CDP Technical Note on Scenario Analysis

Conducting and disclosing scenario analysis

Contents

Version

Version	Revision date	Revision summary
1.0	December 14, 2017	First published version.
2.0	March 8, 2019	Minor updates to information about TCFD Knowledge Hub (see Section 6).
2.1	April 7, 2020	Question numbers updated to align with the 2020 CDP climate change questionnaire.
2.2	January 7, 2021	Question numbers updated to align with the 2021 CDP climate change questionnaire. Typos corrected.
3.0	January 21, 2022	Updated to align with 2021 TCFD Annex, and list of scenarios in Appendix 4 aligned with the reporting guidance for C3.2a.
4.0	January 17, 2023	Minor revisions and question numbers updated to align with the 2023 CDP climate change questionnaire.

Section 1: Integration of TCFD and scenario analysis into CDP

a. Introduction

This technical note provides an overview of climate-related scenario analysis, key considerations for conducting scenario analysis – as identified by the Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD), and how CDP has incorporated scenario analysis into our questionnaires.

We recommend readers review the TCFD's full report as this note will not present the TCFD's recommendations or its incorporation of scenario analysis in their entirety. The TCFD's final report was released as three distinct documents in June 2017, followed by an additional scenario analysis technical supplement for non-financial companies:

- **Main report** – Recommendations of the Task Force on Climate-related Financial Disclosures
- **Implementation Annex (updated in 2021)** – Implementing the Recommendations of the Task Force on Climate-related Financial Disclosures
- **Scenario analysis technical supplement** – The Use of Scenario Analysis in Disclosure of Climate-related Risks and Opportunities
- **Additional scenario analysis technical supplement for non-financial companies** – Guidance on Scenario Analysis for Non-Financial Companies

If you have any questions, comments, or suggestions about the content of this document please contact CDP.

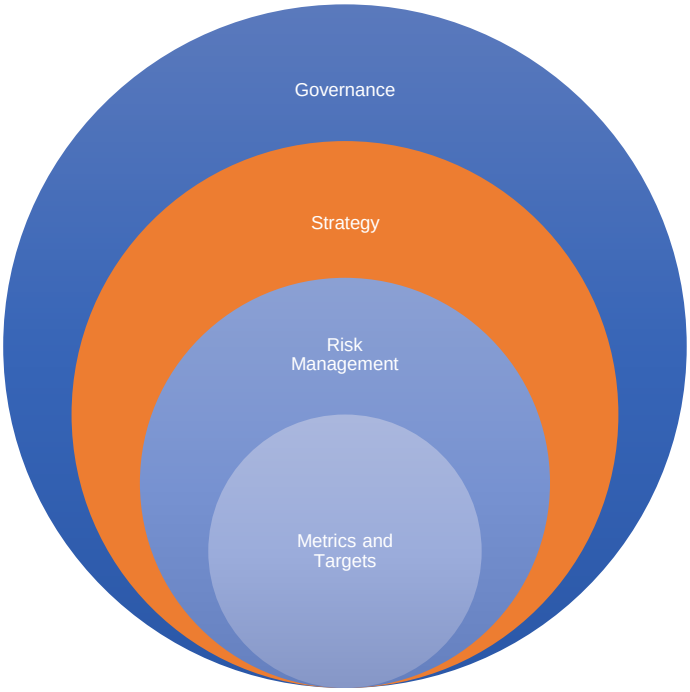
b. Integration of TCFD and scenario analysis into CDP's questionnaires

CDP recognizes the important role of the TCFD in mainstreaming climate-related information and advancing the availability of financially relevant information for global markets. The recommendations will ensure climate information is integrated into mainstream financial reports, providing transparency and a roadmap to meet the commitments of the Paris Agreement.

In recognition of the TCFD's report, CDP has committed to align its questionnaires with the TCFD's recommendations, alongside introducing a sectoral focus and adopting a forward-looking approach. This harmonization is designed to help minimize the reporting burden for responding organizations.

This means a greater emphasis on elements such as board oversight, climate risk assessment and management (including integration into a company's business planning processes), and the use of forward-looking scenario analysis to determine the resilience of a company's strategy to climate risks.

The TCFD structured its recommendations into four thematic areas that represent core elements of how organizations operate: Governance, Structure, Risk Management, and Metrics and Targets.



These overarching recommendations are supported by recommended disclosures, with guidance for all sectors and supplemental guidance for specific sectors.

Please see **Appendix 1** for details on the TCFD's core recommendations

Appendix 2 details the TCFD's Strategy guidance for all sectors, and supplemental guidance provided by the TCFD for specific sectors.

Appendix 5 provides the TCFD's process for applying scenario analysis to climate-related issues.

CDP's technical note on the TCFD's recommendations can be found here

Section 2: Scenario analysis, a strategic planning tool

a. The purpose of scenario analysis

Scenario analysis is a strategic planning tool to help an organization understand how it might perform in different future states. It is designed to embrace complexity and uncertainty, allowing decision makers to evaluate the organization's flexibility, resilience, or robustness across a range of potential outcomes. Scenario analysis is not designed to produce rigid predictions nor irrational futures, but is designed to consider possible and plausible alternative futures.

The ultimate goal of scenario analysis is to encourage and equip decision makers to consider factors that shape their choices today through strengthening internal coherence. Thorough scenario analysis uses rigor and a structured approach to enable decision makers to evaluate potential outcomes based on a variety of assumptions, and to understand how adjusting one or more of these variables impacts the organization's business.

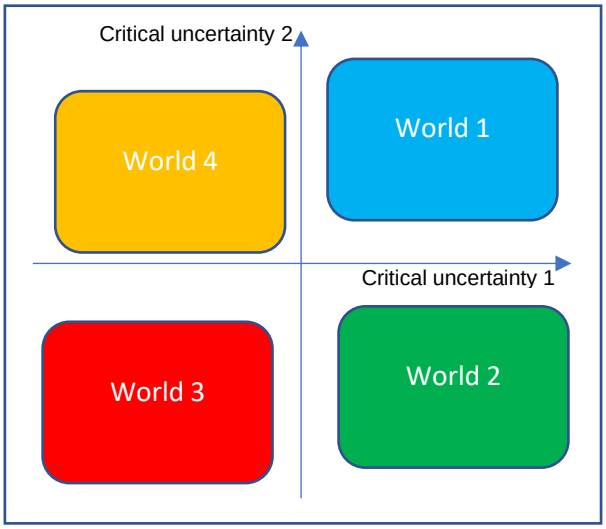
Scenario analysis focuses on a range of forward-looking variables or pathways rather than historic data. Crucially, scenario analysis not only identifies potential risks but can also offer insight into opportunities including energy efficiency, changes in energy sources and/or technologies, new products and services, new markets or assets, and increased resilience.

b. What is a scenario?

