



Massachusetts Institute of Technology



Climate-Related Financial Disclosures The Use of Scenarios

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Climate Scenarios in Corporate Disclosure Workshop

The Massachusetts Institute of Technology (MIT) has deep expertise in developing climate and energy models and scenarios. Moreover, combatting climate change while ensuring and expanding global access to affordable and reliable energy is a key priority for the Institute. MIT also has a long history of working with industry. For these reasons, MIT decided to assist in the development, application, and interpretation of high-quality, climate-related scenarios that can provide investors with decision-useful information about oil and gas companies, many of which are currently attempting to produce climate-related, scenario-based disclosures.

To this end, MIT held a workshop, “Climate Scenarios in Corporate Disclosure,” on November 28 and 29, 2018, that gathered participants from oil and gas companies, global scenario producers, the financial community, and NGOs together with other experts to discuss climate-related scenarios and their use in financial disclosures. The workshop was held under the Chatham House Rule.¹ This white paper is meant to reflect and build upon the content of the discussions held at the workshop. However, the views and opinions herein expressed are those of the authors and do not necessarily reflect the official policy or position of any of the workshop participants, nor that of MIT.

Organizations of Workshop Participants

BP	International Energy Agency
Breckinridge Capital Advisors	International Institute for Applied
Caisse de dépôt et placement de Québec	Systems Analysis
CDP	JP Morgan Chase
Ceres	MIT
Chevron	Pacific Northwest National Laboratory
ConocoPhillips	Royal Dutch Shell
Exxon Mobil	S&P Global Ratings
GIC Pte Ltd	State Street Global Advisors
Harvard University	Wellington Management

¹ “When a meeting, or part thereof, is held under the Chatham House Rule, participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed.” More information can be found at www.chathamhouse.org/chatham-house-rule.

CONTENTS

Executive Summary	1
1. Introduction	5
2. Scenarios, Climate-Economy Models, and Scenario Analysis	7
2.1. Scenarios	7
2.2. Climate-Economy Models	13
2.3. Scenario Analysis	16
3. Scenario-Based Disclosure: Interests and Expectations	21
4. State of Scenario Analysis in Oil and Gas Company Climate-Related Financial Disclosure	23
5. Challenges to Corporate Transparency, Comparability, and Completeness	26
6. Recommendations for the Enhanced Understanding and Use of Scenarios	29
6.1. Oil and Gas Industry	29
6.2. Scenario Producers	33
6.3. Financial Community	35
7. Conclusions	36
8. References	38
Appendix 1	41
Appendix 2	42

EXECUTIVE SUMMARY

The growing spotlight on climate change and its severe, widespread ramifications for human life and the global economy has stimulated interest within the financial sector. In June 2017, the Task Force on Climate-related Financial Disclosures (TCFD) released its final report with the goal of helping publicly owned companies disclose clear, comparable, and consistent information about the risks and opportunities presented by climate change. However, the use and disclosure of scenario analysis, which is recommended in the report as a method to achieve this goal, continues to be a challenging task.

In November 2018, MIT held a workshop, “Climate Scenarios in Corporate Disclosure,” that gathered participants from oil and gas companies, credit rating agencies, the investment community, global scenario providers, NGOs, and academia together with other experts to further the discussion of climate scenarios and their use in financial disclosures, with a special focus on those produced by oil and gas companies. This paper draws from the insights of the workshop participants, as well as from an examination of the climate scenario literature, in an effort to accomplish three objectives:

- 1. Provide clear guidance to stakeholders, particularly the diverse financial community, on key aspects of climate-economy models, scenarios, and scenario analysis in the climate-related disclosures of oil and gas companies.**
- 2. Explore the barriers put forward by the oil and gas industry and others to providing clear, comparable, and consistent scenario-based climate-related disclosures, as recommended by the TCFD.**
- 3. Offer recommendations that address these barriers and advance the overall usefulness of scenario-based, climate-related disclosures.**

While the TCFD has recommended scenario analysis as a tool to describe the resilience of a company’s strategy to the risks and opportunities of climate change, the effectiveness of this tool depends on a clear understanding of climate scenarios, the climate-economy models used to produce them, and the various analytical techniques used to evaluate them. Climate-related scenarios have several features with significant implications for interpreting and using scenarios in disclosure analyses. These include carbon pricing, which can be formulated in different ways in various models, and technological assumptions, which are often dictated by highly uncertain assumptions about what developments might occur in the latter half of the century. In addition, there is a distinction between scenario outcomes and scenario paths, which is often overlooked; reliance on scenario outcomes can lead to overconfidence in corporate resilience.

The climate-economy models used to generate scenarios are many and diverse, and almost all were developed for purposes unrelated to the support of corporate risk analysis and disclosure. This is important insofar as the structure of these models can significantly influence the outcome of scenarios (and thus the scenario analyses and disclosures that follow) in significant ways. Understanding the differences in the modeling philosophies and methodologies used is crucial

to interpreting the scenarios each model produces, as well as to fully understanding the scenario analyses that depend on these models.

Scenario analysis can take many forms to address various elements of what the TCFD has termed “strategy resilience” (i.e., the resilience of a company’s strategy to climate-related risks). To promote consistency in the treatment of strategy resilience, we offer a framework that includes both an assessment of the vulnerability of a company’s current asset position and an assessment of its forward-looking preparedness. We propose that a complete treatment of strategy resilience should address these four elements:

- **Exposure**, a measure of what company assets or value is at risk, either of physical harm or of diminution in value under a particular scenario;
- **Sensitivity**, a measure of how much the financial condition or operations of a company are likely to be affected by specified levels of change to isolated risk drivers;
- **Adaptive capacity**, which refers to a system’s or entity’s ability to monitor, learn, and transform in an unstable environment; and
- **Strategic planning**, a method for preparing to address known risks within specific scenarios.

The financial community is extremely diverse, a fact reflected in its members’ priorities for corporate scenario-based disclosures. Investors differ in whether they want scenario-based disclosures to prioritize company-specific insights, comparability with the disclosures of other companies within their industry, or even comparability across industries. They differ in whether they place more importance on assessing a company’s current strategic positioning and vulnerabilities or gaining insight into forward-looking corporate preparedness. Furthermore, they differ in the extent to which they want companies to disclose quantitative results related to strategy resilience. These myriad expectations can make the scenario-based disclosure environment challenging to navigate to everyone’s satisfaction.

We identify three primary shortcomings of current scenario-based, climate-related disclosures from oil and gas companies that limit their usefulness to the financial community:

- **Lack of comparability.** The scenario analysis process varies in practice in several ways. These include whether or not the disclosures use a common, publicly available scenario as a reference point (or “reference scenario”), and if so, which one; and whether or not a quantitative financial output is disclosed, and if so, what kind. These differences make it difficult to compare companies equitably.
- **Lack of transparency.** When quantitative outputs are disclosed, presentations often lack important information needed to interpret the resulting analysis. This hampers clarity and makes it difficult, if not impossible, to interpret the analysis.
- **Incomplete scope.** Many climate-related disclosures provide only half the story with regard to strategy resilience: either an analysis of vulnerability without a corresponding evaluation of preparedness, or a description of preparedness without any evaluation of the vulnerabilities for which the business is prepared. Such disclosures fail to fully present the many interconnected factors related to strategy resilience that could potentially affect the value of a company.

As companies have come under increasing pressure from investors, regulators, climate change-focused NGOs, shareholders, and others to provide more in-depth disclosures of climate-related risk and resilience, oil and gas companies have offered a variety of reasons for their generally limited scenario-based disclosures. We observe three types of objections to the use of scenario-based disclosures: concerns about scenarios, about scenario analysis, and about disclosure in general. We believe that objections related to scenarios, which typically revolve around comparability and specificity, can be addressed through well-designed disclosure. Those about scenario analysis, which typically center on the treatment of either current and forward-looking analysis, can be addressed more thoroughly than they have been to date—and some companies have already demonstrated steps in the right direction. Those about disclosure itself, particularly those related to proprietary information or the potential liability risk of misleading information, are deeply rooted challenges that require solutions beyond the scope of this paper.

We expect that some firms may be reluctant to disclose the likely impact of climate change on their operations or vice versa, and may wish to avoid the explicit recognition of any such linkages. We also acknowledge that firms that seek to disclose climate-related risks in good faith still encounter significant difficulties in doing so due to general disclosure concerns.

We offer the following recommendations for participants in the climate-related financial disclosure system to facilitate the effective use of scenarios in alignment with TCFD recommendations. These recommendations are designed to (1) address the shortcomings of current scenario-based disclosures in terms of comparability, transparency, and scope; (2) navigate the concerns about scenarios and scenario analyses that are often used to justify incomplete disclosure; and (3) retain the strategic benefits of the climate-related scenario analysis exercise for the reporting companies.

Oil and gas industry members should:

(A) Connect custom scenarios to reference scenarios. Custom scenarios allow companies to challenge their corporate strategies in creative ways, using scenarios that have been tailored to their resilience needs. However, it is important that companies link these custom scenarios to reference scenarios that investors use and understand. Companies can do this by providing transparency on how relevant risk drivers differ between the custom and reference scenarios.

(B) Incorporate and link each element of strategy resilience. Each element of strategy resilience—exposure, sensitivity, adaptive capacity, and strategic planning—should be addressed in climate-related financial disclosures. Such disclosure should not only demonstrate the company's current vulnerability to climate change, but also how robust the company's adaptive capabilities and specific strategies are against the risk drivers specified in distinct scenarios.

Scenario producers should:

(A) Develop suites of distinct policy pathways. There are many pathways to any specific temperature outcome for the climate, and defaulting to any particular path (e.g., one that forms

the basis for a single 2°C scenario) limits companies' ability to consider how the transition to a low-carbon economy might occur. Subjecting a company's strategy to multiple distinct and challenging scenarios is a better way to demonstrate strategy resilience.

(B) Explore sensitivity to key (non-policy) uncertainties. Scenario producers should consider providing sensitivity analysis in their scenarios so that both investors and companies can gain a better understanding of the importance of various parameter assumptions in their models. These parameters include both those that embody the most uncertainty, as well as those that have the most influence on the evolution of the scenario.

The financial community should:

(A) Continue to make the case for more useful and informative scenario analysis and disclosure.

Each type of actor in the financial community knows best how scenario-based, climate-related disclosures might provide the information they need. Direct engagement among reporting firms and investors and participation in efforts that focus on climate-related issues in finance will be key to sustaining the pressure needed to get companies to produce better scenario-based disclosures.

(B) Be wary of general claims of resilience that are not visibly grounded in clear, consistent, and transparent use of scenarios. This report is, in part, meant to equip members of the financial community with the understanding and vocabulary required to make the most of scenario-based disclosures. Once the financial community understands that scenarios can provide comparable, complete, and consistent analysis, general claims will no longer be considered satisfactory.

Scenario analysis is one of many tools used to assess an organization and cannot provide all the answers. In fact, many characteristics of scenarios, their models, and the resulting analyses make it daunting for firms to satisfy the wide range of expectations held by the diverse set of stakeholders calling for more expansive scenario-based disclosures. These expectations encompass the tension between the disclosure goals of providing firm-specific detail and of supporting comparison among firms; also, it is naturally difficult to provide comparable and relevant forward-looking analysis without heightening existing disclosure concerns. Nevertheless, well-designed scenario-based disclosures can provide useful information to the financial community while also addressing significant oil and gas industry concerns. Better scenario-based financial disclosures alone will not be sufficient to improve the markets' evaluation of climate-related risks, but we believe they can make an important contribution.

1. INTRODUCTION

Climate change is increasingly capturing the interest of the financial sector. Much of this attention is due to rising investor and regulator concern about the potential future impacts of climate change on financial stability. The G20 finance ministers and central bank governors took a key step toward addressing this concern by asking the Financial Stability Board (FSB) to examine the impacts of climate change on the global financial system. The FSB then established the Task Force on Climate-related Financial Disclosures (TCFD) to help publicly owned companies disclose “clear, comparable, and consistent information about the risks and opportunities presented by climate change.”² In June 2017, the TCFD released its final report, outlining its recommendations for companies.^{3,4}

The TCFD report was extremely well-received,⁵ and many publicly owned companies have therefore attempted to produce disclosures in alignment with the recommendations. However, the recommended disclosure of strategy resilience (referred to as “Strategy c” within the TCFD report’s “strategy” element) continues to be the least-implemented TCFD-recommended disclosure, despite a proliferation of guides devised to help companies with the implementation of scenario analysis.^{6,7}

*Strategy c: Describe the resilience of the organization’s strategy, taking into consideration different climate-related scenarios, including a 2°C scenario.*⁸

Since MIT is committed to helping the world address the problem of climate change,⁹ and the Institute is involved in the development of climate change scenarios, in November 2018, MIT gathered professionals from oil and gas companies, credit rating agencies, the investment community, global scenario providers, NGOs, and academia together with other experts to participate in a workshop, “Climate Scenarios in Corporate Disclosure.” Of particular note was the inclusion of scenario producers (i.e., organizations in the business of developing climate-related scenarios).

2 TCFD (2017) *Final Report: Recommendations of the Task Force on Climate-related Financial Disclosures*. Pg. i.

3 TCFD (2017) *Final Report: Recommendations of the Task Force on Climate-related Financial Disclosures*.

4 The report recommends that climate-related disclosures be made available in a company’s mainstream annual financial filings. We use the phrases “financial disclosures,” “corporate disclosures,” and “corporate reporting” in this paper to acknowledge the TCFD’s recommendation, but we also recognize that most companies have chosen to disclose climate-related information elsewhere.

