilience to risks. We collected insights on actions taken and/or planned to manage the risks and increase opportunities as companies integrate data assessments into their planning efforts, and any finance mechanisms in place to manage these risks and opportunities.

4. **Disclosing climate-related risks and opportunities:**

Disclosing relevant climate-related physical and transition risks and opportunities and potential financial impacts.

- **Method:** We gathered insights on considerations for how companies disclose their assessments,

measurements, and investments. C2ES assessed and cataloged the considerations companies incorporate when developing climate-related impacts and the barriers to more decision-useful disclosure.

The core results of the study are presented by focal area in Section 2. These results include current practices, noted gaps or challenges, keys to success, and how each focal area may evolve in the coming years.

In Section 3, we summarize the trends observed in a maturity map (basic, intermediate, mature), to capture and categorize the activities identified through the company interviews. Using the maturity levels, we describe how a company can progress over time.

In Section 4, we conclude with policy recommendations to improve corporate disclosure of climate-related risks and opportunities.

Section 5 concludes with a look ahead to emerging topics such as net-zero targets, adaptation and resilience plans, and transition plans.

II. KEY FINDINGS

Within each focal area, our study identified several current practices, challenges, and useful insights on how companies are improving their ability to progress in the focal area. Our results suggest companies continually evolve their practices to evaluate climate-related risks and opportunities and their potential financial impacts.

MEASURING EXPOSURE

How are we defining the focal area?

The first stage in our research framework, measuring, captures how companies identify, measure, and eventually monitor exposure to their physical and transition climate risks and opportunities. Measuring exposure is often the first step in the evaluation of financial risks and opportunities, and typically relies on the selection and analysis of forward-looking data developed by reputable, peer-reviewed third-party external sources.

How do companies measure exposure to climate-related risks and opportunities?

Identify relevant climate risks and opportunities (actual and potential): Before companies can select the data needed to assess impacts, companies identify the risk and opportunities that they may be exposed to. Companies typically take a wide view of potential risks and opportunities at the initial stages, as data have not yet been obtained by the company to evaluate the magnitude of potential impacts from such risks and opportunities.

In identifying climate-related exposure, the companies in our study asked themselves questions beginning with their operations and supply chains. Examples include:

- Are there any critical facilities close to rivers to which, if heavy precipitation occurs in a short amount of time and results in flooding of the facility, essential equipment and infrastructure may be exposed?

- Does the company rely on traditional or renewable energy markets, either through direct investment, a reliance on availability, or price of energy commodities?
- Has the company considered how, when, and where to measure exposure to climate-related risks and opportunities in their supply chain?

Companies must identify the climate risks and opportunities that they intend to focus on throughout the scenario analysis to effectively measure the resulting risks and opportunities.

Measure exposure (actual and potential): Exposure data are generally externally sourced from reputable, peer-reviewed, third-party sources, and are forward-looking. The data often help to determine how external conditions such as weather and climate (for physical impacts), as well as energy markets and macroeconomic conditions (for transition impacts), will change under different future potential climate change scenarios. Assessing exposure for physical impacts is different than assessing exposure transition impacts.

To measure physical impacts, data to assess exposure are collected from models used to assess climate change conditions, developed by academic and governmental organizations, and summarized by the IPCC. The data are necessarily forward-looking, typically projecting out into the future to 2050, 2080, or 2100; considers change in conditions relative to a historical baseline; and varies significantly by geography. The intent of the forward-looking data is to help companies understand the exposure of the company's business (e.g., facilities, operating regions, or supply routes) to relevant physical weather and climate hazards such as high temperatures, drought, extreme precipitation, or wildfires over the lifetime of their assets.

Physical climate scenarios typically explore temperature ranges under several Representative Concentration Pathways (RCPs) that represent plausible future emission trajectories. The scenarios are exploratory in nature, as they explore the impacts of the emission pathways on the physical changes to the climate.

The study observed that companies use data at one of three levels of granularity:

1. *Raw climate data*, such as daily temperature and precipitation patterns over time. The data are particularly difficult to access, apply, and interpret without specialist knowledge in climate data and climate data processing. Sources include NOAA or the Copernicus Climate Database.
2. *Pre-processed climate data*, available through public climate services. Examples include future extreme precipitation or heatwave frequency available from platforms such as Climate Explorer¹¹ or Climate Atlas.¹²
3. *Processed and interpreted climate data*, available from third-party climate data analytics providers that are processed and categorized using proprietary methods and impact functions.

Companies in our study were most likely to use the pre-processed data, or leverage the third-party sources for interpreted climate data, as raw climate data required a high-level of expertise to use.

For physical risks, companies typically apply a high-warming scenario (e.g., RCP 8.5) as well as a lower or moderate-warming scenario (e.g., RCP 4.5). Companies interviewed were careful to apply multiple warming scenarios, due to the inherent uncertainty on the extent to which climate change can and will be mitigated by policy action in the future.

To supplement this study's findings, C2ES has compiled an interim physical climate data to help companies identify the relevant climate data and sources depending on their needs. The resource is designed to

assist companies in navigating the ever-expanding list of publicly available tools and data. As the availability, analysis, and accessibility of climate data evolves, more resources will likely become available to further aid companies in measuring climate exposure to identify their associated physical risks.

To measure transition exposure, the data are different from physical risk data in several important parameters:

1. There is not one single community providing transition impact data, such as the academic climate science community which develops climate change scenarios (for RCPs). There are several reputable sources providing potentially relevant data, such as the International Energy Agency (IEA) or the Network for Greening the Financial System (NGFS), but in general, a large number of various sources for potential transition impacts exist.
2. Scenarios are often normative, as opposed to exploratory. The transition scenarios assess the necessary changes to energy systems and economies to reduce or limit emissions to specific targets and warming (e.g., a 2 degree C or 1.5 degree C temperature rise limit from pre-industrial times).
3. At present, two basic types of externally available transition data exist: changes to energy markets (e.g., share of energy provided by renewables vs fossil fuels) and the macroeconomic impacts associated with a low-carbon transition (e.g., Gross Domestic Product [GDP] or consumption impacts). The impacts to other sectors, consumer preferences, and supply chains must be deduced on a company-by-company basis, using the energy and macro data.

BOX 2: Why are there different physical and transition scenarios?

Physical climate scenarios are developed by the IPCC and were designed to assist with understanding the impacts of climate change on atmospheric processes, biological systems, agricultural systems, and other natural processes. These scenarios are *exploratory* in nature.

Transition scenarios assess the cumulative impacts of the changing climate and climate-related policies on our economic and energy systems. They are often normative by design and are selected to achieve specific outcomes (such as a well-below 2 or 1.5 degree C target).

Physical and transition scenarios therefore have different underlying fact bases, use cases, and goals. The AR6 report of the IPCC collected physical and transition scenarios under different Shared Socioeconomic Pathways (SSPs).

Transition scenarios focused on possible policy trajectories depending on the level of action by governments, businesses, and other societal actors in reducing emissions and transitioning to a low-carbon economy. Typical scenarios include:

4. A **“business as usual”** scenario or one where energy and carbon policies continue at their current trajectory or meet stated policies. This is often aligned with the higher-warming physical scenarios and represents a scenario where a low-carbon transition does not occur.
5. An **“announced pledge”** scenario, where countries implement policies successful at meeting their Paris Agreement pledges or Nationally Determined Contributions (NDCs). This scenario represents a partial low-carbon transition, but not successful at meeting Paris or net-zero transition. Note that C2ES conducted this study in Summer 2021 before the 26th Conference of Parties (COP26) took place and therefore, does not capture the extent to which companies may be assessing scenarios where the pledges of the Glasgow Climate Pact are met.
6. A **“net-zero”** scenario, where sufficient action is taken to achieve net-zero emissions by 2050, leading to a reasonable chance of limiting warming to 1.5 degree C.

Whether assessing physical or transition data and after obtaining said data, companies must then interpret the data. To determine whether a risk or opportunity is potentially important and materially relevant, companies will either compare it to a historical baseline (e.g., change in the number of drought days relative to a baseline) or compare it to a defined threshold (e.g., number of days above 35 degree C). They also compare data to strategic and asset-specific design vulnerabilities, as is discussed in the next subsection on *assessing* impacts.

What are the challenges to measuring exposure?

