



Evaluating Climate-Related Financial Impacts on Power Utilities

Approaches and insights for quantifying energy transition-related financial risk and opportunity in the power utilities sector, in response to the recommendations of the Task Force on Climate Related Financial Disclosures (TCFD)

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Executive summary

The analysis and disclosure of climate-related financial impacts is an important tool to achieve a sustainable and timely transition to a low carbon future.

This analysis provides strategic insights to individual companies and their investors, enabling more effective risk management and investment decision making, ultimately ensuring the allocation of capital to activities consistent with a low carbon future.

Power utilities – particularly in Europe – have been early adopters of scenario analysis as an important tool to develop strategic responses to energy transition. The experience of these companies in analyzing energy transition scenarios and their associated financial impacts can therefore offer value to other companies and sectors which are at an earlier stage of transition.

The Financial Stability Board's Task Force on Climate Related Financial Disclosure (TCFD) has developed recommendations to assist public companies and other organizations to more effectively disclose climate-related risks and opportunities through their existing reporting processes, including using scenario analysis to assess and report on strategic resilience.

Four years on from the release of the TCFD's recommendations,¹ there is scope for further clarity and consistency in climate-related financial disclosure practices.² The purpose of this document is to build capacity in the power sector globally by sharing insights from WBCSD's power sector members, many of whom have been developing detailed responses to TCFD for years.

The methodologies to undertake climate-related financial risk and opportunity analysis are still under development, across all sectors, and this report does not attempt to present a "correct" method. Instead, insights and case studies from companies which have already undertaken significant work in this area are shared, in order to accelerate the adoption across the power sector globally of consistent and effective TCFD-aligned analysis and disclosure. This will improve the resilience and strategic decision making of companies in the sector, while also accelerating decarbonization. There may also be relevant learnings from this work that can be applied to other sectors.

The key features of approaches presented in this report are summarized below.

Developing an effective framework for analysis of climate-related financial risk and opportunity – including the choice of scenarios and timeframes. In particular:

- Alignment of level of ambition with stakeholder expectations.
- Scenario choice beyond the minimum recommended by the TCFD, including more extreme scenarios for stress testing purposes.
- The importance of alignment of short, medium and long term time horizons with company targets, stakeholders and portfolio.
- Understanding the interplay between transition and physical scenarios.
- Different approaches have been used with success by WBCSD's members, including top-down, bottom-up and hybrid approaches.

Evaluating climate-related financial risk and opportunity

- A step-by-step approach to analyze climate-related financial risk and opportunity is presented, with case studies and insights from WBCSD members.
- Example terminology and scenario indicators are presented, in order to improve commonality of approach by different companies.
- Options for expressing the outcomes of scenario analysis including metrics such as value at risk are presented. Metrics are developing quickly and there is no current consensus on the “correct” way of evaluating and measuring financial risks and opportunities.
- Importance of balancing resource requirements with business planning, and the role that a phased approach to analysis can play in this. Multi-departmental teams working on this topic is also seen as key.
- Keeping abreast of developments in datasets, tools and stakeholder expectations.
- While the focus is generally on risk, the importance of including opportunity as an integral part of the analysis is also highlighted.

The presentation of the approaches in this report, illustrated by relevant case studies from the experience of WBCSD’s power utility members, aims to accelerate the adoption across the power sector globally of consistent and effective TCFD-aligned analysis and disclosure.

In turn this is expected to improve the resilience and strategic decision making of companies in the power sector, aligned with a low carbon future.



① Introduction



1 Introduction

1.1 PURPOSE OF THIS REPORT

The analysis and disclosure of climate-related financial impacts is an important tool to achieve a sustainable, tangible and timely transition to a low carbon future.

The analysis provides strategic insights to individual companies and their investors, enabling more effective risk management and investment decision making, ultimately ensuring the allocation of capital to activities consistent with a low carbon future.

The purpose of this report is to support power utilities to quantify the financial impacts of energy transition-related risk and opportunity using scenario analysis, aligned with the TCFD recommendations.

While the target audience of this report is electric utilities, the issues identified here are relevant to investors and other stakeholders, as well as companies in other sectors. The effective evaluation of climate-related risk and opportunity, and subsequent integration of strategic insights into strategy,

governance and disclosures, requires a broad range of stakeholders in strategy, finance, risk and sustainability as well as senior board level support. This report aims to build capacity of these key stakeholders, including those undertaking the analysis, developing strategic responses and business planning, disclosing to investors, and undertaking governance and risk management functions.

1.2 BACKGROUND

The TCFD has developed a framework to assist public companies and other organizations to more effectively disclose climate-related risks and opportunities through their existing reporting processes, including using scenario analysis (Figure 1).^{3,4}

Four years on from the release of the TCFD's original recommendations, corporate reporting on climate change is still evolving. The 2021 TCFD Status Report⁵ shows that there is scope for further improvement in climate-related financial disclosure practices, in particular, disclosures about

the potential financial impact of climate-related issues and the resilience of an organization's strategies under different climate scenarios require more clarity.

WBCSD is the premier global, CEO-led community of over 200 of the world's leading sustainable businesses working collectively to accelerate the system transformations needed for a net zero, nature positive, and more equitable future.

We do this by engaging executives and sustainability leaders from business and elsewhere to share practical insights on the obstacles and opportunities we currently face in tackling the integrated climate, nature and inequality sustainability challenge; by co-developing "how-to" CEO-guides from these insights; by providing science-based target guidance including standards and protocols; and by developing tools and platforms to help leading businesses in sustainability drive integrated actions to tackle climate, nature and inequality challenges across sectors and geographical regions.

Figure 1: Climate-related risks, opportunities, and financial impact



Source: [FINAL-2017-TCFD-Report-11052018.pdf](https://www.tcf.org/~/media/TCFD/2017/11/2017-TCFD-Report-11052018.pdf) (bbhub.io)

As part of this work, a project was undertaken with six of WBCSD's multinational power utility members to share approaches for quantifying climate-related financial risk and opportunity, aligned with the TCFD recommendations, and key outcomes from that project have formed the basis of this report. In addition to this report, WBCSD is undertaking work to develop a reference approach to climate scenario analysis for the energy sector, and so relevant insights have been shared between these workstreams.

Companies face various challenges when using scenario analysis to assess strategic resilience, and some of these are listed below.

1. **Scenario choices** – How to choose, interpret and navigate public climate scenarios for corporate strategic resilience assessment.
2. **Scenario process** – How to apply scenarios; which parameters, conditions and inputs to use and over which timeframes; relationship with sensitivity analysis; data availability and reliability (particularly across supply chains).
3. **Resilience measures** – What represents evidence of strategic and operational resilience and how to measure resilience? Adaptive capacity, flexibility, skills and competencies, business model and portfolio development.
4. **Risk management integration** – How to link scenario analysis to risk management processes in order to respond to the unique characteristics of climate-related risk.
5. **Financial disclosure** – How to estimate and disclose the possible financial impacts of climate change based on scenario analysis.

6. **Decision-useful metrics for business and information users** – How to balance scenario analyses designed to provide business-relevant outputs that describe impact, risks, opportunities and climate resilience with the needs of users of climate-related financial information, including existing and potential investors.

This report focusses on challenge 5, Financial Disclosure, while seeking to also add value to other areas where directly relevant.

1.3 SCOPE OF GUIDANCE

This report covers the following areas:

Section 1: Introduction (this section) – Including the background to the report, its purpose and target audience.

Section 2: Framing the analysis – An introduction to scenario analysis in the context of TCFD, including the value of scenarios and other relevant resources besides this report. The importance of the selection of relevant scenarios, timelines and scenario indicators; and key considerations when companies are developing the framework for the analysis.

Section 3: Translating energy transition scenarios into quantitative financial impacts – Overview of approaches for applying scenarios to portfolios, assets and business lines. The guidance includes general principles and steps, reflecting the experience of WBCSD's power utility members in responding to the TCFD recommendations.

Case studies: Throughout the document, case studies from WBCSD's power utility members which demonstrate different approaches to applying scenario

analysis to determine quantitative impacts are presented, in order to illustrate the approaches under discussion.

1.4 OTHER USEFUL GUIDANCE SOURCES

This report assumes the reader has a reasonable knowledge of the TCFD framework, and builds on useful TCFD-related sources for the power utility sector which are already available (or will shortly be made available), including:

- **The recommendations of the TCFD.**⁶ The TCFD has developed a framework to assist public companies and other organizations to more effectively disclose climate-related risks and opportunities through their existing reporting processes. The 2017 TCFD recommendations report⁷ outlines the TCFD framework for reporting climate-related financial information while the "Annex" provides both general and sector-specific guidance (including the Energy Sector, of which electric utilities are part) on implementing the Task Force's disclosure recommendations, and a technical supplement⁸ provides further detail on scenario analysis. More recent publications have included additional guidance on scenario analysis for non-financial companies,⁹ guidance on metrics, targets and transition plans¹⁰ and an annex on implementing the recommendations of the TCFD.¹¹

- Report by the TCFD Electric Utilities Preparer Forum,**¹² The Forum was a collaboration between CLP, EDF, EDP, EnBW, Enel, Iberdrola and WBCSD, and aimed to advance the implementation of the recommendations of TCFD by reviewing members' current climate-related financial disclosures, identifying examples of disclosure practice that are consistent with the TCFD's recommendations, and considering how disclosures might evolve over the TCFD's "implementation path", which anticipates the development of climate change related disclosure practices over a three to five year period following the publication of the recommendations in June 2017. The report provided a snapshot, including examples, of how Forum member companies were providing effective climate-related financial disclosures.
- Setting science-based targets: A guide for electric utilities**¹³ is a guide published by WBCSD to help electric utility companies set science based targets and reduce emissions in line with 1.5°C to accelerate the transition to a zero-carbon economy. The guide reviews the Science-Based Targets Initiative's (SBTi) latest scenario¹⁴ for the power sector and helps utilities understand what it means for them and how to overcome the key challenges they face to setting and achieving their SBTs. These include how to ensure a just transition away from fossil fuels; develop a robust understanding of emissions from the value chain; and abate certain sources of value chain emissions.
- The SDG Sector Roadmap for Electric Utilities,**¹⁵ launched by WBCSD in March 2021, sets a new standard for global best practice on how the sector and its value chain can continue to work towards the realization of the SDGs. Developed with 11 leading companies, it describes pathways for the electric utilities sector to maximize its contribution to the SDGs on the road to 2030 and beyond. It explores the sector's interaction with the SDGs, identifies nine priority goals, and outlines seven key impact opportunity areas where the sector is well placed to drive transformation in line with the objectives of the SDGs.
- Guidance that the Climate Disclosure Standards Board (CDSB) and Sustainability Accounting Standards Board (SASB) published together on TCFD: The TCFD Implementation Guide**¹⁶ offers practical "how-to" guidance for companies to use SASB standards and the CDSB Framework to take the TCFD recommendations from principles to practice. The **TCFD Good Practice Handbook**¹⁷ provides real-world examples of good-practice, TCFD-aligned disclosure and key takeaways to help reporting companies communicate more effectively with investors on climate risk.