5 Since its release, the TCFD report has garnered widespread support: “Nearly 800 public- and private-sector organizations have announced their support for the TCFD and its work, including global financial firms responsible for assets in excess of \$118 trillion.” (TCFD, 2019)

6 There are more than 120 resources tagged to Strategy c) in the TCFD Knowledge Hub, a platform operated by the Climate Disclosure Standards Board that compiles resources for those interested in implementing the TCFD recommendations. www.tcfhub.org

7 TCFD (2019) *2019 Status Report*.

8 TCFD, *supra* note 3.

9 MIT President L. Rafael Reif issued “A Plan for Action on Climate Change” in October 2015. It stresses “the open collaboration and ability to hear new ideas that are central to our research relationships, central to our ability to help government and business think creatively together, and central to our ability to convene and inform the thinking of those with opposing views.” (Reif, R., *et al.*, 2015)

This paper draws from the insights of the workshop participants,¹⁰ as well as from the literature on and the current application of climate scenarios, in an effort to accomplish three objectives:

1. Provide clear guidance to stakeholders, particularly the diverse financial community, on key aspects of climate-economy models, scenarios, and scenario analysis in the climate-related disclosures of oil and gas companies.
2. Explore the barriers put forward by the oil and gas industry and others to providing clear, comparable, and consistent scenario-based climate-related disclosures, as recommended by the TCFD.
3. Offer recommendations that address these barriers and advance the overall usefulness of scenario-based, climate-related disclosures.

We do not attempt to debate the philosophy or effectiveness of disclosure as a mechanism for promoting either efficient market operations or the transition in the energy system that is required to avoid catastrophic climate change. We also provide this analysis within the current regulatory context, and we do not consider the possibility that such disclosure might at some point be mandated by law. We focus on the use of scenarios in risk disclosure by oil and gas companies in particular because (1) some portions of the oil and gas industry are especially vulnerable to the potential impacts of a transition to a low-carbon future; (2) the industry is familiar with scenario analysis as an internal strategic planning tool; and (3) MIT has a long history of working with companies from the diverse energy sector.¹¹

Climate-related risks are broadly categorized as physical or transition risks. Physical risks include those to supply chains and physical assets from severe weather events and from chronic, climate-related strain on resources. Transition risks are those brought about by the shifts in the political, technological, social, and economic landscape that are likely to occur during the transition to a low-carbon economy. We focus on transition risks because, due to the concentration of greenhouse gases (GHGs) already present in the atmosphere and the momentum of climate systems, scenarios of global-scale, long-term climate trends are not expected to significantly diverge from one another until around 2040, beyond the time frame of interest for most financial actors.¹² This does not mean that physical risks are unimportant before mid-century; quite the contrary, physical risks associated with climate change are already impacting corporate operations and their financial counterparts around the world. However, the variability and local specificity of physical risks are such that global scenarios are insufficient to provide top-down estimations of these risks for use in corporate-level analyses and disclosures. Companies will therefore have to engage in additional analysis to account for potential physical risks to their businesses. Nevertheless, in the execution of transition risk analysis, potential policy responses to a wide range of

10 The workshop was held under the Chatham House Rule: “When a meeting, or part thereof, is held under the Chatham House Rule, participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed.” www.chathamhouse.org/chatham-house-rule

11 The MIT Energy Initiative is MIT’s hub for energy research, education, and outreach. www.energy.mit.edu

12 Steinberg, N. (2019) “*Scenario Analysis for Physical Climate Risk: Foundations.*” Four Twenty Seven.

near-term physical risks and events can and should be accounted for by using a sufficiently robust selection of transition scenarios.

The remainder of this report is structured as follows:

- Section 2 reviews what scenarios, climate-economy models, and scenario analysis are, and outlines several of the most critical aspects of each that stakeholders might want to consider when assessing climate-related financial disclosures.
- Section 3 emphasizes the diversity of interests represented by the financial community and other disclosure audiences and discusses the range of expectations for scenario-based disclosures that results.
- Section 4 provides a snapshot of how scenarios are currently used in the climate-related disclosures of oil and gas companies and explains why these have been of limited use to the financial community.
- Section 5 explores the common objections to the use of climate scenarios in disclosures and explains how these might be addressed with well-designed and executed scenario analysis.
- Section 6 offers recommendations to the oil and gas industry, scenario producers, and the financial community.
- Section 7 concludes with a discussion of how the lessons and recommendations of this report can be used to promote robust disclosures that provide useful information to the financial community while addressing the significant concerns of the oil and gas industry.

2. SCENARIOS, CLIMATE-ECONOMY MODELS, AND SCENARIO ANALYSIS

While the TCFD has recommended scenario analysis as a tool to describe the resilience of a company's strategy to the risks and opportunities of climate change, the effectiveness of this tool depends on a clear understanding of climate scenarios, the climate-economy models used to produce them, and the various analytical techniques used to evaluate them.

2.1. Scenarios

Scenarios are hypothetical constructs of the future that follow an internally consistent logic and narrative. The TCFD states:

*A scenario describes a path of development leading to a particular outcome. Scenarios are not intended to represent a full description of the future, but rather to highlight central elements of a possible future and to draw attention to the key factors that will drive future developments. It is important to remember that scenarios are hypothetical constructs; they are not forecasts or predictions, nor are they sensitivity analyses.*¹³

¹³ TCFD (2017) *Technical Supplement: The Use of Scenario Analysis in Disclosure of Climate-related Risks and Opportunities*. Pg. 2.

Climate scenarios¹⁴ generally include some description of how socioeconomic factors and energy technologies will develop and interact to produce particular emissions profiles, which in turn are expected to lead to changes in global climate conditions over time.

The TCFD also states that scenarios should be plausible: “The events in the scenario should be possible and the narrative credible (i.e., the descriptions of what happened, and why and how it happened, should be believable).”¹⁵ Typically, the more plausible a scenario is, the more useful it is likely to be. However, the plausibility of any particular scenario is not always clear, especially in complex socio-technical systems.^{16,17} It is easier to quantify rates of technological improvement, cost curves, technology availability, and their uncertainties, for example, than it is to quantify rates of societal adoption, cultural attitudes, and lifestyle shifts. Shell provides an example of how plausibility and possibility frame its scenarios:

*Unlike Shell’s Mountains and Oceans scenarios, which unfolded in an open-ended way based upon plausible assumptions and quantifications, the Sky Scenario was specifically designed to reach the Paris Agreement’s goal in a technically possible manner.*¹⁸

Generally, climate scenarios may be either “exploratory” or “normative.”

- **Exploratory (or descriptive) scenarios** “describe how the future might unfold, according to known processes of change or as extrapolations of past trends.”¹⁹ “Business-as-usual” scenarios and “outlook” scenarios are generally exploratory.
- **Normative (or prescriptive) scenarios** “describe a prespecified future, presenting ‘a picture of the world achievable (or avoidable) only through certain actions.’”^{20,21} They are often modeled by starting with the goal in mind and working backward to engineer pathways that achieve the target, frequently taking other constraints such as cost into consideration.

14 In this work, we use the term “climate scenarios” and “climate-related scenarios” interchangeably to refer not only to scenarios that incorporate weather, temperature, water stress, and other physical climate projections, but also to scenarios that outline the transitions to a low-carbon economy with integrated energy, socioeconomic, technological, policy, and market-related factors.

15 TCFD (2017) *Final Report: Recommendations of the Task Force on Climate-related Financial Disclosures*.

16 The concept of a window of opportunity to achieve a 1.5°C or 2°C target provides a helpful abstraction for exploring plausibility. As time passes and nations fall short of their ambitions to curb emissions, it becomes increasingly difficult to make up the difference, and the window for action becomes smaller. This difficulty can be likened to plausibility; the more difficult a target becomes to achieve, the less plausible the scenario of achieving that target becomes. These windows have been closing for some time. In fact, some claim that the 1.5°C window is almost, if not entirely, closed already (Rogelj, *et al.*, 2015). A “closed” window may be thought of as one where the target has become implausible, even though the possibility of meeting it technically remains open until the relevant date has actually passed; an incredibly cheap and scalable negative emissions technology could conceivably be invented and deliver the world from catastrophic climate change—but that is not at all likely.

17 EPRI (2018) calls the plausibility of a normative scenario its “attainability.”

18 Shell (2018a) *The Numbers Behind Sky*.

19 Carter, T. and La Rovere, E.L. (2001) *TAR Climate Change 2001: Impacts, Adaptation, and Vulnerability. Chapter 3: Developing and Applying Scenarios*. IPCC.

20 Ibid.

21 Ogilvy, J. (1992) “*Future Studies and the Human Sciences: The Case for Normative Scenarios*.” *Futures Research Quarterly*, 8(2), 5–65.

A “2°C scenario,” in which the average global temperature rise is limited to 2°C above that of preindustrial times, is an example of a normative scenario.

An advantage of using a normative scenario such as the 2°C target is that it increases the comparability of disclosures. Insofar as specific scenarios become common across many analyses, they become “reference scenarios”—i.e., scenarios used by many different entities for their own analyses. While the TCFD found the approach of using detailed, transparent, publicly available reference scenarios “intuitively appealing,” it nonetheless refrained from recommending specific scenarios for use because “existing, publicly available climate-related scenarios are not structured or defined in such a way that they can be easily applied consistently across different industries or across organizations within an industry.”²² Given the diversity of scenario paths, scenario outcomes, scenario-producing model methodologies and modelers, the formal adoption or standardization of a particular scenario path, climate-economy model, or third-party provider by the TCFD or regulatory body appears unlikely.

Some of the most well-known scenario producers include the International Energy Agency (IEA), the members of the Integrated Assessment Model Consortium (IAMC), the International Renewable Energy Agency (IRENA), and the Organisation for Economic Co-operation and Development. The Energy Modeling Forum (EMF) also provides a useful intercomparison of a wide range of energy and climate models and scenarios. Although not formally approved by the TCFD or a regulatory body, the IEA scenarios included in its *World Energy Outlook* represent the current de facto standard for global energy transition scenarios. The three most commonly referenced scenarios from the IEA include the Current Policies Scenario (CPS), the New Policies Scenario (NPS), and the Sustainable Development Scenario (SDS).

- The CPS “embodies the effects of only those government policies and measures that had been enacted or adopted by mid-2018” and is “designed to offer a baseline picture of how global energy markets would evolve without any new policy intervention.”²³
- The NPS “takes into account the policies and implementing measures affecting energy markets that had been adopted as of mid-2018, together with relevant policy proposals, even though specific measures needed to put them into effect have yet to be fully developed” and is meant “to provide a benchmark to assess the potential achievements (and limitations) of recent developments in energy and climate policy.”²⁴
- The SDS is “an integrated scenario specifying a pathway aiming at: ensuring universal access to affordable, reliable, sustainable, and modern energy services by 2030 (SDG [Sustainable Development Goal] 7); substantially reducing air pollution (SDG 3.9); and

22 TCFD (2017) *Final Report: Recommendations of the Task Force on Climate-related Financial Disclosures*.

23 International Energy Agency (2018) *World Energy Model Documentation: 2018 Version*.

24 Ibid.

taking effective action to combat climate change (SDG 13).^{25,26} The SDS is at the lower end of other decarbonisation scenarios, projecting a median temperature rise by 2100 of 1.7°C to 1.8°C.

The shortcomings of applying these and other conventional climate scenarios to corporate, climate-related, financial risk analysis have received substantial attention.²⁷ The use of such scenarios for analyses and disclosures requires an understanding of three key features of climate scenarios:

- **Carbon pricing.** Carbon pricing is one way scenarios represent the political and market pressure for a transition toward a low-carbon economy and the resulting degree of stress on fossil fuel companies—although these influences can take many forms. Emissions mitigation in any country will ultimately stem from an amalgamation of policy levers—including carbon taxes or a cap-and-trade system, product mandates such as Corporate Average Fuel Economy or CAFE standards, subsidies for renewables, regulations, and bans—adopted by multiple jurisdictions. Climate-economy models require a quantitative representation of the pressure these measures would create. While some simulation models, such as the World Energy Model used by the IEA, explicitly cover a wide variety of these levers, others, including many optimization models,²⁸ require a single representation of policy pressure to allocate computational power toward the representation of other sectors, land use, or earth systems. This is most commonly modeled as a “carbon price,” or an additional cost of emitting CO₂, generally expressed in \$/ton. It is often either aggregated into a single global carbon price or a set of regionally enacted carbon prices. This carbon price allows for comparison between scenarios without requiring the modeling and tracking of explicit penalties, subsidies, mandates, and the like.

However, this modeled “carbon price” is an approximate cost. Great care should be taken when accounting for the intertwined consequences that such a tax might have on energy markets or government spending decisions, let alone on the assets²⁹ of a specific company. The simplified aggregation required for modeling purposes generally assumes that the same marginal cost increase is applied to all CO₂ emissions in the modeled economy (and to all other GHGs adjusted for their global warming potentials³⁰). This equal marginal cost is a very strong assumption considering that the regulations and subsidies that make up most

25 The Sustainable Development Goals (SDGs) are a set of 17 goals adopted by all UN member states in 2015 “to promote prosperity while protecting the environment.” SDG 7: “Ensure access to affordable, reliable, sustainable, and modern energy for all.” SDG 3.9: “By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination.” SDG 13: “Take urgent action to combat climate change and its impacts.” sustainabledevelopment.un.org

26 International Energy Agency (2018) *World Energy Model Documentation: 2018 Version*.

27 See, for example: 2 Degrees Investing Initiative and the CO Firm (2017). *The Transition Risk-o-Meter: Reference Scenarios for Financial Analysis*. Pg. 9.

28 See discussion of cost efficiency models on page 13.

29 Assets, with reference to companies, may refer either to the physical infrastructure owned or operated by the company or to the financial value of the company. If used in reference to financial firms, the term “financial assets” will be used.