With the final recommendations of the TCFD released in 2017, many companies have still only just begun using climate data—physical or transition—to identify and measure their exposure. As such, several challenges were identified in our study:

- **A lack of standardization and guidance in data and scenario selection:** Companies interviewed indicated that they must select the data that is most

relevant to their company and the hazards they face but doing so is not a straightforward task. For example, when looking at precipitation impacts, several potential metrics exist for “very wet days” and “days with precipitation above 20mm,” with the appropriate metric remaining unclear. There are no standards on what metric to use in what situation or what scenario to apply when, to what, and why.

- **A lack of sector-specific guidance on what data to apply:** Further to the above, companies are unsure which data is most relevant to their sector, both from a transition or a physical perspective. Some companies in our study expressed interest in having sectoral/geographic specific scenarios or datasets. Data need be relevant to a sector, locations within the sector, and be specific to a company’s risks.
- **Data availability and scale is inconsistent:** Once metrics are selected, the data may still not be available for all locations within a company’s portfolio and at the necessary scale for decision-making. Data is particularly difficult to obtain for riverine and overland flooding without paying for proprietary data. Further, there is a lack of concrete forward-looking metrics for certain highly relevant, climate-related impacts such as forest fires and tropical cyclones.
- **Data comprehension and translation requires expertise:** Few companies, especially prior to the TCFD recommendations, have staff with dedicated training and expertise in understanding, analyzing, and translating climate data (physical or transition), and few in leadership positions have had a prior need to consider forward-looking climate data for decision-making.
- **Model uncertainty remains:** Significant uncertainty remains in existing models, due to the complexity of climate simulations, the uncertainty of how humans will behave, and the forward-looking nature of the models. Further, comprehending the implications of the model uncertainty can be challenging for non-practitioners. Nonetheless, companies in the study are still moving forward with using the best available data and information they can access to begin to identify and measure their exposure and eventually address their climate-related financial risks and opportunities.

What innovations are expected to help companies improve measuring exposure?

While current challenges exist in identifying and measuring climate data, we anticipate that greater understanding and insights will emerge throughout the business community in the next few years due to the following factors:

1. **Increased baseline knowledge:** As companies undergo more iterations of understanding and identifying climate impacts, the knowledge of how climate-related risks and opportunities affect the business and climate literacy within the company (including senior leadership) will increase.
2. **More user-friendly and decision-useful climate analytics and services:** More decision-useful publicly available online tools, data, analytics, and services are being developed for different intended audiences and released for use at no cost.
3. **Increased sharing and disclosure of leading practices:** As climate disclosures become more common (especially if securities regulators begin to require climate disclosure), there will likely be further enhancements to the climate scenario analysis being disclosed and more methodological details. See the disclosure section for further details.
4. **Improved guidance from regulators and investors:** Over time, due to demand, additional sectoral guidance and standards will likely emerge from regulators and investors regarding scenario analysis and decision-useful climate-related financial disclosures.

Greater information sharing, outreach, and collaboration is necessary to build internal capacity for measurement of climate exposure and disclosure among large companies. Doing so can help companies identify where to move capital and resources to decarbonize and enhance their climate resilience; respond proactively to investor, regulatory, and policy-driven transition risks and annual, growing physical risks; and alleviate unintended consequences of their decisions on their host communities and the stakeholders they serve.

ASSESSING SENSITIVITIES AND IMPACT

What is the focal area?

In measuring exposure to climate risks and opportunities, companies measure what is changing in the external physical or economic environment under climate change and the transition to a low-carbon economy. They must determine *how* the external change will impact their company. They must assess how revenues, supply chain, and capital costs are sensitive to a changing climate or a transition to a low-carbon economy.

How are companies currently assessing sensitivities and impact to climate-related risks and opportunities?

Companies assess sensitivities by considering the interaction between the measured climate exposure and their company along the following dimensions:

- **Physical asset performance and integrity:** Assess how increased acute physical weather events (e.g.,

Useful Insights:

Companies in our study provided the following useful insights to measure exposure to climate risk:

1. Start with simpler climate data and/or a narrative approach, before considering more complicated data. Companies obtained a more solid grasp of the impacts by starting with qualitative processed and organized data before proceeding to more specialized, quantitative data.
2. Consult with various internal teams to help identify the most relevant climate impacts and to further socialize the climate risk assessment findings and its intent to inform internal decision making.
3. Obtain data, insights, and feedback from external experts, not limited to consultants but to also include academic, industry experts, and relevant partners where possible.
4. Commit to data governance and monitoring to track relevant impacts over time.
5. Understand the uncertainties that are inherent in climate projections and associated financial analysis without these uncertainties becoming a roadblock for further action.

extreme storm events, wildfires, heat waves) may cause physical damage to assets such as buildings, infrastructure, and equipment. They also assess how chronic changes (e.g., rising temperatures, water stress, sea level rise) will affect the operating conditions and maintenance schedules for the lifetime of the assets.

- **Customers, markets, and revenue streams:** Assess how a transition to a low-carbon economy (e.g., the energy and macroeconomic shifts measured) will affect the company's business model, strategy, financial planning, and revenue streams.

- **Operations:** Assess how rising temperatures, more extreme weather events, and carbon pricing will affect operating costs, worker efficiency, business continuity, and worker health and safety. More advanced analysis will also assess the interdependency on local community services (e.g., transit, utilities, emergency services) and how these may be affected by climate change.
- **Supply chain:** Assess the sensitivity of key suppliers and/or transportation hubs (e.g., major ports and airports) to disruptions from climate events, or cost increases from pass-through carbon costs.

CASE STUDY: PG&E

Pacific Gas and Electric Company (PG&E) is an investor-owned utility providing electric generation and electric and natural gas transmission and distribution services to customers in Northern and Central California. According to PG&E, the company is focused on providing “safe, reliable, affordable, and clean energy to more than 16 million Californians.”

PG&E's infrastructure, operations, and services span more than 70,000 square miles and are exposed to a variety of physical climate hazards—including extreme heat, precipitation, sea level rise, wildfire, and drought—and climate-driven extreme weather is an increasingly regular occurrence throughout California.

PG&E is working to integrate climate science into key business functions and is creating tools to support planning and decision-making that account for future climate conditions. The company is measuring its exposure to various hazards using California-specific data sources such as CalAdapt, a clearinghouse of peer-reviewed data that portrays how climate change might affect California at the state and local level. Such climate data is currently feeding into PG&E's multi-year, service area-wide climate change vulnerability assessment to understand how the company's assets, operations, and services are vulnerable to climate hazards. With the assessment, options for adaptation will be identified. Through this process, PG&E will engage with disadvantaged and vulnerable communities to ensure that proposed adaptation options include the perspectives of these communities.

In addition to assessing and mitigating its physical risks from climate change, PG&E also has a key role in the transition to a low-carbon economy. In California, Executive Order B-55-18 established a statewide goal to achieve economy-wide carbon neutrality by 2045 and to maintain net negative emissions thereafter. As a utility, PG&E will play an important role in helping the state achieve this goal by reducing its own carbon footprint and by enabling customers and communities to achieve their climate goals through programs for energy efficiency, demand response, distributed generation and storage, and electric vehicle adoption.

PG&E sees disclosure of climate-related risks as an opportunity for information-sharing and collaboration in pursuit of solutions, and currently discloses TCFD-aligned material in its CDP reporting as well as its annual Corporate Sustainability Report. With an increasing focus on Environmental, Social, and Governance (ESG) factors, this type of disclosure provides greater visibility into the company's goals and progress and is informed by a continuous improvement approach that includes regular benchmarking and engagement with ESG ratings agencies and evolving ESG reporting frameworks.

A wide range of factors must be assessed to determine overall impact. There are two types of impact assessment that companies undertake, depending on their resources, maturity, need, and time available for the assessment:

1. **Qualitative:** A qualitative analysis assesses the gravity of climate risks and opportunities based on whether they cause a high, medium, or low impact to the business. High, medium, low scoring is one example of a discrete scale that can be applied. The assignment of a risk or opportunity to high, medium, or low is determined considering both the exposure data determined in measuring and a qualitative assessment of the sensitivity to the climate risk/opportunity determined by internal consultation and expert input. Financial impacts are articulated at a high level.
2. **Financially quantitative:** A financially quantitative assessment determines a potential financial figure or range associated with the risk/opportunity. To accomplish this, a clear mathematical or financial relationship between the exposure and a financial sensitivity needs to be established (e.g., a 1 percent decline in efficiency per 1 degree C increase in temperature). These relationships are typically termed “impact functions.” The impact functions are again best determined by internal consultation based on historical observations or specifications for the company.

