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TCFD Climate Scenarios and Company Valuation:
Insights from IFRS Climate Disclosures & Econometric-Financial Modeling

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Foreword

I am deeply grateful to the Nasdaq Nordic Foundation for their generous sponsorship and to the Hanken School of Economics for their invaluable in-kind support. This research is a critical exploration of climate-related financial disclosures and their integration into corporate financial management, addressing one of the most pressing issues of our time — climate change.

The significance of this work lies in its potential to influence how organisations worldwide incorporate climate risks and opportunities into their financial reporting and strategic planning. The TCFD and IFRS guidelines provide a robust framework for this integration, promoting transparency and accountability. The EU's commitment to sustainability through initiatives like the CSRD, ESRS, and the EU Taxonomy further strengthens this framework, ensuring that sustainability is embedded into corporate governance.

This study delves into the complexities of climate scenario analysis and its application in financial forecasting. By examining the practices of Nordic companies, it highlights both the challenges and opportunities in achieving comprehensive and comparable sustainability reporting. The use of Monte Carlo simulations and Discounted Cash Flow analysis to assess the financial impacts of climate change is particularly noteworthy, offering a practical approach for businesses to enhance their resilience and strategic adaptability.

The research presented here is a vital step towards better understanding and managing climate risks, providing valuable insights for policymakers, financial institutions, and businesses alike. It underscores the importance of long-term planning and resilience in the face of climate change, emphasising the need for ongoing efforts to improve sustainability reporting and align it with global standards.

I trust that this report will contribute significantly to the ongoing discourse on sustainability and financial reporting, aiding stakeholders in making informed decisions that support sustainable growth and resilience in a changing climate.

Finally, I would like to thank all my co-authors who put tremendous effort into the Herculean task at hand over the year 2023-24, and my wonderful colleague Carina Knoll for her work in proofreading and finalising the report.

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Prof. Dr. Othmar Lehner

The Report at a Glance

Chapter 1: Introduction The introduction sets the stage for the report by outlining the global focus on climate change and its implications for financial and risk management. It introduces the Task Force on Climate-related Financial Disclosures (TCFD) and the International Financial Reporting Standards (IFRS), emphasising the importance of integrating climate risks into financial planning. It also discusses the European Union's initiatives to enhance sustainability reporting, setting the context for the subsequent chapters.

Chapter 2: EU and Global Sustainability Reporting Frameworks This chapter examines the various sustainability reporting frameworks and regulations implemented by the European Union and at a global level. It covers key aspects of the European Sustainability Reporting Standards (ESRS) and the EU Taxonomy, highlights the significance of the IFRS Sustainability Disclosure Standards (SDS), and discusses the interoperability between IFRS SDS and ESRS.

Chapter 3: Impact of Sustainability-related Aspects on IFRS Financial Reporting Focusing on the integration of sustainability into financial reporting, this chapter explores how climate-related aspects affect IFRS financial statements. It delves into the impacts on various line items, including property, plant, equipment, intangible assets, and financial assets and liabilities, and examines the connection between sustainability information and financial reporting.

Chapter 4: Climate Scenarios: Sources, Content and Applications This chapter provides an in-depth look at climate scenarios, their sources, and applications. It reviews major climate models and data sources, such as those from the IPCC and IEA, and discusses methodologies for scenario analysis, which are crucial for assessing and mitigating climate risks.

Chapter 5: How Nordic Companies Talk About Climate Risk This chapter analyses how Nordic companies communicate their climate risks and strategies. It includes findings from sustainability reports and interviews, highlighting the perception of climate risks, challenges, quantification efforts, decarbonisation strategies, and the impact of new EU regulations.

Chapter 6: Quantifying Risks and Opportunities This chapter introduces methodologies for quantifying climate risks and opportunities, with a focus on Monte Carlo simulations and the Discounted Cash Flow (DCF) analysis. It discusses how these methods can be used to evaluate the financial impact of climate risks on enterprise value.

Chapter 7: The Impact of Climate Risks on Enterprise Value This chapter explores how climate risks and opportunities affect enterprise value. It discusses the application of IFRS Sustainability Standards, climate scenario planning, economic transmission channels, and the integration of climate risk into financial forecasting and strategic planning.

Chapter 8: Illustrative Case Study This chapter presents a detailed case study named “EREL” to illustrate the practical application of Monte Carlo simulations and DCF analysis in assessing the financial impacts of climate change on a hypothetical real estate company. It includes tasks, solutions, and key takeaways.

Chapter 9: Report Summary and Main Takeaways The final chapter summarises the report’s key findings and offers main takeaways. It highlights the critical insights into the intersection of financial reporting, sustainability, and climate risks, providing practical guidance for Nordic companies in their sustainability reporting and strategic planning efforts.

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Glossary

ABM	Agent-based Model
APS	Announced Pledges Scenario
CCS	Carbon Capture and Storage
CDS	Climate Data Storage
CDSB	Climate Disclosure Standards Board
CSO	Climate Security Observatory
CSRD	Corporate Sustainability Reporting Directive
DNSH	Do No Significant Harm criteria
EFRAG	European Financial Reporting Advisory Group
ESG	Environmental, Social and Governance
ESMA	European Securities and Markets Authority
ESRS	European Sustainability Reporting Standards
EU	European Union
FSB	Financial Stability Board
GIS	Geographic Information System
GRI	Global Reporting Initiative
IAMC	Integrated Assessment Model Consortium
IASB	International Accounting Standards Board
IEA	International Energy Agency
IFRIC	International Financial Reporting Interpretations Committee
IFRS	International Financial Reporting Standards
IIASA	International Institute for Applied Systems Analytics
IIRC	International Integrated Reporting Council
IPCC	Intergovernmental Panel on Climate Change

IRO	Impacts, Risks and Opportunities
ISSB	International Sustainability Standards Board
MCS	Monte Carlo Simulation
NFRD	Non-Financial Reporting Directive
NGFS	Network for Greening the Financial System
NZE	Net Zero Emissions Scenario
PCAF	Partnership for Carbon Accounting Financials
RCP	Representative Concentration Pathways
SASB	Sustainability Accounting Standards Board
SBT	Science-based Targets
SSP	Shared Socioeconomic Pathways
STEPS	Stated Policies Scenario
TCFD	Task Force on Climate-related Financial Disclosures
WEO	World Energy Outlook

1 Introduction

The global focus on climate change has heightened awareness of its financial risks and opportunities, prompting organisations to integrate climate considerations into their financial and risk management processes. The Task Force on Climate-related Financial Disclosures (TCFD) has developed guidelines for evaluating these risks and opportunities through scenario simulations. Similarly, the International Financial Reporting Standards (IFRS) emphasise the significance of incorporating climate risks in business valuation, as mandated by IFRS S2, which requires entities to disclose the impact of such risks and opportunities on their financial position, performance, and cash flows across various time horizons, integrating them into financial planning.

In parallel, the European Union (EU) is enhancing sustainability reporting by integrating frameworks like the Corporate Sustainability Reporting Directive (CSRD), the European Sustainability Reporting Standards (ESRS), and the EU Taxonomy. These initiatives aim to embed sustainability into corporate governance and provide stakeholders with credible insights into Environmental, Social, and Governance (ESG) practices. Central to this effort is ESRS Section E1, focusing on climate adaptation and change, aligned with the EU's commitment to the Paris Agreement and climate neutrality. The EU Taxonomy classifies sustainable economic activities, guiding investments towards sustainability and encouraging corporations to adopt sustainable practices and manage environmental risks effectively.