Scenarios are stories that have been methodically developed for the future, and aim to shed light on the decisions that we need to make today. A scenario describes a potential path of development that will lead to a particular outcome or goal. Scenario analysis is the process of highlighting central elements of a possible future and drawing attention to key factors (or critical uncertainties) that could drive this future.

Scenarios are not forecasts or predictions. Scenario analysis is a tool to enhance critical strategic thinking by challenging 'business-as-usual' assumptions and instead exploring alternatives based on their relative impact and likelihood of occurrence (i.e. critical uncertainties).

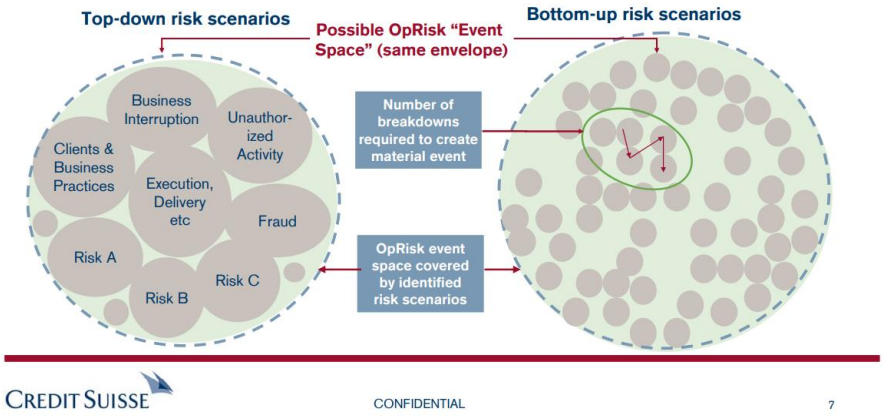
A simplistic but effective way to conduct scenario analysis is to select two business-critical uncertainties and use these to create a scenario matrix (see diagram below). This scenario matrix approach provides four distinct worlds to explore.



c. A top-down approach to scenario analysis

A top-down approach to scenario analysis is an effective way to identify and assess substantive risks and capture tail events.

- With top-down risk identification, many low-level risks and management techniques can be encapsulated within a single, meaningful scenario.
- The bottom-up risk identification process can provide a greater number of scenarios, but can lead to overcomplicated scenarios at risk of missing macro-trends.



Section 3: How scenario analysis can be used to understand strategic resiliency in a climate change context

a. Why conduct climate-related scenario analysis

Scenario analysis is a tool that can be used to inform an organization's short-term strategic thinking and medium- to long-term strategy formulation. Climate-related scenarios can focus an organization's strategic thinking on potentially complex and uncertain scenarios such as a 2°C or lower world.

A core aim of the TCFD recommendations is for organizations to improve their understanding of future risks and develop suitable resilience strategies. This includes focusing organizations' attention on climate-related scenario analysis (Strategy, Recommended Disclosure c) and its role in organizations developing resilient strategies for a low-carbon economy consistent with a 2°C or lower world. In selecting a "2°C or lower scenario", the TCFD recommends using or developing a 1.5°C scenario. For further details, see TCFD Guidance on Scenario Analysis (pg. 26).

Common climate-related scenarios are based on exposure to either transition risk pathways or physical risks. Transition risk pathway scenarios consider how an organization is impacted by changes to policy/regulation, technology or market changes aimed at emissions reductions, energy efficiency, subsidies/taxes or other constraints or incentives implemented to facilitate a low carbon

Reasons to consider conducting climate-related scenario analysis

i. Scenario analysis can help organizations consider climate-related issues with the following features:
   a. Possible outcomes that are highly uncertain (e.g. the physical response of the climate and ecosystems to higher concentrations of atmospheric GHG's)
   b. Possible outcomes that may have substantive impacts on the organization's strategy (e.g. the evolution of policies and regulations relating to the transition to a well-below 2°C world)
   c. Medium- to long-term outcomes (e.g. uncertainties relating to the transition to a low-carbon economy)

   Potential outcomes that are highly uncertain with potentially substantive impacts can be identified as critical uncertainties and should be explored in greater detail through the process of developing scenarios.

ii. Scenario analysis can enhance organizations' strategic conversations about the future by investigating in a structural manner potential futures that challenge business as usual. Importantly, it broadens decision makers' thinking across a range of plausible scenarios, including scenarios where climate-related issues can be significant.

iii. Scenario analysis can help organizations frame and assess the potential range of plausible business, strategic, and financial impacts from climate-related issues, factoring these into relevant strategic and financial planning. This can lead to more robust strategies under a wider range of uncertain future conditions.

iv. Scenario analysis can help organizations identify external environmental indicators and recognize when the environment is shifting towards a particular scenario (or to a different stage along a scenario's path), allowing organizations to reassess and adjust strategic and financial planning accordingly.

v. Scenario analysis can assist investors, policy makers, regulators, and other stakeholders to understand the robustness of an organization's strategies and financial planning, and aid comparability of risks and opportunities across organizations.

vi. The process of developing scenarios can be as useful as the outputs. Other reporting and assessment methodologies, such as developing science-based targets (SBTs) or setting a carbon price, can assist in developing climate-related scenario analysis.

economy (for example, the ‘well below 2°C’ goal committed to by the Paris Agreement). Physical risk scenarios assess the impact of acute or chronic physical change related to climate change such as extreme weather, rising sea levels, water shortage, etc.

b. Application of scenario analysis to climate-related issues

As recognized by the TCFD, using scenario analysis to understand climate-related risks and opportunities and assess their potential business implications is a relatively recent advancement for the broader business world.