② Framing the analysis



2 Framing the analysis

2.1 PROCESS OVERVIEW

Figure 2 below presents a summary from the TCFD¹⁸ process for applying scenario analysis to climate-related risks and opportunities.

This report supplements information already in the public domain on Steps 2-4 of the process, noting that before undertaking Step 2 it may be helpful to undertake some preparatory activities, including:

- Engaging with stakeholders to understand their expectations in terms of level of ambition, timelines and goals of the analysis;
- Earmarking or developing internal resource to undertake analysis activities;
- Undertaking an external review of tools, datasets and scenarios that may have

become available since the previous version of the analysis was undertaken (if relevant);

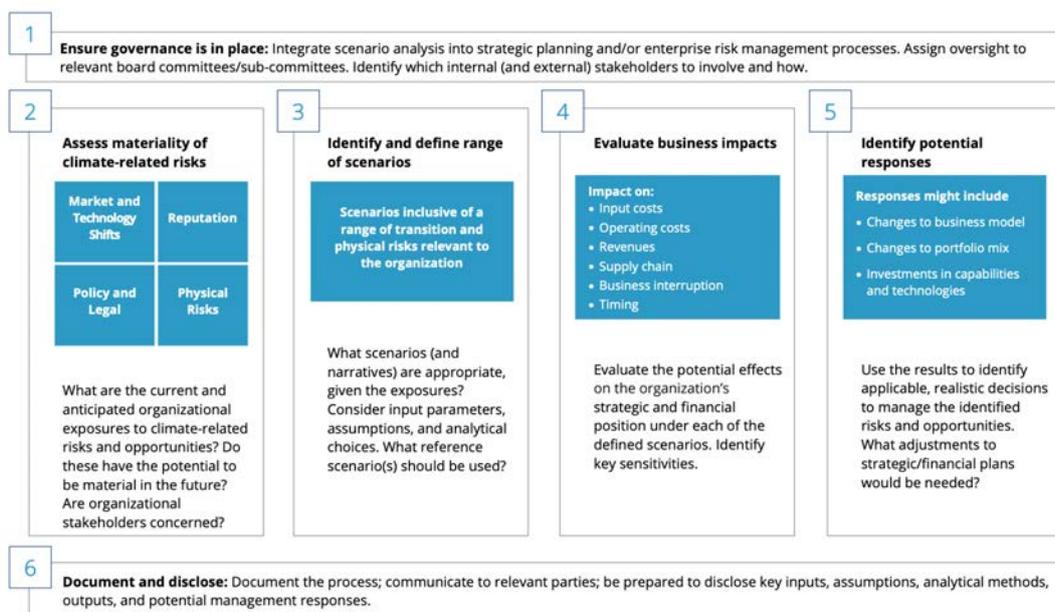
- Educating internal stakeholders and business units as to the purpose and value of the process;
- Gathering relevant information on assets, business lines, any previous analysis undertaken (for example for CDP disclosure) and sources of climate-related risk and opportunity; and,
- Benchmarking with industry peers.

These activities will lay the groundwork for the framing of the analysis, which includes the selection or development of relevant scenarios, datasets and timelines, discussed further in the following sections. Further

guidance on undertaking these pre-analysis activities can be found in Chapter B of the TCFD's recent guidance on Scenario Analysis.¹⁹

In the experience of WBCSD's members, effective analysis requires the involvement of multiple internal stakeholders, including from sustainability, finance, operations, risk management and investor relations – all of whom may have slightly different objectives, and so alignment of objectives by this core stakeholder group is very important. The expertise of core stakeholders is supplemented by regional and functional input, including representatives from each market, business line/asset, procurement, legal and innovation.

Figure 2: Process for applying scenario analysis to climate-related risks and opportunities



Source: [The Use of Scenario Analysis in Disclosure of Climate-Related Risks and Opportunities](#)

2.2 INTRODUCTION TO SCENARIO ANALYSIS IN THE CONTEXT OF TCFD

A scenario describes a plausible, but hypothetical, path of development leading to a particular future outcome. Scenarios are not forecasts or predictions — they are “what if” narratives designed to inform and challenge strategic thinking.²⁰

By way of example, Figure 3 below presents global surface temperature change relative to 1850-1900 under a range of scenarios.²¹

Scenario analysis is a well-established method for developing strategic plans that are more flexible in or robust to a range of plausible future states under and conditions of uncertainty. The analysis can be qualitative by exploring relationships and trends, or quantitative by relying on measurable and numerical data or analysis models.

Organizations can use scenario analysis to assess the potential business, strategic, and financial implications of climate-related risks and opportunities. The TCFD guidance^{22,23} highlights the important role of scenario analysis for this purpose. The TCFD recommends that scenario analysis is used as a tool for the

resilience of an organization’s strategy, taking into consideration a 2°C or lower scenario and business-as-usual scenario, and their implications over short, medium and long term time horizons. Since the release of the TCFD’s recommendations, analysis by the IPCC²⁴ has led to support for analyses also to take account of a 1.5°C scenario.

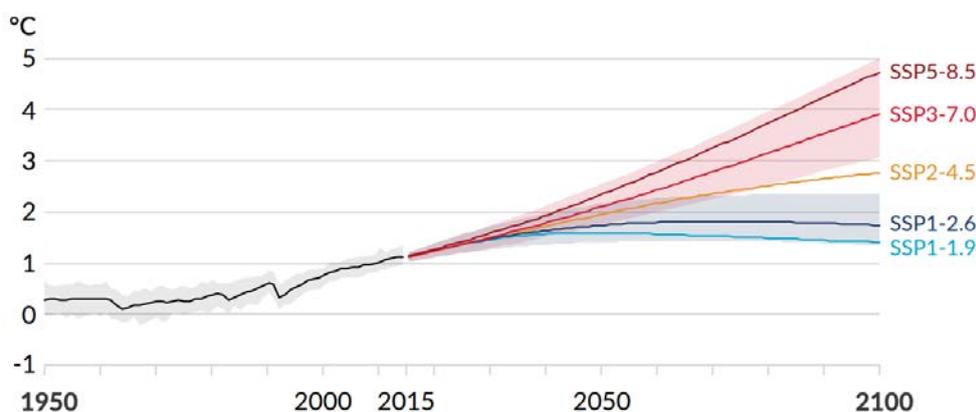
The TCFD Electric Utilities Preparer Forum²⁵ demonstrated that through the process of conducting scenario analysis, organizations are better positioned to identify opportunities and risks, for example by shifting portfolios to low-carbon generation, strengthening infrastructure, and using financial instruments to support the energy transition.

A summary of key recommendations made by the TCFD for consideration when companies are framing scenario analysis is presented below (for the full description please refer to the TCFD recommendations):²⁶

- In order to analyze the resilience of the organization’s strategy, the TCFD recommends consideration of different climate-related scenarios, including a 2°C or lower scenario.

- Consider a range of scenarios to inform management’s assessment, including key inputs, assumptions, analytical methods and applicability in impact assessments (including potential business impacts and management responses).
- Understand the nature and relevancy of the climate-related risks and opportunities the organization may face under these climate-related scenarios.
- The organization is recommended to familiarize itself with relevant scenarios developed by the IEA and the IPCC and ensure consistency with global projections.
- Consider the time horizon of assessment - including short, medium and long term, taking into consideration the useful life of the organization’s assets or infrastructure and the fact that climate-related issues often manifest themselves over the medium and longer terms.

Figure 3: Global surface temperature change relative to 1850-1900



Source: [Climate Change 2021- The Physical Science Basis - Summary for Policymakers](#)

2.3 SCENARIO OPTIONS

The choice of scenario(s) and resources will have an important impact on the outcomes of the analysis. There are many climate-related scenarios and public resources that can be leveraged for analysis. A non-exhaustive list of examples is provided below – for a longer discussion of options see the TCFD recommendations:

- IEA World Energy Outlook²⁸ (requires license) and other IEA scenarios, for example IEA Energy Technology Perspectives;²⁹
- Nationally Determined Contributions plans for each country;
- National and Regional Policy Documents, and associated planning. For example in the UK the National Grid Future Energy Scenarios³⁰ and the UK Climate Change Committee reports, recommendations and carbon budgeting analysis;³¹
- Sector Bodies/ Trade Association scenarios (e.g. by Wind Europe, IRENA, Hydrogen Council);
- IPCC Reports and Projections;
- Corporate scenarios, for example Shell Sky;

- World Bank;
- Regional/ National carbon market projections;
- Proprietary scenarios, for example from AFRY/Poyry, Wood Mackenzie; and Bloomberg New Energy Finance (BNEF).³²

Figure 4 below summarizes the types of scenarios available. When selecting or developing internal scenarios, a number of considerations are important:

- Alignment of key parameters and assumptions with the company's internal projections and views (examples include macro-economic variables, energy mix and commodity prices. For a further breakdown see TCFD Recommendations);³³
- Alignment of key parameters and assumptions with stakeholder expectations. For example, if the electric utility has a large state owned shareholding then it may be particularly important to demonstrate that the company's strategy is aligned with national climate strategy;
- The scope of the scenario – for example geography, sector, timeline – and subsequent relevance to the

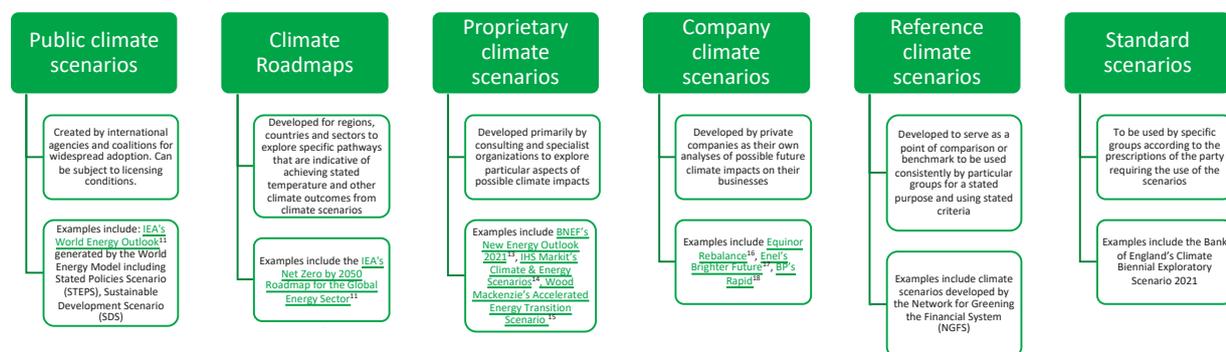
company and its assets;

- Level of granularity of the scenario;
- Scenario indicators which are included; and,
- How up to date the scenario is.