The alignment of EU sustainability standards with global efforts, epitomised by the IFRS Sustainability Disclosure Standards, enhances transparency and comparability of sustainability data across borders. The establishment of the International Sustainability Standards Board (ISSB) and the rollout of IFRS Sustainability Disclosure Standards mark significant milestones in global sustainability reporting. Despite criticisms, these standards aim to streamline reporting practices and align corporate disclosures with broader sustainability goals.

However, the TCFD's 2021 status report identified several challenges, including difficulties in organizational alignment, lack of quantifiable data, comprehensive risk evaluation, and the attribution of effects in financial accounts. Moreover, aligning the extended time horizons associated with climate-related risks and opportunities with shorter business planning horizons poses significant challenges. Another difficulty is obtaining approval for publicly disclosing the results. Disclosing the financial effects of climate-related risks and opportunities becomes more complex when entities provide only specific information about these effects, compounded by the mix of other sustainability-related risks and opportunities, making separation for climate-related disclosure difficult. This can include for example, isolating the effect of climate on the value of an asset at risk from other risks.

Climate scenarios are crucial for anticipating and mitigating risks posed by climate change, enabling businesses, policymakers, and financial institutions to plan strategically. Methodologies and data sources behind major climate scenarios, such as those from the Intergovernmental Panel on Climate Change (IPCC), are vital for comprehensive assessments that help businesses identify both transitional and physical risks, enhancing strategic decision-making.

This research analyses climate risks and opportunities within the context of the TCFD climate scenarios. While it cannot resolve all issues, it examines and proposes how simulations,

particularly Monte Carlo simulations, can aid in understanding the impact of climate risks on IFRS line items and overall enterprise value as an initial step—fulfilling the requirements of IFRS S2. Through examining sustainability reports and conducting interviews with listed Nordic companies, the study explores current practices and needs related to sustainability reporting and climate-related valuations, aiming to provide guidance on meeting IFRS sustainability requirements and enhancing transparency regarding climate risks' implications on business valuation.

Climate risk and opportunity simulations, along with stress tests, are essential for assessing organisational resilience and adaptability, providing insight into how climate-related parameters impact asset and enterprise value. The report explores how climate-related risks affect financial figures and the Discounted Cash Flow (DCF) valuation method, proposing a framework for integrating climate risk into financial forecasting and enterprise valuation. Practical applications for banks, asset managers, and businesses are discussed, guiding internal management decisions, informing investors, and facilitating regulatory oversight, essential for robust financial reporting and strategic planning.

The report concludes with a case study “EREL” illustrating the application of Monte Carlo Simulation (MCS) and DCF analysis to assess the financial impacts of climate change on a fictive real estate company. This case study demonstrates how climate risks influence cash flow planning, discount rates, and terminal value growth factors, providing a robust framework for decision-making and risk management, enabling companies to develop resilient strategies for climate risk management and sustainable growth.

Ultimately, this comprehensive report, supported by the EREL case study, discusses the feasibility and methodology of linking TCFD and company valuation in accordance with IFRS S2. It delves into various crucial aspects related to the intersection of financial reporting, sustainability, and climate risk within the evolving international financial reporting standards. The background section provides a historical overview of the development of the IFRS S standards, offering insights into the driving forces shaping these accounting frameworks, followed by an exploration of European Union regulations on sustainability reporting, shedding light on the regional context and regulatory landscape.

In conclusion, this report provides a detailed exploration of the links between financial reporting, sustainability, and climate risks under the latest IFRS S standards, offering practical guidance for Nordic companies in their sustainability reporting and strategic planning efforts. Three main takeaways emerge: delving into the intersection of IFRS line items and economic transmission channels; highlighting the multifaceted approach of Nordic companies in addressing climate risks and opportunities; and recognising the critical role of growth rate assumptions over five-year planning horizons in assessing the long-term impact of climate risks, emphasising the importance of long-term resilience and strategic adaptability.

The report investigates the intersection of IFRS line items and economic transmission channels affected by climate risks, such as asset valuations, liabilities, revenues, and expenses. These impacts manifest through economic transmission channels, encompassing physical risks like extreme weather events affecting asset integrity and transitional risks such as policy changes influencing market dynamics. Understanding these channels is essential for accurately reflecting climate risks in financial statements and ensuring compliance with IFRS S2 requirements.

Analysing sustainability reports and interviews with Nordic companies reveals a nuanced approach to addressing climate risks and opportunities. Companies exhibit varying degrees of alignment with sustainability frameworks, with some only partially integrating them into strategic operations, indicating a need for more comprehensive integration. Climate scenario planning also varies, ranging from active use to a lack of detailed planning, suggesting opportunities for improvement. Moreover, there is a deficiency in comparability and quantification in disclosures, impeding stakeholders' understanding of companies' climate risk exposure and resilience.

A significant insight from this research is the importance of growth rate assumptions over five-year planning horizons when evaluating the long-term impact of climate risks. Traditional five-year planning may not fully capture the extended and dynamic nature of climate risks and opportunities. Emphasising sustainable growth rates offers a more accurate reflection of a company's ability to adapt and thrive amidst climate challenges, underscoring the significance of long-term resilience and strategic adaptability over rigid short-term planning.

2 EU and Global Sustainability Reporting Frameworks

In recent years, the European Union has taken significant steps towards fostering sustainability and accountability within its corporate landscape. Central to this endeavour are the Corporate Sustainability Reporting Directive (CSRD) and the European Sustainability Reporting Standards (ESRS), which aim to enhance transparency and governance regarding environmental, social, and governance (ESG) practices among large capital firms. These regulations, part of the EU's broader strategy encapsulated in the EU Green New Deal, underscore the importance of integrating sustainability into corporate governance structures.

Under the CSRD, which builds upon the previous EU Non-Financial Reporting Directive (EU 2014/95), large capital firms are mandated to incorporate sustainability reporting into their financial statements, ensuring a comprehensive consideration of the entire value chain, due processes, and continuous governance. This reporting framework adheres to the structure outlined in the ESRS, which comprises various sections addressing environmental, social, and governance aspects subject to a double materiality analysis.

Within this framework, Section E1 of the ESRS holds particular significance, focusing on climate adaptation and climate change issues. This section is pivotal in understanding how companies identify, assess, and manage climate-related risks and opportunities, aligning with the EU's commitment to the Paris Agreement and its overarching goal of achieving climate neutrality. Parallel to the ESRS, the European Union Taxonomy (EU Taxonomy) Regulation stands as a crucial legislative instrument aimed at promoting sustainable investments. This classification system categorises economic activities based on their environmental sustainability, guiding stakeholders in making informed decisions that contribute to the EU's environmental objectives and the transition to a low-carbon economy.

Simultaneously, as climate change continues to present challenges for businesses globally, the need for robust environmental disclosures and strategies to address climate risks becomes increasingly vital. The International Sustainability Standards Board (ISSB) has responded to this demand by consolidating various voluntary frameworks into globally accepted sustainability reporting standards, aiming to streamline reporting practices and align corporate disclosures with broader sustainability objectives. This initiative marks a significant milestone in achieving comparable and reliable sustainability information across industries.