30 The global warming potential of a GHG “integrates the RF [radiative forcing] of a substance over a chosen time horizon, relative to that of CO₂.” (IPCC, 2013)

national mitigation efforts usually reflect widely varying marginal costs per ton avoided. Moreover, if a global price is used, the scenario will typically assume that all nations apply the same marginal penalty to their emissions—a highly unlikely condition of real-world policy. Given these considerations, the particular carbon price profile used in a model to achieve a 2°C scenario may be an inaccurate or misleading metric to apply for the purposes of assessing the economic viability of a specific asset or project.

- **Technological assumptions.** The mix and pace of actions that need to be taken in the next several decades to reach specific climate outcomes by 2100 are heavily influenced, if not dictated, by assumptions about technological developments—some of which are not expected until the latter half of the century. Models often have to “force” 2°C outcomes by making assumptions about the invention, advantageous economics, and rapid scale-up of certain technologies (e.g., carbon capture and storage, bioenergy with carbon capture and storage, and other negative emissions technologies), many of which are currently unproven at scale, uneconomical, of questionable public acceptance, or otherwise problematic. Such assumptions can be obscured in scenario analyses that focus on the first half of the 21st century.

For example, IEA’s 450 Scenario “sets out a pathway for the energy sector that is consistent with having a 50% chance of limiting the global temperature increase to less than 2 degrees Celsius (°C).”³¹ The IEA’s SDS actually has a very similar emissions profile as the 450 Scenario through 2040, assuming no negative emissions.³² However, the SDS emissions profile has been updated to decline much more steeply post-2040. With these substantial reductions post-2040, the climate is able to reach a median stabilization point around 1.7°C–1.8°C by 2100, as opposed to 2°C. This means that entities reporting analysis only through 2040 might be able to claim resilience to a more aggressive climate outcome without an associated change in near-term risk.

- **Scenario outcomes vs. scenario paths.** A scenario “outcome” refers to the endpoint of a scenario, usually a temperature target such as limiting the level of temperature rise by 2100 to 2°C. However, there are many ways to achieve any one temperature outcome; these are the “scenario paths.” The political, technological, and economic developments and associated risk drivers (e.g., which sectors and regions bear the most emissions reductions, or which energy technologies win out in different economies) can be distinctively different between pathways with the same outcome. Box 1 illustrates four very different pathways to the same temperature rise outcome of 1.5°C. This particular pathway comparison emphasizes the role of peak emissions, the rate of emissions reduction, and whether bioenergy with carbon capture and storage is incorporated. Pathway differences have significant implications for carbon-intensive industries because the transition to a low-carbon economy could (and

31 <https://www.iea.org/weo/energyandclimatechange>

32 Muttitt, G. (2018) *Off Track: How the International Energy Agency Guides Energy Decisions Towards Fossil Fuel Dependence and Climate Change*. Oil Change International, Institute for Energy Economics and Financial Analysis.

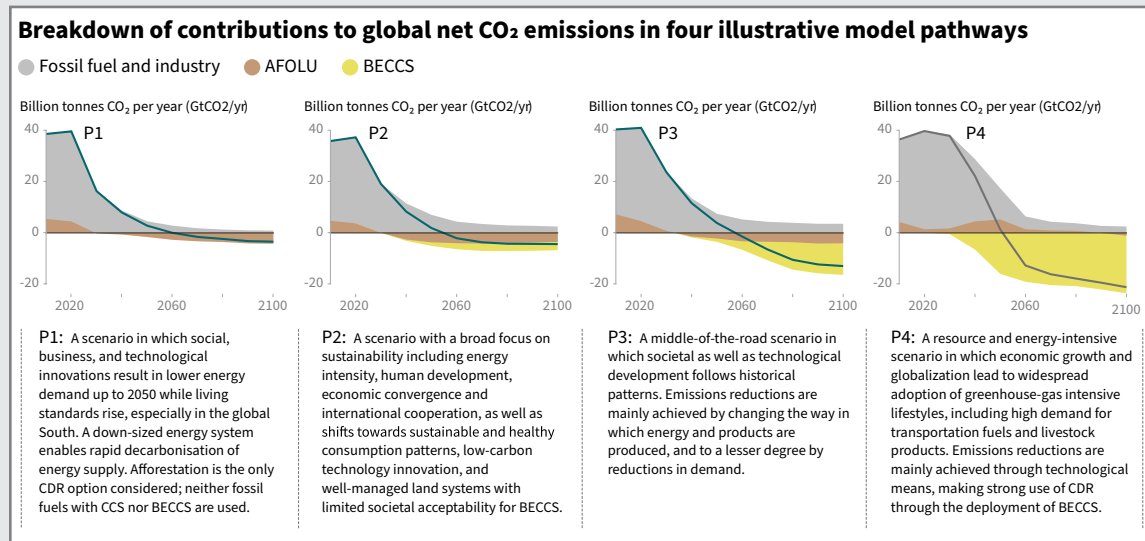
probably will) evolve very differently from the specific pathway laid out in any particular scenario. Furthermore, dramatic investments in emissions reduction become a less expensive option the further it is in the future with the assumption of high discount rates.

Understanding these three features helps explain why the TCFD has emphasized the importance of using a range of scenario paths to describe a company's resilience rather than relying on a single scenario. Developing families or suites of paths can serve to define "envelopes" of transition impacts, which in turn can illuminate the range of plausible impacts a company might encounter due to climate change.

Box 1. Four Model Scenario Pathways from the IPCC

In 2018, the Intergovernmental Panel on Climate Change (IPCC) laid out four model pathways to reaching the goal of restraining global warming to an temperature increase of 1.5°C. The IPCC report explained:

Different mitigation strategies can achieve the net emissions reductions that would be required to follow a pathway that limits global warming to 1.5°C with no or limited overshoot. All pathways use Carbon Dioxide Removal (CDR), but the amount varies across pathways, as do the relative contributions of Bioenergy with Carbon Capture and Storage (BECCS) and removals in the Agriculture, Forestry, and Other Land Use (AFOLU) sector. This has implications for emissions and several other pathway characteristics.¹



Source: IPCC, "Special Report: Global Warming of 1.5°C" (2018)

1 Intergovernmental Panel on Climate Change (2018) *Global Warming of 1.5°C*.

2.2. Climate-Economy Models

The computer models that are used to produce the scenarios employed in climate-related disclosures have received little focus compared to that devoted to the scenarios themselves. Yet, the structure of the models can significantly influence the scope, detail, and even outcome of scenarios (and thus the scenario analyses and disclosures that follow). Here, we offer a brief characterization of climate-economy modeling frameworks to provide a basis for discussing the implications of model choice for climate-related scenario-based disclosures.

Each scenario that depicts the transition to a low-carbon economy in some way represents the relationships among overall economic activity, carbon-emitting activities such as fossil fuel use, and emissions mitigation measures. Scenarios conditioned upon a global temperature outcome, such as the 2°C goal, also require an analysis of the response of the climate system to projected emissions. The climate-economy modeling frameworks applied to this task are many and diverse, and almost all were developed for purposes other than to support corporate risk analysis and disclosure; usually they were intended to explore ways to employ policy to meet certain goals and/or to explore the uncertainty embedded in technological assumptions.

In the context of their use in disclosure by oil and gas firms, these modeling frameworks may be usefully discussed within the categories outlined in Figure 1.³³ In general, integrated assessment models (IAMs) are designed to support studies of long-term climate influences and goals. They therefore require a long time horizon (usually to 2100) and a broad scope (many sectors, all of the greenhouse gases, and wide coverage of human emissions-producing activities). Most energy sector models provide shorter-term simulations, with a focus on fossil-fuel energy use and CO₂ emissions. Energy sector models generally target specific emissions pathways that, as studied with separate climate models, are associated with a probability of reaching specific climate outcomes.

The models that we classify as IAMs can be further divided into two subgroups: those designed for *cost-benefit analysis* by comparing the costs of mitigation and climate-related damages, and those framed to explore *cost-efficient* paths of development and emissions control. A cost-benefit IAM incorporates a submodel of the economy and greenhouse gas emissions to drive another submodel of the climate and the resulting temperature change; it then applies functions that represent the estimated economic damages that will be caused by a rising temperature.³⁴ These models are applied to study the trade-off between the costs of mitigation and of climate-related damages to analyze socially optimal paths of emissions reduction over time and to estimate the social cost of CO₂ emissions. To achieve these goals, such models are limited to highly simplified representations of the global economy, emitting activities, and the climate system response. Furthermore, they depend on the extremely problematic task of estimating long-term climate damage. As a result, these models are rarely used to generate scenarios for corporate risk analysis.

33 Several studies are available that provide more detailed classifications of climate-economy models, e.g., Nikas, *et al.* (2019), Stanton, *et al.* (2009), Ortiz, *et al.* (2009), Fussler (2010), and Paltsev (2016).

34 Examples of this approach include [DICE](#), [FUND](#), and [PAGE](#).

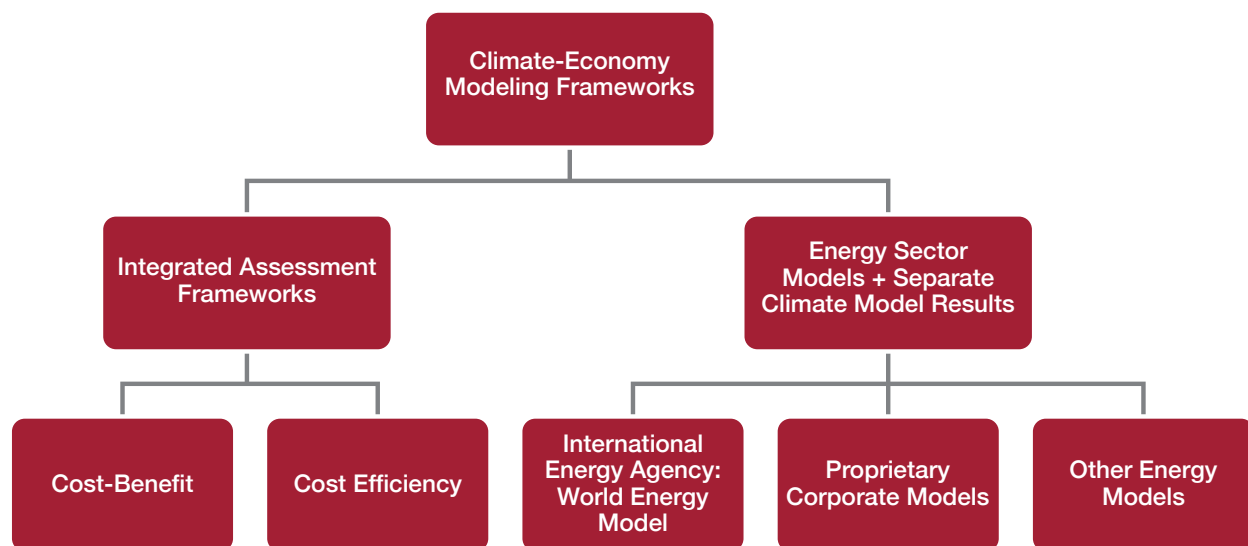


Figure 1. Climate-Economy Modeling Frameworks Used in Scenario Development

A cost efficiency IAM represents the global climate-economy system in terms of individual national economies or regional aggregates, usually linked by international trade.³⁵ Most IAMs consider disaggregated economic sectors, because modeling the interaction among sectors is important to understanding the behavior of the most emissions-intensive ones—e.g., electric power; transportation; buildings; energy-intensive industry; and agriculture, forestry, and other land use. Scenarios based on IAM simulations usually incorporate existing mitigation policies and measures, such as vehicle standards and mandates for renewable-power generation. These models assume an emissions cap or temperature target with the objective of finding a cost-effective path that meets that constraint. Most often, the policy instrument imposed to meet the target is summarized as a price on carbon dioxide emissions applied equally to all sources in all regions.³⁶ Scenarios using cost efficiency energy-economy models are usually associated with a particular climate outcome, most often stated in terms of the simulated temperature increase in 2100.

Energy sector models focus on providing detailed representations of the interplay among various technologies and fuels, as well as on the emissions (of CO₂ and sometimes methane) associated with the modeled energy mix. In the interest of capturing the complexity of the energy sector more fully, other sectors of the economy are aggregated, sometimes reducing energy demand to a simple function of GDP. Because many of these models simulate only a few future decades (commonly not more than 20 to 25 years) they cannot analyze the connection between a simulated emissions path and a century-scale climate outcome. Therefore, researchers using these models to study a particular climate goal must link their energy sector emissions profile through 2035 or 2040 to one taken from some other source, usually a longer-term emission scenario such as one developed

35 Examples of these models include [REMIND](#), [GCAM](#), [MESSAGE](#), [IMAGE](#), [AIM](#) and the [MIT ISGM](#).

36 See discussion on carbon pricing in climate scenarios in Section 2.1. Scenarios.

using an IAM. Energy sector models—including those used by Greenpeace,³⁷ IRENA,³⁸ and the Deep Decarbonization Pathways Project³⁹—reflect a diverse array of motivations, modeling philosophies, model applications, methods, and study objectives.⁴⁰

The International Energy Agency (IEA) is the most widely used source of energy sector scenarios. Its flagship model is the World Energy Model (WEM) used in its annual *World Energy Outlook*.⁴¹ This model takes as inputs assumptions about technology, policy, CO₂ prices, fuel prices, and various socioeconomic drivers; it simulates the interactions among supply, primary energy demand, energy transformation processes, final energy demand, and energy service demand; and it outputs the resulting energy flows, CO₂ emissions, and investments up to 2040.⁴² To simulate the energy sector effects of a climate outcome, the IEA adopts an emissions pathway at the lower end of the RCP2.6 scenarios to inform its 2°C compliant energy transition scenarios (see footnote 48 for explanation of RCPs).⁴³

Oil and gas companies typically have their own models of the energy sector. Though now sometimes applied to the task of reporting on climate-related risk, most of these models were developed for very different reasons, such as to inform strategic decisions and major investment choices. The methodologies used are diverse, ranging from internally consistent and centrally designed mathematical models (such as the IAMs) to simulations based on estimations submitted by separate corporate divisions. Many of these models use the outputs and parameter values of credible models such as the IEA's WEM in an effort to ground their models in expert-informed energy-sector data. The companies may then substitute parameter values they believe to be more representative of their particular situations. As a result, these models often demonstrate substantial granularity in the demand drivers and end-use sectors of the particular firm's energy domain.