Several of the members develop their own internal scenarios, or adapt existing scenarios such as from the IEA to use slightly different assumptions – see for example the case studies by Enel and Acciona in Section 2.5. The main drivers for doing this included insufficient granularity or relevance of the available scenarios, or an internal view which was different from assumptions in readily available scenarios such as the IEA. In order to sense check the scenarios that are created, benchmarking against external scenarios was found to have value by the members.

The financial sector has raised questions about comparability of analyses using different scenarios. The TCFD therefore recommends transparency in terms of the scenarios, parameters and assumptions in disclosures.

Figure 4: Types of scenarios



2.4 INSIGHTS FROM WBCSD MEMBERS ON DEVELOPING AN EFFECTIVE FRAMEWORK FOR THE ANALYSIS

Supplementing the TCFD recommendations, the following insights and approaches are suggested based on the experience of WBCSD members in the Sustainable Energy Supply workstream:

Alignment of level of ambition with stakeholder expectations

- The members felt that the expectations of stakeholders have moved on since the issue of the original TCFD recommendations, and as a result meeting the minimum requirements of the TCFD recommendations is unlikely to be sufficient.
- In particular, recent Intergovernmental Panel on Climate Change (IPCC) work³⁵ has emphasized reaching net zero, and the importance of limiting global warming to 1.5°C, rather than the “well below 2°C” in TCFD. The emphasis of stakeholder expectations has therefore shifted from being Paris Agreement aligned to reaching net zero. A shift in the expectations of investors has also been observed, from climate disclosure to action towards net zero.³⁶

- Interim targets and metrics have also become more relevant. There is an increasing need to disclose intermediate milestones (for example 2030, 2035 and 2040).

The importance of alignment of short, medium and long term time horizons with company targets, portfolio and stakeholder expectations

- It is important to set short, medium and long term timelines which are aligned with company targets, portfolio and reporting. For example, where a long term net zero target has been set by the company, the long term time horizon of the scenario analysis could be aligned with this in order to demonstrate capability to achieve this long term objective under different scenarios.
- Energy transition impacts may materialize in the nearer term compared with physical climate-related impacts, and so some members felt it was useful to define different (shorter) timescales for the transition analysis than the physical analysis. Other members felt it was important that the timelines for both physical and transition were aligned as external stakeholders expected this.
- The composition of the portfolio was an important consideration for some members when considering appropriate timelines.

For example, members with long life assets, such as nuclear assets, found value in exploring the impact of scenarios on those assets right to the end of their lifetime.

Scenario choice including scenarios chosen for stress testing purposes

- Stress testing against a range of scenarios can add value to resilience assessment and strategy development under a range of future pathways.
- In particular, power sector members found value in stress testing against extreme physical scenarios. Power utility businesses may own or control a range of relatively long life power generation, transmission and distribution assets which could be exposed to both chronic and acute physical climate impacts over the longer term. Therefore, stress testing against more extreme physical scenarios can provide insights into the impacts on financial performance, for example due to business interruption from greater severity and frequency of extreme weather events or power demand increases due to chronic temperature rise and associated demand for air conditioning.

- Physical scenarios were generally found by members to be more impactful in the mid-long term, while for some members which have already implemented strategic changes to their business models, transition scenarios were not particularly stressing, or more stressing in the shorter term.
- The power sector has generally decarbonized faster than the global economy as a whole, and so stringent transition scenarios may have relatively less impact for this sector (particularly in Europe) when compared with the global economy.

The interplay between transition and physical approaches and scenarios

- The development of scenarios incorporating both transition and physical indicators and impacts is important, aligned with the emphasis on consideration of all categories of climate-related risk and opportunity identified by the TCFD. The value and limitations of different types of scenarios has been considered in a parallel WBCSD project.
- However, it was suggested by the members that it is also possible to have separate assessment for transition and physical as part of a coordinated approach. The methodologies for analyzing energy transition risk are different from physical climate risk, and different scenarios form the basis which are not necessarily perfectly aligned. The scenarios may include different inputs/ outputs or assumptions, and useful stress testing may occur over different timeframes. As a result it may be that different teams and resources within the company would be best

placed to undertake the analysis for transition and physical risk, in order to ensure a high quality of analysis using the most relevant expertise. It is important to match scenarios to purpose, for example if the purpose is to assess resilience to physical risks then a challenging physical scenario will be appropriate.

- While impacts of different risks are generally analyzed individually, they are all interrelated, and so it can be difficult to recombine effects. This is an area of consideration for several of the members moving forward as they look to develop their approaches.

Different approaches have been used with success by WBCSD's members, including top-down, bottom-up and hybrid approaches.

- Some power utility members apply a top-down approach, building macro models for power markets which are then applied to specific business lines and assets - see for example Enel Case Study in Section 2.5 covering transition risk and opportunity. This approach has the advantage of ensuring a consistent approach is applied to the whole portfolio, ensuring comparability of the results and so aiding the creation of data-driven strategic insights which fairly reflect the whole portfolio. It should be noted that for physical phenomena Enel goes to the asset level (in a similar way to the Acciona approach mentioned below) and so the company has a

hybrid approach overall to analysis for both physical and transition.

- In contrast, other members apply a bottom-up approach, identifying issues which could have a material impact first – for example see Acciona Case Study for physical climate analysis. Climate-related issues which could have a material impact are identified at groups of locations and/ or business lines, taking into account geographical exposure and vulnerability. This approach has the advantage of ensuring that insights and considerations which are relevant to specific assets and business lines are fully incorporated into the analysis.
- A hybrid approach, incorporating elements of both the top-down and bottom-up approach, is used with success by some members, such as EDP. The company applies a top-down approach as a general guidance and direction from the group, then applies bottom-up information collected from business units, which are disaggregated by regions.



2.5 CASE STUDIES ON FRAMING THE ANALYSIS

CLP: Case study on framing the analysis

An example of scenario selection from CLP³⁷ is reproduced below in Figure 4. As can be seen, a business-as-usual pathway and 1.5°C - 2°C pathway have been selected, aligned with relevant IEA scenarios. This approach is consistent across most of WBCSD's members who participated in this project and is aligned with the TCFD recommendations to consider a "better than 2°C" scenario against business-as-usual.

In addition, CLP has developed a bespoke "Deferred Transition scenario", which tracks a path from high to low carbon, but over a compressed timeframe. This 'Deferred Transition' scenario is in line with the recommendations of The United Nations Principles for Responsible Investments (UNPRI) and the Network for Greening the Financial System (NGFS), but fine-tuned with policy and regulatory outlook as well as climate projections in the geographies where CLP has a presence. This scenario could be expected to have disruptive impacts on the

operational landscape, making it particularly important for business resilience testing.



Figure 4: CLP climate scenarios

Scenario	Example trends ¹
Warming of 3-4°C by 2100 (based on Intergovernmental Panel on Climate Change (IPCC) Representative Concentration Pathway 8.5 and IEA Stated Policies Scenario (STEPS))	<ul style="list-style-type: none"> Emissions continue to rise, peaking after 2040 and resulting in warming reaching 3-4°C by 2100. In Australia, the highest monthly rainfall over a 10-year period decreases by 0.7mm by 2050 compared to historic averages.² In India, the number of extreme hot days with temperatures above 40°C increases by 23 days per year by 2050 compared to historic averages. Renewables have a 47% share of global electricity generation by 2040. Carbon pricing reaches US\$35 per tCO₂ by 2040.³
Warming of 1.5-2°C by 2100 (based on IPCC Representative Concentration Pathway 4.5 and IEA Sustainable Development Scenario (SDS))	<ul style="list-style-type: none"> Emissions decline from 33 gigatonnes (Gt) in 2020 to less than 10 Gt by 2050, in line with the Paris Agreement to limit warming to 1.5-2°C by 2100. In Australia, the highest monthly rainfall over a 10-year period increases by 10mm by 2050 compared to historic averages. In India, the number of extreme hot days with temperatures above 40°C increases by 16 days per year by 2050 compared to historic averages. Renewables have a 72% share of global electricity generation by 2040. Carbon pricing reaches US\$125-140 per tCO₂ by 2040.
Deferred Transition scenario (based on the UNPRI's Inevitable Policy Response and NGFS climate scenarios, where a late or deferred transition from the 3-4°C pathway to the 1.5-2°C pathway occurs)	<ul style="list-style-type: none"> Most climate-related scenarios assume a gradual transition from the BAU to a lower carbon economy, with actions on reducing emissions starting today and significant deviation from the base case happening over the following few years. The Deferred Transition scenario takes an alternative approach, in which no significant changes in policy or technology occur in the near-term future, and the emissions trajectory follows the BAU case. As the effects of climate change become more apparent, governments will be forced to urgently revise their climate policies, leading to a sudden transition toward the goals of the Paris Agreement and a net-zero carbon economy. Technology advances such as battery storage and electric vehicles are also expected to contribute to the sudden change in energy demand and supply pathways. Such a deferred transition scenario could be expected to have disruptive impacts on the operational landscape, making it particularly important to include business resilience testing.