This chapter thus also delves into the importance of the International Financial Reporting Standards (IFRS) Sustainability Disclosure Standards (SDS) and their role in addressing climate-related risks and opportunities. It examines the evolution of sustainability reporting frameworks, from voluntary initiatives to the establishment of the ISSB, highlighting the growing recognition of sustainability issues in business decision-making and the need for standardised reporting practices.

Furthermore, the chapter explores the concept of materiality in sustainability reporting, particularly focusing on the investor-centric approach of the IFRS SDS. It discusses the implications of this approach on reporting practices and stakeholder engagement, while also considering criticisms regarding its narrow focus and potential limitations in addressing broader sustainability concerns.

2.1 European Union Sustainability Reporting Regulations

The Corporate Sustainability Reporting Directive (CSRD) and the European Sustainability Reporting Standards (ESRS) represent significant strides towards enhancing transparency and accountability in sustainability reporting across the European Union. Following the previous non-financial reporting directive (EU 2014/95), the CSRD now applies to all large capital firms if certain thresholds are met. These frameworks are part of the EU's broader strategy (EU Green New Deal) to integrate sustainability into corporate governance, aiming to provide stakeholders with reliable and comparable information on companies' environmental, social, and governance (ESG) practices. The CSRD demands the consideration of the whole value chain, due processes and continuous governance as well as external assurance. The report needs to be part of the financial statements and follow a certain structure as outlined in the European Sustainability Reporting Standard (ESRS). The ESRS is divided into two general sections that always apply (ESRS 1 and 2), as well as five environmental, four social and one governance section. These are subject to a double materiality analysis, meaning an inside-out as well as an outside-in perspective of impacts, risks and opportunities (IROs). In other words, the applicable standards are dependent on the outcome of an analysis of which topics are relevant for a specific company along its value chain.

Figure 2.1.1 The ESRS in an overview. Created by authors, Source EuroLex 2023/2772

Within the ESRS, Section E1 specifically addresses issues related to climate adaptation and climate change. This section is crucial for understanding how companies assess, manage, and report on their climate-related risks and opportunities. The emphasis on climate adaptation and change reflects the EU's commitment to the Paris Agreement and its goal of making Europe the first climate-neutral continent. The ESRS E1 on climate change will be relevant for most companies, either because of their own impact on the climate (for example through emissions or energy usage) or because of the physical as well as transitional climate risks that the company will face over time.

This section delves into the key aspects of ESRS E1 and the EU Taxonomy, examining their respective roles in shaping sustainability reporting and fostering sustainable practices within the European corporate landscape. Furthermore, it explores the nuanced differences between ESRS E1 and the EU Taxonomy, shedding light on their complementary nature and their combined impact on corporate governance, risk management, and reporting compliance processes. Through a comprehensive analysis, this chapter aims to elucidate the evolving regulatory landscape surrounding sustainability reporting in the European Union.

2.1.1 Key Aspects of ESRS E1

Understanding and effectively addressing the intricate challenges posed by climate change is imperative for modern businesses striving towards sustainability. Key aspects of the European Sustainability Reporting Standard (ESRS) E1 shed light on crucial dimensions of this endeavour. From identifying and integrating climate change risks into comprehensive risk management strategies to evaluating their profound impacts on business models and strategic planning, ESRS E1 offers a structured approach. Additionally, it emphasises the importance of scenario analysis, setting climate-related targets, ensuring robust governance structures, and fostering stakeholder engagement. Through this lens, companies can navigate the complexities of climate change, mitigate risks, capitalise on opportunities, and contribute positively to communities and ecosystems. This chapter explores these pivotal aspects in depth, underscoring their significance in the context of sustainable business practices.

1. Identification and Integration into Risk Management

- Identification and Assessment: Companies are required to disclose how they identify and assess climate change risks and opportunities. This includes both the physical risks associated with climate change impacts (such as extreme weather events and long-term shifts in climate patterns) and transition risks related to the shift towards a low-carbon economy (including policy changes, technological advancements, and market shifts).
- Integration into Risk Management: Firms must explain how climate change risks and opportunities are integrated into their overall risk management strategies. This involves detailing the processes for risk identification, assessment, management, and monitoring.

2. Impact on the Business Model and Strategy

- Business Model Considerations: Disclosures should cover how climate change impacts the company's business model, including the implications for products, services, supply chains, and business relationships.
- Strategic Planning: Companies need to outline how their strategies address climate change, including any goals or objectives set to manage related risks and capitalise on opportunities. This may involve shifts in operations, investments in renewable energy, or the development of new products and services.

3. Use of Scenario Analysis

- Scenario Planning: E1 encourages companies to use scenario analysis (following the TCFD) to assess the resilience of their strategies under different climate-related scenarios, including both physical and transition risks. Disclosures should include the

scenarios considered, assumptions made, and potential impacts on the company's financial performance and operations.

4. Targets and Performance Indicators

- Climate-Related Targets: Companies are expected to set and report on specific, measurable climate-related targets, such as reductions in greenhouse gas emissions, increases in energy efficiency, or enhancements in climate resilience.
- Performance Against Targets: Disclosures must include information on the progress made towards achieving these targets, including any metrics or indicators used to measure performance.

5. Governance and Oversight

- Governance Structures: Firms should disclose information on the governance structures and processes in place for overseeing climate change issues. This includes the roles and responsibilities of the board of directors, committees, and senior management in addressing climate-related risks and opportunities.

6. External Impact and Engagement

- Impact on Communities and Ecosystems: Disclosures should also consider the company's impact on communities, natural habitats, and ecosystems in the context of climate change, including efforts to mitigate adverse impacts and enhance positive outcomes.
- Stakeholder Engagement: Companies need to report on how they engage with stakeholders, including investors, customers, and local communities, on climate change issues. This includes how stakeholder feedback is integrated into climate strategy and risk management.

2.1.2 Key Aspects of EU Taxonomy

Closely related to ESRS E1, albeit a different regulation is the European Union Taxonomy (EU Taxonomy). The EU Taxonomy Regulation represents a significant legislative instrument designed to promote sustainable investments by providing a detailed classification of economic activities based on their environmental sustainability. This regulatory framework aims to guide and support companies in navigating through the complexities of sustainable finance. The EU Taxonomy is a classification system established to identify which economic activities can be considered environmentally sustainable. It serves as a critical tool for investors, companies, and policymakers, helping them make informed decisions that contribute to the EU's environmental objectives and the transition to a low-carbon, sustainable economy.

Economic activities under the EU Taxonomy are classified into three main categories, each determined by their contribution to environmental sustainability:

- Primary Activities: Directly contribute to one of the six environmental objectives of the EU Taxonomy, such as climate change mitigation and adaptation. These activities aim to have a direct positive impact on the environment.

- Transition Activities: Support the transition to a climate-neutral economy. Although not considered fully sustainable yet, these activities are crucial for reducing dependence on fossil fuels.
- Enabling Activities: Indirectly support primary activities by facilitating or enhancing their implementation. This includes the development of technologies or services that promote renewable energy or improve energy efficiency.

To qualify as a sustainable activity, it must substantially contribute to at least one of the six environmental objectives following the detailed technical screening criteria, without significantly harming any other objective, adhering to the "Do No Significant Harm" (DNSH) principle. Within these DNSH tests, a climate vulnerability risk analysis is done for activities under the environmental objective of climate change adaptation. Additionally, these activities must meet minimum social safeguards.