Methods ranging in complexity and completeness are applied to connect modeled emissions to their effects on global temperature. In some scenario constructions, an integrated framework linking human and planetary systems enables a modeled emissions path to drive a companion climate

37 Greenpeace (2015) *Advanced Energy [R]evolution*.

38 International Renewable Energy Agency (2016) *Remap – Renewable Energy Roadmaps*.

39 Deep Decarbonization Pathways Project (2015) *Pathways to Deep Decarbonization 2015 Synthesis Report*.

40 Other, more technical considerations that could potentially impact the output of a particular scenario include, but are not limited to, model perspective (top-down vs. bottom-up), degree of foresight (perfect foresight vs. recursive dynamic), and solution concept (simulation vs. optimization) (see Paltsev, 2016, for details and examples).

41 www.iea.org/weo/weomodel

42 International Energy Agency (2018) *World Energy Model Documentation: 2018 Version*.

43 International Energy Agency (2017) *World Energy Outlook 2017*.

model.⁴⁴ In other, simpler scenario constructions, frameworks are designed to be easily attached to other economic or emissions models, generally making use of reduced-form representations calibrated to results from larger climate models.⁴⁵ In these applications, the simulation of the economy and its energy system is based on an emissions path derived from analyses associated with particular climate outcomes.⁴⁶ IAMs and other analysis frameworks have explored the implications for oil and gas or other economic sectors using emissions paths that yield these atmospheric conditions.⁴⁷

2.3. Scenario Analysis

Scenario analysis is the use of scenarios to challenge common conceptions about how the future will unfold and impact an entity's objectives. Such analysis depends upon the use of multiple scenarios to counter purely extrapolative or conventional thinking. The TCFD states:

*Scenario analysis is a tool to enhance critical strategic thinking. A key feature of scenarios is that they should challenge conventional wisdom about the future. In a world of uncertainty, scenarios are intended to explore alternatives that may significantly alter the basis for “business-as-usual” assumptions.*⁴⁸

In the context of climate-related financial disclosures, and the analysis of transition risk in particular, scenario analysis generally includes mapping a company's operations and economic returns under the different paths described by the scenarios. Scenario analysis is often characterized as either primarily qualitative or primarily quantitative.

44 The MIT Integrated Global System Model (IGSM) framework is an example, building upon more than 30 years of experience designing, using, and improving climate-economy models. The IGSM framework integrates the Economic Projection and Policy Analysis model — a multi-sector, multi-region model of the economy, greenhouse and other climate-relevant emissions, and land use — with the MIT Earth System Model— a coupled model of the atmosphere, ocean, and land that takes into account the atmospheric chemistry that influences climate effects (e.g., the atmospheric lifetime of methane) and includes the effects of changes in land use and in the cryosphere. The framework represents MIT's effort to provide the field with “a sound foundation of scientific knowledge to aid decision-makers in confronting future food, energy, water, climate, air pollution, and other interwoven challenges.” (MIT Joint Program on the Science and Policy of Global Change, 2018.)

45 The most prominent example of the latter, designed to support integrated analysis, is the Model for the Assessment of Greenhouse-Gas Induced Climate Change (MAGICC). To compute global mean temperature given a particular emissions path, MAGICC uses a model of atmosphere-ocean dynamics of minimal complexity, calibrated to mimic the results of larger climate models. www.magicc.org

46 For example, the Representative Concentration Pathways (RCPs) adopted by the IPCC have been used for analysis by ensembles of climate models and have become associated with particular climate targets (van Vuuren, *et al.*, 2011). RCP2.6, which represents an atmospheric concentration profile ending at a radiative forcing of 2.6 watts per square meter at the year 2100, is associated with an atmospheric limit of 450 parts per million CO₂-equivalent and is taken as satisfying a 2°C goal. However, while climate response to radiative forcing is the subject of much study, a fair amount of uncertainty remains. This relates to the modeling of chemical physics within the atmosphere, which is outside the scope of this work. However, the estimates of what the resulting “carbon budgets” are for the century share that uncertainty. Therefore, it must be understood that, even if certain sociological and technical targets associated with a particular temperature target are met, there is still a wide range of actual climate responses that may occur. The Shared Socioeconomic Pathways (SSPs) were developed to expand upon the RCPs by providing assumptions about population, urbanization, and overall economic growth (Riahi, *et al.*, 2017).

47 For summaries of this work see Chapter 6 of Volume 3 of the IPCC's *Fifth Assessment Report* (IPCC, 2014).

48 TCFD (2017) *Technical Supplement: The Use of Scenario Analysis in Disclosure of Climate-related Risks and Opportunities*. Pg. 2.

- **Quantitative analysis** refers to the presentation of quantified financial or operational information within a scenario. When the analyses are based on comparable scenarios and metrics, the presentation of quantitative metrics can make comparison between reporting companies easier. Quantitative scenario analysis can take many forms, targeting various aspects of a company’s vulnerability to climate-related risks. Box 2 provides examples of quantitative analysis used in climate-related disclosure by oil and gas companies.

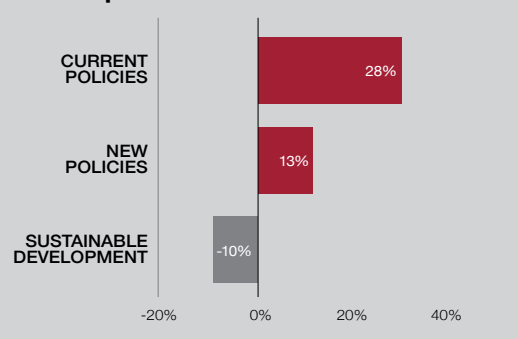
Box 2. Examples of Quantitative Analysis Disclosure

Excerpt 1, from Equinor’s 2018 Sustainability Report:

Portfolio stress test¹—Equinor annually conducts a price sensitivity analysis² for our project and asset portfolio against the assumptions regarding commodity and carbon prices in the range of energy scenarios of the International Energy Agency (IEA), as presented in their *World Energy Outlook* report. This analysis is used to assess energy transition-related risks. The practice is in accordance with a shareholder resolution passed in 2015, suggesting that stress testing should be done against third-party scenarios to allow for comparability.

The sensitivity analysis in 2018 demonstrated that our portfolio continued to be robust in the various IEA scenarios (*World Economic Outlook 2018*). The chart illustrates changes in the net present value (NPV) of Equinor’s asset and project portfolio when replacing our own assumptions regarding oil, gas, and carbon prices with those of the IEA scenarios.³

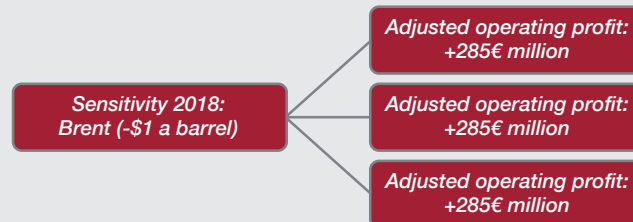
NPV impact on base case



Excerpt 2, from Shell’s 2018 Energy Transition Report:

At our current CO₂ emission levels, we estimate that a \$10 per tonne increase in global CO₂ prices would result in a reduction of about \$1 billion in Shell’s pre-tax cash flows.⁴

Excerpt 3, from Eni’s 2018 Path to Decarbonization⁵:



1 Stress-testing is a well-established practice in the financial industry used to communicate a portfolio’s performance under a specific “stressful” scenario.

2 Equinor uses the term “sensitivity analysis” here to describe what we call “exposure analysis.”

3 Equinor (2018) *2018 Sustainability Report*. Pg. 18.

4 Shell (2018b) *Shell Energy Transition Report*. Pg. 37.

5 Eni (2018) *Path to Decarbonization: Eni for 2018*. Pg. 36.

- **Qualitative analysis** focuses on the identification of trends and on the overarching narratives of the scenarios, often providing insight into less quantifiable company characteristics such as strategy, agility, philosophy, vision, and culture. This kind of analysis can weave together multiple trends of various scales and complexity into a narrative to provide context relevant to a company's forward-looking strategy. Box 3 provides examples of qualitative scenario analysis using excerpts from ConocoPhillips's 2019 climate report.

The most informative scenario analysis integrates both qualitative and quantitative aspects.⁴⁹

Box 3. Example of Qualitative Analysis Disclosure

ConocoPhillips: *Managing Climate-Related Risks* (2019)

Excerpt 1, from "Scenario Descriptions" section:

Scenario 1 includes rapid technology development with a low carbon price introduced by governments to kick-start technology advancement. The technological progress accelerates the development and uptake of electric cars, battery storage, smart grids, and renewable power, all of which reduce GHG emissions. The technological transformation is so rapid that CO₂ capture and storage is not required. Breakthroughs in technology, such as power storage, drive the adoption of alternatives to oil and natural gas together with energy efficiency improvements.

Excerpt 2, from "Key Strategic Linkages to Our Scenario Planning" section:

Our corporate strategy and Climate Change Action Plan reflect several findings from our scenario analyses. We have acted to:

Identify and fund profitable emissions reduction projects, including methane emissions reductions. Reducing our Scope 1 and Scope 2 emissions intensity reduces the impact of any future regulations, or the introduction of carbon prices or taxes and helps maintain our low cost of supply into the future. We have upgraded the use of a marginal abatement cost curve (MACC) in Long-Range Planning to identify the most cost-effective emissions reduction opportunities available to the company globally.

Excerpt 3, from "Long-Term Risks" section:

We recognize that our GHG intensity will be compared against peers, so we track this as a competitive risk at the corporate level. Investors, the financial sector, and other stakeholders compare companies based on climate-related performance, and GHG intensity is a key indicator. For this reason, our GHG intensity target aligns with the long-term time horizon to ensure we manage the risk appropriately. It also demonstrates our goal to be a leader in managing climate-related risk.¹

1 ConocoPhillips (2019) *Managing Climate-Related Risks: Building a Resilient Strategy for the Energy Transition*.

⁴⁹ The TCFD acknowledges that an organization might be forced to rely on qualitative analysis in lieu of quantitative analysis if it lacks the capacity to implement quantitatively focused scenario analysis. The expectation is that that companies should start to support scenario analyses with greater quantitative rigor as best practices are devised and as data and tools of the appropriate scale and complexity are made available. (TCFD, 2017a)

Strategy Resilience

Strategy c) recommends that companies describe “the resilience of the organization’s strategy.”⁵⁰ The TCFD acknowledges that “while there is no single definition of strategy resilience,” companies should “describe the characteristics of their strategies that allow them to adapt to climate-related changes materially affecting their business while maintaining operations and profitability and safeguarding people, assets, and overall reputation.”⁵¹ Given this flexibility, we offer a framework for thinking about what the TCFD calls “strategy resilience”⁵² with the goal of providing some consistency in how companies treat it (see Figure 2). This framework of strategy resilience has two main pillars: vulnerability and preparedness. Vulnerability incorporates the elements of exposure, sensitivity, and adaptive capacity (the latter is often included due to its interaction with exposure and sensitivity).^{53,54,55} Analysis of exposure and sensitivity focuses on an organization’s current asset position and operations. Preparedness incorporates the elements of strategic planning and adaptive capacity. Strategic planning is primarily a forward-looking exercise. Assessment of adaptive capacity involves both present and forward-looking aspects.

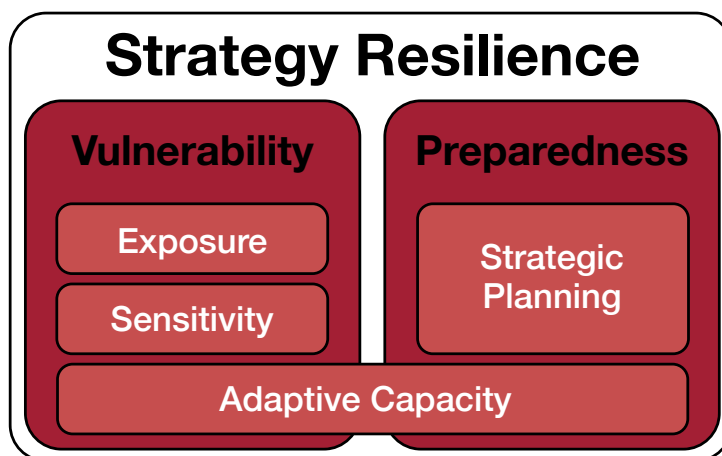


Figure 2. Strategy Resilience Framework

- **Exposure.** Exposure is a measure of the degree to which a company’s assets are likely to be impacted by a particular risk driver or scenario (i.e., value at risk), typically stated as

50 See page 5 for Strategy c.

51 TCFD (2019) *2019 Status Report*.

52 We adopt the use the term “strategy resilience,” as opposed to “strategic resilience,” to align with the TCFD’s usage.

53 Thomas, *et al.* (2018) “*Explaining differential vulnerability to climate change: A social science review.*” Wiley Interdisciplinary Reviews: Climate Change, 10:2, e565.