¹ Physical climate event figures averaged across CLP Markets of Hong Kong, Mainland China, Australia and India.

² Historic average references years 1986 to 2005.

³ Mainland China only.

Source: https://www.clpgroup.com/content/dam/clp-group/channels/sustainability/document/sustainability-report/2020/CLP_Sustainability_Report_2020_en.pdf.coredownload.pdf

Enel: Case study illustrating top-down macro approach to scenario analysis

A case study illustrating a top-down macro approach to scenario analysis of energy transition risk and opportunity is provided by Enel, and summarized in Figure 5 below. Enel develops short-, medium- and long-term scenarios for the energy industry and for macroeconomic and financial conditions in order to support its strategic and industrial planning and the evaluation of investments.

Future trends in climate variables (in terms of acute and

chronic phenomena) define the "physical scenario", while the economic transition towards solutions to reduce atmospheric concentrations of CO₂ define the "transition scenario".

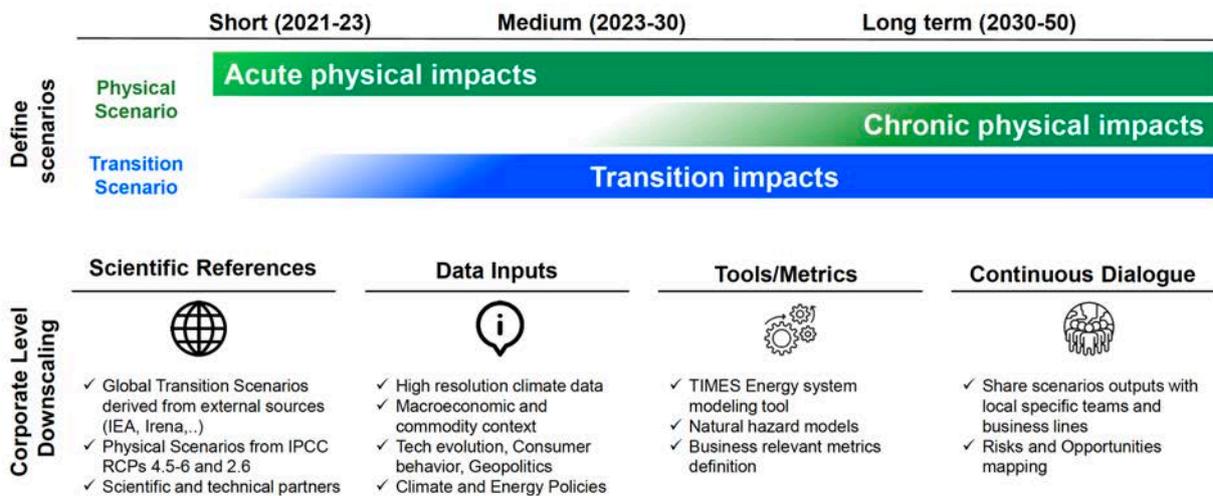
The adoption of these scenarios and their integration into corporate processes takes account of the guidelines of the TCFD and enables the assessment of the risks and opportunities connected with climate change.

A top-down approach to scenario development is taken, with macro models for power markets being built which are then applied to specific business lines and

assets. Desktop research is conducted for every country of interest and the company benchmarks international and national documents and energy plans to ensure coherence with internal strategic pillars and ambitions.³⁸

It should be noted that for physical phenomena Enel go to the asset level (in a similar way to the Acciona approach explained below) and so the company has a hybrid approach overall to analysis when both physical and transition are considered.

Figure 5: Time horizons and downscaling framework of Enel group's climate scenario



Source: Case Study provided for SES Workshops by Enel

Acciona: Case study illustrating bottom-up material drivers approach

Acciona applies a bottom-up approach to scenario development, identifying issues which could have a material impact, including climate-related issues at groups of locations and/ or business lines, taking into account geographical exposure and vulnerability.

The company uses a digital climate change model, which

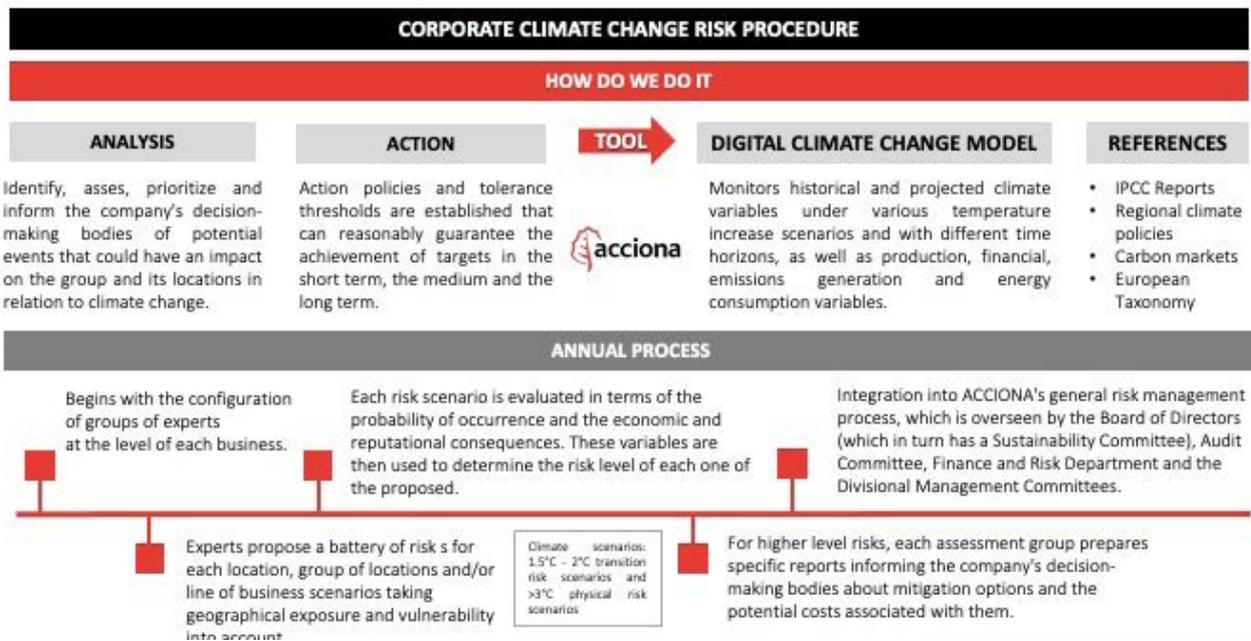
monitors historical and projected climate variables for all Acciona locations under various temperature increase scenarios and with different time horizons, based on the latest IPCC reports, as well as production, financial, emissions, generation and energy consumption variables.

The risks which are more severe and material are presented in specific reports informing the company's decision-making bodies about mitigation

options and the potential costs associated with them. The risks are translated and integrated into Acciona general risk management, which is overseen by the Board of Directors, Audit Committee, Finance and Risk Department and Divisional Management Committees.

Figure 6 below shows the bottom-up approach of Acciona corporate climate change risk procedure.

Figure 6: Acciona corporate climate change risk procedure



Source: Acciona. (2020) Sustainability Report 2019.

Available at: <https://accionacorp.blob.core.windows.net/media/3592163/sustainability-report-2019-doble.pdf>

EDP: Case study illustrating hybrid approach

EDP applies a top-down approach to climate scenario development, and then incorporates bottom-up information collected from business units, which are disaggregated by regions. Climate scenario analysis and risk and opportunities quantification is conducted as part of the Climate Risk Management Framework shown in Figure 7.

The potential physical and transition climate risks and opportunities that may impact EDP group's business have been identified and reviewed to be aligned with the corporate risk taxonomy. The risks and opportunities are assessed against three aggregated climate scenarios, which are based on the International Energy Agency (IEA) Current Policies Scenario (CPS) and IPCC RCP 8.5, IEA Stated Policies Scenario (STEPS) and IPCC RCP 4.5, and

IEA Sustainable Development Scenario (SDS) and IPCC RCP 2.6.

The selection of material climate risks and opportunities by the business units are done according to estimated financial thresholds. All material climate risks and opportunities are consolidated in the Climate Value at Risk (VaR) analysis, which will be further discussed in Section 3.3.4.

Figure 7: EDP group climate risk management framework



Source: EDF workshop for Sustainable Energy Supply project



③ Translating energy transition scenarios into quantitative financial impacts



③ Translating energy transition scenarios into quantitative financial impacts

This section of the report presents an overview of approaches for applying scenarios to portfolios, assets and business models in order to estimate quantitative financial impacts. General principles and steps which have been found to have value by WBCSD's power utility members are presented, and illustrated by case studies.

3.1 OVERVIEW OF STEP-BY-STEP APPROACH

An overview of key steps in the process is presented below.

1. Framing of analysis

- Discussed in detail in Section 2 of this report. This includes the selection or development of scenarios, timelines, and data gathering to inform the analysis.

2. Identify relevant climate-related risks and opportunities

- An assessment is undertaken to identify the climate-related risks and opportunities which could have a material financial impact across the organization's portfolio, segmented by asset type/ country/region/business line as appropriate.
 - Aligned with the TCFD guidance, the development of climate-related risk and opportunity over a short, medium and long-term time horizon are considered.
 - Climate-related risks and opportunities are considered across a range of areas, shown in Figure 8 below.³⁹
- Risks and opportunities which may have a material financial impact can be identified using a range of considerations, including:
 - Asset sensitivity – leveraging the insights of asset-level expertise in the business.
 - Portfolio exposure – determined at corporate level.
 - Current energy transition risks and opportunities (for example incoming regulations) and physical climate hazards in geographies of relevance.
 - Projected climate trends and scenarios in geographies of interest.