The EU Taxonomy outlines six environmental objectives:

- Climate Change Mitigation: Activities that contribute to reducing climate change effects.
- Climate Change Adaptation: Activities that increase resilience to the impacts of climate change.
- Sustainable Use and Protection of Water and Marine Resources: Measures for efficient water use and protection of aquatic ecosystems.
- Transition to a Circular Economy: Activities that increase resource efficiency, waste reduction, and recycling.
- Pollution Prevention and Control: Activities aimed at reducing air, water, and soil pollution.
- Protection and Restoration of Biodiversity and Ecosystems: Efforts to protect natural habitats, restore ecosystems, and conserve biodiversity.

Entities must reveal Key Performance Indicators (KPIs) reflecting their performance regarding the identified sustainable economic activities. This includes the Green Asset Ratio (GAR) for financial companies, and revenue, capital expenditures (CapEx), and operational expenditures (OpEx) related to taxonomy-aligned activities for non-financial companies.

Said current EU regulation makes it clear that climate topics need to be carefully considered in the governance, risk, and reporting compliance processes of all larger capital (limited) companies.

2.1.3 Differences between ESRS E1 and EU Taxonomy

The main reference in the ESRS to the EU Taxonomy regarding climate is found in the ESRS E1-1 topic standard on the transition plan for climate protection. Companies must disclose how their strategy and business model align with the Paris Climate Agreement's 1.5-degree target and the target of achieving climate neutrality by 2050. Quantification and explanation of transition plan investments are required, with a focus on key performance indicators such as capital expenditures (CapEx) and potential CapEx plans in the EU Taxonomy chapter.

Insights highlight the need for EU Taxonomy disclosures to support transition plan disclosures financially, aligning with ESMAs (European Security Market Authority) current enforcement focus, which NFRD (EU Non-Financial Reporting Directive, preceding the CSRD) companies

already should consider. Additionally, there are several thematic connections between ESRS and EU Taxonomy, including climate risk and vulnerability analysis, ecological criteria related to water, pollution, and circular economy, as well as social criteria assessing minimum social protection standards within the EU Taxonomy.

Specifically, in the ESRS E1 transition plan for climate change, quantification involves measurements and assessments related to the company's alignment with the Paris Climate Agreement's goals and the EU Taxonomy criteria.

This includes:

- Alignment with Paris Agreement Goals: Companies are required to quantify how their strategies and business models align with the objectives of the Paris Climate Agreement, particularly the target of limiting global warming to 1.5 degrees Celsius above pre-industrial levels. This may involve calculating their carbon emissions trajectory and setting targets for emissions reduction in line with this goal.
- Investments in Transition Activities: Quantification entails disclosing and explaining the investments made as part of the transition plan. This includes quantifying the financial resources allocated to activities aimed at reducing greenhouse gas emissions, transitioning to renewable energy sources, improving energy efficiency, and implementing sustainable practices across the value chain.
- Key Performance Indicators (KPIs): Companies are expected to quantify their progress towards achieving climate-related objectives through the use of key performance indicators (KPIs). This may include metrics such as capital expenditures (CapEx) allocated to climate-related projects and investments, as well as targets for reducing carbon intensity or increasing the use of renewable energy sources.
- EU Taxonomy Criteria: Quantification involves demonstrating how the company's investments and activities align with the environmental objectives outlined in the EU Taxonomy. This may require quantifying the environmental benefits of projects and initiatives in terms of their contribution to climate mitigation, adaptation, and other sustainability goals defined by the taxonomy.

Overall, quantification of climate impacts in the ESRS E1 transition plan for climate change focuses on providing transparent and measurable information about the company's efforts to mitigate climate risks, potential opportunities, and transitioning to a low-carbon economy - and the impact this has on capital costs, cash flows and ultimately the company value.

2.1.4 Impact on Governance and Compliance

In conclusion, the evolving regulatory landscape surrounding climate-related sustainability reporting within the European Union is becoming increasingly robust and intricate. With the implementation of the CSRD and the development of the ESRS, alongside the comprehensive classification provided by the EU Taxonomy, the EU is setting a precedent for thorough and effective sustainability disclosures. These regulations not only align with the EU’s ambitious Green New Deal but also enhance corporate accountability by integrating sustainability into the core of corporate strategy, governance and reporting processes.

The environmental standard E1 of the ESRS, addressing climate adaptation and change, underscores the EU's commitment to meeting the objectives of the Paris Agreement and

achieving climate neutrality. Complementary to the ESRS, the EU Taxonomy Regulation plays a pivotal role by classifying what constitutes environmentally sustainable economic activities, thereby guiding investment decisions and corporate strategies towards sustainable development. These frameworks collectively encourage corporations to adopt more sustainable practices, assess and manage environmental risks more effectively, and contribute toward the broader goal of climate neutrality.

Overall, the EU's regulatory measures are not just about compliance; they are about integrating sustainability into corporate governance and strategies encouraging companies to adopt forward-thinking strategies that align financial success with environmental stewardship and social responsibility. This chapter has provided a critical overview of how these regulations shape corporate behaviours and the investment landscape, ultimately contributing to a sustainable future.

After exploring essential EU regulations on climate-related sustainability reporting, the next chapter continues with the examination of the impact of sustainability-related considerations on financial reporting under the IFRS financial reporting standards. The newly published IFRS SDS standards will be adopted in non-EU legislation. The interplay between the EU standards and the global IFRS Sustainability Disclosure Standards highlights a dynamic, multi-layered approach to sustainability reporting that could serve as a model for other regions. The convergence of these standards not only aids in harmonizing reporting requirements but also ensures that sustainability data remains transparent, comparable, and useful for a variety of stakeholders. As sustainability-related considerations have multifaceted implications not just on the level of sustainability reports, but in financial reporting as well. Chapter 3 will delve into the impacts of such considerations on valuation, risk assessment, and financial performance under IFRS financial reporting.

2.1.5 Importance of the IFRS SDS standards

Climate change is expected to pose challenges for companies worldwide. Thus, identifying climate risks and developing strategies to mitigate and adapt to them are vital for companies. (Adams & Mueller, 2022). The increasing demand for robust environmental disclosures has led to significant developments in sustainability reporting. Amidst growing market demands for transparent and consistent sustainability information, the International Sustainability Standards Board (ISSB) aimed to consolidate various voluntary frameworks into a globally accepted sustainability reporting standard, addressing fragmentation in reporting practices and aligning corporate disclosures with broader sustainability goals. This initiative marks a critical step towards achieving comparable and reliable sustainability information in the corporate sector. Companies are also recognising the financial risks of climate change, which has led to an increase in the number of companies reporting on them. This change is accelerated by the work of the TCFD, which provides a framework for such reporting (KPMG, 2020). Furthermore, Müller et al. (2024) note, that reporting about climate change is mostly done elsewhere, than in the financial statements. Reporting about the impacts of climate change in financial line items, such as impairments or contingent liabilities is more prominent in the case of EU firms.

In his work published in 2012, Negash presented two potential strategies for increasing the quality of environmental disclosures. The first proposal suggested creating a new mandatory report dedicated solely to environmental issues, while the second proposal entailed modifying the existing framework to include a minimum level of information on environmental and

climate-related matters within the existing International Financial Reporting Standards (IFRS). The article posits that an enhanced IFRS framework would reduce the self-promotional nature of sustainability reports and improve both the quality and consistency of disclosures (Negash, 2012).

Meanwhile, market participants increasingly demand consistent and comparable sustainability data including risks and opportunities. Demand is fuelled by the fact that sustainability-related information is becoming an integral part of business decision-making, for example, in investments (IFRS Foundation, 2024b).