54 UNEP FI, Vivid Economics, Carbon Delta (2019) *Changing Course: A Comprehensive Investor Guide to Scenario-Based Methods for Climate Risk Assessment, in Response to the TCFD*.

55 For a breakdown of vulnerability to climate change as it pertains to investor portfolios, see UNEP FI, Vivid Economics, Carbon Delta (2019) *Changing Course: A Comprehensive Investor Guide to Scenario-Based Methods for Climate Risk Assessment, in Response to the TCFD*. Pg. 27 and 33.

a dollar value or discounted net present value (NPV) amount.⁵⁶ In some sense, exposure serves as the foundation for the rest of a scenario analysis exercise, the starting point. When referring to climate risk, exposure assessments can provide insight into how a specific climate transition scenario might affect the financial position of a company, assuming no change in corporate strategy. For an oil and gas company, exposure is a function of both its production profile and a potential carbon price profile. Consider, for instance, a case in which one company has 100 million barrels of oil equivalent (mmboe) to be produced over the next 10 years while a competitor has 100 mmboe to be produced over the next three years. If the carbon price is projected to rise over time, then the first company has a greater financial exposure even though both companies have the same 100 mmboe of oil “exposed” to some sort of carbon pricing risk.⁵⁷ Furthermore, financial exposure includes not only the exposure of the reserves themselves but also of the planned development and extraction of those resources, which takes into account the cost structure and carbon intensity of those development and extraction activities. These aspects can vary significantly between companies and projects.

- **Sensitivity.** Sensitivity analyses demonstrate how much the financial condition or operations of a company are likely to be affected by specified levels of change (generally represented by a percentage change on either side of a base case) of isolated drivers—e.g., the price of a fuel, energy demand, carbon price, etc. It can be expressed in overall terms, or with reference to a particular future period. For example, the free cash flows from 2025–2030 might change by a specific amount given a 10% increase in projected energy demand over the base case.
- **Adaptive capacity.** Adaptive capacity is a system’s ability to monitor, learn, and change in an unstable environment; it describes the ability of systems to handle both identified and unidentified challenges. It is the flexible component of preparedness (i.e., “the company’s ability—and flexibility—to adjust its strategy in response to emerging climate conditions, including alternative ways to use resources and the robustness and redundancy of business processes”⁵⁸), and “can be regarded as the mechanism for resilience.”⁵⁹ For oil and gas companies, this can include their “ability to shift away from high-carbon suppliers and customers, pass through costs, or abate their emissions directly.”⁶⁰ Adaptive capacity may also

56 Trucost uses this exposure methodology to calculate what it calls the “total risk premium” for investee companies. It then uses that premium to aggregate risk for entire investment portfolios. (Trucost, 2019)

57 If production profiles are currently locked-in (i.e., very costly to change regardless of strategy changes), an exposure calculation with the assumption of no change in strategy will be close to the actual impact. If the production profiles are more readily changeable, the projected exposure will represent a potential upper bound of the actual exposure. Hence the need for forward-looking assessments of preparedness.

58 TCFD (2019) *2019 Status Report*.

59 Bhamra, R., Dani, S., and Burnard, K. (2011) “*Resilience: The Concept, a Literature Review and Future Directions*.” *International Journal of Production Research*, 49:18, 5375–5393

60 UNEP FI, Vivid Economics, Carbon Delta (2019) *Changing Course: A Comprehensive Investor Guide to Scenario-Based Methods for Climate Risk Assessment, in Response to the TCFD*. Pg. 33.

take into account other information highlighted in the World Business Council on Sustainable Development Oil & Gas Preparer Forum, including evidence of capital discipline to control costs and risks, capital and cost-base flexibility, lifetime of reserves, and intellectual property.⁶¹

Building adaptive capacity might include activities such as investing in new technologies and spending on research and development (R&D). However, R&D alone is not necessarily demonstrative of a firm's adaptive capacity. If a firm's disclosure on resilience relies heavily on R&D, it should include evidence of actual and planned portfolio operations that take advantage of the R&D—such as transitioning toward a lower carbon energy mix or making specific plants more efficient.

- **Strategic planning.** Strategic planning encompasses the specific plans made to face an identified source of risk (e.g., climate change) and constitutes the other element of preparedness. Adaptive capacity is needed both to undertake strategic planning and to carry out the plans developed. Strategic planning differs from adaptive capacity, however, in that planning implies a commitment of resources—from the company's asset portfolio and/or capabilities. This often includes identifying “options for increasing the company's resiliency through adjustments to strategic and financial plans.”⁶² Strategic planning also requires a thorough understanding of an organization's vulnerabilities and of the challenges it faces. Examples of such planning in the oil and gas industry include capital expenditure plans and commitments as well as investment in and projected earnings from non-fossil fuel activities.⁶³

Strategy resilience to climate-related risks, as the TCFD has suggested, can mean different things to different entities. To promote consistency in corporate disclosures, we offer a framework that incorporates assessments of both current asset vulnerability and forward-looking preparedness. Additionally, this framework provides a vocabulary with which to identify gaps in current scenario-based disclosures by oil and gas companies (see Section 4).

3. SCENARIO-BASED DISCLOSURE: INTERESTS AND EXPECTATIONS

Calls for more useful climate-related disclosures generally focus on “investors,” but interest in disclosure spans a wide range of the financial community, including credit rating agencies, banks, insurers, sovereign wealth funds, pension funds, asset managers, and investment consultants. The motivations and interests of these investors are shaped by factors such as institutional role, strategic

61 WBCSD (2018) *Climate-Related Financial Disclosure by Oil and Gas Companies: Implementing the TCFD Recommendations*.

62 Bhamra R., Dani, S. and Burnard, K. (2011) “*Resilience: The Concept, a Literature Review and Future Directions*.” International Journal of Production Research, 49:18, 5375–5393

63 WBCSD, supra note 61.

planning/investment horizon, analytical capability, business scope, and investment philosophy.⁶⁴ (See Appendix 1.) For example, creditors and credit rating agencies are primarily interested in how climate-related risks might affect credit-worthiness and ability to pay back loans under a variety of specific scenarios. Insurance companies, on the other hand, might care most about scenarios where the increased frequency and severity of climate events suggests the need for higher premiums, or even creates physical risks deemed “uninsurable.”⁶⁵

Workshop discussions highlighted this diversity of interests in climate-related financial disclosure, with participants from the financial community presenting a wide range of desires for scenario analysis and disclosure. Investors differed in whether they wanted scenario-based disclosures to prioritize company-specific insights, comparability with other companies in their industry, or comparability across industries. They differed in whether they placed more importance on assessing a company’s current strategic positioning and vulnerabilities or gaining insight into forward-looking corporate preparedness. Furthermore, they differed in the degree to which they considered it important for companies to disclose quantitative results related to strategy resilience. These myriad expectations make the scenario-based disclosure environment challenging to navigate to the satisfaction of all. Concerns about the ability of scenarios and scenario analysis to handle these expectations are addressed in Section 5.

Also among those calling for more expansive climate-related disclosures are a great variety of organizations and individuals—including NGOs, environmental and climate activists, and some investors—who seek to combat climate change through all avenues, including through the operation of the global capital markets. Thus, the growing interest in climate-related financial risk is to some degree due to the outspoken efforts of these actors to shine a light on what they believe to be the unsustainability of the fossil fuel industry. With the TCFD’s recommendation that companies disclose their resilience with regard to a 2°C scenario, some more environmentally motivated actors view scenario analysis as a tool to expose the fundamental misalignment of some firms in the fossil fuel industry with a normative 2°C future. Others simply want scenario analysis to be used internally to bring the issue of 2°C scenario vulnerability to the board level, in the hopes of ultimately moving these firms to more climate-friendly policies and business models.⁶⁶

Whatever the motivations of various actors, the use of a normative scenario can contribute to the goal of providing clear and comparable climate-related disclosure for the benefit the financial community. Firstly, while the 2°C target was not arrived at for the purpose of providing a company-level strategy resilience threshold, it does represent the implications of a goal accepted by most governments—and one that would test the current business models used in many industries,

64 A breakdown of the high-level objectives of scenario analysis for institutional investors is provided by IIGCC (2019) *Navigating Climate Scenario Analysis - A Guide for Institutional Investors*.

65 Reserve Bank of Australia. (2019) *Financial Stability Review October 2019*. Box C: Financial Stability Risks from Climate Change.

66 Still others seek to hold oil and gas companies accountable for their role in contributing to climate change in the first place, whether through acting knowingly to discredit climate change as a real phenomenon or simply through their business of producing a product whose use is a main contributor to climate change.

including the oil and gas industry. Secondly, a normative global target—set by a near unanimous international community and modeled by a wide variety of academic, nonprofit, governmental, and private institutions—provides a well-recognized scenario outcome for companies to include in their analyses and disclosures (and one much less subject to conflict of interest than using global outlooks produced by ExxonMobil, Shell, BP, and others).

4. STATE OF SCENARIO ANALYSIS IN OIL AND GAS COMPANY CLIMATE-RELATED FINANCIAL DISCLOSURE

Despite substantial publicity surrounding TCFD-aligned disclosures, the use of scenario analysis to describe the strategy resilience of fossil-fuel companies to climate-related risks remains limited in adoption.⁶⁷

In 2018, the Carbon Tracker Initiative assessed the climate-related disclosures of eight⁶⁸ oil and gas companies, with a particular focus on the logic of each company's scenario analysis and the usefulness of results for investors.⁶⁹ The report provides a table that shows whether companies used proprietary scenarios or third-party scenarios. If a third-party scenario was used, the report noted why it was used, immediately making clear the difficulty of comparing companies with widely varying disclosure practices. The report also provides a table that reveals whether or not a company included a 2°C scenario and the disclosed impact of assessing such a scenario, highlighting the different outputs from the different analyses. We found this format to be useful in illustrating the variability of different oil and gas disclosure practices and sought to expand upon it. Table 1 combines, updates, and expands on this effort to lay out how companies use reference scenarios for quantitative financial disclosure.⁷⁰ It includes the form of the analyses (e.g., exposure analysis, sensitivity analysis, etc.), the parameters analyzed, the third-party sources used to provide those parameters, and the form of quantitative financial output disclosed (e.g., NPV, cash flow, etc.).

While almost all of the selected companies have released new climate-related reports or updates since the Carbon Tracker Initiative report, most did not disclose quantitative financial impacts of climate scenarios, and those companies that did used only the same limited quantitative disclosures as in their previous reports. As a result, these climate-related reports are of limited use to investors for three reasons:

67 In the TCFD's *2019 Status Report*, Strategy c) continued (as of the TCFD's *2018 Status Report*) to be the least implemented recommended disclosure. Furthermore, banking rose to have the highest rate of implementation across most of the recommended disclosures, including Strategy c), overtaking the energy sector (TCFD, 2019).

68 BP, Chevron, ConocoPhillips, Eni, ExxonMobil, Shell, Statoil (now Equinor), and Total.

69 Carbon Tracker (2018) *Under the Microscope: Are Companies' Climate Scenario Analyses Meeting Investors' Requirements?*

70 Only quantitative analyses are included, since the qualitative disclosures in the reports are even more difficult to compare. Also, only analyses that incorporate or reference third-party scenarios are included, again, to emphasize the comparability of the quantitative analyses. Finally, descriptions, qualitative or quantitative, of IEA scenarios were not included unless a company-specific metric was compared to it. Many companies included descriptions of the IEA scenarios without connecting them to any company-specific analysis.

Table 1. Uses of Reference Scenarios for Quantitative Financial Disclosure by Select Oil and Gas Companies

	Analysis Type	Reference Scenario Used for Metric Disclosure					Quantitative Financial Disclosure	Source
		Emission Pathway	CO ₂ Emissions Intensity	Demand	Commodity Price	Carbon Price		
BP	Comparison*	Shell Sky Scenario, IEA SDS, IPCC P1, Equinor Renewable Scenario	N/A	IEA NPS, IEEJ Outlook 2019, IHS Rivalry, OPEC World Oil Outlook 2040, Equinor Energy Perspectives 2018, ExxonMobil 2018 Outlook for Energy, CNPC Energy Outlook 2050, EIA Outlook 2017	N/A	N/A	N/A	i
Chevron	N/A	N/A	N/A	N/A	N/A	N/A	N/A	ii
Conoco-Phillips	N/A	IEA CPS, IEA NPS, IEA 450	N/A	N/A	N/A	N/A	N/A	iii
Eni	Exposure	N/A	N/A	N/A	IEA SDS	IEA SDS	Impact on aggregate fair value of properties	iv
Equinor	Exposure	IEA	N/A	N/A	IEA CPS, IEA NPS, IEA SDS	IEA CPS, IEA NPS, IEA SDS	Impact on NPV of asset and project portfolio	v
ExxonMobil	Comparison*	EMF 27 scenarios	EMF 27 scenarios	EMF 27 scenarios, IEA SDS	IEA SDS	N/A	N/A	vi, vii
	Sensitivity	N/A	N/A	Light-duty fuel, Heavy-duty fuel	N/A	N/A	N/A	vii
Shell	Sensitivity	N/A	N/A	N/A	N/A	\$10/tonne increase in global CO ₂ price	Impact on pre-tax cash flow and NPV	viii
	Sensitivity	N/A	N/A	N/A	\$10/barrel change in oil price	N/A	Impact on cash flow	viii
Total	Comparison*	N/A	IEA NPS, IEA SDS	N/A	N/A	N/A	N/A	ix
	Exposure	N/A	N/A	N/A	N/A	\$40/ton CO ₂ price	Impact on NPV	ix

* Reference scenario was used as a comparison to the company-specific outlook or custom scenario but was not used for any other analysis disclosure purpose.