The most significant effects of climate change are likely to emerge over the medium- to long-term, but their precise timing and magnitude are uncertain. This uncertainty presents a challenge for organizations. Scenario analysis allows the testing of outcomes under a variety of possibilities, enabling an organization to explore a range of potential effects of climate change on their business operations, strategies and financial performance.

To appropriately incorporate the potential effects of climate change into their planning processes, organizations need to consider how climate-related risks and opportunities may evolve, as well as their potential business implications. Scenario analysis is a key method of exploring and assessing these implications.

Given the importance of forward-looking assessments of climate-related risks and opportunities, scenario analysis is an important and useful tool for an organization to use, both for understanding strategic implications of climate-related risks and opportunities, and for informing stakeholders of how the organization is positioning itself in recognition of these issues. It also can aid investors, lenders, and insurance underwriters in informing their own financial decision making.

c. Considerations for climate-related scenario analysis

Basic Components and Characteristics

- **Horizon Year –** the chosen future scenario limit (e.g., 2050, 2100).
- **Focal Question(s) –** The critical questions or potential decisions that the company seeks to address.
- **Driving Forces or Drivers –** The underlying external causes of change in relation to the focal question, which derive from a number of broad processes within STEEP categories — social, technological, economic, environmental, and policy. For a process to be considered as a driver it needs to (1) be continuous over a period of time and (2) influence the outcomes of the focal question durably and consistently. A time-bound, episodic process may not be a driver but rather a crisis or shock.
- **Scenario Logic –** A description of the relationship between various drivers and change, including the causal assumptions underlying the described relationship. Scenario logic seeks to establish internal consistency between various statements and assumptions that underpin the scenario.
- **Development Pathways –** The trajectory between the present and future states resulting from the drivers and related cause-effect relationships laid out by the scenario logic.
- **Key Uncertainties –** The uncertainties surrounding how drivers, assumptions, and scenario logic may play out and, wherever possible, the source of these uncertainties.

- **Storyline –** A narrative that links historical and present events with hypothetical futures by presenting a seamless and integrated narrative describing the causal train of events (pathways) and the underlying drivers, assumptions, and affected systems.

- **Plausible** – events explored in the scenario should be possible and credible.

- **Distinctive** – each scenario should focus on a different set of combinations of the key factors. Scenarios should be clearly differentiated in structure and in message, not a variation of a single theme.

- **Consistent** – each scenario should take into account internal logic and external factors while not diverting from the evidence of current trends and positions unless these logical explanations are a core part of the scenario.

- **Relevant** – all scenarios should contribute material insights into the future that can relate to strategic and/or financial implications of climate-related risks and opportunities**.**

- **Challenging** – scenarios should challenge convention and business-as-usual assumptions. When considering material sources of uncertainty, scenarios should try to explore alternatives that challenge business as usual.

Choices for constructing scenarios and conducting scenario analysis

- **Parameters -** Macro trends; GDP, macro-economic variables, demographic and societal changes.

- **Assumptions -** Policy changes, technological developments, energy mix, pricing of key commodities, and how these are reflected by micro-economic factors.

  Key parameters and assumptions are used to identify the key drivers and pathways for a scenario's development. Organizations should strive to identify and understand the material drivers for their business and then build these into their scenarios.

- **Analytical choices –** choice of scenarios (publicly available scenarios or organizational-specific scenarios), qualitative vs. quantitative analysis, time horizons, supporting data and models.

  There are a number of other analytical decisions that lie outside of parameters and assumptions – they are choices that can focus and position the route a scenario may follow without being a driver of the scenario itself.

- **Business impacts/effects** – earnings, costs, revenues, asset value, capital allocation/investments, timing, responses, and/or business interruption due to physical impacts.

  In addition to considering key parameters, assumptions, and other analytical choices for the scenario analysis process, organizations should also carefully consider potential impacts or effects and how management can consider these.

d. Typical categories of climate-related risks and opportunities

The graphic below, found in the TCFD's scenario analysis technical supplement provides a summary of typical categories of climate-related risks and opportunities an organization should consider when applying scenario analysis:

Appendix 3 details key parameters, assumptions, analytical choices and impacts, as described by the TCFD.

Appendix 4 provides information on types of scenario analysis and publicly available scenarios.

Section 4: How to report climate-related scenario analysis

a. Scenario analysis in CDP's questionnaires

Scenario analysis is included in CDP's climate change and water security questionnaires. As of 2022, the CDP forests questionnaire does not have any questions related to scenario analysis.

Please note, CDP recognizes that organizations may explore unique scenarios that do not align with publicly available scenarios. In this instance, to improve transparency and comparability, organizations should disclose how the parameters, assumptions and analytical choices differ from those of the publicly available scenarios. CDP has accommodated for this in both climate change and water security questions.

Climate change questionnaire

Scenario analysis is broadly involved in the narrative behind all sub-questions in C3 (Business Strategy), which is designed to elicit how companies are evaluating their climate risks and integrating them into business reliance strategies.

Question number (CDP climate change)	Question text
C3.2	Does your organization use climate-related scenario analysis to inform its strategy?
C3.2a	Provide details of your organization's use of climate-related scenario analysis.
C3.2b	Provide details of the focal questions your organization seeks to address by using climate-related scenario analysis, and summarize the results with respect to the focal questions.

Water security questionnaire

CDP recognizes that water-specific scenario analysis is an emerging, strategic planning tool for examining possible futures, including the uncertainties and opportunities linked to factors such as land use change, socioeconomic trends, hydrological changes, and climatic changes. Some sector bodies and leading companies have developed tools and future scenarios related to water, reinforced by analysis of national and subnational models of water systems. Credible, publicly available scenario analysis tools for assessing future water risks are WRI Aqueduct and WWF Water Risk Filter. Both tools combine different climate scenarios (IPCC Representative Concentration Pathways – RCP and IIASA Shared Socio-economic Pathways - SSP) to explore future water risks. Another example is the scenarios framework of the Beverage Industry Environmental Roundtable (BIER) which is based on future states of resource availability and governance (http://www.bieroundtable.com/future-scenarios).