Most companies in our study took a qualitative assessment approach. Only a few companies then conducted a more-in depth quantitative financial assessment for select assets that are highly exposed to climate-related risks and opportunities, are critical to business success, and are of high value through a pilot project to test the methods and gain buy-in before proceeding to a wider, more extensive assessment. The pilot projects observed focused on specific assets in a specific region and were designed for learning and methodological development.

The analysis is only useful if the results are presented to senior leadership and incorporated into strategic planning and risk management in alignment with the TCFD recommendations. Study participants indicated the importance of distilling the complex information into clear messages for senior leadership, as a way of communicating the top risks and opportunities identified. The next section provides insight on how to

translate the findings into action after the results have been communicated.

Companies face potential pitfalls in communicating the results discussed as part of our study. Communication of quantitative results requires care as financial figures will garner scrutiny, and leadership may initially be hesitant when reviewing financial figures produced using imprecise forward-looking approaches. Companies within our study reported that focusing on top-line messages (while communicating uncertainty) was an effective approach.

What are the challenges to assessing sensitivity to climate-related risks and opportunities?

The challenges listed below largely pertain to developing a financially quantitative analysis but can also apply to qualitative understanding of sensitivity.

1. **Lack of peer examples:** Given the lack of strong examples of quantitative disclosure, companies do not have peer reference for understanding whether a quantitative analysis is accurate, whether results are comparable, or if companies are using comparable methodologies. Greater detail is provided in the disclosure section on reasons for the lack of more quantitative disclosure.
2. **Insufficient indicators to assess sensitivity in a low-carbon transition:** Transition scenarios focus on energy markets, transportation, and macroeconomic impacts. Translating these changes to other sectors such as chemicals, technology, and others can be difficult given the lack of precedent for the economy-wide decarbonization needed to achieve net-zero emissions.
3. **Difficulty quantifying opportunities:** Assessing the magnitude of opportunities adds a further layer of complication, as the ability to capture opportunities depends on the development of new markets and technological innovations and advancements, to capture or maintain market share, and to make timely investments (as with other new ventures). Differing policy developments and regulations around the world, or lack thereof, can also affect the magnitude and longevity of opportunities. These uncertain factors combined with the additional model uncertainty of climate data add to the complexity around quantifying the financial benefits of opportunities.

CASE STUDY: American Airlines

American Airlines is among the world's largest airlines, according to fleet size, scheduled passengers carried, and revenue passenger-miles. In 2020, the company conducted a qualitative assessment to understand physical and transition risks and opportunities related to climate change and their impact to its business and the major transit hubs that form the foundation of its network.

American measured its exposure to potential physical risks using a high emissions scenario to identify acute and chronic hazards that may affect its operations. It conducted a site-specific approach when estimating and analyzing physical risk, focusing on its nine most critical airports and its largest maintenance facility. American first looked at historical trends and impacts, including changes in climate between 1990 and 2018, and then at projections for 2035 and 2060. It based future projections on the IPCC's RCP 8.5 emissions scenario, which assumes essentially "business as usual" between now and 2100. American chose the high-emissions RCP 8.5 scenario chosen because it produces an up-to-6 degree C rise in global temperatures, which would cause the most significant potential physical impacts on its facilities, creating an upper-level boundary condition for its analysis.

The company assessed its transition risks and opportunities using the International Energy Agency's (IEA) 2019 World Energy Outlook global climate change scenarios, which include a 6 degree C Current Policies Scenario that generally aligns with the higher-emissions RCP 8.5 scenario used for its physical risk assessment, a 2.7 degree C Stated Policies Scenario that assumes the policies agreed to as part of the Paris Agreement are enacted, and a 1.65–1.85 degree C Sustainable Development Scenario that aligns with net-zero carbon by 2070.

American then conducted an analysis with expert input to determine a qualitative assessment of overall risk. Analysts based the susceptibility of each location to overall risk on the business importance of each site. They assessed corporate-level risks and opportunities in the short- (0–2 years), medium- (2–15 years), and long-term (15–30 years), assessing the financial impact level qualitatively as high, medium, and low.

In its first TCFD-aligned ESG report, American provided examples of financial risks due to acute physical impacts of climate change under the chosen physical risk scenario. Example of risks include: extremely high temperatures could exceed the maximum allowable temperature at which aircraft are certified to operate; increased hot days could interrupt operations by causing heat buckling on runways and other infrastructure damage, leading to increased operational and repair costs for airports that would be passed through to airlines; flooding from intense precipitation at major hubs could interrupt expansion strategies; and sea-level rise in coastal cities could require financial investments to harden resilience at airports, or even relocation.

For its transition risks, American identified regulatory risks, such as carbon taxes that increase the price of jet fuel and raise operating costs, or mandates for new technologies that require additional capital. Shifting consumer behavior could result in businesses choosing travel alternatives, and collateral used to secure loan (e.g., aircraft and spare parts) could lose value as economies move to low-carbon alternatives.

This qualitative assessment was used to help American prioritize resilience investments and mitigations strategies. The airline continues to explore emission reduction options and options to grow the market for sustainable aviation fuel, a drop-in alternative to petroleum jet fuel with the potential to reduce aviation emissions significantly.

The results of the qualitative assessment and TCFD alignment were disclosed in American's 2019 ESG Report, with an update in the 2020 ESG report. American provided a summary of the climate-related transition and physical risks in its 2021 10-K filing to the SEC, though noted that it was not able to accurately predict the materiality of any potential losses or costs associated with the physical effects of climate change.

4. **Lack of foundation for developing quantitative impact functions:** Impact functions are typically produced using historically observed impacts or design specifications. If these impacts have never been observed before, then developing the functions becomes a more hypothetical exercise. There are climate data analytics and service providers that combine exposure and vulnerability to capture overall risk and opportunity, but the impact functions may be too general to apply to an individual company’s context, sector, and scale. When there is lack of information to develop meaningful impact functions, the utility of the analysis for decision making can suffer.
5. **False precision:** Particularly with a financially quantitative assessment, companies can face the impulse to try and make the assessment exact by adding variables and interdependencies. However, given the uncertainty in the data, there is a fundamental limit to the precision that can be applied. At best, the analysis achieves an order-of-magnitude estimate of the overall impacts. False precision can cause some to mistrust the exercise, or to be unable to engage with it to make meaningful resource allocations or to include in public disclosure of climate-related financial data.

What innovations are expected to help companies improve their ability to assess sensitivity and impacts?

Similar to the section on measuring exposure, we expect greater regulatory clarity to help inform what level of detail is most decision-useful to regulators and investors in a disclosure context. Additionally, when and if more regulations encourage more consistent disclosure, more

companies’ public disclosures of climate-related financial risks and opportunities will, over time, become more measurable and comparable.

ADDRESSING CLIMATE-RELATED FINANCIAL RISKS AND OPPORTUNITIES

What is the focal area?

Whereas measuring climate risks and opportunities determines what changes a company will experience and assessing sensitivity and impact determines the extent of risk and opportunity, addressing risks and opportunities reflects how a company plans to prepare and respond to a changing physical climate, regulatory environment, and other market changes. “Addressing” climate risks and opportunities can refer to how the company will *mitigate* (reduce) greenhouse gas emissions and transition to a low-carbon economy (e.g., through a net-zero transition plan for its own operations or how it will develop goods and services for a low-carbon future). It can also refer to how the company will *adapt* to the physical changes in our climate by enhancing its adaptive capacity and resilience.

Additionally, investors are increasingly looking to understand residual aspects of climate risks—including direct costs of carbon insetting or offsetting, as well as potential losses due to lack of resilience or if insurance is no longer available.

How are companies currently addressing impacts?

Our study found that few companies are taking the significant actions needed to address the risks and opportunities identified from their climate

Useful Insights:

Companies that were successful at assessing vulnerability to climate risk in our study did the following:

1. Take a progressive approach, by starting with a qualitative assessment to understand hotspots and then, where possible, develop a financially quantitative assessment.
2. Undergo extensive internal consultation to develop impact functions, and not rely on external data or service providers to apply proprietary impact functions.
3. Communicate results to senior leaders by highlighting the most decision-useful aspects of the analysis and not focus on the exact financial values coming from the analysis (using financial ranges if including financial values to allow for uncertainties).

scenario analyses. Most companies are still improving their capabilities to measure exposure and assess vulnerabilities. As such, our conclusions below reflect emerging practices from our study participants and denote an area warranting ongoing research.