Figure 8: Examples of climate-related risks and opportunities

Type	Climate-Related Risks ³²	Potential Financial Impacts
Transition Risks	Policy and Legal <ul style="list-style-type: none"> – Increased pricing of GHG emissions – Enhanced emissions-reporting obligations – Mandates on and regulation of existing products and services – Exposure to litigation 	<ul style="list-style-type: none"> – Increased operating costs (e.g., higher compliance costs, increased insurance premiums) – Write-offs, asset impairment, and early retirement of existing assets due to policy changes – Increased costs and/or reduced demand for products and services resulting from fines and judgments
	Technology <ul style="list-style-type: none"> – Substitution of existing products and services with lower emissions options – Unsuccessful investment in new technologies – Costs to transition to lower emissions technology 	<ul style="list-style-type: none"> – Write-offs and early retirement of existing assets – Reduced demand for products and services – Research and development (R&D) expenditures in new and alternative technologies – Capital investments in technology development – Costs to adopt/deploy new practices and processes
	Market <ul style="list-style-type: none"> – Changing customer behavior – Uncertainty in market signals – Increased cost of raw materials 	<ul style="list-style-type: none"> – Reduced demand for goods and services due to shift in consumer preferences – Increased production costs due to changing input prices (e.g., energy, water) and output requirements (e.g., waste treatment) – Abrupt and unexpected shifts in energy costs – Change in revenue mix and sources, resulting in decreased revenues – Re-pricing of assets (e.g., fossil fuel reserves, land valuations, securities valuations)
	Reputation <ul style="list-style-type: none"> – Shifts in consumer preferences – Stigmatization of sector – Increased stakeholder concern or negative stakeholder feedback 	<ul style="list-style-type: none"> – Reduced revenue from decreased demand for goods/services – Reduced revenue from decreased production capacity (e.g., delayed planning approvals, supply chain interruptions) – Reduced revenue from negative impacts on workforce management and planning (e.g., employee attraction and retention) – Reduction in capital availability
Physical Risks	Acute <ul style="list-style-type: none"> – Increased severity of extreme weather events such as cyclones and floods 	<ul style="list-style-type: none"> – Reduced revenue from decreased production capacity (e.g., transport difficulties, supply chain interruptions) – Reduced revenue and higher costs from negative impacts on workforce (e.g., health, safety, absenteeism) – Write-offs and early retirement of existing assets (e.g., damage to property and assets in “high-risk” locations)
	Chronic <ul style="list-style-type: none"> – Changes in precipitation patterns and extreme variability in weather patterns – Rising mean temperatures – Rising sea levels 	<ul style="list-style-type: none"> – Increased operating costs (e.g., inadequate water supply for hydroelectric plants or to cool nuclear and fossil fuel plants) – Increased capital costs (e.g., damage to facilities) – Reduced revenues from lower sales/output – Increased insurance premiums and potential for reduced availability of insurance on assets in “high-risk” locations

³² The sub-category risks described under each major category are not mutually exclusive, and some overlap exists.

Type	Climate-Related Opportunities ³³	Potential Financial Impacts
Resource Efficiency	<ul style="list-style-type: none"> – Use of more efficient modes of transport – Use of more efficient production and distribution processes – Use of recycling – Move to more efficient buildings – Reduced water usage and consumption 	<ul style="list-style-type: none"> – Reduced operating costs (e.g., through efficiency gains and cost reductions) – Increased production capacity, resulting in increased revenues – Increased value of fixed assets (e.g., highly rated energy-efficient buildings) – Benefits to workforce management and planning (e.g., improved health and safety, employee satisfaction) resulting in lower costs
Energy Source	<ul style="list-style-type: none"> – Use of lower-emission sources of energy – Use of supportive policy incentives – Use of new technologies – Participation in carbon market – Shift toward decentralized energy generation 	<ul style="list-style-type: none"> – Reduced operational costs (e.g., through use of lowest cost abatement) – Reduced exposure to future fossil fuel price increases – Reduced exposure to GHG emissions and therefore less sensitivity to changes in cost of carbon – Returns on investment in low-emission technology – Increased capital availability (e.g., as more investors favor lower-emissions producers) – Reputational benefits resulting in increased demand for goods/services
Products and Services	<ul style="list-style-type: none"> – Development and/or expansion of low emission goods and services – Development of climate adaptation and insurance risk solutions – Development of new products or services through R&D and innovation – Ability to diversify business activities – Shift in consumer preferences 	<ul style="list-style-type: none"> – Increased revenue through demand for lower emissions products and services – Increased revenue through new solutions to adaptation needs (e.g., insurance risk transfer products and services) – Better competitive position to reflect shifting consumer preferences, resulting in increased revenues
Markets	<ul style="list-style-type: none"> – Access to new markets – Use of public-sector incentives – Access to new assets and locations needing insurance coverage 	<ul style="list-style-type: none"> – Increased revenues through access to new and emerging markets (e.g., partnerships with governments, development banks) – Increased diversification of financial assets (e.g., green bonds and infrastructure)
Resilience	<ul style="list-style-type: none"> – Participation in renewable energy programs and adoption of energy-efficiency measures – Resource substitutes/diversification 	<ul style="list-style-type: none"> – Increased market valuation through resilience planning (e.g., infrastructure, land, buildings) – Increased reliability of supply chain and ability to operate under various conditions – Increased revenue through new products and services related to ensuring resiliency

³³ The opportunity categories are not mutually exclusive, and some overlap exists.

3. Optional interim step: heat mapping of climate-related risk and opportunity

- Climate-related financial risk and opportunity analysis is a technically detailed and time consuming exercise, and so to ensure efficiency and effective resource management, a phased approach can be helpful.
- This starts with a high level, light touch review of the entire business in order to identify and map potential hotspots of climate-related risk and opportunity onto the portfolio.
- This optional heat mapping exercise enables the identification

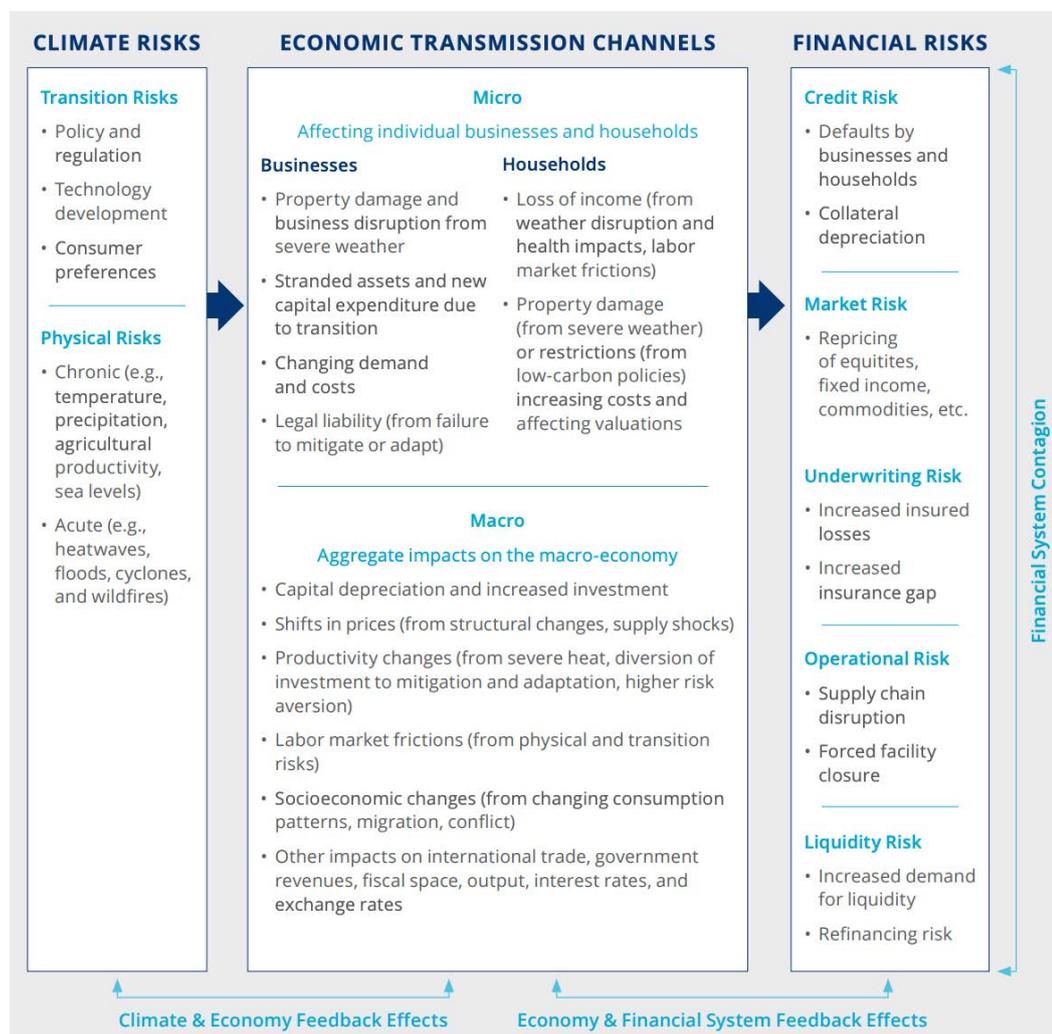
of particular assets or business lines which are potential hotspots of risk/opportunity, and is followed by deep dive analysis into those assets or business lines to assess quantitative financial impacts.

- This avoids the need for detailed analysis of the whole portfolio. This targeted approach may not be acceptable to stakeholders interested in whole business performance, however, it may be a useful balance between resource requirements and business insights arising from the most exposed areas of the business.

4. Evaluate quantitative financial impacts on the business

- The potential effects on the organization's strategic and financial position is evaluated under each of the defined scenarios, and key sensitivities identified.
- Potential areas of financial impact on the organization can include Capex, Opex, revenues, supply chain, business interruption and/or timing. These impacts can then feed to the company's financial statements and valuation. The links between climate-related scenarios and these financial drivers of a company's performance are analyzed in order to

Figure 9: Climate-related financial risk transmission channels



understand the most material financial risks and opportunities to the business. Examples for the power sector are presented in Figure 9.⁴⁰

- Quantitative financial analysis can then be undertaken at the asset level (e.g. X power generation plant) or business line level (e.g. Y digital services or Z retail business line) by building scenarios into the financial model of the assets/business lines which are potentially most exposed to climate related risk or opportunity, to calculate potential financial impact.
- The outcome of this step includes quantitative financial results under different scenarios, highlighting how the financial impact of climate related risk and opportunity is manifested in a company's performance and position. The financial impact may be presented in a number

of ways and there is not consensus yet on the methodology or most appropriate metric(s). Examples of forward-looking climate-related metrics include Value-at-Risk (VaR), Implied Temperature Rise (ITR) and Carbon Earnings at Risk.