i) BP (2019) *BP Energy Outlook: 2019 Edition*. www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/energy-outlook/bp-energy-outlook-2019.pdf

ii) Chevron (2018) *Climate Change Resilience: A Framework for Decision Making*. www.chevron.com/-/media/shared-media/documents/climate-change-resilience.pdf. Pg. 30–34.

iii) ConocoPhillips (2019) *Managing Climate-Related Risks: Building a Resilient Strategy for the Energy Transition*. static.conocophillips.com/files/resources/climate-change-report.pdf

iv) Eni (2018) *Path to Decarbonization: Eni for 2018*. www.eni.com/docs/en_IT/enicom/sustainability/EniFor-2018-Decarbonization.pdf

v) Equinor (2018) *2018 Sustainability Report*. www.equinor.com/content/dam/statoil/documents/sustainability-reports/2018/equinor-sustainability-report-2018.pdf

vi) ExxonMobil (2018) *2018 Outlook for Energy: A View to 2040*. corporate.exxonmobil.com/-/media/Global/Files/outlook-for-energy/2018-Outlook-for-Energy.pdf

vii) ExxonMobil (2019) *2019 Energy & Carbon Summary*. corporate.exxonmobil.com/-/media/Global/Files/energy-and-carbon-summary/Energy-and-carbon-summary.pdf

viii) Shell (2018b) *Shell Energy Transition Report*. www.shell.com/energy-and-innovation/the-energy-future/shell-energy-transition-report/_jcr_content/par/toptasks.stream/1524757699226/3f2ad7f01e2181c302cdc453c5642c77acb48ca3/web-shell-energy-transition-report.pdf

ix) Total (2018) *Integrating Climate into Our Strategy*. www.total.com/sites/default/files/atoms/files/total_climat_2018_en.pdf

- **Lack of comparability.** There is wide variation in practice as to whether or not corporate scenario-based disclosures use or refer to a reference scenario for quantitative analyses. Moreover, companies that use reference scenarios vary in which one they choose. None of the three observed US oil and gas companies provided quantitative financial outputs from their analyses that employed a reference scenario.⁷¹
- **Lack of transparency.** Even when disclosed analyses do take advantage of reference scenarios, the disclosures often lack information needed to interpret the resulting analysis. For example, the time frame over which the financial metrics are calculated is often unclear, and reports may fail to identify the discount rates used. Furthermore, the mixing of third-party and proprietary inputs for parameters in sensitivity analysis (e.g., demand, commodity price, carbon price) hampers the interpretation of the output of such analyses.⁷²
- **Incomplete scope.** Many climate-related disclosures provide only half the story: either an analysis of vulnerability without commensurate evaluation of preparedness, or a description of preparedness without any evaluation of the vulnerabilities for which they are prepared. For example, while some of the companies claim “portfolio resilience” (see Box 2), it is often only in reference to an assessment of exposure and does not address the company’s potential strategic response to changing carbon prices and/or fossil fuel demand (see Section 2.3).⁷³ Such disclosures fail to fully account for various interconnected factors related to strategy resilience that could potentially affect the value of a company.

Few companies exhibited all three shortcomings. For example, ExxonMobil provided relatively detailed comparisons between its outlook and the Energy Modeling Forum’s *Study 27* scenarios along multiple important dimensions, including emissions pathway, CO₂ emissions intensity, oil demand, and commodity price. However, none of these translated into quantitative financial outcomes for the company, resulting in an incomplete presentation of vulnerability.

The relative sophistication of each company in one or another aspect of disclosure suggests that clear, comparable, and consistent climate-related disclosures are, in fact, attainable. If all companies were willing to match their peers in the areas where their peers provided strong disclosure, the field would take a giant leap forward. Section 5 reviews the challenges oil and gas companies have faced in doing so.

71 This is in line with the general understanding that European companies are subject to more stringent regulatory regimes. It is also possible that the US companies are more sensitive to risk of litigation.

72 Carbon Tracker Initiative (2018) *Under the Microscope: Are Companies’ Climate Scenario Analyses Meeting Investors’ Requirements?* Pg. 6

73 TCFD (2019) *2019 Status Report*.

5. CHALLENGES TO CORPORATE TRANSPARENCY, COMPARABILITY, AND COMPLETENESS

Companies facing increasing pressure from investors, regulators, and climate change–focused NGOs to provide more in-depth scenario-based descriptions of their strategic resilience have offered a variety of reasons for their generally limited disclosures of climate-related risk and resilience.⁷⁴ Objections to scenario-based disclosures fall into three categories: those about scenarios, those about scenario analysis, and those about disclosure.

Two arguments often used in tandem to argue that scenarios cannot provide useful information to investors are: (1) customized, company-specific scenarios cannot enable accurate comparison among companies, and (2) global reference scenarios, which can provide a basis for comparison, do not reflect the nuanced developments likely to be seen in any specific sector or firm, nor do they offer the detail needed to produce assessments that would be useful to investors making decisions. While both of these concerns have merit individually, they neglect the possibility of combining techniques to provide a report that meets both expectations of comparability and specificity (see Section 6.1, Recommendation A).

The primary purpose of custom scenarios is that they represent a company's thinking about its positioning with respect to what it believes to be its main risk drivers. These scenarios should not be expected to be directly comparable to those of other companies. They simply need to be checked for credibility. This can be done by identifying and discussing the differences between a custom scenario and a reference scenario in terms of their main risk drivers (see Section 6.1, Recommendation A).

Global reference scenarios were not built to accurately reflect every sector in the granularity necessary for in-depth corporate assessment. They do not incorporate the strategic responses of any given company, and they do not need to do so to be useful. Instead, the strategic responses of a company should directly address the vulnerabilities revealed by the assessment of the scenarios (see Section 6.1, Recommendation B).

Some have voiced the concern that the very act of reporting on a particular normative scenario has the potential to mislead investors into thinking that such a scenario has a high likelihood of occurring—thus overstating the climate-related risks faced by a company.⁷⁵ While this misunderstanding might occur for an unsophisticated investor who disregards the hypothetical nature of scenarios, it does not absolve a firm from disclosing the transparent analysis about scenarios that members of the financial community are requesting. More importantly, the act of *not* reporting on normative scenarios also has the potential to mislead investors into thinking that the transition risks in such

⁷⁴ IHS Markit articulates a summary of some of the most common concerns with the use of scenarios in oil and gas climate-related disclosures. See IHS Markit (2017) *Climate-Related Financial Risk and the Oil and Gas Sector*.

⁷⁵ Ibid.

scenarios are completely unlikely—thus *understating* the climate-related risks faced by a company. Those who use the former argument must also acknowledge the latter.

Similarly, two arguments are often used in tandem to create a case for why scenario analysis cannot provide useful information about oil and gas companies in particular: (1) the most comparable metrics tend to be those relating to vulnerability (i.e., exposure and sensitivity), which are static metrics focused on present assets and operations and do not account for the elements of preparedness required for the accurate assessment of oil and gas companies; and (2) analysis of forward-looking elements of preparedness (i.e., adaptive capacity and strategic planning) requires the use of different assumptions and is inherently incomparable between companies. While both of these concerns have merit individually, they again neglect the possibility of combining present-focused analysis with forward-looking analysis to provide a report that meets expectations of both comparability and specificity (see Section 6.1, Recommendation B).

Many investors are cautious of self-reported claims of strategic strength and flexibility. To determine a baseline for comparing relative strengths and weaknesses among companies in the same industry, investors find it more useful if companies quantify the impacts of a particular normative scenario on their current assets, assuming no change in strategy. With this information, these investors can use their own forward-looking analysis and/or engagement with management to judge which companies will be flexible enough to adjust to changes in the environment. Analyzing sensitivity and exposure to risk can also help investors judge not only how sensitive financial outcomes are to specific factors but also how the magnitude of the sensitivity might change under different scenarios. Indeed, investors have their own perspectives on the plausibility of certain scenarios, and sensitivity analysis draws attention to the uncertainty of particular risk drivers in those scenarios. From the perspective of companies in the oil and gas industry, the quantitative assessment of the performance of specific reserves or current assets under a normative scenario, assuming no change in assets/operations, can be misleading because it does not account for the dynamics of their production portfolios, which can change drastically in a matter of years or completely turn over in a matter of decades.⁷⁶ However, to the extent that investors understand these assessments as static snapshots, with the appropriate amount of transparency regarding their calculation, measures of exposure and sensitivity are crucial to understanding the current positioning of an organization.

The demand for scenario analysis to provide forward-looking information poses yet another challenge. In the workshop, a number of active, engaged investment managers stated that they were more interested in adaptive capacity and strategic planning than they were on exposure or sensitivity analysis for the purposes of making a holistic assessment of a company's resilience to a normative scenario such as one that envisions a 2°C climate outcome. Forward-looking adaptive capacity and strategic planning elements of strategy resilience—those having to do with a company's *preparedness*—however, are inherently harder to compare across companies due, in part, to their dependence on the different vulnerabilities of the specific organizations. Nevertheless, the forward-looking assessments of preparedness, can benefit indirectly from scenario comparability.

76 IHS Markit (2017) *Climate-Related Financial Risk and the Oil and Gas Sector*.

The exposure and sensitivity elements of strategy resilience—those having to do with a company’s *vulnerability*—are directly related to the particular scenario used. Thus, comparability between scenarios used to assess the vulnerabilities of the companies enhance the comparability of company strategies that respond to those vulnerabilities. While comparability on forward-looking analysis is not easily achieved, completeness in scope and transparency can still serve as a way to satisfy those on either side of the disclosure. Companies should disclose forward-looking aspects, in addition to present asset-focused analysis, to the degree possible, albeit perhaps with less dependence on quantification (see Section 6.1, Recommendation B). Furthermore, linking specific elements of preparedness to the identified vulnerabilities of a company will allow audiences to gauge the robustness of the company’s strategy resilience within its own vulnerability context (see Section 6.1, Recommendation B).

Thus, our review of the general objections raised about the use of scenarios suggests that the issues of comparability, transparency, and scope can largely be resolved by (1) the careful use of reference and proprietary scenarios in tandem, and (2) a full treatment of strategy resilience.

We expect that some firms may be reluctant to disclose the likely impact of climate change on their operations or vice versa, wishing rather to avoid the explicit recognition of the linkages between them. Nevertheless, even those companies that would like to provide a full disclosure of climate-related risk still face a familiar set of difficulties. Two particular challenges are:

- **Proprietary information.** Companies do not want to reveal sensitive strategic information that might damage their competitive or trading position.⁷⁷ The TCFD 2019 Status Report found that the reason cited most often for not implementing the Strategy c) disclosure was “concern around disclosing confidential business information as part of scenario assumptions.”⁷⁸ This concern is particularly relevant to quantified estimates for preparedness, which might reveal proprietary strategic or trading information.
- **Liability risk.** Companies do not want to expose themselves to liability for providing misleading information. The failure to disclose certain information can also be deemed misleading, according to some securities regulations.⁷⁹ Companies that conduct extensive scenario analysis internally, sometimes with hundreds of modeled scenarios, cannot describe each scenario in detail, nor would that be the most useful way to disclose such analyses. Thus, decisions about what scenarios to disclose, in what detail, and why, present real challenges.

Companies must weigh the benefits of greater investor confidence, gained by revealing favorable aspects of their asset positions and plans, against any risks related to their competitive positions, possible regulatory intervention, and legal liability. These concerns, however, are not scenario-specific

⁷⁷ For example, if a company’s scenario-based disclosure identifies that some portion of its real assets are at risk of being stranded in a specific scenario, the company could have difficulty selling those assets.

⁷⁸ TCFD (2019) *2019 Status Report*.

⁷⁹ Vizcarra, H. (2019) “*Climate-Related Disclosure and Litigation Risk in the Oil & Gas Industry: Will State Attorneys General Investigations Impede the Drive for More Expansive Disclosures?*” *Vermont Law Review*. 43 (2019): 733.

and cannot be solved simply by choosing a particular scenario or scenario analysis. Instead, companies will have to iterate upon their own disclosures and those of their peers until the right balance is struck.

In general, concerns related to scenarios can be addressed through well-designed disclosure. Those related to scenario analysis can be addressed more clearly and comprehensively than they have been to date—and some companies have already demonstrated steps in the right direction. Those about disclosure in general reflect the real underlying concerns that companies always have to manage; they are not unique to climate-related financial disclosures.

6. RECOMMENDATIONS FOR THE ENHANCED UNDERSTANDING AND USE OF SCENARIOS

We offer the following recommendations for participants in the climate-related financial disclosure system to facilitate the effective use of scenarios in alignment with TCFD recommendations. These recommendations are designed to (1) address the shortcomings of current scenario-based disclosures in terms of comparability, transparency, and scope, (2) navigate the concerns about scenarios and scenario analyses that are often used to justify incomplete disclosure, and (3) retain the strategic benefits of the climate-related scenario analysis exercise for the reporting companies.

6.1. Oil and Gas Industry

(A) Connect custom scenarios to reference scenarios

Custom scenarios produced by oil and gas companies are important both for the reporting company and for investors. They allow companies to challenge their corporate strategies in creative ways, using scenarios designed to their particular specifications. They also provide investors with insight into the risk drivers that companies consider most important. However, without transparency regarding the assumptions and characteristics of custom scenarios, investor audiences are (1) less able to compare, even broadly, the disclosures of different oil and gas companies and (2) less likely to view the custom scenarios as credible tests of oil and gas strategy resilience.