The need for a standardised reporting framework initially prompted an upsurge in the number of voluntary frameworks with different emphases and requirements. (IFRS Foundation, n.d.) Initially, the GRI standards became the most widely used sustainability reporting standard. (KPMG, 2020) After the GRI, which promotes accounting for the organisation's impact on various stakeholders, several other sustainability reports emerged (such as the Climate Disclosure Standards Board (CDSB) in 2007, the International Integrated Reporting Council (IIRC) in 2010, and the Sustainable Accounting Standards Board (SASB) in 2012) that only promote financial materiality. To tackle this fragmentation and the abundance of organisations, the IFRS Foundation, supported by public authorities, other standard setters, and market participants, founded the ISSB to collaborate with other standard setters and build on the existing frameworks to create a globally accepted framework. (IFRS Foundation, 2024b, Deloitte, 2020b) Hence, the ISSB's work is based on an array of pre-existing voluntary reporting framework initiatives, such as the Climate Disclosure Standards Board (CDSB), the Value Reporting Foundation's Integrated Reporting Framework, industry-based Sustainable Accounting Standards Board (SASB) Standards, and the World Economic Forum's Stakeholder Capitalism Metrics, and the Task Force on Climate-related Financial Disclosures (TCFD). (IFRS Foundation, n.d.) More specifically, the structure of the ISSB Standards is based on the TCFD framework's structure of dividing the report into four main topic areas: Governance, Strategy, Risks, and Metrics and Targets. The SASB's work was integrated into the ISSB standards using the industry-based disclosure recommendations of the SASB. In the view of the IFRS, the former diverging frameworks were threatening with the fragmentation of reporting practices causing limited comparability of information, hence the need for a globally accepted framework (Deloitte, 2020a).

In November 2021, the International Sustainability Standards Board (ISSB) was founded in response to the demands of companies, investors, international standard setters, and policymakers (Deloitte, 2020a). Increased shareholder demand for comparable and consistent sustainability information made the situation more urgent for the IFRS Foundation to act. Thus, the ISSB was founded by the Trustees of the IFRS Foundation and consists of eight to fourteen members with adequate professional experience and diverse competence representing each geographical region of the world, including Asia-Oceania, Europe, the Americas, and Africa (IFRS Foundation, 2021). The ISSB is responsible for the preparation and issuance of exposure drafts and final sustainability reporting standards (IFRS Foundation, 2021). Members commit to developing and maintaining sustainability reporting standards that converge with national and regional sustainability reporting standards (IFRS Foundation, 2021).

The ISSB is integrated into the pre-existing governance structure of the IFRS Foundation and works in parallel with the International Accounting Standards Board (IASB) (Deloitte, 2020a).

This collaboration between the two boards ensures that the IFRS Accounting Standards are compatible with the IFRS Sustainability Disclosure Standards (IFRS Foundation, n.d.). To enhance the collaboration between the boards, both are supported by the Integrated Reporting and Connectivity Council with suggestions for implementing the Integrated Reporting Framework into their work (IFRS Foundation, n.d.).

Just two years after the ISSB was founded, two standards dealing with the disclosure of sustainability-related information were published in June 2023. These are IFRS S1 "General requirements for the disclosure of sustainability-related financial information" and IFRS S2 "Climate-related disclosures". The two standards are to be applied for financial years beginning on or after 1 January 2024. IFRS S1 comprises all regulations that are useful from the perspective of the primary users of financial reporting, the providers of equity and debt capital, to be able to make decisions about the financial resources they provide. IFRS S2 - comparable to the European standard ESRS E1 "Climate Change" - defines specific disclosures on the disclosure of information for the identification, assessment and management of climate-related risks and opportunities (Baumüller 2023).

However, as an answer to the IFRS Foundation Trustees' Consultation Paper on Sustainability Reporting, academics criticised the newly proposed IFRS standards because of their investor focus, arguing that sustainable development requires a multi-stakeholder focus. Thus, the single materiality, which only considers the impacts of climate change on the company but fails to address the impact of the company on the climate, the environment, and on the various other stakeholders impacted, is unsuitable for supporting the reaching of sustainable development goals (Adams & Mueller, 2022).

2.2 The IFRS Sustainability Disclosure Standards (SDS)

2.2.1 Materiality and Investor Focus

The International Financial Reporting Standards (IFRS) Sustainability Disclosure Standards (SDS) incorporate a unique aspect known as financial materiality. This concept pertains to the assessment of companies' social and environmental performance within sustainability reports. The Sustainability Accounting Standards Board (SASB) introduced the financial (or single) materiality concept, which focuses solely on the external effects of sustainability-related issues on the company.

Conversely, the double materiality approach considers both the internal and external perspectives. This entails reporting not only the financial materiality, which encompasses the impact of sustainability issues on the company but also the impact materiality, which pertains to the company's influence on the environment and vulnerable stakeholders. The Corporate Sustainability Reporting Directive (CSRD) of the European Union endorses the double materiality approach.

"In the context of sustainability-related financial disclosures, information is material if omitting, misstating, or obscuring that information could reasonably be expected to influence decisions that primary users of general purpose financial reports make based on those reports, which include financial statements and sustainability-related financial disclosures and which provide information about a specific reporting entity." (IFRS Foundation, 2023).

The definition of materiality presented above pertains to financial materiality, which requires reporting entities to disclose the effects of sustainability-related issues on their financial performance. Critics argue that this approach only takes into account the impact of these issues on the company, without considering their broader implications for sustainable development. This short-termism contradicts the long-term time horizons mentioned in the standards and allows for the exclusion of externalities (Adams & Mueller, 2022). It is argued that requesting companies to report on the financial impact of climate change creates an incentive for investors to prioritise financially relevant sustainability issues, thereby driving a change from that perspective (Giner & Luque-Vílchez, 2022).

This focus on the decision-usefulness of "primary users of general purpose financial reports", namely existing and potential investors, lenders, and other creditors, is in line with the objective of the IFRS Sustainability disclosure standards. The objective of these standards is to require entities to disclose sustainability-related risks and opportunities that are useful to primary users of general-purpose financial reports in making decisions related to providing resources to the entity. However, some critics argue that the investor-focused approach of the ISSB standards is too narrow and may not address the information needs of other stakeholders from the sustainability report (Adams & Abhayawansa, 2022).

In a similar manner to the IAS 1 Presentation of the Financial Statements in the Financial Reporting Standards, the IFRS S1 General Requirements for Disclosure of Sustainability-related Financial Information specifies fundamental requirements, such as the structure of the statements and the concepts included in the statements. IAS 1 and IFRS S1 are linked by their common aim of enhancing transparency, accountability, and the provision of valuable information to stakeholders. While IAS 1 focuses on financial dimensions, IFRS S1 expands the scope to sustainability issues, acknowledging the growing significance of environmental and social factors in assessing an entity's performance and prospects. Together, they promote a more integrated approach to reporting, reflecting both the financial and non-financial consequences of business activities on value creation.