Question number (CDP water)	Question text
W7.3	Does your organization use scenario analysis to inform its business strategy?
W7.3a	Provide details of the scenario analysis, what water-related outcomes were identified, and how they have influenced your organization's business strategy.

Section 5: Closing remarks

The TCFD includes scenario analysis as one of its 11 key recommendations. Scenario analysis is a strategic planning tool, gaining momentum for its use in exploring potential futures and an organization's business strategies resilience

However, CDP understands that scenario analysis is a resource- and time-intensive tool. Recognizing this, CDP echoes the TCFD's recommendations that there should be a progressive approach to adopting scenario analysis as a strategic planning tool. As an organization's experience matures, scenarios should shift from qualitative to quantitative and qualitative, in turn providing stakeholders with increasingly decision-useful information.

CDP encourages organizations to seek additional information through other sources. For instance, early adopters are now releasing scenario analysis papers, industry bodies are creating sector specific scenarios, and expert groups are developing further guidance. As scenario analysis continues to mature, more material will become available.

Easy actions

1. Attend a global CDP event or webinar.
2. Pick a publicly available 1.5°C scenario and think through the risks and opportunities associated with it, assessing its applicability to your organization
3. Review material on the TCFD Knowledge Hub

TCFD Knowledge Hub

CDSB, in collaboration with the TCFD, have developed a unique and focused online knowledge hub - TCFD Knowledge Hub - to support the efforts to scale up the widespread adoption of the TCFD recommendations and the development of high-quality, consistent, and comparable disclosures of climate-related financial information. The TCFD Knowledge Hub is an essential tool that collates, structures and makes accessible a variety of practical resources that facilitate efficient and effective implementation of the TCFD recommendations by the report preparers.

Whether new to climate-related financial reporting or already working towards implementing the TCFD recommendations, this platform provides insights and guidance for the disclosure process. The type of content aggregated includes technical guidance, tools, research papers, frameworks, methodologies, case studies, webinars, and FAQs.

Visit www.tcfdhub.org and explore the resources.

Appendix 6 provides information on evolving climate-related scenario analysis

Appendix 7 refers to outputs from climate-related scenario analysis

Appendix 8 discusses next steps for organizations conducting scenario analysis

If you have any questions, comments, or suggestions about the content of this document please contact CDP.

Section 6: Appendices

Appendix 1: TCFD recommendations and supporting recommended disclosures

Governance	Strategy	Risk Management	Metrics and Targets
Disclose the organization's governance around climate-related risks and opportunities.	Disclose the actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning where such information is material.	Disclose how the organization identifies, assesses, and manages climate-related risks.	Disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material.
Recommended Disclosures	**Recommended Disclosures**	**Recommended Disclosures**	**Recommended Disclosures**
a) Describe the board's oversight of climate-related risks and opportunities.	a) Describe the climate-related risks and opportunities the organization has identified over the short, medium, and long term.	a) Describe the organization's processes for identifying and assessing climate-related risks.	a) Disclose the metrics used by the organization to assess climate-related risks and opportunities in line with its strategy and risk management process.
b) Describe management's role in assessing and managing climate-related risks and opportunities.	b) Describe the impact of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning.	b) Describe the organization's processes for managing climate-related risks.	b) Disclose Scope 1, Scope 2, and, if appropriate, Scope 3 greenhouse gas (GHG) emissions, and the related risks.
	c) Describe the resilience of the organization's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario.	c) Describe how processes for identifying, assessing, and managing climate-related risks are integrated into the organization's overall risk management.	c) Describe the targets used by the organization to manage climate-related risks and opportunities and performance against targets.

Appendix 2: TCFD's strategy guidance for all sectors, and supplemental guidance for specific sectors

Strategy **Disclose the actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning where such information is material.**				
Recommended Disclosure c) **Describe the resilience of the organization's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario.**	**Guidance for All Sectors** Organizations should describe how resilient their strategies are to climate-related risks and opportunities, taking into consideration a transition to a lower-carbon economy consistent with a 2°C or lower scenario and, where relevant to the organization, scenarios consistent with increased physical climate-related risks. Organizations should consider discussing: • where they believe their strategies may be affected by climate-related risks and opportunities; • how their strategies might change to address such potential risks and opportunities; • the potential impact of climate-related issues on financial performance (e.g., revenues, costs) and financial position (e.g., assets, liabilities); and • the climate-related scenarios and associated time horizon(s) considered.	**Supplemental Guidance for Insurance Companies** Insurance companies that perform climate-related scenario analysis on their underwriting activities should provide the following information: • description of the climate-related scenarios used, including the critical input parameters, assumptions and considerations, and analytical choices. In addition to a 2°C scenario, insurance companies with substantial exposure to weather-related perils should consider using a greater than 2°C scenario to account for physical effects of climate change and • time frames used for the climate-related scenarios, including short-, medium-, and long-term milestones.	**Supplemental Guidance for Asset Owners** Asset owners that perform scenario analysis should consider providing a discussion of how climate-related scenarios are used, such as to inform investments in specific assets.	**Supplemental Guidance for Non-Financial Groups** Organizations with more than one billion U.S. dollar equivalent (USDE) in annual revenue should consider conducting more robust scenario analysis to assess the resilience of their strategies against a range of climate-related scenarios, including a 2°C or lower scenario and, where relevant to the organization, scenarios consistent with increased physical climate-related risks. Organizations should consider discussing the implications of different policy assumptions, macro-economic trends, energy pathways, and technology assumptions used in publicly available climate-related scenarios to assess the resilience of their strategies. For the climate-related scenarios used, organizations should consider providing information on the following factors to allow investors and others to understand how conclusions were drawn from scenario analysis: • Critical input parameters, assumptions, and analytical choices for the climate-related scenarios used, particularly as they relate to key areas such as policy assumptions, energy deployment pathways, technology pathways, and related timing assumptions. • Potential qualitative or quantitative financial implications of the climate-related scenarios, if any.