The current practices of the companies in our study are as follows:

1. **Prioritizing risks and opportunities:** To prioritize the climate-related financial risks and opportunities that require action, several companies we interviewed use the results of the assessment of sensitivities to label specific risks and opportunities as most important to the company. Determining importance can be a difficult task and companies have taken several approaches to prioritize impacts:

- **Stakeholder engagement:** Engagement was a core component for each of the other focal areas, but more engagement will be required in this focal area to further elucidate the impacts that require action or inclusion in a climate transition and resilience or adaptation plan. There may be non-tangible factors not included in the analysis or quick-win improvements to the company's reputation and unrelated to financial impact.
- **Establishing a threshold of financial materiality:** Financial materiality is critical way to frame risk and quantification is necessary for companies to conduct their assessment and evaluation and can be the driving factor in considering risk mitigation or adaptation response. In many countries, including the United States, financial materiality has been assigned a strict definition by securities regulators and affects what needs to be disclosed by most corporations. In others (e.g., the European Union), materiality has a less strict definition. Establishing financial threshold for when actions need to be taken or controls need to be in place can help clarify for the company, investors, and stakeholders why specific actions are being prioritized. Further, there is little guidance from regulators on how to apply the concept of financial materiality to forward-looking and scenario-based estimates of financial impact, which may become more relevant due to the long-term nature of climate risks. Several companies interviewed reported using specific metrics or took into consideration materiality

in deciding whether and when to address risks, though many companies indicated that they do not systematically address or manage risks in a direct way.

2. **Identifying capital projects:** From the analysis, capital projects are being identified to address prioritized impacts that can harden infrastructure, protect natural ecosystems, or reduce emissions. Some companies indicated in our study that they have already begun including climate-related capital projects into their capital planning. In our study, some companies indicated that they needed to demonstrate a clear financial return on investment (ROI) for decarbonization or resilience activities. Others indicated ROI was not necessary, and that ROI can be counterproductive due to the inherent uncertainty of long-term risks. For these companies, resilience investments were made on merit alone so long as the investment was not cost prohibitive.
3. **Operational updates:** Companies are also looking at operations and identify ways to become more efficient (and reduce emissions), build in redundancies, improve employee safety, health, and productivity under extreme weather conditions. Some companies update existing business continuity plans (BCPs) to reflect the relevant and prioritized climate risks. Other companies have begun looking at key suppliers and identifying ways to improve supplier resilience or redundancy. For examples, after one company incurred severe shipping disruptions, it invested in supply chain management infrastructure to address future risks.

In October 2021, the TCFD released supplementary guidance on developing transition plans to help companies make transition planning (and broader climate strategy) more aligned with corporate strategy, subject to governance, credible, actionable, and specific.¹³ The TCFD guidance had not yet been released during the company engagement phase (Spring/Summer 2021), and at the time, companies in our study had not yet developed policies/documents titled "transition plans," although many companies indicated their analysis to date could help inform transition plans. Further study is merited to help companies overcome challenges in using climate-related scenario analysis to drive strategies, plans, or policies that could meet the criteria for transition plans set out by the TCFD.

BOX 4: Opportunities: Creating the Clear Business Imperative

The methodical approach outlined for evaluating climate impacts through scenario analysis is applicable to risks and opportunities. However, in our study, we noted that companies often took a more ad-hoc approach to opportunities, especially after the opportunity had been qualitatively identified. We found that it was easier for companies to understand their risks quantitatively (e.g., what the risks to revenue or cost pressures might be), than to confidently assert the magnitude of the opportunity quantitatively. For example, while a market opportunity can be identified by the analysis and perhaps a market size, factors determining revenue capture may include timing of the opportunity, ability to maintain or grow market share, and the need for innovation or investment for the opportunity to materialize. As such, companies are often less confident quantifying opportunities when they depend on several external uncertain factors.

Through our study—in our interviews with companies and in reviewing their sustainability and CDP reports—we found that companies framed opportunities along one or more of the following parameters:

1. **Clear, new market, or technological opportunities arising directly from a transition to a low-carbon economy, often due to increased consumer demand:** Specifically, for sectors in the energy, utilities, and transportation sectors, these opportunities arise directly from a low-carbon economy such as delivery of renewable energy sources and sustainable transportation options and fuels. For these companies, an opportunity exists today that only increases over time in a low-carbon transition. For example, utilities cited increased customer demand for low- or zero- carbon energy, with voluntary opt-ins from commercial and residential customers who want environmentally friendly options. Other sectors, especially in heavy industrial and extractive industries noted an increased demand for raw materials, such as nickel and copper, necessary for greater electrification. In any instance, investments are required today to begin positioning companies who are dependent on these new markets and technologies to realize the opportunity.
2. **Opportunity to exceed regulatory requirements:** Companies in different sectors, especially in the manufacturing, utilities, and chemicals sectors, noted where they were positioned to benefit from upcoming regulations, such as renewable energy portfolio standards, methane emissions reductions, energy efficiency standards, and phase-out of specific chemicals, since their existing efforts already met or exceeded upcoming regulations.
3. **Opportunities to outperform competitors on climate metrics, which may drive value in a low-carbon transition:** For sectors, such as commercial real estate, industrials, and transportation, performance on energy usage or emissions can decrease costs and lead to market outperformance in a low-carbon transition (e.g., low-carbon buildings and sustainable aviation fuel will be valuable in a transition). For these companies, an opportunity exists today that will accelerate in the future, should industries and policymakers remain focused on achieving significant emissions reductions.
4. **Opportunity to serve as an enabler of a low-carbon transition:** For companies in the chemicals, heavy industrial, and technology sectors, opportunities exist to produce products and services that help companies become more energy efficient, achieve low- or zero- greenhouse gas emissions, and capture specific transition opportunities. Where opportunities may not be available or widespread today, companies cite they have begun, or will begin, investing in research and development to capitalize on them.

What are the challenges to addressing climate-related risks and opportunities?

Participants in our study noted that, of the four focal areas, addressing climate-related financial risks and opportunities is the most difficult to implement. They noted the following challenges:

1. **Few public precedents exist for addressing potential risks and opportunities:** As noted, few study participants have taken strong action to address the potential impacts they identified. There is often a lack of clarity on what is the best action (e.g., capital investment, operational improvement, policy, or regulation) to address the impact, even once it is well studied.
2. **Defining materiality:** Defining a clear materiality threshold can be a challenge as the term holds a strict definition with securities regulators (specifically financial materiality), and with the uncertainty of climate-related financial metrics, aligning on a materiality threshold specifically for climate-related impacts is difficult. Some companies are disclosing all climate-related risks and opportunities they assess, others are disclosing only those that meet a definition of financially material (which are often chosen internally), adding to the confusion and inconsistency across disclosures. Some stakeholders have noted that since climate change's impacts are systemic, with the potential to impact upstream, midstream, and downstream economic values, a better way to approach materiality would be to sequence, and thereby prioritize, materiality concerns based on how they could affect a companies' capabilities.
3. **Developing clear, actionable plans:** Gaining full buy-in for clear and actionable climate transition and resilience or adaptation plans are difficult, again due to the inherent uncertainty and long-term nature of the impacts. Regulated industries may face difficulty making the case to regulators to invest in resilience or low-carbon measures, since they typically need approval from regulators to make large capital investments. We expect companies to soon begin following the TCFD's recent guidance on action on transition plans, as referred to in the above.
4. **Inconsistent policy signals:** In many cases, there is no clear ROI for an investment in decarbonization, adaptation, or resilience without government incentive or market shifts. Without certainty on the long-term availability of policy incentives, companies

may have difficulty making the case for investing in emissions reductions and resilience projects for their assets, let alone mitigation and resilience projects outside their fences into their host communities.

What innovations are expected to help companies improve address climate-related risks and opportunities?

We expect a combination of greater stakeholder scrutiny and greater regulatory pressure to motivate companies to increase decarbonization, adaptation, and/or climate resilience planning by:

1. **Greater demands for transition plans:** Numerous efforts by regulators and stakeholders are emerging globally to inhibit cases of "greenwashing." In October 2021, the TCFD released guidance on transition plans. Public pressure asking companies to substantiate how they will implement their climate targets via transition plans will likely continue to grow.
2. **Further clarity on adaptation and climate resilience plans:** We anticipate that, similar to transition plans, there will be increased demand for and guidance on how companies can develop concrete adaptation and climate resilience plans.

DISCLOSING CLIMATE-RELATED RISKS AND OPPORTUNITIES

What is the focal area?