The concept of materiality in sustainability reporting standards aligns with the materiality definition in Financial Reporting Standards, which states that “information is material if omitting, misstating, or obscuring it could reasonably be expected to influence decisions that the primary users of general purpose financial reports would make.” (IFRS, 2023a)

2.2.2 IFRS SDS as a Global Baseline

The IFRS SDS adopted by the ISSB are intended to create globally applicable sustainability-related standards in the sense of a "global baseline" (IFRS Foundation, 2023) and thus as a "minimum standard for sustainability reporting" (Borcherding & Engels, 2023), which - as is also the case for IFRS in the context of financial reporting - must be adopted into (supra)national law in order to become legally binding. As the IFRS SDS are understood as a minimum standard, (supra)national legislations are free to make additions with regard to disclosure requirements. To establish these minimum standards worldwide, the ISSB works with local authorities and is supported by the G20 as well as finance ministers and central bank governors from over 40 jurisdictions. In addition, the ISSB's IFRS SDS are based on the standards of the Sustainability Accounting Standards Board (SASB) and the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD), thus drawing on already

established and internationally recognised sustainability reporting standards. This is intended to ensure rapid acceptance of IFRS SDS worldwide (IFRS Foundation, 2024b).

2.2.3 IFRS SDS Endorsement in the EU and Globally

In order for IFRS SDS to become legally binding in the EU, a separate endorsement process is required - as is the case for IFRS financial reporting. IFRS SDS is not expected to be adopted in the near future due to the sustainability reporting adopted by the EU in accordance with the Corporate Sustainability Reporting Directive (EU 2022/2464) (CSRD) and the European Sustainability Reporting Standards (ESRS) developed by EFRAG (Borcherding/Engels, 2023). Although the ESRS are directly applicable to globally active companies based in the European Union, it may be necessary to, for example, apply the IFRS SDS for subgroups or subsidiaries outside the EU. Particularly in countries outside the EU whose financial reporting is already based on IFRS, a rapid adoption or integration of IFRS SDS into existing local sustainability standards can be expected. Brazil[1] as a pioneer in this field is already adopting IFRS SDS. Other countries such as the UK[2] or Australia[3] are integrating the IFRS SDS into their own local sustainability reporting standards. It is therefore becoming apparent that the IFRS SDS will quickly gain acceptance as global sustainability reporting standards. At the end of 2023, almost 400 organisations from 64 countries pledged to promote the introduction or use of climate-related reporting of the ISSB as part of the 28th United Nations Climate Change Conference.

Especially for internationally operating EU-based groups with subsidiaries or subgroups outside the EU, it will probably not be sufficient to implement only the ESRS published by EFRAG, but also the IFRS SDS. At this point, however, it should be mentioned that efforts are being made at the EU level to avoid multiple burdens on companies. Interoperability between the two frameworks is to be achieved through close cooperation between the standard setters (EFRAG, 2022). However, in order to fulfil the content of the CSRD and the ESRS published in this context, additional information may need to be provided (EFRAG, 2023b).

2.3 Interoperability of IFRS SDS and ESRS

The European Commission and EFRAG ensured a high level of interoperability with the previously adopted and comparable ISSB standards “IFRS S1” and “IFRS S2” as early as the preparation process for the European Sustainability Reporting Standard (ESRS) 2 “General Disclosures” and ESRS E1 “Climate-related Disclosures”. Thus, all data points required by IFRS S2 were taken into account either in ESRS 2 (if they are of an overarching nature) or in ESRS E1. The cooperation between the standard setters EFRAG and ISSB in the course of developing the respective sustainability reporting standards has led to the fact that companies reporting in accordance with ESRS will essentially disclose similar information to those following IFRS SDS. Several disclosure standards are similar between the two standard sets (Carlin, 2024). For a more detailed table of comparison between the ESRS and IFRS SDS, see Appendix I.

Due to the high level of interoperability between ESRS and IFRS SDS, the risk that companies based in the EU will have to provide additional information in order to comply with IFRS SDS

[1] See in more Detail IFRS Foundation (ed.) (2024c), download at: https://www.ifrs.org/news-and-events/news/2023/10/brazil-adopts-issb-global-baseline/ (29 February 2024).

[2] See UK Government (ed.) (2023), download at https://www.gov.uk/guidance/uk-sustainability-disclosure-standards (as at 29 February 2024).

[3] In Detail https://kpmg.com/au/en/home/insights/2022/04/issb-sustainability-reporting-disclosures-guide.html (29 February 2024).

is significantly reduced. Thus, the primary addressees of financial materiality under both ESRS 1.48 and IFRS S1.1 are the primary addressees of financial reporting and therefore the (potential) providers of equity and debt capital. At this point, it should be noted that the IFRS SDS focuses exclusively on financial materiality, while EU sustainability reporting within the framework of the CSRD provides for dual materiality.

In order to identify differences between IFRS S1, IFRS S2, and ESRS, EFRAG has created a mapping table[4]. Although the aim was to maximise consistency, there are two differences that lead to differences in reporting between IFRS S1 and S2 – as adopted to date – and ESRS (EFRAG, 2023a). The first difference, which affects all companies, is that IFRS S2 requires companies to state whether their greenhouse gas emission targets are gross or net targets. For net targets, IFRS S2 requires disclosure of how the entity uses the emission credits to achieve the net targets. In contrast, ESRS E1.34ff stipulates that targets for reducing greenhouse gas emissions are only to be defined as gross targets, and therefore the offsetting of emission credits and avoided emissions is not permitted. However, ESRS E1.57 recognises that emission credits can be used for neutrality claims, whereby corresponding information must be provided if the company claims climate neutrality, which includes emission credits. The second difference is that IFRS S2 requires financial institutions to disclose specific information about greenhouse gas emissions associated with their investments (see IFRS S2.B58-B563). ESRS E1 does not currently contain a corresponding requirement for financial institutions[5]. However, it is expected that such provisions will be included in future sector-specific standards (EFRAG, 2023a).

In addition, ESRS 1.131 allows companies to disclose material information in their ESRS sustainability statement on the basis of individual judgment, taking into account the sector-specific IFRS SDS. This provision applies during the transition period until the sector-specific ESRS have been prepared and published. As a result, differences can be avoided during this interim phase.

In addition, ESRS 1.131 allows companies to disclose material information in their ESRS sustainability statement on the basis of individual judgment, taking into account the sector-specific IFRS SDS, during the transition period until the sector-specific ESRS have been prepared and published, which means that differences can in fact already be avoided.

The ESRS also provides a certain degree of flexibility in reporting. Under ESRS 1.114, companies can include additional disclosures in their ESRS sustainability statements that are based either on other legal requirements or on generally recognised sustainability reporting standards and frameworks from other standard-setting bodies such as the ISSB or the Global Reporting Initiative (GRI). This regulation allows companies to fulfil various standards and increases the usefulness and relevance of reporting in accordance with ESRS. However, if a company includes additional information in its sustainability statement that originates from

[4] The mapping table can be downloaded under https://efrag.org/Assets/Download?assetUrl=%2Fsites%2Fwebpublishing%2FMeeting%20Documents%2F2307280747599961%2F04-02%20EFRAG%20SRB%20%20230823%20-%20EFRAG%20IFRS%20interoperability%20and%20mapping%20table.pdf (05.02.2024)

[5] However, ESRS E1.AR46b requires financial institutions to consider the Partnership for Carbon Accounting Financial (PCAF) accounting and reporting standard for greenhouse gases for the financial sector, in particular Part A "Financed Emissions" (December 2022 version), when disclosing information on their Scope 3 GHG gross emissions, but there are no comparable disclosure requirements for financed investments as under IFRS S2.

other legislation or recognised sustainability reporting standards, this information must be clearly identified as such and meet the qualitative requirements for information (ESRS 1.114).