Please note: If a sector is not identified in the supplemental guidance for disclosures above, organizations should disclose in line with the Guidance for All Sectors

Appendix 3: Key considerations: Parameters, Assumptions, Analytical Choices and Impacts

Parameters/Assumptions	Analytical Choices	Business Impacts/Effects
• **Discount rate** – what discount rate does the organization apply to discount future value? • **Carbon price** – what assumptions are made about how carbon price(s) would develop over time (within tax and/or emissions trading frameworks), geographic scope of implementation, whether the carbon price would apply only at the margin or as a base cost, whether it is applied to specific economic sectors or across the whole economy and in what regions? Is a common carbon price used (at multiple points in time?) or differentiated prices? Assumptions about scope and modality of a CO2 price via tax or trading scheme? • **Energy demand and mix** – what would be the resulting total energy demand and energy mix across different sources of primary energy e.g. coal/ oil/ gas/ nuclear/renewables (sub-categories)? How does this develop over time assuming supply/end-use efficiency improvements? What factors are used for **energy conversion efficiencies** of each source category and for end-use efficiency in each category over time? • **Price of key commodities/products** – what conclusions does the organization draw, based on the input parameters/ assumptions, about the development over time of market prices for key inputs, energy (e.g. coal, oil, gas, electricity)? • **Macro-economic Variables** – what GDP rate, employment rate, and other economic variables are used? • **Demographic variables –** what assumptions are made about population growth and/or migration? • **Efficiency –** to what extent are positive aspects of efficiency gains/clean energy transition/physical changes incorporated into scenarios and business planning? • **Geographical tailoring of transition impacts** - what assumptions does the organization make about potential differences in input parameters across regions, countries, asset locations, and markets? • **Technology** – does the organization make assumptions about the development of performance/cost and resulting levels of deployment over time of various key supply and demand-side technologies (e.g. solar PV/CSP, wind, energy storage, biofuels, CCS/CCUS, nuclear, unconventional gas, electric vehicles, and efficiency technologies in other key sectors including industrial and infrastructure)? • **Policy** – what are assumptions about strength of different policy signals and their development over time (e.g. national headline carbon emissions targets; energy efficiency or technology standards and policies in key sectors; subsidies for fossil fuels; subsidies or support for renewable energy sources and for CCS/CCUS) • **Climate sensitivity assumptions** - assumptions of temperature increase relative to CO2 increase?	• **Scenarios** – what scenarios does the organization use for transition impact analysis and which sources are used to assess physical impact both for central/base case and for sensitivity analyses? • **Quantitative vs. qualitative or "directional"** – is the scenario exercise fully quantitative or a mix of quantitative and qualitative? • **Timing** – how does the organization consider timing of implications under scenarios e.g. is this considered at a decadal level 2020; 2030; 2040; 2050 • **Scope of application** – is the analysis applied to the whole value chain (inputs, operations and markets), or just direct effects on specific business units / operations? • **Climate models/data sets** – which climate models and data sets support the assessment of climate-related risks? • **Physical risks** – when assessing physical risks, which specific risks have been included and their severity (e.g., temperature, precipitation, flooding, storm surge, sea level rise, hurricanes, water availability/ drought, landslides, wildfires or others)? To what extent has the organization assessed the physical impact to its portfolio (e.g. largest assets, most vulnerable assets) and to what extent have physical risks been incorporated in investment screening and future business strategy? • To what extent has the impact on prices and availability in the **whole value chain** been considered, including knock on effects from suppliers, shippers, infrastructure, and access to customers?	• **Earnings** – what conclusions does the organization draw about impact on earnings and how does it express that impact (e.g. as EBITDA, EBITDA margins, EBITDA contribution, dividends)? • **Costs** – what conclusions does the organization draw about the implications for its operating/production costs and their development over time? • **Revenues** – what conclusions does the organization draw about the implications for the revenues from its key commodities/ products/ services and their development over time? • **Assets –** what are the implications for asset values of various scenarios? • **Capital Allocation/ investments –** what are the implications for capex and other investments? • **Timing –** what conclusions does the organization draw about development of costs, revenues and earnings across time (e.g. 5/10/20 year)? • **Responses –** what information does the organization provide in relation to potential impacts **(**e.g. intended changes to capital expenditure plans, changes to portfolio through acquisitions and divestments, retirement of assets, entry into new markets, development of new capabilities etc.)? • **Business Interruption due to physical impacts** – what is the organization's conclusion about its potential business interruption/productivity loss due to physical impacts both direct effects on the organization's own assets and indirect effects of supply chain/product delivery disruptions?

Appendix 4: Types of climate-related scenario analysis to consider

Transitional scenarios focus on plausible assumptions about the development of climate policies and climate-friendly technologies to limit GHG emissions. Transition scenarios focus on how policy and technology will influence pathways for energy supply and GHG emissions and how they interact with economic activity and energy consumption, among other factors. Transitional scenarios may have material consequences for organizations in certain sectors in the short- medium- and long-term. These scenarios can offer insights into a faster or slower transition, depending on different rates of change in key parameters.

Physical scenarios address patterns of physical impacts attributed to climate change. They typically present the results of global climate models that show the response of Earth's climate to changes in atmospheric GHG concentrations.

While an organization's sector is likely be more exposed to transitional (e.g. fossil fuel and energy intensive industries) or physical risk factors (e.g. agriculture), transitional and physical scenarios are complementary when assessing climate-related impacts. Using both types of scenario analysis allows for an organization to account for the full range of implications of climate change to inform suitable strategic thinking and strategy formulation.

Publicly available climate-related scenarios

A range of peer-reviewed, publicly available scenarios are available for organizations to explore (examples included in the TCFD recommendations are featured below). Institutions using various assumptions on future political, economic, social, technological, and environmental conditions developed these scenarios. Despite not providing the level of transparency, range of data outputs, and functionality in tools required by businesses, these scenarios and their assumptions present a contextual and methodological starting point for organizations in developing their own organizational and business-specific scenarios.