The stated motivation for the TCFD recommendations is to enhance climate-related financial disclosure so that investors can make informed asset allocation decisions. However, as indicated in the above sections, several challenges to conducting a fulsome climate scenario analysis (from measuring to addressing) inhibit disclosure. Much of scenario analysis has served as an internal strategic tool to discuss climate-related financial risks and opportunities and has not yet translated to comprehensive disclosure. With this section, we will highlight how companies are incorporating climate risk and opportunity analysis into their disclosures and the barriers to disclosure, specifically.

In October 2021, the TCFD released its fourth status report that included a chapter on barriers to disclosure of financial impact. Interviews with companies for this study were conducted in summer 2021 and did not collaborate with the TCFD's own study released

CASE STUDY: Alcoa Corporation

Alcoa Corporation (Alcoa) is a global industry leader in bauxite, alumina, and aluminum products with headquarters in Pittsburgh, PA.

In 2019, Alcoa conducted the first analysis of its operations following the recommendations from the TCFD. With the help of an external consultant, Alcoa assessed its climate-related transition and physical risks and opportunities to identify paths to improve processes for addressing such risks and leveraging the opportunities

For physical risk exposure, Alcoa completed three separate studies in 2020 to understand the climate data for each of operating impoundment sites in Australia, South America, and Spain. The studies included historical meteorological data (rainfall, temperature, wind, evaporation, etc.) from multiple external peer-reviewed sources that was typically over 100 years, or as far as independent location records exist. Alcoa also developed climate change modelling scenarios for 2050 and 2100 to serve as a guide on the likely impacts to the baseline historical climate data for its operating impoundment locations. The data and modelling scenarios support the master planning at their locations and future impoundment designs and operational strategies by enabling Alcoa to consider potential physical risk impacts.

The various input data was used to qualitatively identify high impact locations for further risk analysis. Transition risk and opportunity analysis used carbon pricing data to examine policy, reputational, technology, and market-related risks associated with a low-carbon transition. The analysis is an ongoing process, with further efforts to become more precise over the next 2–3 years.

In understanding how to address the impacts of climate change determined through the assessment, a Climate Change Policy was developed that includes:

- objectives and practices to ensure alignment with the Paris Agreement
- procedures for integration of climate into decision-making processes
- enhancement of resilience operations (informed by the qualitative analysis).

An example of Alcoa's efforts to minimize emissions and align with the low-carbon transition is the ELYSIS joint venture technology that eliminates all direct greenhouse gas emissions from the traditional smelting process. Alcoa invented the process, which emits pure oxygen, and it is currently being ramped up to industrial-sized scale through additional development work, with a goal that the ELYSIS technology can be offered for commercial application as soon as 2024.

in October. However, our results nonetheless confirm the TCFD's status report findings, and this section will serve to supplement the TCFD's findings on disclosing financial impacts.

How are companies approaching the disclosure of climate-related financial information?

Companies participating in our study used the following main considerations to determine what information to disclose based on their scenario analysis.

1. **Address broad investor expectations:** Disclosures are primarily motivated by investor demand. Different investors will have different expectations

and needs for climate-related financial information. Our research included conversations with several financial institutions, many of whom noted they are not necessarily requiring climate-related information from clients or investees, but rather engaging in a range of strategic planning conversations anchored to the transition and physical aspects of climate impacts to business. Non-financial sector companies indicated they receive pressure to calculate a financial impact, although the values are often shared in private and not necessarily through disclosure. Some financial institutions are asking companies to disclose their upstream and downstream scope 3 emissions to help them better

evaluate the breadth and scale of potential climate-related risks and opportunities.

2. Disclose financial value where there is comfort:

As noted in prior sections, companies face several uncertainties when undertaking risk and opportunity analysis. Companies will choose to disclose qualitative summaries or trends analysis (without explicit financial impacts or information) to avoid numerical disclosure and potential liabilities. Doing so helps indicate the trajectory of risks and, if applicable, the actions the company is taking to address the risks. This type of disclosure may seem less mature, especially if more companies within a sector are disclosing some financial information.

3. Match level of disclosure with ambition: Some companies seek to lead on climate-related financial disclosures, whereas others are comfortable being “middle of the pack.” As it stands at the writing of this report, disclosure of actual and potential financial impact is the practice of leading companies.

4. Where and how to disclose: As most disclosures are nonfinancial, most companies felt most comfortable disclosing climate-related risks and opportunities through nonfinancial reporting avenues such as sustainability, corporate responsibility, or ESG reports. They do not necessarily anticipate disclosing risks in financial reports unless explicitly mandated by regulators. Several companies that had previously assessed physical impacts claimed that they did not meet the materiality threshold in disclosure requirements for Securities and Exchange Commission filings. Several companies also considered that disclosure of quantitative financial impact values is, currently, generally not considered appropriate given inherent uncertainty

in the forward-looking data currently used, and the lack of wide precedent for disclosure of that detail. Additionally, not all companies use the TCFD, and those that do are at different stages of disclosing in line with its recommendations. The TCFD is however, primarily seen as the gold standard for disclosures and a key communication tool with stakeholders. At the time of this writing, companies report their risks and opportunities the most comprehensively to CDP. Non-U.S. companies or companies operating internationally were more comfortable disclosing climate related risk information in financial filings and often see their robust disclosure as a competitive advantage.

What are the challenges to disclosing climate-related risk and opportunity information?

The challenges we identify are very similar to those identified by the TCFD in its most recent, fourth status report. Companies face the following challenges in disclosing climate-related financial information:

- 1. Lack of standardization:** While all disclosures will have caveats and legal language related to the over-interpretation of forward-looking information, companies will be hesitant to disclose information that contains such high uncertainty – especially when it comes to financial values and information. Many are uncomfortable that their scenario approach is not consistent with that of their peers. Decisions of where to disclose include materiality considerations such as for potential regulatory filings; several companies shared that they had previously assessed physical impacts that did not meet the materiality threshold.
- 2. First mover disadvantage:** If a company discloses climate-related financial information (particularly if

Useful Insights:

Companies that were successful at beginning to address impacts did the following:

- Clearly connect or integrate transition, adaptation, and climate resilience plans to broader strategic planning.
- Did not follow strict definitions of financial materiality for determining which risks and opportunities to address.
- Did not let the perfect be the enemy of the good, and work toward transition, adaptation, and climate resilience opportunities using pilot projects, test cases, and experimentation.

CASE STUDY: BHP

BHP is among the world's top producers of major minerals like copper, iron ore, and nickel with a team of approximately 80,000 employees and contractors worldwide, primarily in Australia and the Americas. According to BHP, the commodities the company provides are essential to modern life and they seek to continually evolve their approach to deliver them sustainably into the future.

In BHP's 2020 Climate Change Report, the company used climate scenario analysis to assess the impact of climate change on the demand for its mining commodities and the impact on rolling present value.

BHP develops planning cases to inform their strategic choices and the timing of their execution, and to underpin an annual corporate planning process. These planning cases consist of plausible commodity-specific forecast ranges (high, mid and low cases) that are developed through in-depth, rigorous bottom-up analysis.

In 2021, BHP released a Climate Transition Action Plan. BHP indicates that it will systematically integrate one or more Paris-aligned scenarios (including 1.5-degree C scenarios) into its strategy and capital prioritisation processes beginning in FY2022. Doing so will enhance its current approach, in which the 1.5C scenario is used to inform and test strategic portfolio decisions.

In the 2020 report, BHP discloses the financial impact under each climate scenario using the rolling present value (RPV) metric over time. BHP does not disclose specific values of RPV under each scenario, but instead discloses the values relative to a reference scenario. In that scenario analysis, BHP's portfolio performed better as the world pursued greater emission reductions due to the resulting growth in demand for many of its commodities. These findings further improved internal understanding of the implications of the transition to a low-carbon future for BHP.

Furthermore, BHP's FY2021 financial statements describe how operational emissions reduction projects are considered in key accounting judgements and estimates. The statements also describe the two scenarios (Central Energy View and Lower Carbon View) currently being used as inputs to its operational planning cases, based on its current estimates of the most likely range of futures for the global economy and associated subsystems.

it is net negative), they may be negatively compared to peers which have not disclosed financial information. Those peers may also experience negative financial impacts (e.g., through divestments), but the analysis is not conducted or disclosed for comparison.