Many oil and gas companies create their own scenarios for the strategic benefits the exercise provides. If they choose to use custom scenarios as opposed to reference scenarios to disclose financial outputs, however, they should link these custom scenarios to reference scenarios that investors use and understand.⁸⁰ Disclosures should also provide transparency on how certain risk drivers differ between the custom and reference scenario. This kind of transparency will increase clarity in the absence of direct scenario comparability. Some oil and gas companies have started providing these connections, albeit in often limited ways (for example, by comparing just one or two metrics; such as global emissions or oil demand, as shown in Table 1). While transparency on how a custom scenario's

⁸⁰ This linking of custom scenarios to reference scenarios has also been identified by the Center for Climate and Energy Solutions as a best practice. (Meyer, 2018)

global emissions profile compares to that of one or more reference scenarios (such as that shown in Figure 3) can be useful, linking that is limited to global emissions profiles lacks the granularity to be useful to investors seeking to differentiate between scenarios. The metrics included in Table 1⁸¹ (i.e., emissions pathway, CO₂ emissions intensity, demand for product(s), price of commodities, and CO₂ price), provide a core set of risk drivers whose divergences from those of reference scenarios could provide substantive transparency. As a good example of how this might be done, BP's *Energy Outlook* compares the growth of energy consumption for primary energy provided by oil, gas, coal, nuclear, and hydro, as well as growth in carbon emissions between 2017 and 2040, represented in percentage per annum and related to those of a number of other outlooks.⁸²

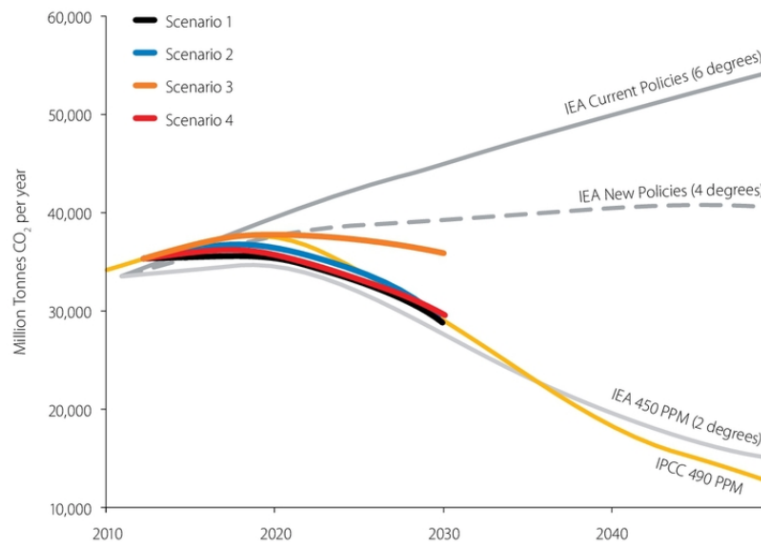


Figure 3. Scenario Comparison—Estimated Global Emissions Trajectories

Source: ConocoPhillips (2019) *Managing Climate-Related Risks*⁸³

MIT is not in the business of picking reference scenarios; the responsibility of choosing a reference scenario ultimately falls on the particular disclosure producer. As suggested by the complexities in Section 2, reference scenario choice will depend on a great many factors and may vary by industry. In practice, they should have certain characteristics, including being widely available, detailed, and transparent. Moreover, it is important that the scenario producer is reputable, widely regarded, and credible—suggesting a notion of independence from external interests, corporate or otherwise. Certain financial institutions might even request that companies reference particular scenarios in their disclosures; companies would then have to decide on the extent to which they cater to such requests or explain their preference for another reference scenario or scenario set. These choices will inevitably evolve over time as new scenarios are produced, investors become more scenario savvy, and certain scenarios become recognized as more or less suitable for specific types of companies and financial actors.

81 See Table 1 on page 24.

82 BP (2019) *BP Energy Outlook: 2019 Edition*. Pg. 129

83 ConocoPhillips (2019) *Managing Climate-Related Risks: Building a Resilient Strategy for the Energy Transition*. Pg. 17.

(B) Incorporate and link each element of strategy resilience

Each element of strategy resilience—exposure, sensitivity, adaptive capacity, and strategic planning (see Section 2.3)—should be addressed in scenario-based climate-related financial disclosures. As observed in Section 4, those oil and gas companies that do utilize reference scenarios to inform quantitative financial analysis generally rely on the analysis of exposure. The UNEP FI Investor Pilot, “a collaborative effort to explore, enhance, and apply a methodology for assessing the impact of physical and transition risks and opportunities on the portfolios of institutional investors,” emphasized that “there is a clear need for better disclosure of climate-related data from investee companies, particularly including a company’s individual sensitivity and adaptive capacity.”⁸⁴ The Carbon Tracker Initiative also released a model disclosure for oil and gas companies that aims to balance the granularity of detail desired by investors with the risks of revealing information of “commercial sensitivity.”⁸⁵ The model disclosure focuses on forward-looking information pertaining to upstream capital expenditure strategy; exploration, appraisal, and development of reserves; project economics; producing reserves; and the use of long-term assumptions. These are examples of measures of preparedness.

Forward-looking strategic planning can be addressed by mapping the estimated impact of plans the company might implement in any scenario to the specific vulnerabilities identified for that scenario. The table in Box 4 includes “reduced energy cost due to better energy storage from renewable energy” as an external sensitivity factor. Similarly, targeted changes in operating modes or strategic pivots—as opposed to such exogenous factors as third-party technological advancements—could be used to illustrate how specific risk factors might be counteracted or mitigated. For example, in the table Factors: Increase Energy Efficiency of Extractive Operations; Next Year Change: -3% in Energy Costs; Next Year Effect on Company’s Net Result: +10 million USD. Such disclosure would demonstrate how robust specific strategies are against vulnerabilities revealed under particular scenarios.

Finally, adaptive capacity should provide the basis for any strategic plans, demonstrating that the company would have the capacity to implement those plans should particular conditions arise. It’s possible that certain vulnerabilities could be mitigated entirely by the company’s adaptive capacity. But, whether that is true or not, adaptive capacity should be linked to those aspects of vulnerability or preparedness to which it might apply.

We recognize that providing quantification in forward-looking analyses may heighten the aforementioned concerns about disclosing proprietary information and creating liability for reporting companies. Indeed, quantifying the financial impacts of adaptive measures might be deemed too revealing by companies precisely for the level of perceived comparability they provide. That’s why most firms currently depend on qualitative analysis to handle forward-looking strategy. Nevertheless,

84 UNEP FI, Vivid Economics, Carbon Delta (2019) *Changing Course: A Comprehensive Investor Guide to Scenario-Based Methods for Climate Risk Assessment, in Response to the TCFD*. Pg. 15.

85 Carbon Tracker Initiative (2019) *Reporting for a Secure Climate: A Model Disclosure for Upstream Oil and Gas*.

Box 4. Example of Sensitivity Analysis Disclosure

Adapted from Jagd, J.T. (2018) *How can companies considering TCFD-recommended scenario analysis provide disclosures that help investors: a short guide*. Carbon Standards Disclosures Board

The critical point to emphasize is that the sensitivity guidance is provided per risk factor, all other things being equal. This means that investors have a chance to evaluate, for instance, whether portfolios are heavily dependent on oil price sensitivity or freight rate sensitivity. This method can be adapted to assess the identified risk/opportunity factors using climate change scenarios, as shown in the table below.

This would help investors evaluate whether portfolios are heavily exposed to specific physical climate risks (e.g., flooding in their manufacturing countries), uncertain regulatory changes (e.g., new carbon taxes) or other market volatilities (e.g., a reduced second-hand market for used fossil fuel vehicles). If one factor has more than one impact [with the potential to counteract each other], the impacts should be included individually and shown as a gross financial impact. This would allow the investor to evaluate how to aggregate the impacts for the portfolio. If the company foresees that [it] will mitigate some of the impacts with new products, using renewable energy sources, moving to new facilities, etc., this should also be included as well and shown with the gross financial impacts.

Following more conventional business risk sensitivity guidance, a climate change sensitivity guidance could be disclosed in a table similar to the table below.¹

Factors	Next year		Next 5 years, accumulated		Next 10 years, accumulated	
	Change	Effect on company's net result	Change	Effect on company's net result	Change	Effect on company's net result
Change of taxes on direct emissions	+/- 10 USD/tonnes of CO ₂ e (scope 1)	-/+ 320 m USD	+/- 10 USD/tonnes of CO ₂ e (scope 1)	-/+ 1,480 m USD	+/- 10 USD/tonnes of CO ₂ e (scope 1)	-/+ 2,738 m USD
Flooding of fields with damage to crops results in crops prices increase			+ 25 USD/metric tonnes crops cost	-1,375 m USD	+ 25 USD/metric tonnes crops cost	-2,600 m USD
Reduced energy cost due to better energy storage from renewable sources			-25% of energy cost	+4,125 m USD	-25% of energy cost	+8,000 m USD
Reduced market for used fossil fuel vehicles results in impairment of fleet					-50% of value at the end of vehicle ownership / lease period	-12,500 m USD

Source: Jagd, J.T. (2018). CO₂e = CO₂ equivalent.

¹ Jagd, J.T. (2018) *How can companies considering TCFD-recommended scenario analysis provide disclosures that help investors: a short guide*. Center for ESG Research, Carbon Standards Disclosures Board.

the forward-looking elements of strategy resilience should, to the extent possible, be linked to analyses of the elements of vulnerability that they are meant to address. This will allow investors to (1) understand how the scenario analysis exercise is being used to plan for various possible futures, and (2) assess the robustness of those plans to handle identified vulnerabilities.

If strategic planning is not linked to the vulnerabilities uncovered during the scenario analysis, the whole process loses value as an actionable exercise. In that case, the strategic planning appears to be a siloed effort, conducted without input from the scenario analysis findings. Workshop participants emphasized that meeting the TCFD's recommendations required more than simply "going through the motions"; companies actually need to have enough confidence in their execution of the exercise to have the process inform their strategic decisions.

6.2. Scenario Producers

Climate-economy models have traditionally targeted policy design, macroeconomic output, energy mix requirements, policy cost, and even damage cost estimation. They have not generally been constructed specifically to examine sectoral risk dynamics or the risks to specific investment portfolios over particular time frames. It is possible that a new generation of climate-economy models could be developed to give reporting companies the sectoral granularity they need, while also accounting for long-term global outcomes, and such new models might improve the future scenarios for the purpose of climate-related financial disclosures. However, current scenarios can still be useful for company-level analysis. The following recommendations are presented to help scenario producers increase the utility of their scenarios in this context. Note, however, that new institutional support and sources of finance will likely be needed to enable scenario producers to bring about these improvements.

(A) Develop suites of distinct policy pathways

Resilience to a single scenario, even an aggressively normative one, does not demonstrate strategy resilience. There are many pathways to any particular temperature outcome (see Box 1). Defaulting to any particular path (e.g., one that forms the basis for a 2°C outcome) limits a company's consideration of how the transition to a low-carbon economy might occur. Alternatively, a firm might cherry-pick the pathway with the most favorable assumptions for disclosure. Subjecting a strategy to multiple distinct and challenging scenarios—particularly at the more aggressive end of a robust envelope of plausible outcomes—is a better way to demonstrate strategy resilience.

Oil and gas companies have generally chosen to use global scenarios provided by the IEA to describe their strategy resilience. However, even in its Sustainable Development Scenario, which targets a temperature outcome of 1.7°C to 1.8°C, natural gas consumption continues to grow until 2030.⁸⁶ Many climate reports from oil and gas companies make heavy use of this IEA-projected demand growth. However, as investors, especially larger ones with global and cross-sectoral coverage, begin to use a variety of global climate scenario models to attain an increasingly granular understanding of their

86 IEA (2018) *World Energy Outlook*.

own portfolio-wide climate-related risk,⁸⁷ the positions of oil and gas companies will more frequently be analyzed using models and scenarios that might not be as favorable to the oil and gas industry.

Theoretically, it might be possible for a company to use multiple scenarios from multiple scenario providers to broaden its envelope of scenario paths. However, such a method would require an inordinate amount of work to disclose and contextualize the many differences between the various modeling methodologies, parameter choices, and assumptions. It is therefore preferable to draw scenario pathways from the same, credible, and well-understood model—one where the important parameters are abundantly transparent. Widely accepted scenario producers such as the IEA could eliminate the need for multi-model scenario analysis by expanding their offerings to include those scenario pathways in which investors have expressed interest. These might include a “delayed policy scenario” (identified by the UNEP FI Investor Pilot members⁸⁸), in which new climate policies are put off until a specific year—at which point drastic measures are taken, or several 1.5° scenario pathways similar to those illustrated in Box 1.

While the shared socioeconomic pathways offer a version of this approach for IAMs, exploring a range of socioeconomic pathways, such suites may be constructed from energy sector models to present scenarios that are more relevant to oil and gas companies. Likewise, emissions projections from the IPCC database, which span a range of potential climate outcomes, may be used as a starting point but were not developed for the purpose of detailed energy transition modeling. If used, these projections should be used in conjunction with other, more detailed modeling efforts in order to be useful for oil and gas company disclosures. If a common set of scenarios is agreed to cover the most significant risk drivers within a particular sector, and a large subset of the sector provides disclosures using this same set of scenarios, it would help investors by providing greater comparability. It may also provide some protection from allegations that companies are misleading investors with their choice of scenarios, as this set would have been generally agreed upon to be relevant to for the sector.⁸⁹

(B) Explore sensitivity to key (non-policy) uncertainties

Scenario producers should also consider providing sensitivity analysis with their scenarios so that both investors and companies can gain a better understanding of the importance of various parameter assumptions in their models. These parameters might include both those that embody the most uncertainty (e.g., commodity price projections, car sales, electric vehicle sales, etc.), as well as those that have the most influence on the trajectory of the scenario (e.g., technology cost reduction curves, consumer demand curves, etc.). The identification and reporting of such parameters and data will require collaboration between scenario producers and reporting companies

87 UNEP FI, Vivid Economics, Carbon Delta (2019) *Changing Course: A Comprehensive Investor Guide to Scenario-Based Methods for Climate Risk Assessment, in Response to the TCFD*. Pg. 19.