These publicly available scenarios meet the following criteria:

- Peer-reviewed
- Used/referenced and issued by an independent body
- Supported by publicly available data sets, wherever possible
- Updated regularly
- Linked to functional tools (e.g. visualizers, calculators, and mapping tools)

Transition scenarios:

i. IEA NZE 2050

IEA's Net Zero by 2050 scenario presents a roadmap for the energy sector to transition to a net zero energy system by 2050. It assumes that advanced economies will reach net zero in advance of 2050 and sets out an emissions trajectory consistent with a 50% chance of limiting the global temperature rise to 1.5°C without a temperature overshoot.

ii. IEA B2DS

IEA's Beyond 2°C Scenario (B2DS) sets out a rapid decarbonization pathway in line with international policy goals. The B2DS looks at how far known clean energy technologies could go if pushed to practical limits, in line with countries' ambitious aspirations in the Paris Agreement. In this scenario, the energy sector reaches carbon neutrality by 2060 to limit future temperature increases to 1.75°C by 2100. This pathway implies that all available policy levers are activated throughout the outlook period in every sector worldwide, requiring unprecedented policy action as well as effort and engagement from all stakeholders.

iii. IEA 2DS

IEA's 2°C Scenario is built on a projected warming limit of 2°C and is part of the annual publication "Energy Technology Perspectives", providing scenario analysis based on the development of lower carbon technology and its deployment in various sectors. The IEA ETP 2DS sets out an energy system development pathway and an emissions trajectory consistent with at least a 50% chance of limiting the average global temperature rise to 2°C. It sets the target of cutting CO2 emissions by almost 60% by 2050 (compared with 2013), followed by continued decline after 2050 until carbon neutrality is reached. It also identifies changes that help ensure a secure and affordable energy system in the long run, while emphasizing that transforming the energy sector is vital, but not enough on its own.

iv. IEA 450

IEA's World Energy Outlook 450 scenario is expressed as realizing a 50% chance of limiting warming to a 2°C rise by 2100 (originally based upon a projected warming limit of 2°C through limiting the concentration of GHG's to around 450ppm of CO2 equivalent) and offers steps by which that goal might be achieved. It references many separate measures which are required to reduce energy-related emissions from 2015 to 2040, including stronger deployment of technologies that are familiar and available at a commercial scale today, delivering close to 60% of the emissions reductions. Technologies referenced include the building of significant additional nuclear capacity and rapid CCS expansion.

v. IEA Sustainable Development Scenario

IEA's Sustainable Development Scenario (SDS) is compatible with the Paris Agreement's less ambitious "well-below 2°C" goal. It assumes all energy-related SDGs and all current net-zero pledges are achieved, with advanced economies reaching net zero emissions by 2050, China by 2060 and all others by 2070 at the latest. It has a 50% probability of limiting global temperature rise to 1.65°C, assuming no extensive net negative emissions. With some net negative emissions after 2070, temperature rise could be reduced to 1.5°C by 2100.

vi. IEA APS

IEA's Announced Pledges Scenario (APS) takes account of all climate commitments made by governments around the world including Nationally Determined Contributions (NDCs) as well as longer-term net-zero targets and assumes they will be met in full and on time. The global emissions difference between the APS and the NZE represents the "ambition gap" that needs to be closed for governments to achieve the goals agreed in the 2015 Paris Agreement.

vii. IEA STEPS (previously IEA NPS)

IEA's Stated Policies Scenario (STEPS) does not take for granted that governments will meet all announced goals. It instead looks at where the energy system might go without additional policy implementation, looking at existing policies and measures and those under development. The global emissions difference between the STEPS and the APS represents the "implementation gap" that needs to be closed for governments to achieve their announced decarbonization targets.

viii. IEA CPS

IEA's Current Policies Scenario (CPS) includes only existing energy policies. This default setting for the energy system is a benchmark against which the impact of "new" policies can be measured.

ix. Greenpeace Advanced Energy [R]evolution

Refers to the Advanced Energy [R]evolution scenario. Based on Greenpeace's basic Energy [R]evolution scenario, which includes significant efforts to exploit opportunities for energy efficiency, along with large-scale integration of renewables, biofuels, and hydrogen into the energy mix, the Advanced Energy [R]evolution scenario sets out an ambitions pathway towards a fully decarbonized energy system by 2050 through much stronger efforts to move energy towards a 100% renewable energy supply. Consumption pathways remain similar to the basic scenario, but

faster introduction of technologies leads to complete decarbonization. The IEA's Current Policies Scenario serves as the reference point in the development of Greenpeace's Advanced Energy Revolution scenario.

x. DDP

The Deep Decarbonization Pathways (DDP) initiative builds and brings to the public debate realistic decarbonization pathways to 2050. These are designed to deeply reduce carbon emissions while satisfying socio-economic objectives. The pathways are developed country by country, considering in each case the specific context and highlighting key drivers of the transformation and their potential effects.

xi. IRENA REmap

IRENA's REmap determines the potential for countries, regions, and the world to scale up renewables to ensure an affordable and sustainable energy future. Remap assesses worldwide renewable energy potential assembled from the bottom-up, starting with country analyses in collaboration with country experts, and then aggregates these results to arrive at a global picture. REmap accounts for renewable power technologies but also considers technology options in heating, cooling, and transport. In determining the potential to scale up renewables, REmap focuses on possible technologies pathways and assesses numerous other metrics including: technology, sector and system costs; investment needs; externalities relating to air pollution and climate; CO_2 emissions; and economic indicators such as employment and economic growth. Based on these country-driven results, REmap provides insights to policy and decision makers for areas in which action is needed.

xii. BNEF NEO

Bloomberg New Energy Finance's (BNEF) New Energy Outlook (NEO) focusses on the annual long-term economic analysis of the world's power sector out to 2050. 2021's edition presents three scenarios that are aligned with the Paris Agreement, achieving net-zero emissions in 2050. The Green Scenario is a net-zero pathway where so-called 'green hydrogen' complements greater electricity use, recycling and bioenergy. The Grey Scenario assumes greater use of electricity and renewable power is complemented by carbon capture and storage technology and allows for the continued use of some fossil fuels. The Red Scenario assumes smaller, modular nuclear is deployed to complement wind, solar and battery technology in the power sector, with dedicated nuclear plants manufacturing so-called "red hydrogen".

xiii. NGFS scenarios framework

To facilitate the uptake of climate scenario analysis by central banks, financial regulators, and the larger financial community, the Network for Greening the Financial System (NGFS) developed a global set of scenarios and published guidance on conducting such analysis.