- Litigation risk:** Many companies are fearful of potential litigation risk if they underestimate financial impacts and the real climate impacts lead to shareholder losses in their 10-K filings. While climate or ESG disclosures go through similar legal review processes as other corporate disclosures, for many companies, disclosure location is a core concern. 10-K's are seen as a legal domain where financial metrics and material risks are appropriate, while the ESG/CSR report are still generally viewed as the domain of climate disclosures. Additionally, disclosure of quantitative financial impact values is, currently, generally not considered appropriate given inherent

uncertainty in the forward-looking data currently used, and the lack of wide precedent for disclosure of that detail.

Disclosing climate-related financial risks and opportunities presents companies with unique challenges because companies do not, in general, disclose the potential financial impacts of forward-looking risks and opportunities, regardless of risk type. For example, companies rarely disclose the financial impacts of cyber-security vulnerabilities. A recommendation by regulators for financial risk disclosure may remain controversial, for the reasons articulated above.

How is the disclosure landscape expected to evolve to address challenges?

For many companies, action by securities regulators to mandate a form of, and standardized

Challenges in companies' disclosure of climate-related financial risks: C2ES' response to 2021 SEC request for information

In March 2021, the U.S. Securities Exchange Commission (SEC) issued an extensive request for information to inform its proposed rulemaking to mandate climate-related financial disclosure for publicly traded companies. To inform its comments and recommendations for designing the process of mandatory climate-related financial disclosures, C2ES gathered feedback from its Business Environmental Leadership Council, especially from member companies with TCFD-aligned reports. Several companies who provided input to the SEC comments include those interviewed for this project. C2ES received input from thirteen large, publicly traded companies representing different industry sectors.

C2ES sought input on where gaps exist, where industry efforts can contribute to developing disclosure criteria, and where careful consideration is warranted, such as regarding questions of data quality, scenario analysis, and liability. The feedback received aligned well with the findings of this study. Feedback from companies helped illustrate the following challenges in disclosing climate-related financial information:

Lack of standardization of scenario analysis: Companies expressed concern over lack of standard use of scenarios, should climate-related financial risk disclosure become mandatory. The TCFD does not require using a specific scenario and provides companies with a framework for selecting and reporting their chosen scenarios. Nonetheless, several companies expressed concern that, depending on the scenario used, companies' climate-related risks could appear to be smaller when compared to those of their competitors. Companies requested clarity, and in some cases more standardization, around using scenarios, while recognizing the need for flexibility in using them.

Assurance: Given concerns over data quality and availability, many companies expressed concern over the level of assurance required for any mandatory future climate-related financial risk disclosure. If firms are not currently disclosing or are at an earlier stage of disclosure, they may face substantial additional barriers to entry and costs from initial enforcement. C2ES's previous research has found that small- and medium-sized companies face significant costs to assess and disclose climate-related information due to capacity constraints, and often require technical assistance, although there are open source efforts developing to provide free and useable climate data to markets.

Legal liability and safe harbor provisions: Given the lack of standardization for how companies should disclose their climate-related financial risks, many were concerned about legal liability and exposure to legal action from regulators, investors, and the public. Whereas some stakeholders interpret existing safe harbors in 10-k filings to be sufficient, companies seek greater assurance that any uncertainties disclosed, or any future-facing statements related to climate, including their net-zero goals, will not subject them to legal action. As such, companies have advocated for furnishing, instead of filing, climate-related information to reduce legal liability.

Data quality and availability, especially for Scope 3 emissions: Companies expressed concern over any proposed mandatory disclosure of supply chain, or Scope 3 emissions, due to variability in data availability and quality, and the extent to which companies disclose all 15 categories of Scope 3 emissions in their GHG inventories. Scope 3 emissions have upstream and downstream categories per the GHG Protocol. Supply chain or embedded emissions (i.e., upstream) inform the operational characteristics toward decarbonizing a reporting company's supply chain. Downstream emissions reflect the end-use sectors—namely mobility, residential & commercial resourcing, and industrial processes. Companies requested greater clarity on which emissions would need to be disclosed and how companies should disclose using agreed upon methodologies. Several financial institutions currently request Scope 3 GHG emissions data, however some companies contend that Scope 3 emissions data alone does not necessarily provide a comprehensive view of how a company is addressing its climate risk and companies are concerned that disclosing data that is poor quality can lead to greater litigation risk. A more useful approach could be for companies to explain where they have operational control throughout their full value chains and where and how they are engaging with suppliers to reduce GHG emissions throughout. Doing so across sectors can help advance transparency and emissions reductions in the real economy.

BOX 5: Standardizing net-zero scenarios among investors: insights for companies

In 2021, the Portfolio Alignment Team (PAT), formed by the UN Special Envoy for Climate and Finance, released a report on *“Measuring Portfolio Alignment: Technical Considerations”*. The report indicated three methods for understanding and communicating the alignment of a portfolio with a net-zero target:

1. Binary target measurement: the share of the portfolio that has set a net-zero target.
2. Benchmark divergence models: Using reported emission data from investees, compare alignment of a company to emission reduction pathways produced by groups such as the IPCC and report on divergences.
3. Implied temperature rise (ITR): Express the alignment of the portfolio with a specific temperature target, based on the emissions intensity of the portfolio.

As investors begin to assess their portfolios using these metrics the report notes that “attaining some degree of common practice related to portfolio alignment is important not only to facilitate comparability and transparency within and across financial institutions, but also to provide clarity and consistency for nonfinancial institutions on how their behavior related to the net-zero transition may impact their interactions with banks, asset managers, asset owners, and insurance companies.”

approach to, climate-related financial disclosure will be the key development that enhances climate-related financial disclosures.

Several countries are beginning to implement requirements to disclose under the TCFD, with recent action by New Zealand, Switzerland, and the United Kingdom, and interest from the U.S. Securities and Exchange Commission in requiring increased disclosure. However, in each of these countries, the requirements for scenario analysis, financial impact analysis, and disclosure are still non-specific. Generally, regulators maintain that scenario analysis is not a process that lends itself well to standardization, which limits comparability. Therefore, some study participants remain sceptical that

regulation will directly address issues of consistency in scenario analysis.

Other participants in our study indicated that standardization of scenario analysis may be useful for disclosure but creates challenges when trying to use scenarios for business planning. Standardized scenarios may not be useful for every company and bespoke or tailored scenarios become more valuable and decision-useful. Study participants also noted that normative 1.5 degree C scenarios may not be decision-useful, given the challenges toward meeting such scenarios and that plausible scenarios should also be incorporated. More exploration into this area is needed.

Useful Insights:

Companies that publicly disclosed their climate risks and opportunities, and/or who felt that they conducted a comprehensive internal evaluation undertook the following:

- Provided qualitative directional information related to financial impacts without disclosing quantitative financial impacts due to lack of standardization in scenario analysis.
- Approached disclosure progressively, indicating where appropriate that greater disclosure could be expected in future reports.
- Benchmarked to peers to ensure disclosures were consistent within sector.

III. MATURITY MAP FOR CLIMATE-RELATED RISK AND OPPORTUNITY ANALYSIS

A goal of the study was to determine how companies were able to achieve comfort in evaluating climate-related risks and opportunities by performing a climate scenario analysis and then using the results to drive company strategy, financial planning, and disclosure. Across all our focal areas, we identified trends in the approaches companies took and their comfort with the results of the scenario analysis they conducted. Some companies had certain activities which provided them increased confidence in their results while others felt more cautious or less certain with the results and planned to undertake further analysis to advance their work on climate risks and opportunities prior to public disclosure.

As such we categorized our observed actions into a maturity map – where actions that produced more impactful and influential analysis (for their companies) are denoted as higher maturity. We identified actions

under each focal area and across all maturity phases. Three phases are chosen: Basic, Intermediate, and Mature. However, companies need not move simultaneously through the phases across all focal areas to advance their work on climate related risk and opportunity. Many companies are in the “Intermediate” or “Mature” phases on measuring and assessing but “Basic” on addressing or disclosure.

By clearly establishing maturity levels for focal points established in the study, we were able to differentiate activities by escalating levels of complexity. Companies may see themselves in different phases and seek to advance from one phase to the next. Our analysis enables us to isolate specific actions a company can take to advance their scenario analysis and disclosures from one phase to another. The table below highlights these actions.