5. Integration into an organization's strategic and risk processes

- The purpose of this step is to apply the learnings from the financial analysis and integrate them into the organization's strategic decision making, risk management and governance processes. Case studies demonstrating this step are presented in the TCFD preparer's forum report.⁴¹

It should be noted that there are a number of challenges associated with quantifying the financial implications of scenarios on a particular company, portfolio or asset.

For example:

- Publicly available scenarios may be insufficiently detailed, specific to the location or type of asset under consideration.
- There may be lack of sufficient data and understanding of the vulnerability of particular assets or business lines to climate-related drivers.
- The interaction between direct and indirect climate change impacts can be difficult to predict or quantify.

However, despite these challenges, the analysis of climate-related risk and opportunity can provide important signposts of climate-related risk and opportunity, improving strategic decision making and risk management.



3.2 INSIGHTS FROM WBCSD MEMBERS ON TRANSLATING ENERGY TRANSITION SCENARIOS INTO QUANTITATIVE FINANCIAL IMPACTS

Supplementing the TCFD recommendations, the following insights and approaches are suggested based on the experience of WBCSD members in the Sustainable Energy Supply workstream:

Define common terminology to reduce the potential for confusion and assist with comparability

The terminology associated with climate-related risk and opportunity analysis varies by organization, which can make comparability and review of analyses more challenging. Additionally, if organizations are delegating some of the analysis from corporate level to business unit or asset level then having common terminology is vital to aid the review and consolidation of the results at a corporate level. Some suggested terminology is below, and a full list is provided in the glossary at the end of this guidance:

- **Scenario** - A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, commodity prices) and relationships. Note that scenarios are neither predictions nor forecasts, but are useful for providing a view of the implications of developments and actions.⁴²

- **Business-as-usual** - Business-as-usual (BAU) scenarios are based on the assumption that operating practices and policies remain as they are at present. Although baseline scenarios could incorporate some specific features of BAU scenarios (e.g., a ban on a specific technology), BAU scenarios imply that no practices or policies other than the current ones are in place.⁴³
- **Scenario indicator** - Climate scenarios typically comprise large data sets, covering emissions, energy and other metrics across a range of sectors. 'Scenario indicators' within these data sets are leveraged to perform climate risk and opportunity assessment and include parameters such as demand and pricing of different commodities, the energy mix, macro-economic variables such as GDP and population growth and CO₂ emissions intensity. Scenario indicators are sometimes called by other terms including climate factors, variables, drivers or parameters.

- **Financial impact** - Climate-related financial impact is a historical or current quantity or forward-looking quantitative outlook (estimate, projection, or forecast) regarding the financial impact of climate-related risks and opportunities on an organization's financial performance or position. The impact on business performance and position is measured through

financial drivers such as capital expenditure (Capex), operational expenditure (Opex) or revenue, arising from shifts in scenario indicators under different scenarios. These drivers then impact the financial statements and valuation of the company. Some members disclose the absolute impact on Capex, Opex and/or revenue, while some disclose the percentage change. The financial impact may be presented in a number of ways and there is not consensus yet on the methodology or most appropriate metric(s). Examples of forward-looking climate-related metrics include Value-at-Risk (VaR), Implied Temperature Rise (ITR) and Carbon Earnings at Risk - discussed further under "Metrics" below.

Define common scenario indicators to aid comparability

- The analysis of the impact of climate-related scenarios is expected to take place on a regular basis across all business lines and assets. As such, there is value in defining a series of key parameters that describe the climate drivers and development pathways over the scenario’s timeframe, termed “scenario indicators”. This ensures consistency of approach across the portfolio, and different iterations of the analysis.
- There is also a wider industry benefit that transparency around key parameters and assumptions will help to support comparability of results between different scenarios used by an organization and across organizations. This is also aligned with the emphasis on sharing key analysis features (parameters, assumptions, analytical choices and impacts) made by the TCFD.⁴⁴
- The scenario indicators listed below are examples which may be material for quantifying financial impact of energy transition-related risk and

opportunity on a power utility’s business performance.

Metrics

- The TCFD’s guidance on Metrics, Targets and Transition Plans outlines key cross industry metrics for all companies to consider disclosing. Other metrics are being explored to measure financial impacts from climate-related risk and opportunity. Example metrics include Value-at-Risk (VaR), Implied Temperature Rise (ITR) and Carbon Earnings at Risk. In a similar way to mainstream financial metrics, no single metric can fully describe climate-related exposure. All of these metrics are at an early stage of development for application in the climate space and so methodologies and approaches are still evolving.
- As approaches to analyzing and disclosing climate-related risk and opportunity are still developing, a key metric which is currently used to analyze and disclose climate impacts is carbon emissions. Generally the focus so far has been on Scope 1 and 2 (and the TCFD guidance says that Scope

1 and 2 should be reported regardless of materiality), however there is a growing focus on Scope 3, as well as scrutiny over the timeframe that reductions are committed over and alignment with net zero.

- Other metrics that can be estimated using current methodologies include energy demand, electrification share and share of renewables in the energy mix, which can be benchmarked against external sources such as IEA, IRENA, BNEF and NECPs.
- Value-at-risk (VaR) measures the loss a portfolio may experience, within a given time horizon, at a particular probability. Climate VaR has a long time horizon (many years) compared with the shorter time horizon of standard financial VaR.
- Some power utility members have conducted scenario analysis and derived quantified financial impacts at both the asset and portfolio level using a VaR tool (see for example EDP case study).

TCFD quadrant	Example scenario indicators for power utilities
Market & technology shift	<ul style="list-style-type: none"> • Energy demand and mix, segmented by energy generation type; • Fuel and commodity prices (e.g. oil, gas and coal); • Technology availability and prices – including production, storage and use (e.g. solar PV/ CSP, wind, energy storage, biofuels, hydrogen, CCS/ CCUS, electric vehicles); • Electrification share (of total energy demand and by sector); • Energy intensity and carbon intensity of GDP, in particular sectors which are key customers; • Stability and security of electricity networks, and associated investment; • Shift towards decentralized energy generation; • Macro-economic variables (e.g. GDP rate, employment rate); and, • Demographic variables (e.g. population growth).
Policy and legal	<ul style="list-style-type: none"> • Carbon prices; • Energy efficiency regulations; • Mandated switch to hydrogen; • Mandated closure of coal or nuclear; and, • Mandated installation of CCS for gas plant.
Reputation	<ul style="list-style-type: none"> • Trackers of successful climate-related litigation; • Retention rates for staff; and, • Capital availability and cost.

- The VaR approach was not used by all members, as some felt that the methodology was not sufficiently advanced yet so would give a false impression of accuracy. In particular, the interplay between different interconnected drivers of climate-related risk and opportunity was felt to be poorly understood. The development of VaR methodologies is an area of focus by both corporate and non-corporate players.

Importance of balancing resource requirements with business planning, and the role that a phased approach to analysis can play in this

- All members discussed the heavy resource requirement associated with scenario analysis, with a team of 20-30 people to develop scenarios and undertake analysis potentially required. Complex computational models, considering a range of indicators such as commodity pricing, production and national policies are required, driven by internal expertise.
- Most of WBCSD's power utility members undertake an annual scenario analysis exercise, to feed into disclosures and internal planning cycles, and considered this particularly important for transition risk, which can change quickly.
- In addition to an annual scenario analysis exercise, regular monitoring was felt to be important, in order to update the analysis for fast changing drivers, for example regulations and policy frameworks relevant to the energy transition space.
- The review process also depends on the timeframe considered. Members suggested to review short and medium term risks annually and long term risks less regulatory (e.g. once in every 2 years).

- There were different approaches regarding how often the physical analysis was undertaken. Some members consider analysis of physical risk could be undertaken less frequently, for example every two years, because the climate does not change as fast as the drivers of energy transition risk and opportunity. However, some members felt that an annual review of physical risk was still useful despite this, because the industry's understanding of the data and how to use it is quickly improving. A yearly update could profit from new scientific findings indicating if the world is aligned with particular trajectories. It may also be helpful for external engagement to send the message that physical risk and opportunity is being analyzed annually, as otherwise external stakeholders may receive the impression that it is not considered as important as energy transition risk and opportunity.
- Given the complexity of the analysis, some members found it useful to undertake a limited analysis initially, and then improve the approach year on year. This provides the opportunity to organically develop internal capabilities and tools, staggering the resource requirements over two or more years.

Keeping abreast of developments in datasets, tools and stakeholder expectations

- While some categories of climate-related risk and opportunity are relatively straight forward to analyze and quantify, for example carbon pricing (see EDF Case Study), others such as reputation are less straight forward, relying on proxy indicators such as databases of litigation actions and results. It is therefore

important to stay abreast of new datasets and tools as these become available, which could help to inform analysis.

- Additionally, the expectations of external stakeholders are developing quickly, and so previous assumptions underlying the analysis such as the choice of scenario and the timeframes under consideration, may require regular review.

Don't forget opportunity!

- While the focus of many analyses is risk, the analysis of climate-related opportunity is a cornerstone of the TCFD recommendations and can provide important insights for strategic positioning, to achieve long term sustainable growth.
- The analysis of opportunity can be undertaken using the same framework as the risk analysis, it does not require a specific, different approach.

3.3 CASE STUDIES ON EVALUATING QUANTITATIVE FINANCIAL IMPACTS

The following case studies from WBCSD member companies demonstrate a range of approaches to evaluating the financial and quantitative impacts of climate change using scenario analysis.

EDF: Case study on evaluating quantitative financial impacts

The financial impacts of some scenario indicators are more straight forward to analyze than others. An example of an indicator which is relatively straight forward is carbon pricing, and an example from EDF of the quantification of the financial impact is presented below.⁴⁷

In terms of transition risk and opportunity, the regulations that encourage decarbonization of the energy mix, such as the European Emission Trading System (EU ETS) are considered to be an opportunity for EDF group. The positive financial impact of this opportunity is estimated by comparing the carbon intensity of the electricity produced by EDF group (51 gCO₂e/kWh in 2020) with the average carbon intensity of the electricity in Europe (275 gCO₂e/kWh in 2018). An increase of €10/tCO₂e of the EU ETS carbon price would result in a competitive advantage for EDF group estimated to be €900 million per year, which would enhance the company's financial capacity to deliver the zero emissions investments needed in the future.