Physical scenarios:

RCP scenarios

Developed by the IPCC, the Representative Concentration Pathway (RCP's) are time- and space-dependant trajectories of concentrations of GHGs and pollutants from human activities (including changes in land use). RCP's provide a quantitative description of atmospheric pollutants over time as well as radiative forces in 2100.

The RCPs include a stringent mitigation scenario (RCP2.6), two intermediate scenarios (RCP4.5 and RCP6.0), and one scenario with very high GHG emissions (RCP8.5). Scenarios without additional efforts to constrain emissions ('baseline scenarios') lead to pathways ranging between RCP6.0 and RCP8.5

i. RCP 1.9

Representative Concentration Pathway (RCP) 1.9 is the IPCC's lowest emission pathway that focuses on limiting warming to below 1.5°C by the end of the century, which is the aspirational goal of the Paris Agreement. RCPs provide a quantitative description of atmospheric pollutions over time, as well as radiative forces in 2100. In RCP 1.9, radiative forcing is limited to no more than 1.9 W/m2 above pre-industrial levels.

ii. RCP 2.6

In RCP 2.6, radiative forcing peaks at 3.1 W/m2 before returning to 2.6 W/m2 by 2100, achieved through; a shift to renewable energy sources; CO2 remaining at today's level until 2020, then decline and becoming negative in 2100; and CO2 concentrations peaking by 2050, followed by a modest decline to around 400 ppm by 2100.

iii. RCP 3.4

RCP 3.4 represents the IPCC's intermediate pathway between the very stringent RCP2.6 and the less stringent mitigation efforts associated with RCP4.5.

iv. RCP 4.5

RCP 4.5 represents one of IPCC's intermediate stabilization pathways in which radiative forcing is stabilized at approximately 4.5 W/m2 after 2100.

v. RCP 6.0

RCP 6.0 represents one of IPCC's intermediate stabilization pathways in which radiative forcing is stabilized at approximately 6.0 W/m2 after 2100.

vi. RCP 7.0

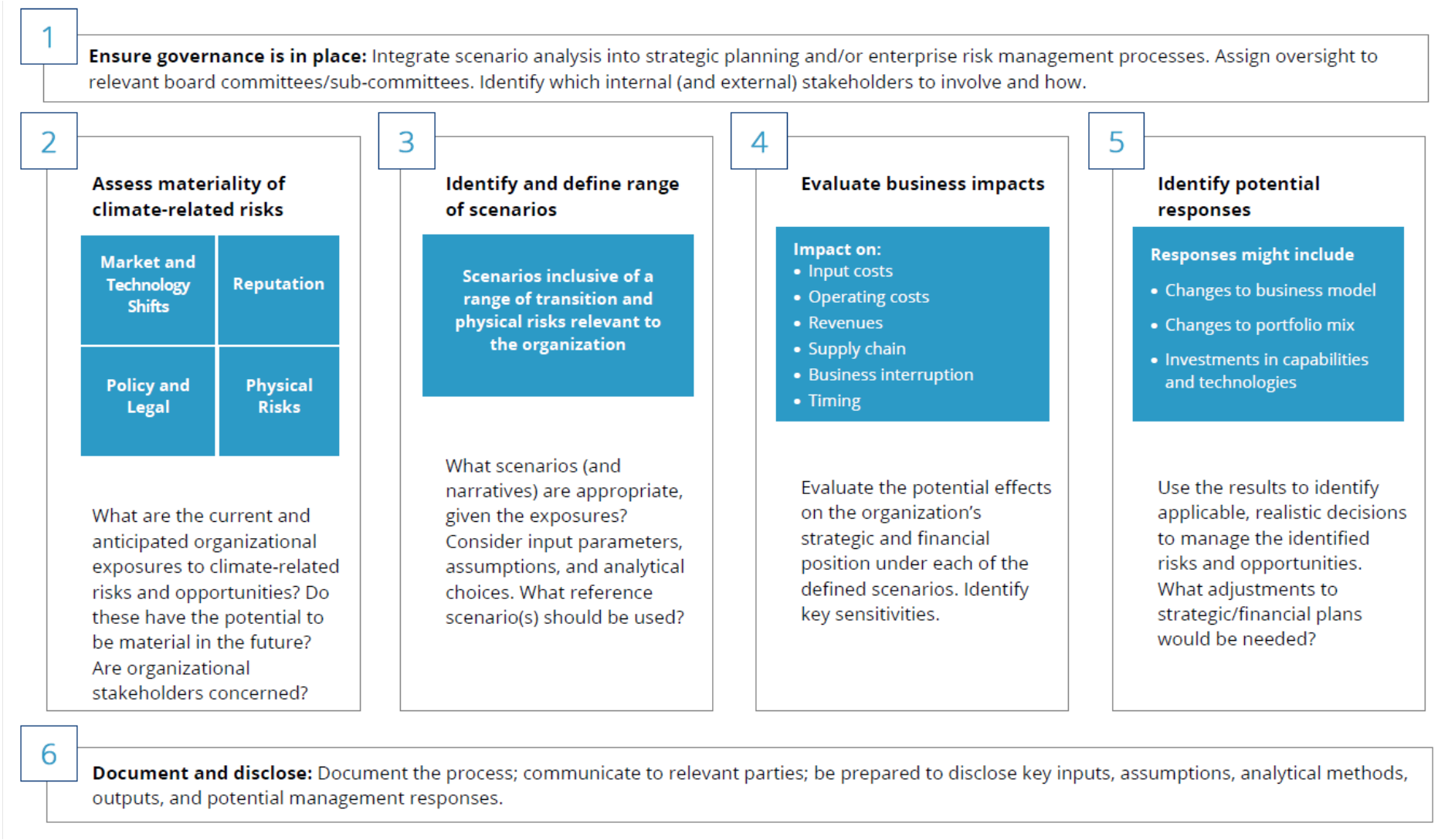
RCP 7.0 consists of a baseline outcome rather than a mitigation target, and represents the medium-to-high end of the range of future emissions and warming resulting from no additional climate policy.

vii. RCP 8.5

RCP 8.5 represents the IPCC's high-end pathway in which radiative forcing reaches greater than 8.5 W/m2 by 2100, and continues to rise for some time afterwards.