TABLE 1: Maturity Map—by Focal Area

	DETERMINING YOUR PHASE	HOW TO ADVANCE PHASES
<i>Basic</i>	<p>The company has, at most, identified potential climate exposure using a desktop study that did not include forward-looking data. The company has begun to consider possible climate-related financial opportunities, but specific options have not yet been identified.</p> <p>The analysis is isolated to a sustainability or ESG team with little broader input from the company.</p>	<p>Basic → Intermediate</p> <p>To move to the intermediate phase requires a deeper understanding of the risks and opportunities the company is exposed to, combined with greater understanding of the uncertainties of forward-looking information. The following tasks enable the company to begin accessing and understanding more valuable climate information:</p> <ul style="list-style-type: none"> • Identify exposure to risks and opportunities with help of internal and external consultation. Understand what weather and climate issues the company is already observing. • Conduct workshops or tabletop exercises to elucidate the possible opportunities considering the transition to low-carbon economy. • Gain a greater understanding of uncertainty by conducting a sensitivity analysis of the climate data. Based on the range in the uncertainty, what are the possible impacts? This can help full contextualize the range of possibilities.
<i>Intermediate</i>	<p>The company has obtained high-level data from public data portals or through a third-party provider. The company’s literacy and comfort at using and describing climate data (physical and transition) is rapidly improving.</p> <p>The company has conducted a broad stakeholder engagement process to identify exposure to weather, climate, and transition-related risks and opportunities.</p>	
<i>Mature</i>	<p>The company uses advanced climate metrics and can access and understand the data without external support.</p> <p>The company has implemented climate data tracking controls to monitor ongoing climate-related risks and opportunities.</p> <p>Multiple business units have established a level of climate literacy and make regular use of climate data.</p>	<p>Intermediate → Mature</p> <p>To become mature, companies need to be using highly specialized climate data and have strong internal governance surrounding climate data tracking and application. These activities will enable greater buy-in and support for quantitative financial analysis.</p> <ul style="list-style-type: none"> • Hire resources with a solid understanding of climate data. • Implement data tracking and governance, and an overall data architecture. <p>Engage with climate science experts in academia, and/or global leaders on the energy transition or other specialist.</p>

Assessing

	DETERMINING YOUR PHASE	HOW TO ADVANCE PHASES
<i>Basic</i>	The company has conducted a qualitative assessment of vulnerability, without broad company consultation (i.e. remains siloed in the ESG or sustainability team).	<p>Basic → Intermediate</p> <p>To move to Intermediate, companies must acquire a bottom-up understanding of how climate-related risks and opportunities will impact strategy, product design, facility operation, and human capital.</p> <ul style="list-style-type: none"> Identify company asset/climate exposure pairs through stakeholder engagement and consultation with operational teams (e.g., facility managers, asset managers) to get an on-the-ground understanding of how weather and climate impact facilities and operations. <p>Engage with finance and strategy teams to test vulnerability of the company’s key markets and revenue streams to a low-carbon economy.</p>
<i>Intermediate</i>	<p>The company is beginning to conduct broader stakeholder consultation into qualitatively assessing vulnerability to climate impacts and inform the analysis with real-world examples.</p> <p>The company has conducted (or is conducting) a pilot project to assess the financial implications of climate-related risks and opportunities.</p>	
<i>Mature</i>	The company has conducted (or is conducting) a company-wide financial vulnerability assessment. The “impact functions” to capture the financial impact are developed in collaboration with operations, finance, and other relevant business lines.	<p>Intermediate → Mature</p> <p>Becoming mature requires the development and approval of impact functions for financial quantification.</p> <ul style="list-style-type: none"> Conduct a pilot project to test financial quantification and socialize the results with leadership, to gain buy-in to broader impacts. Conduct a sensitivity analysis to produce a range of possible outcomes, as opposed to concrete numbers. Doing so helps mitigate the risk of suggesting false precision in the results. <p>Integrate results into broader risk management processes for ongoing tracking and monitoring.</p>

Addressing

	DETERMINING YOUR PHASE	HOW TO ADVANCE PHASES
<i>Basic</i>	The company has, at most, conducted a prioritization assessment of the top impacts (from both risks and opportunities) for addressing in future projects.	<p>Basic → Intermediate</p> <p>To move to intermediate, companies must further establish the criteria for a successful and actionable transition/adaptation plans.</p> <ul style="list-style-type: none"> • Work with stakeholders, particularly investors, to understand what is expected of the company to communicate resilience. • Have conversations with finance and leadership as to what constitutes a material risk, and how that can be defined. <p>Consider implementation from the beginning: understand how transition and adaptation plans will be implemented, and develop a roadmap with key performance indicators and milestones</p>
<i>Intermediate</i>	<p>Transition and/or adaptation or climate resilience plans have been developed and approved by leadership.</p> <p>Climate mitigation and climate adaptation projects have been included in future capital planning.</p>	<p>Intermediate → Mature</p> <p>To become mature, companies must focus on how to demonstrate the value of climate-related capital projects to senior leadership.</p> <ul style="list-style-type: none"> • Determine what the company needs to approve a large climate-related capital project: some companies require a clear financial ROI, others are comfortable with a values-based argument. <p>Continually track status on capital projects and demonstrate progress toward resilience.</p>
<i>Mature</i>	Climate mitigation and climate adaptation projects have been implemented or are in-progress. This can include capital plans and/or operational improvements.	

Disclosing

	DETERMINING YOUR PHASE	HOW TO ADVANCE PHASES
<i>Basic</i>	<p>The company lists the physical and transition risks and opportunities it faces at a qualitative level and does not disclose the methodology to determining the risks through scenario analysis. The relative importance of the risks and opportunities is not disclosed.</p> <p>Impact on business planning is not disclosed.</p>	<p>Basic → Intermediate</p> <p>In the first steps to advance disclosure, companies need to establish their goals for disclosure, and the expectations of investors and stakeholders.</p> <ul style="list-style-type: none"> • Establish a benchmark for current disclosures within the industry by comparing existing peer disclosure, which (absent regulations) can set baseline expectations. • Determine what would be a reasonable first or second disclosure based on the benchmark and based on investor expectations. • Develop an achievable 3 to 5-year roadmap for progressive disclosure.
<i>Intermediate</i>	<p>The company discloses the risks and opportunities, and indicates the relative importance of the impacts using a qualitative scoring approach (e.g. high, medium, or low).</p> <p>The impact on business planning is disclosed at a high level.</p>	
<i>Mature</i>	<p>The company discloses the financial impacts of risks and opportunities at a quantitative or semi-quantitative level, such that a reader can assess the impacts relative to other financial risks.</p> <p>Transition / adaptation planning or other action related to the financial scenario analysis is disclosed.</p>	<p>Intermediate → Mature</p> <p>Companies defined as mature on financial disclosure of climate risks will have disclosed financial impacts associated with climate change. To achieve that milestone, the company will likely need to be mature in all or most of the other focal areas to have the material necessary for a clear and comprehensive disclosure. Over and above the material, the company will need to have developed comfort with being a leader on disclosure (in advance of disclosure requirements) and has comfort with the uncertainty of climate financial data and the risk of restatement in public disclosure due to changing input data and evolving methodologies.</p>

BOX 6: Tips for gaining buy-in to measure, assess, address, and disclose climate-related risks and opportunities

Our study found that companies must be fully bought-in, at all levels, to the process of determining and disclosing climate-related risks and opportunities, especially the financial impacts. Champions for greater climate disclosure need buy-in to gain the required input data for assessments, to invest in resilience, and to approve disclosures of any kind. Companies identified the following tips to help enhance disclosure:

Board and executive support: Support from leadership is necessary to garner the buy in and resources needed to conduct a full analysis of climate-related risks and opportunities. Leadership will likely be more supportive of undergoing the analysis where investor pressure is highlighted. Benchmarking can help establish practices to try and match or exceed competitor's efforts, especially for companies that consider themselves leaders in sustainability.

Educate employees in different business units on the relevance of climate risks and opportunities: Meaningful analysis requires an understanding of the sensitivity of the company to climate hazards, and multiple business functions must contribute to this process. Employee education and capacity building can be an effective strategy to engage individual business functions to provide insights on climate-related risks and opportunities.

Develop a roadmap: A roadmap is an effective tool for indicating the current state of disclosures, the intended end state, and how/when the company can achieve it. The roadmap can provide assurance to leadership and other stakeholders of the plan and pathway to better disclosure, and the relevance for each business function and/or certain individual roles in creating better climate risk and opportunity analysis.

IV. POLICY RECOMMENDATIONS

Companies still struggle with several core elements of evaluating climate-related risks and opportunities and disclosing those publicly. Challenges include gaining comfort with factoring in uncertainty within physical and transition risks into the assessment process and key findings, understanding how to develop a comprehensive, yet flexible strategy to address the risks, and continuing to integrate financial and climate risk analytics and reporting. Earlier sections recommended approaches and tools that companies can use to improve how they measure, assess, address, and disclose their climate-related risks and opportunities. In this section, based on our findings, we propose policies that can reduce these challenges and accelerate improvements in climate-related risk and opportunity measurement, assessment, action, and disclosure.