88 Ibid, Pg. 15.

89 Omissions unsupported by science and reason could lead to liability. For example, Peabody Energy Corporation was accused of misleading investors by only considering IEA's Current Policy Scenario in its disclosures and claiming an inability to project downturns in future coal use. (Attorney General of the State of New York and the Environmental and Investor Protection Bureaus, 2015.)

to identify sector-specific data needs. This might also require companies to articulate key factors that contribute to, or are sensitive to, particular classes of uncertainty. This process would provide both investors and oil and gas companies with insight into what drivers they might consider testing more rigorously on their own to ensure resilience. It would also provide investors with an idea of what issues they would like companies to address in their disclosures.

6.3. Financial Community

The financial community is broad and diverse; each member has its own institutional role, strategic planning/investment horizon, analytical capability, business scope, and investment philosophy. Actors will thus have different desires for the scenario-based disclosures of investee companies. Nevertheless, the below recommendations should be generally relevant to financial actors interested in driving the proper use of climate scenarios.

(A) Continue to make the case for more useful and informative scenario analysis and disclosure

As the primary consumers of climate-related financial disclosures, it is important that investors of all types continue to call for progress in scenario-based climate-related disclosures. Each type of actor in the financial community knows best what type of information is most useful for its specific needs and how scenario-based climate-related disclosures might be able to provide such information.

This call for better scenario-based disclosures can take a variety of forms. Particularly for financial institutions, direct engagement among reporting firms and investors will be key to providing the context needed for greater understanding of the degree to which companies are prepared for climate-related impacts. This includes crucial insights not only into the results of scenario analyses, but also into the internal processes of the firms (e.g., scenario development, scenario modeling, subsequent analyses, oversight, etc.). This interaction surely includes communication among individual parties, but would also usefully include joint meetings—among reporting firms, investors, NGOs, and scenario producers—of the type conducted at the outset of this study.

Participation in coalitions that operate at the intersection of climate and sustainability issues and the financial sector provides another way to advance the climate readiness of the financial system. Notably, the members of the Network for Greening the Financial System pledged its commitment to the TCFD, stating that the TCFD recommendations are an “obvious avenue of convergence for a global standardized framework on climate disclosures.”⁹⁰ Additionally, the United Nations-supported Principles for Responsible Investment, which has a signatory base of more than 2,300 and more than \$86 trillion of financial assets under management, has created TCFD-aligned indicators that will become mandatory reporting for its signatories in 2020.⁹¹

90 NGFS (2019) *A Call for Action: Climate Change as a Source of Financial Risk*.

91 PRI (2019) *TCFD-based reporting to become mandatory for PRI signatories in 2020*. News and Press.

(B) Be wary of general claims of strategy resilience that are not visibly grounded in clear, consistent, and transparent treatment of scenarios

The first objective of this report was to provide clear guidance to stakeholders, particularly the diverse financial community, on key aspects of climate-economy models, scenarios, and scenario analysis in the climate-related disclosures of oil and gas companies. This guidance is, in part, meant to equip these stakeholders with the understanding and vocabulary to make the most of scenario-based disclosures.

As oil and gas companies continue to tailor their climate-related corporate reports, it is important for report audiences to stay vigilant to the treatment of strategy resilience. If a company uses a particular reference scenario, either as the basis for its analysis or as a comparison for its own custom scenario, it is important for audiences to understand the construction of and underlying assumptions within the scenario used. If a company does not use a reference, it is important to know why not, especially when other companies are willing and able to use one. Section 3 discusses how the relative sophistication of each company in one or another aspect of disclosure suggests that clear, comparable, and consistent climate-related scenario-based disclosures are, in fact, attainable. Section 6.1 suggests ways in which oil and gas companies might enhance the clarity, consistency, and transparency of their scenario-based disclosures. Together, these recommendations provide a strong basis for a wave of better scenario-based climate-related disclosures. General claims of resilience should no longer serve as satisfactory practice.

7. CONCLUSIONS

Scenario analysis is one of many tools for assessing an organization and cannot provide all the answers. The UNEP FI's Investor Pilot correctly notes that "while scenario analysis can be a useful tool to explore and disclose the potential impacts of an uncertain future, it does not provide precise forecasts and should not form the sole basis for corporate or investor decision-making."⁹² Nevertheless, scenario analysis has been highlighted by the TCFD as a tool particularly suited to providing decision-useful information to investors regarding strategy resilience to climate-related risks (or at least one that holds the potential to become such a tool).

Scenarios, and the risks they outline, naturally reflect differences in the various models used to produce them as well as in the crucial assumptions made about the interconnected policy drivers and technologies, now and in the latter part of the century. Given the fundamental uncertainties in such assumptions, it is important that scenario analysis be conducted using a range of projections, encompassing an envelope of potential pathways that are diverse enough to stretch conventional thinking about the future. To support this more complete analysis, energy-economy modeling groups should be encouraged to provide consistent suites of alternative pathways.

92 UNEP FI, Vivid Economics, Carbon Delta (2019) *Changing Course: A Comprehensive Investor Guide to Scenario-Based Methods for Climate Risk Assessment, in Response to the TCFD*. Pg. 20.

There is an evident tension between the disclosure goals of providing specificity about a firm's climate-related risks and supporting comparison among firms—even those in the same sector. As the variety of scenarios and climate-economy models suggests, the standardization of a reference scenario to which companies could link their own custom scenarios, let alone the standardization of particular scenario path to analyze, would be a contentious task. That is why “thoughtfully designed transparency requirements of modeling methodologies—rather than full standardization—could further enable comparability, while reducing the risks of correlated model errors and preserving incentives to improve methodologies.”⁹³ The judicious use of custom scenarios, with clear explanations of how they differ from widely accepted reference scenarios, can substantially aid in meeting the dual objectives of company-level specificity and disclosure comparability.

Private firms have commercial and legal concerns about the disclosure of financial information beyond what is required by law, and the call for climate-related data only adds to what are familiar and long-standing issues. It is nevertheless possible, by combining quantitative analyses of current asset exposures with qualitative expressions of future options, to provide a useful picture of a firm's strategy resilience. Providing only part of this information, or doing so with inconsistent components, is not helpful.

While this report focuses on the oil and gas industry, much of the discussion herein can be applied to other industries. Furthermore, as regulatory bodies around the world consider mandating climate-related financial disclosures, often with reference to the TCFD, the discussions in this report may serve as a reference on the use of scenarios more broadly. While better scenario-based financial disclosures alone will not be sufficient to solve the market's incorporation of climate-related risks, they can make an important contribution.

93 UNEP FI, Vivid Economics, Carbon Delta (2019) *Changing Course: A Comprehensive Investor Guide to Scenario-Based Methods for Climate Risk Assessment, in Response to the TCFD*. Pg. 15.

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APPENDIX 1

Factors shaping the interests of various members of the financial community:

- **Institutional role.** Whether the analysis recipient is a credit rating agency, bank, insurer, sovereign wealth fund, pension fund, asset manager, or other financial institution affects its strategic goals, regulatory mandates, investment horizon, level of aversion to systematic climate-related risk, etc. An institution's perspective on and implementation of fiduciary duties, a field undergoing some evolution, comes into play.⁹⁴ For those financial actors with substantially diversified holdings, a tension between macro and micro fiduciary duties rises to the surface—e.g., an investor might want a coal company it owns but cannot sell to go out of business if such a development would increase the performance of the rest of its portfolio over the long run.
- **Strategic planning/investment horizon.** Directly related to institutional role, the strategic planning or investment horizon is particularly important for financial institutions interested in predicting how their investments will fare over time. Longer-term forecasts are necessarily more uncertain and consequently of less concern to some investors. While investment horizons have, over recent years, begun to shift toward the longer term,⁹⁵ misalignment between stated investment goals, investment horizon, the time frame covered in financial reporting, and the analysis of disclosure can leave important risks unmanaged.⁹⁶
- **Analytical capability.** The extent to which an investor possesses qualitative capabilities (e.g., sectoral expertise, partnerships, networks, etc.) or quantitative capabilities (e.g., energy-economy modeling) can influence what type of scenario analysis is preferred. Also, the investor's level of engagement with a company might allow non-quantitative factors—such as corporate innovation, risk management process, and creativity—to play a larger role in valuation because engagement contributes to understanding firm-specific context.
- **Business scope.** Depending on the scope of the investor's holdings (e.g., sector coverage, geographical coverage, regional economies, etc.) the investor may be more or less exposed to certain transition or physical risks related to climate change. For example, an investor dealing primarily with regulators, ultimate owners, and other key stakeholders in countries promoting aggressive climate action may place more importance on disclosure based on a 2°C scenario.
- **Investment philosophy.** Investors may be categorized as value-minded (primarily driven by financial returns) or values-oriented (primarily driven by larger social values).⁹⁷ Value-minded investors prioritize financial return and are interested in climate change and the low-carbon transition only insofar as these pose material risk to a company's assets and future cash flows through a variety of risk factors (e.g., reduced demand for fossil fuels, higher carbon taxes, lower wellhead prices, etc.). Values-oriented investors prioritize certain socially responsible or sustainable agendas (e.g., activism, impact, portfolio screening, etc.) and are more interested in how a company expects to perform under a particular low-carbon scenario. They may also take into account the impact of the company's current and projected activities on climate change, including everything from use of renewable power to advocacy.

94 See the Fiduciary Duty in the 21st Century Project for more information. www.fiduciaryduty21.org

95 The Economist (2018) *Changes on the institutional investment horizon*. The Economist Intelligence Unit.

96 2° Investing Initiative (2017) *Limited Visibility: The Current State of Corporate Disclosure on Long-Term Risks*.

97 Cort, T., and Esty, D. (2018) *ESG Standards: Looming Challenges and Pathways Forward*. Conference Paper.

APPENDIX 2

Selection of Literature on Climate-Related Disclosures of Oil and Gas Companies

The TCFD's *2018 Status Report* concluded that Strategy c)⁹⁸ was the least implemented of the recommended disclosures.⁹⁹ When grouping companies by financial service industries—banks, insurance companies, asset managers, and asset owners—and by non-financial groups—energy; transportation; materials and buildings; and agriculture, food, and forestry products—the TCFD found that a higher percentage of companies in the energy, materials and buildings, and insurance groups tended to disclose scenario analyses compared to those in the banks, asset managers, asset owners, transportation, and agriculture, food, and forest products groups.¹⁰⁰ In the TCFD's *2019 Status Report*, Strategy c) continued to be the least implemented recommended disclosure; however, banking rose to have the highest rate of implementation across most of the recommended disclosures, including Strategy c), overtaking the energy sector.¹⁰¹

The Investor Climate Compass report¹⁰² examines how 10 of the largest oil and gas companies¹⁰³ responded on five core areas of investor concern—governance, strategy, implementation, transparency, and public policy—as framed by the four investor networks¹⁰⁴ that collaborate to make up the Global Investor Coalition on Climate Change. A comparison of performance in each of the five areas, supplemented by a CDP performance analysis, resulted in strategies for investors and objectives for the companies.

The Oil and Gas Preparer Forum—composed of the World Business Council on Sustainable Development and oil and gas companies Eni, Equinor, Shell, and Total—initially set the stage for the state of climate-related financial disclosure as undertaken by the oil and gas industry. Its 2018 report showcased the current efforts of companies to produce climate-related disclosure in alignment with the TCFD.¹⁰⁵ Excerpts taken primarily from Eni's *2017 Path to Decarbonization report*,¹⁰⁶ Equinor's *2017 Sustainability Report*,¹⁰⁷ the *2018 Shell Energy Transition Report*,¹⁰⁸ and Total's 2017 annual

98 See page 5.

99 TCFD (2018) *Status Report 2018*.

100 Ibid.

101 TCFD (2019) *Status Report 2019*.

102 Asia Investor Group on Climate Change, CDP, Ceres, Institutional Investors Group on Climate Change, and Investor Group on Climate Change (2017) *Investor Climate Compass: Oil and Gas—Navigating Investor Engagement*.

103 BP, Chevron, ConocoPhillips, Eni, ExxonMobil, Occidental, Shell, Statoil (now Equinor), Suncor, and Total

104 The Institutional Investors Group on Climate Change, Ceres, Investor Group on Climate Change, and the Asia Investor Group on Climate Change

105 World Business Council on Sustainable Development (2018) *Climate-Related Financial Disclosure by Oil and Gas Companies: Implementing the TCFD Recommendations*.

106 Eni (2017) *Path to Decarbonization: Eni for 2017*.

107 Statoil (2017) *Sustainability Report 2017*.

108 Shell (2018b) *Shell Energy Transition Report*.

report¹⁰⁹ include an assortment of disclosed information such as sensitivity to carbon pricing, sensitivity to oil price, committed and uncommitted capital expenditure, lifetime of reserves, descriptions of portfolio optimizations, management of the cost base, internal rate of return, production forecasts, supply cost curves and break-even figures, quantitative assumptions, capital allocation, and expenditure plans.¹¹⁰ This snapshot also supports the observation that, while companies in the energy sector tend to be at the forefront of corporate climate-related disclosure by non-financial companies,¹¹¹ they generally produce separate climate change reports instead of including the disclosures in their mainstream financial filings as recommended by the TCFD.¹¹²

109 Total (2017) *Annual Report*.

110 World Business Council on Sustainable Development (2018) *Climate-Related Financial Disclosure by Oil and Gas Companies: Implementing the TCFD Recommendations*.

111 TCFD (2018) *Status Report 2018*.

112 McClamrock, J., et al. (2018) “*Insider: One Year On, 4 Early Trends in Climate-Related Scenario Analysis*” World Resources Institute.



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