Please note: While each RCP scenario is based on an internally consistent set of assumptions, the four RCPs together cannot be treated as a set with consistent internal assumption logic. Furthermore, RCP 8.5 cannot be seen as the 'business as usual' or 'no climate policy' reference scenario for the other RCP's as each of their political, economic, social, technological, legal, and environmental assumptions differ from one another.

Appendix 5: The TCFD's process for exploring and applying climate-related scenario analysis



Appendix 6: Evolving scenario analyses

Scenario analysis is an iterative process that can develop in complexity and sophistication as organizations' experience in constructing and exploring scenarios matures.

The TCFD identified areas organizations can develop as their experience matures: qualitative vs quantitative; range of scenarios; and number of variables.

i. Qualitative vs quantitative

Organizations just starting out in the exploration of scenario analysis may choose to start with qualitative narratives or storylines to explore the potential range of climate change implications for the organization.

As an organization gains experience with qualitative scenario analysis, the scenarios and associated analysis of development pathways can incorporate quantitative information to illustrate potential pathways and futures.

For organizations with significant experience conducting scenario analysis, greater rigor and sophistication in the use of data sets, quantitative models, and analysis may also be necessary.

It is advisable that organizations at risk of significant impacts by the climate-related transition and/or physical risks should consider some level of quantitative (alongside qualitative analysis) scenario analysis.

ii. Range of scenarios

Exploring a range of scenarios is key to identifying potential futures and their impact on an organization. A 2°C or lower scenario (preferably 1.5°C) is a minimal requirement identified by the TCFD, but organizations should also explore potential futures that could have a substantive impact on their strategy and financial planning.

Industries most at risk to transitional factors (e.g. fossil fuel and energy-intensive industries) should consider exploring scenarios that relate to the transition to a low-carbon economy, from rapid uptake to slow progression of climate-related policies. Industries most at risk of physical impacts (e.g. agriculture and infrastructure) may consider exploring greater than 2°C scenarios to account for physical effects of climate change and the associated risks to assess their businesses strategy and financial planning resilience.

However, both transition and physical considerations are complementary when assessing climate-related issues and should be used in unison to understand the implications of climate change. It is important to note that lower transition risk is likely to result in higher levels of physical risk from climate change.

iii. Number of variables

The number of variables can be expanded with the evolution in complexity of scenarios and can align with the implementation of qualitative and quantitative analysis and range of scenarios.

Appendix 7: Outputs from climate-related scenario analysis

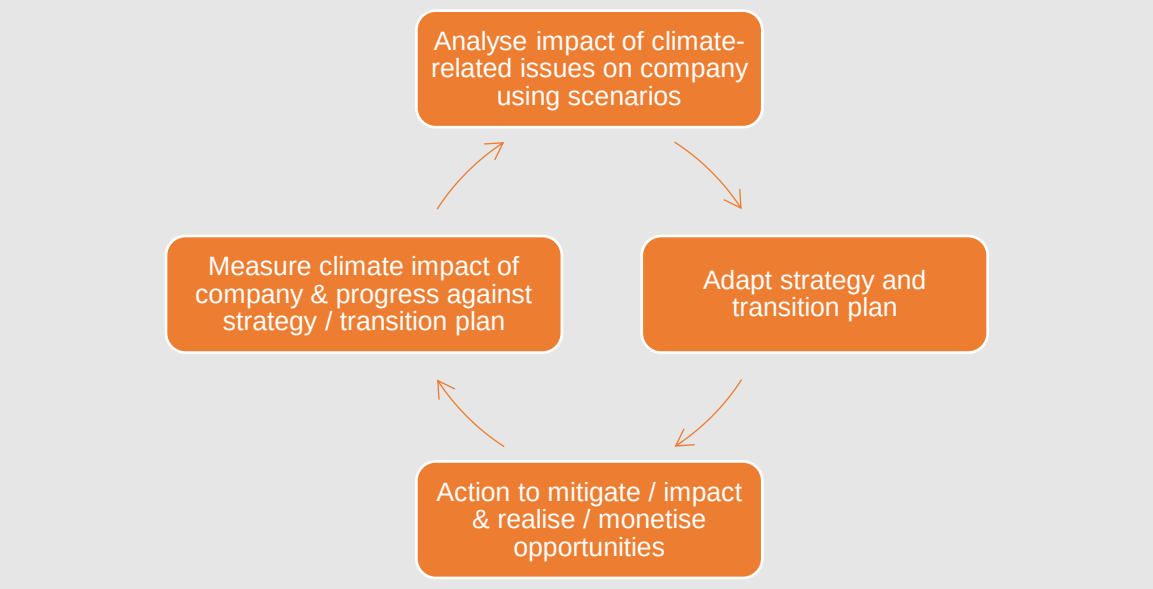
Dutifully conducted climate-related scenario analysis can assist organizations assess their business, strategic thinking, and strategy formulation, aiding organizations to evaluate the impact of potential climate-related risks that can be carefully monitored, together with opportunities presented by the transition to a low-carbon economy (e.g. resource efficiency, shift of energy sources, products and services, access to new markets, organizational resilience/robustness through renewable energy and efficiency projects, or portfolio diversification).

Scenario analysis can enable an organization to identify assets currently in a portfolio that may become obsolete or non-performing, also known as stranded assets. In the transition to a low-

carbon economy, the risk of stranded assets may become more pronounced as businesses and investors shift their portfolios to renewables or new technologies.

Appendix 8: Next steps

Scenario analysis presents an opportunity for organizations to develop their understanding of potential risks and opportunities in the future, based on the scenarios explored. 2°C or lower scenarios (preferably 1.5°C) are a key recommendation provided by the TCFD, and present organizations with the virtuous cycle below:



Having completed at least one cycle enables the organization's scenario exploration to mature, developing into the incorporation of more rigorous quantitative and qualitative analysis that can start the organization on the path to a robust and resilient business strategy that aligns with a low-carbon economy.

Maturity curve of strategic planning with the development of scenarios and transition plans