Enel: Case study on evaluating quantitative financial impacts

Enel undertakes hotspot analysis of climate-related risk and opportunity, at the portfolio level,

in order to identify key areas of high risk and opportunity, which could warrant further detailed (quantitative) analysis and disclosures in the Company's Annual and Sustainability Report.⁴⁸

Enel has adopted a framework that explicitly represents the main relationships between scenario variables and types of risk and opportunity shown in Figure 10, specifying the strategic and operational approaches to managing them, comprising mitigation and adaptation measures.

There are two main macro-categories of risks/opportunities: those connected with developments in physical variables and those linked to the evolution of the transition scenarios.

Physical risks are divided in turn between acute and chronic, with the former linked to extremely intense meteorological conditions

and the latter to more gradual but structural changes in climate conditions.

The energy transition towards a more sustainable model, characterized by a gradual reduction of CO₂ emissions, has risks and opportunities connected both with changes in the regulatory and legal context and trends in technology development, electrification and the consequent market developments.

Figure 11 is an extract from Enel's Annual Report which summarizes the financial impacts of transition risks on Enel's business. As can be seen, considering the transition scenarios developed by Enel Group for Italy and Iberia, an increase in in the penetration of renewables on the Global Power Generation segment of its business could produce an increase of <EUR 100 million in EBITDA by 2030 compared with 2022.

Figure 10: Framework of main risks and opportunities

Scenario phenomena	Time horizon	Risk & opportunity category	Description	Impact	Management approach
Transition	Starting with medium term (2024-2029)	Market	Risk/opportunity: changes in the prices of commodities and energy, evolution of energy mix, changes in retail consumption, changes in competitive environment.	Considering two alternative transition scenarios, the Group assesses the impact of trends in the proportion of renewable sources in the energy mix, electrification and the penetration of EVs to estimate their potential impacts.	The Group is maximizing opportunities by adopting a strategy founded on the energy transition and the rapid expansion of renewable generation and the electrification of energy consumption .
Transition	Starting with medium term (2024-2029)	Product & Services	Opportunity: increase in margins and greater scope for investment as a consequence of the transition in terms of greater penetration of new electrical technologies for residential consumption and electric transportation .	Trends in the electrification of transportation and residential consumption will potentially have an impact on our business.	The Group is maximizing opportunities thanks to its strong positioning in new businesses and "beyond commodity" services .
	Starting with medium term (2024-2029)	Technology		Considering two alternative transition scenarios, the Group assesses the potential opportunities to scale up current businesses in response to trends in the electrification of transportation.	The Group is maximizing opportunities thanks to its strong positioning in global networks.

Figure 11: Correspondence and degree of intensity between scenario key parameters and operational business indicators

Scenario phenomena	Risk & opportunity category	Time horizon ⁽¹⁾	Description of impact	GBL affected	Scope	Quantification - Type of impact	Quantification - range			
							<100 €mil	100- 300 €mil	>300 €mil	
Chronic physical	Market	Short term	<p>Risk/opportunity: Increase or decrease in electricity demand. Electricity demand is also affected by temperature, whose fluctuations can have an impact on our business. Although structural changes should not emerge in the short/medium-term, in order to assess the sensitivity of Group performance to potential temperature variations, we have performed an analysis of sensitivity to changes of +/- 1% in electricity demand for the Group as a whole.</p>	<p>Global Power Generation and Global Infrastructure and Networks</p> 	Group	EBITDA/year	+1%			
							-1%			
Chronic physical	Market	Short term	<p>Risk/opportunity: Increase or decrease in renewables generation. Renewables generation is also affected by the availability of resources, whose fluctuations can have an impact on our business. Although structural changes should not emerge in the short/medium-term, in order to assess the sensitivity of Group performance to potential temperature variations, we have performed an analysis of sensitivity to changes of +/- 10% in potential electricity output by technology.</p>	<p>Global Power Generation</p> 	Group Potential hydroelectric output	EBITDA/year	+10%			
							-10%			
					Group Potential wind output	EBITDA/year	+10%			
							-10%			
		Group Potential solar output	EBITDA/year	+10%						
				-10%						

(1) Time horizon : short (2020-2022); medium (up to 2030); long (2030-2050).

 Upside scenario current policies  Downside scenario current policies

Source: https://www.enel.com/content/dam/enel-com/documenti/investitori/sostenibilita/2020/sustainability-report_2020.pdf

Iberdrola: Case study on evaluating quantitative financial impacts

Climate-related financial risk and opportunity assessment is coordinated at corporate level by Iberdrola, through an internal multidisciplinary working group, including representatives for each business unit. The methodology considers the impacts on operational indicators resulting from change in macroeconomic or industry parameters which are considered most significant for Iberdrola's businesses in each

country. These indicators are termed "Key parameters of the scenarios" in the table below, and "Scenario Indicators" in this report, through comparing variations per scenario from the company's business-case scenario baseline (IEA-SDS). A change in these parameters affects the group's various businesses to different degrees, and would impact different operational business indicators as shown in Figure 12, which is also presented in Iberdrola's Sustainability Report 2020⁵⁰ (Page 84-90).

The quantitative financial impact on Iberdrola's EBITDA in 2030 is presented in Figure 13. As can be seen, the Retail and Networks businesses could be impacted with losses of under €100 million in terms of expected EBITDA for 2030 under the IEA-STEPS scenario. On the other hand, the opportunities arising from a IEA-Net Zero scenario could have a positive impact on EBITDA of more than €100 million in 2030 for each of the three businesses: Retail, Global Generation and Networks.

Figure 12: Correspondence and degree of intensity between scenario key parameters and operational business indicators

KEY PARAMETERS OF THE SCENARIOS	Total production (GWh)	Renewable capacity (GW)	Thermal capacity (GW)	Customers (GWh)	Investment in networks (M€)
Final electricity demand (TWh)	✓	✓		✓	✓
Weight of electricity in final energy consumption (%)	✓			✓	✓
Renewable share of the generation mix (%)		✓	✓		✓
Installed renewable capacity (GW)		✓			✓
Installed gas capacity (GW)			✓		
Intensity of CO ₂ emissions (grCO ₂ /kWh)			✓		
Total CO ₂ emissions in the electricity sector (MtCO ₂)		✓	✓		
Carbon price (€/tCO ₂)			✓		

Bold: High degree of intensity in the correspondence of these two parameters

Normal font: Average degree of intensity in the correspondence of these two parameters

Figure 13: Financial transition climate related risks and opportunities on Iberdrola’s business for 2030

Impact 2030			STEPS scenario			Net Zero scenario		
Business	Type of impact		Low/NS	Medium	High	Low/NS	Medium	High
	Retail	GWh	▼				▲	
			▬				▲	
	Global generation	MW/GWh	▬			▬		
			▬					▲
			▼					▲
			▬				▬	
	Networks	Investment (M€)	▼				▲	
			▬					▲

Impact on EBITDA 2030 (M€)			STEPS scenario			Net Zero scenario		
Business	Type of impact		<100/NS	100-300	>300	<100/NS	100-300	>300
	Retail	2030 EBITDA	▼				▲	
	Global generation	2030 EBITDA	▬					▲
	Networks	2030 EBITDA	▼					▲

Legend	
▲	Positive impact
▬	Not significant
▼	Negative impact

EDP: Case study on evaluating quantitative financial impacts

The potential physical and transition climate risks and opportunities that may impact EDP Group's business have been identified and aligned with EDP's corporate risk taxonomy, as shown in Figure 14. For example, physical risks have been matched to the risks regarding physical assets (damage to assets, losses in efficiency/performance) and business risks involving variability in renewable resources and in energy consumption, while transition risks have been matched to business risks (energy markets

and regulation), strategic risks involving technological disruption and changes in the competitive paradigm, and legal risks.

There are several physical parameters (from acute and chronic risks) and transition variables, (price of carbon dioxide, price of coal and natural gas, electricity demand and power generation mix), which are used to quantify climate-related risks and opportunities. The quantification process involves the assessment of material impacts in three time horizons: short term (2025), medium term (2030), and long term (2050).

The outcome of risks and opportunities quantification for each business unit under the different scenarios and time horizons, is then aggregated and consolidated in the Climate Value at Risk (VaR) estimation. Figure 15 shows the structure of the exercise of risk and opportunities quantification, as well as some examples of risk assessment conducted by EDP. The consolidated risk quantification results allow an integrated oversight of Climate Value at Risk in EDP, pinpointing the most resilient areas and the areas which may require mitigation measures.