At the time of this writing, the Securities Exchange Commission (SEC) had already issued a request for information in Spring 2021 for developing regulations requiring climate-related disclosures from publicly traded companies, building on the 2010-issued requirements that companies disclose climate-related financial risks if deemed to be material risks. Though some of the policy recommendations below are not aimed at the SEC necessarily, some recommendations do reflect input that C2ES provided to the SEC in June 2021, which were informed by insights from companies in C2ES' BELC representing different sectors and with ambitious climate goals. Some of the companies interviewed for our study here also overlap with those who provided insights when C2ES developed its initial recommendations to the SEC.

Of note, the recommendations below belong to C2ES and do not necessarily reflect the views of companies interviewed.

1. Provide decision-useful tools to adequately measure physical climate-related financial risks: The U.S. federal government should establish a national climate service, or a hub, to host tools specifically designed to assist companies to measure and assess their physical climate-related financial risks

and opportunities in alignment with the TCFD recommendations. The existing Climate Resilience Toolkit¹⁴ is one federal interagency platform that could be leveraged to incorporate TCFD-related tools, data, information, and case studies. In one of the strongest takeaways from our research, companies cited the need for a single source of reputable, easy to use, public data on climate-related risk that companies can use to evaluate their corporate climate-related financial risk. An interagency working group should inform its development, drawing on and enhancing existing resources from the the Environmental Protection Agency (EPA), National Oceanographic and Atmospheric Administration (NOAA), and other federal agencies and research efforts, such as the U.S. Global Change Research Program (USGCRP). The group should also engage leading companies, namely those with ambitious decarbonization and resilience goals and initiatives, to identify evolving data needs and ensure the tools being produced are decision-useful.

2. Standardize an approach to assess and disclose climate-related financial risks and opportunities: The federal government should standardize an approach to assess climate-related financial risks and opportunities to all industries and support the development of additional industry-based standards and guidance to facilitate disclosure at an industry level. Where possible, the federal government should endorse or enhance using existing standards and frameworks that are focused on financial materiality, are industry-specific, and are widely accepted and broadly in use already. C2ES recommends that the federal government endorse the TCFD framework, given that it was developed through a multi-stakeholder process with global industry experts, and provides flexibility to layer on sector-specific standards for measuring, assessing and disclosing risk. A policy framework that allows for iteration and experimentation should be updated to capture best practices as they evolve, provided that it build

in check points and flexibility. Such an endorsement could spur more companies to use the TCFD and enable greater harmonization in how companies evaluate and report climate-related financial risks. Drawing a distinction between frameworks and standards is useful for assessing how the different existing disclosure efforts complement each other, and how best develop guidance for specific industries.

3. **Develop guidance on using scenarios:** The federal government should develop guidance on the use of scenario analysis and distinguish between transition scenarios, which can be highly sector specific, and physical risk scenarios, which reflect temperature pathways that often depend on policy and market action and are specific to companies and their supply chains. In our study, companies wrestled with the benefits and drawbacks of any regulatory standardization of scenario analysis. Companies broadly agreed that standardization would be helpful, to ensure consistency in disclosure. However, there was less unanimity on how to accomplish standardization without being overly prescriptive (e.g., does everyone use the same net-zero transition scenario? Do companies use the same stress tests for physical risks?). Since each industry, or sub-industry, has bespoke needs and circumstances, the federal government can help reduce uncertainty in which scenarios to use by providing non-prescriptive guidance on how to produce decision-useful climate-financial analysis. C2ES recommends providing a menu of options for companies to help them understand different ways to provide climate financial analysis, and levels of disclosure. We believe that a flexible and collaborative approach that recognizes the scope and urgency of need, while being informed and responsive to existing limitations, is possible.
4. **Improve Disclosure:** *Note: The recommendations to improve disclosure are specific to the U.S. Securities and Exchange Commission (SEC), given its evolving approach to climate-related financial disclosure.*
 - a. Building on recommendation #3, the SEC should assess how to guide the disclosure of scenario analysis across different industries. The SEC should establish industry working groups for stakeholders to provide recommendations on industry- and sector-level considerations, such as which transition and physical risks should be included, any best practice for greenhouse gas calculation methods, and ongoing feedback on challenges and usefulness of disclosure recommendations. In particular, the federal government should work with industry and other stakeholders to provide clarity for how, and the extent to which, scope 3 emissions calculations or estimates should be disclosed across sectors to ensure companies include the most material scope 3 greenhouse gas emissions related to climate-related financial risks and opportunities. Alternatively, companies that do not track and report their scope 3 emissions could describe how they estimate their overall scope 3 greenhouse gas emissions and describe how they engage their supply chain to reduce emissions.
 - b. The SEC should consider safe harbor provisions or liability protections for forward-looking climate disclosures, including the input assumptions and disclosed results of scenario analysis. Where companies face estimations and projections, such as opportunities or scenario analysis, C2ES recommended the SEC ensure and clarify that these projections are subject to some form of relevant safe harbor or liability protection, to encourage, and not disincentivize, robust disclosure.
 - c. Finally, given the lack of existing climate related assurance standards at regulators like the Public Company Accounting Oversight Board (PCAOB), and given the unique and emerging context of climate risk disclosures, the SEC should phase in any verification or assurance requirements while standards are developed. A deeper and ongoing consideration of auditing needs is recommended. The level of assurance on climate risk disclosures should be tiered based on the size of registrants with guidance and technical support for companies, where needed.

V. LOOKING AHEAD

Based on our findings, companies are eager to obtain a standardized set of decision-useful, TCFD-aligned tools, guidance, and resources to enhance their approach to measure, assess, take action on, and disclose their climate-related risks and opportunities.

Moreover, companies are approaching their climate risks and opportunities amidst a broader trend in corporate sustainability, namely the emergence net-zero targets and investor interest in companies' transition plans to a low-carbon economy. Over the past two years, more companies have set targets to achieve net-zero emissions by 2050, or in some cases by 2030, that encompass their scopes 1 and 2, and, in the case of leading companies, scope 3 emissions. According to one report,¹⁵ by mid 2021, at least one-fifth (21 percent) of the world's 2,000 largest public companies now have net-zero commitments, representing annual sales of nearly \$14 trillion. As stakeholder inquiry begins to shift from companies' pledges to how companies plan to achieve their targets, investors have begun to ask companies to disclose their low-carbon transition plans. Such plans include details on how companies will achieve their emissions targets and their strategies to pivot existing assets, operations, and/or entire business models toward a trajectory that aligns with the most recent and ambitious climate science recommendation.

A strong interplay exists between a company's approach to its climate risks and opportunities and its strategy to achieve net-zero emissions and its low-carbon transition plan. Net-zero goals and climate related disclosures can be mutually reinforcing, where net-zero goals can set foundation for disclosure and disclosure can serve as communication of net-zero

strategy. For instance, net-zero targets are noted as a driver of the TCFD work, both as a driver of the need to communicate information, and as a "tool" for prepping risk disclosure. How a company discloses its plans to address, or take action on, its risks and opportunities, can also be sharpened into its transition plan. Companies that understand their climate risks are better positioned to develop resilience to those risks, which can then be expressed in transition plans. Climate-related opportunities can also be expressed as means to achieve net-zero targets and underlie how companies will transition to a low-carbon future via changes to their operations, supply chains, and product and service offerings. According to TCFD guidance issued in October 2021,¹⁶ effective transition plans include disclosure of a company's current GHG emissions performance, the impact on business strategy and financial planning from a low-carbon transition, and actions and activities to support the transition (including changes to businesses and strategy to reduce GHG emissions).

As more stakeholders, including investors and regulators, seek information from companies, demand will increase for companies to issue a congruent narrative that weaves together risks, opportunities, climate targets (both long term net-zero and interim ones), and transition plans, given their overlap and interdependence. Companies that take steps to improve how they measure, assess, address and disclosure climate related risks and opportunities will be better positioned to deliver this congruent messaging on their climate ambition and tailor it effectively to meet the interests of diverse audiences.

ENDNOTES

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The Center for Climate and Energy Solutions (C2ES) is an independent, nonpartisan, nonprofit organization working to forge practical solutions to climate change. We advance strong policy and action to reduce greenhouse gas emissions, promote clean energy, and strengthen resilience to climate impacts.



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