With regard to the reporting requirements of a globally active company, it should be noted that the reporting requirements for the adopted IFRS S1 and S2 are essentially fulfilled at the group level. If IFRS S1 and S2 are adopted into national law by local jurisdictions such as Australia and, if necessary, adapted to include local reporting requirements, these reporting requirements must be met at least at the subsidiary level. As part of the operational implementation, it should be noted that the respective local reporting requirements are complied with at the local individual or subgroup financial statement level outside the EU in addition to the ESRS, which are currently essentially congruent with the basic requirements of IFRS SDS.

When selecting reporting software for sustainability-related disclosures, a globally active company must take into account that the necessary sustainability information can be collected and reported at group and (local) single entity levels.

2.4 Conclusions on Regulations

In conclusion, the European Union has embarked on a transformative journey to bolster sustainability reporting, leveraging initiatives like the CSRD, the ESRS, and the EU Taxonomy. These frameworks are designed to embed sustainability into corporate governance and furnish stakeholders with credible insights into ESG practices.

Central to this effort, the ESRS, notably Section E1, zeroes in on climate adaptation and change, aligning closely with the EU's steadfast commitment to the Paris Agreement and climate neutrality objectives. Complementing the ESRS, the EU Taxonomy classifies sustainable economic activities, offering a roadmap for directing investments towards sustainability. Together, these regulations incentivise corporations to embrace sustainable practices, adeptly manage environmental risks, and actively contribute to climate neutrality.

Moreover, the synergy between EU standards and the global IFRS Sustainability Disclosure Standards epitomises a dynamic approach to sustainability reporting. This intricate framework harmonises reporting mandates, fostering transparency and comparability of sustainability data across borders.

In essence, these regulations signify more than just compliance; they signify a paradigm shift towards embedding sustainability into corporate ethos and strategies. By aligning financial prosperity with environmental stewardship and social accountability, the EU regulations chart a course towards a sustainable future. Meanwhile, the establishment of the ISSB and the subsequent rollout of the IFRS SDS represent significant milestones in the global quest for standardised sustainability reporting. These standards respond to the mounting demand for consistent and comparable sustainability information, aiming to streamline reporting practices and align corporate disclosures with broader sustainability imperatives.

The IFRS SDS, encompassing pivotal standards like IFRS S1 and IFRS S2, provide a comprehensive framework for divulging sustainability-related financial information and climate-related disclosures, respectively. Crafted through collaboration with established frameworks such as the TCFD and the SASB, these standards promise swift global acceptance.

Nevertheless, criticisms have surfaced regarding the investor-centric nature of the IFRS SDS, which predominantly focuses on financial materiality, potentially overlooking broader environmental and stakeholder impacts. While the standards aim to cater to the needs of

primary users of financial reports, concerns linger about their inclusivity and ability to meet the information needs of all stakeholders engaged in sustainability reporting.

Despite these challenges, the IFRS SDS signify a significant stride towards establishing a globally recognised benchmark for sustainability reporting. Their endorsement and integration into existing frameworks like the European Sustainability Reporting Standards underscore efforts to foster interoperability and alleviate reporting burdens on businesses. Through concerted collaboration among standard setters and the adoption of universally accepted standards, the IFRS SDS are poised to play a pivotal role in shaping the future of sustainability reporting on a global scale.

The next chapter presents the impact of sustainability-related aspects on IFRS financial reporting in greater detail.

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1.

2.6 Appendix I: ESRS and IFRS SDS comparison table

Pillar	Specific disclosure	ISSB	ESRS
Governance		IFRS S2.6(a)	ESRS 2.22(a)
		IFRS S2.6(a)(i)	ESRS 2.22(b)
		IFRS S2.6(a)(ii)	ESRS 2.23
		IFRS S2.6(a)(iii)	ESRS 2.26(a)
		IFRS S2.6(a)(iv)	ESRS 2.26(b)
		IFRS S2.6(a)(v)	ESRS 2.22(d)
		IFRS S1.21(b)	ESRS 2.29(b)-(c)
			ESRS EU3
			ESRS 1.124
		IFRS S2.6(b)	ESRS 2.22(c)
		IFRS S2.6(b)(i)	ESRS 2.22(c)(i)
		IFRS S2.6(b)(ii)	ESRS 2.22(c)(iii)
Strategy	Climate-related risks and opportunities	IFRS S2.10(a)	ESRS 2.48(a)
		IFRS S2.10(b)	ESRS E1.18
		IFRS S2.10(c)3	ESRS 2.48(e)
		IFRS S2.10(d)[4]	ESRS 1.77(a)-(c) ESRS 1.78
			ESRS 1.80
			ESRS E1.AR11(b) ESRS 2.9(a)-(b)
		IFRS S2.12*	ESRS 1.10
			ESRS 1.11
			ESRS 1.30(a)
			ESRS 1.130
			ESRS 1.131(b)
	Business model and value chain	IFRS S2.13(a)	ESRS 2.48(b)
		IFRS S2.13(b)	ESRS 2.48(a)
	Strategy and decision-making	IFRS S2.14(a)(i)	ESRS 2.47 ESRS 2.48(b)
			ESRS E1.AR8(b)
		IFRS S2.14(a)(ii)[5]	ESRS 2.68(b) ESRS E1.26 ESRS E1.28
			ESRS E1.AR31
		IFRS S2.14(a)(iii)5	ESRS 2.68(b) ESRS E1.26 ESRS E1.28
			ESRS E1.AR31
		IFRS S2.14(a)(iv)*	ESRS E1.14 ESRS E1.16(a)-(i)
			ESRS E1.AR2-AR5
			ESRS 2.69(a)-(b)
		IFRS S2.14(a)(v)	ESRS 2.68(a)-(e)
			ESRS 2.69(a)-(c) ESRS E1.26-27
		IFRS S2.14(b)	ESRS 2.69(a)-(c)
			ESRS E1.26

Pillar	Specific disclosure	ISSB	ESRS
		IFRS S2.14(c)	ESRS E1.16(j)
			ESRS 2.68(e)
	Financial position, financial performance, and cash flows	IFRS S2.15(a)	ESRS 2.48(d)
		IFRS S2.16(a)	ESRS 2.48(d) ESRS Annex II, Table 2 (Terms defined in the ESRS): current financial effects
		IFRS S2.15(b)	ESRS 2.48(e)
		IFRS S2.16(b)	ESRS 2.48(d)
		IFRS S2.16(c)(i)-(ii)	ESRS 2.48(e)
		IFRS S2.16(d)	ESRS 2.48(e)
		IFRS S2.17**	ESRS E1.AR70(a) ESRS E1.AR73(a)
			ESRS E1.AR74(a)
	Climate resilience	IFRS S2.22(a)	ESRS E1.19
		IFRS S2.22(a)(i)	ESRS E1.19(c)
			ESRS E1.AR8
		IFRS S2.22(a)(ii)	ESRS E1.19(c)
			ESRS E1.AR8(a)
		IFRS S2.22(a)(iii)(1-3)	ESRSE1.19(c)
			ESRS E1.AR8(b)
		IFRS S2.22(b)(i)*	ESRS El 19(a)-(c)
			ESRS E1.AR13(d)
		IFRS S2.22(b)(i)(1)	ESRS E1.AR13(a)
		IFRS S2.22(b)(i)(2)*	ESRS E1.21 ESRS E1.AR11(d)
			ESRS E1.AR12(c)
		IFRS S2.22(b)(i)(3)*	ESRS E1.21 ESRS E1.AR11(d)
			ESRS E1.AR12(c)
		IFRS S2.22(b)(i)(4)*	ESRS E1.20(c)(i)
			ESRS E1.AR12(c)
		IFRS S2.22(b)(i)(5)	ESRS E1.AR13(b)
		IFRS S2.22(b)(i)(6)	ESRS E1.AR13(b)
			ESRS E1.AR7(b)
		IFRS S2.22(b)(i)(7)	ESRS E1.19(a) ESRS E1.AR13(d)
			ESRS E1.AR6
		IFRS S2.22(b)(ii)*	ESRS E1.AR13(c)-(d)
		IFRS S2.22(b)(iii)	ESRS E1.19(b)
		IFRS S1.23 IFRS S1.B42(c)	ESRS E1.AR15 ESRS 1.90
			ESRS 1.123-129
		IFRS S2.23*	ESRS 1.131(b) ESRS 1.130
			ESRS 1.11
			ESRS 1.30(a)