Figure 14: Climate risk taxonomy alignment with corporate risk taxonomy

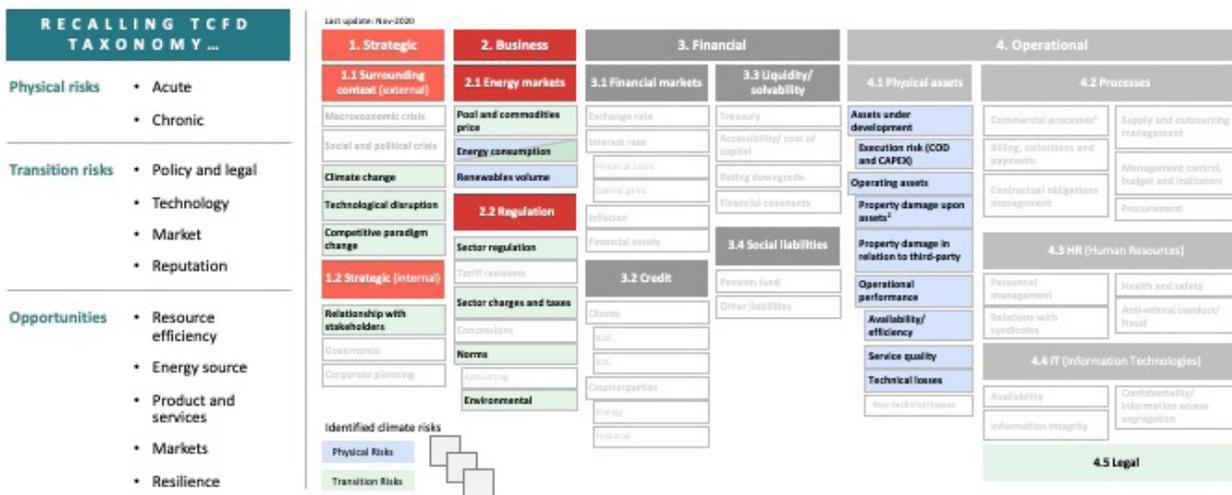
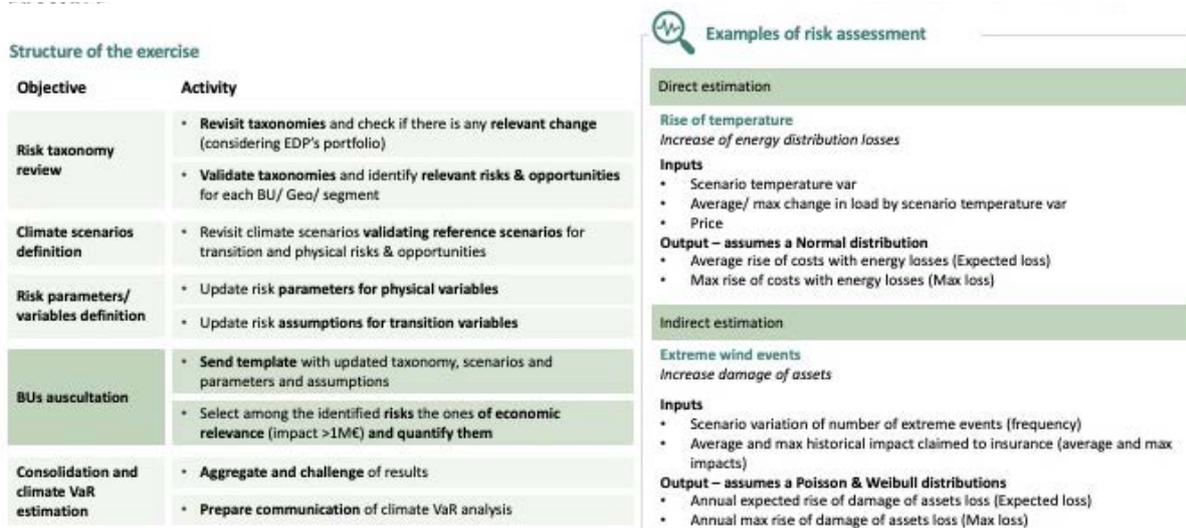


Figure 15: Climate risk taxonomy alignment with corporate risk taxonomy



④ Conclusions and recommendations



4 Conclusions and recommendations

The approaches and case studies developed by WBCSD's power sector members, and presented in this report, offer unique insights from companies which have been developing their responses to TCFD for many years. Methodologies are still under development, however, are shared here to accelerate the adoption across the sector globally of consistent and effective TCFD-aligned analysis and disclosure. This will improve the resilience and strategic decision making of companies in the sector, while also benefitting the global economy and accelerating decarbonization.

The key recommendations arising out of the approaches developed by WBCSD's members include:

- **Developing an effective framework for analysis** of climate-related financial risk and opportunity:

- **Alignment of level of ambition** with stakeholder expectations is key.
- **Choice and range of scenarios** – Including more extreme scenarios can be valuable for stress testing business models.
- **Timeframes** – Set short, medium and long term time horizons that are aligned with company targets (including interim milestones), make sense for the business lines and assets, as well as key stakeholders.

- **Interplay** – Understanding the interplay between physical and transition scenarios is important, for example because scenario assumptions may not be perfectly aligned and impacts may be felt over different time horizons.
- **Terminology** – Using consistent terminology, aligned with the TCFD Recommendations, can avoid confusion and improve comparability.
- **Top-down, bottom-up and hybrid** approaches have all been used with success by WBCSD's members. These approaches have advantages and disadvantages and so companies may wish to explore which approach would add most value.

- **Evaluating climate-related financial risk and opportunity**

- **Define common scenario indicators**
 - The analysis of the impact of climate-related scenarios is expected to take place on a regular basis across all business lines and assets. As such, there is value in defining a series of key parameters that describe the climate drivers and development pathways over the scenario's timeframe, termed "scenario indicators". This ensures

consistency of approach across the portfolio, and different iterations of the analysis. There is also wider value to the industry of this, as it improves comparability of analyses.

- **Consider a phased approach** – A phased approach to analysis can ensure efficient use of resources. This can involve a high level analysis of the full portfolio to identify hotspots of climate-related risk and opportunity, followed by deep dive analysis of assets or business lines which are particularly exposed. The first step is not essential, but can help to focus time and effort on the areas of the business which are most exposed.

- **Metrics** – Climate-related metrics describing financial impacts and resilience come in a variety of forms and are used for different purposes throughout an organization. Metrics such as carbon emissions are commonly used and can support analysis tangibility and comparability, while new emerging metrics such as value-at-risk were found to be valuable to some members, although other members felt that methodologies were not sufficiently advanced yet to give a

meaningful result.

- **Balance resource requirements with business planning** – It is important to balance the resource to undertake the analysis with the value of undertaking the analysis. It may be that it is helpful to undertake energy transition analysis more frequently, as the drivers change more quickly than physical climate change related drivers. However, the expectations of external stakeholders and the potential to improve analysis quickly over time is also worth consideration. Multi-departmental teams working on this topic is also seen as key.
- **Keep abreast of developments in datasets and tools** – While some categories of climate-related risk and opportunity are relatively straight forward to analyze and quantify, for example carbon pricing, others such as reputation are less straight forward. It is therefore important to stay abreast of new datasets and tools as these become

available, which could help to inform analysis. Additionally, stakeholder expectations are developing quickly, which may have implications for scenario choice, timelines and key assumptions such as negative emissions.

- **Don't forget opportunity!** – While the focus of many analyses is risk, the analysis of opportunity is a cornerstone of the TCFD recommendations and can provide important insights for strategic positioning, and long term sustainable growth.

More effective climate-related financial disclosure will be a key tool to accelerate a sustainable transition to a low carbon future. As a relatively early mover in this space, the electric utility sector is ideally placed to share insights from its approaches and contribute to a resilient low carbon future. Methodologies to analyze and quantify climate-related financial risk and opportunity are still under development, and it will be exciting to see these efforts come to fruition over the coming years.

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Glossary

Business-as-usual scenario

- Business-as-usual (BAU) scenarios are based on the assumption that operating practices and policies remain as they are at present. Although baseline scenarios could incorporate some specific features of BAU scenarios (e.g., a ban on a specific technology), BAU scenarios imply that no practices or policies other than the current ones are in place.

Climate-related metric is a quantity indicative of the level of historical, current, and forward-looking climate-related risks and opportunities for a given organization. These indicators are used to track climate-related risks and opportunities and can also be used to measure progress against climate-related targets over the duration of the period for which a target is set.

Climate-related financial impact is a historical or current quantity or forward-looking quantitative outlook (estimate, projection, or forecast) regarding the financial impact of climate-related risks and opportunities on an organization's financial performance or position. The impact on business performance and position is measured through financial metrics such as capital expenditure, operational expenditure or revenue, arising from shifts in scenario indicators under different scenarios.

External scenario: External scenarios are publicly available scenarios that are used by the climate policy and research community. Examples include scenarios developed by the Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA). Publicly available scenarios are typically designed for research and policy purposes and may not

immediately be "fit for purpose" for an organization's scenario analysis.

Internal scenario: Scenarios that define plausible pathways toward different potential futures of an organization; are built based on internally consistent, logical, and credible assumptions; and can be modeled to quantify outcomes specifically for an organization's business operation. Developing climate-related scenarios in-house allows tailoring of scenarios to the specific climate-related risks and opportunities an organization faces.

International Energy Agency (IEA): A Paris-based autonomous intergovernmental organization established in the framework of the Organisation for Economic Co-operation and Development. The IEA works to ensure reliable, affordable, and clean energy for its 29 member countries and beyond. The organisation has four main areas of focus: energy security, economic development, environmental awareness and engagement. Each year the IEA publishes The World Energy Outlook (WEO), which provides analysis and insights on trends in energy demand and supply, and what they mean for energy security, environmental protection and economic development.

Implied Temperature Rise (ITR) – An estimate of the global temperature rise (in °C) above preindustrial levels that would occur if all companies in corresponding sectors had the same carbon intensity as the selected company.

IPCC: Intergovernmental Panel on Climate Change. An international forum of experts established in 1988 and used by the United Nations to undertake periodic assessments that address how climate will change, what its

impacts may be, and how we can respond.

Scenario: A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, commodity prices) and relationships. Note that scenarios are neither predictions nor forecasts, but are useful for providing a view of the implications of developments and actions.

Scenario indicator: Climate scenarios typically comprise large data sets, covering emissions, energy and other metrics across a range of sectors. 'Scenario indicators' within these data sets are leveraged to perform climate risk & opportunity assessment and include parameters such as demand and pricing of different commodities, the energy mix, macro-economic variables such as GDP and population growth and CO₂ emissions intensity. Scenario indicators are sometimes called by other terms including climate factors, variables, drivers or parameters.

Value-at-Risk: Value at risk (VaR) measures the loss a portfolio may experience, within a given time horizon, at a particular probability. Approaches for calculating climate-related VaR are still under development, however ultimately a point may be reached where investors expect climate-related VaR to be disclosed.

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WBCSD's Sustainable Energy Supply project supports energy companies to transition their strategies to achieve positive impact towards the SDGs and emission reductions in line with 1.5°C.

We do this by convening a global sustainability platform of energy companies that enables peer-to-peer exchanges and develops best practice, leading to the collaborative creation of tools and guides for the industry.

Our goal is that by 2025, energy sector members have integrated sustainability objectives into all elements of their company strategy, ultimately leading to the establishment of new norms and stakeholder expectations and driving wider change in the energy sector.

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We do this by engaging executives and sustainability leaders from business and elsewhere to share practical insights on the obstacles and opportunities we currently face in tackling the integrated climate, nature and inequality sustainability challenge; by co-developing "how-to" CEO-guides from these insights; by providing science-based target guidance including standards and protocols; and by developing tools and platforms to help leading businesses in sustainability drive integrated actions to tackle climate, nature and inequality challenges across sectors and geographical regions.

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