Pillar	Specific disclosure	ISSB	ESRS
Risk Management		IFRS S2.25(a)	ESRS E1.20 ESRS E1.22 ESRS E1.23
			ESRS E1.24
		IFRS S2.25(a)(i)	ESRS 2.53(g)
		IFRS S2.25(a)(ii)*	ESRS E1.21
		IFRS S2.25(a)(iii)	ESRS 2.53(c)(ii)
		IFRS S2.25(a)(iv)	ESRS 2.53(c)(iii)
		IFRS S2.25(a)(v)	ESRS 2.53(e) ESRS 2.53(c)
			ESRS 2.65(a)
		IFRS S2.25(a)(vi)	ESRS 2.53(h)
		IFRS S2.25(b)*	ESRS 2.53(c) ESRS E1.20(c) ESRS E1.65(a) ESRS E1.19(b)-(c)
			ESRS E1.24
		IFRS S2.25(c)	ESRS 2.53(e)-(f)
		IFRS S2.26	ESRS 1.QC17
			ESRS 1.115
Metrics		IFRS S2.29(a)(i)(1-2)**	ESRS E1.44(a)-(b)
		IFRS S2.29(a)(i)(3)** IFRS S2.B38-B57	ESRS E1.44(c) ESRS 1.62-67 ESRS 1.QC5 ESRS 1.696
			ESRS E1.AR39(b)
			ESRS E1.AR46(g)
		IFRS S2.29(a)(ii)[7]	ESRS 1.62
			ESRS E1.AR39(a)
		IFRS S2.29(a)(iii)(1-3)	ESRS E1.AR39(b)8 ESRS 2.77(a)
			ESRS 2.80(i)
		IFRS S2.29(a)(iv)*	ESRS E1.50
		IFRS S2.29(a)(v) IFRS S2.B30	ESRS E1.49 ESRS E1.49(a)
		IFRS S2.B31	ESRS E1.AR45(d)
		IFRS S2.29(a)(vi)(1) IFRS S2.B32	ESRS E1.51 ESRS E1.AR45(c) ESRS E1.AR46(c)
			ESRS E1.AR46(i)
		IFRS S2.29(a)(vi)(2)*	ESRS 1.131(b)
			ESRS E1.AR46(b)
		IFRS S2.B19	ESRS E1.AR42
		IFRS S2.B56(a)	ESRS E1.AR46(g)
		IFRS S2.B56(b)[9]	ESRS E1.AR46

Table 2.6.1 ESRS and IFRS SDS comparison table, (Carlin, 2024)

Notes to table 2.6.1

3. Paragraph 10(c) of IFRS S2 requires disclosure of over which time horizons the risks and opportunities are expected to occur. Paragraph 48(e) of ESRS 2 requires disclosure of over which time horizons the anticipated financial effects of the risks and opportunities are expected to occur. Where these time horizons are the same, the disclosure is aligned. Where these time horizons are different, the entity will need to ensure that additional disclosure is provided.

4. Paragraph 10(d) of IFRS S2 does not provide a specific definition of time horizon but requires disclosure of how an entity defines short term, medium term and long term and how these definitions are linked to the planning horizons used for strategic decision making. Paragraphs 77-78 of ESRS 1 include standardised definitions of time horizons, but allow deviation when the use of the pre-defined medium- or long-term time horizons results in non-relevant information (see paragraph 80 of ESRS 1). Paragraph 9 of ESRS 2 mandates disclosure of an entity's definition of medium- or long-term time horizons if they differ from the standardised definitions and the reason for applying these definitions. Disclosure is aligned if default time horizons are used and the specific disclosure required by paragraph 10(d) of IFRS S2 is provided, or if alternative time horizons are used, if the disclosures required by both paragraph 10(d) of IFRS S2 and paragraph 9 of ESRS 2 are provided.

5. Paragraph 68(b) of ESRS 2 requires disclosure of the scope of key actions (that is, coverage in terms of activities, upstream and/or downstream *value chain,* geographies and, where applicable, affected stakeholder groups). The disclosure of upstream and/or downstream value chain applying ESRS corresponds to the disclosure of indirect actions applying ISSB Standards. Disclosure is aligned if the entity applying ESRS discloses the scope of key actions including coverage in terms of value chain and classifies its actions as direct (corresponding to the actions in own operations for ESRS) or indirect (corresponding to the actions in the value chain for ESRS, as suggested in paragraph AR31 of ESRS E1).

6. As part of the required Scope 3 measurement framework described in paragraphs B38-B57 of IFRS S2, paragraphs B43 and B47 of IFRS S2 require the entity to prioritise direct measurement of Scope 3 greenhouse gas emissions. Paragraph 69 of ESRS 1 requires an entity to first make a reasonable effort to collect value chain information before using estimates for value chain data. Both requirements in the standards result in a priority given to direct measurement.

7. Paragraph 29(a)(ii) of IFRS S2 requires an entity to measure its greenhouse gas emissions in accordance with the Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (2004, GHG Protocol), unless required by a jurisdictional authority or exchange on which the entity is listed to use a different method for measuring greenhouse gas emissions. ESRS E1 has been built incorporating in its text content from the GHG Protocol, and has specific requirements regarding organisational boundary (see Section 4.1(vii)). When additional guidance is needed, paragraph AR39(a) of ESRS E1 requires entities to consider the principles, requirements and guidance provided by the GHG Protocol and allows an entity to consider the requirements stipulated by ISO 14064-1:2018 or Commission Recommendation (EU) 2021/2279. Where ISO 14064-1 deviates from the GHG Protocol reporting rules, ESRS require reporting in accordance with ESRS E1, including requirements on organisational boundary (see Section 4.1(vii)) and the GHG Protocol. An entity that is required to apply ESRS E1 is expected to comply with the guidance of the GHG Protocol in disclosing the emissions of the consolidated group under the financial control approach (see paragraph 50(a) of ESRS E1). See also Section 4.2 for the emissions of entities, sites and assets under operational control.

8. In order to align, disclosure of approach, inputs and assumptions used to measure Scope 3 greenhouse gas emissions should also include information about the characteristics described in paragraph B40 of IFRS S2.

9. Paragraph B56(b) of IFRS S2 requires disclosure of the extent to which the entity's Scope 3 greenhouse gas emissions are measured using verified inputs. ESRS sustainability statements are mandatorily subject to assurance. An entity applying ESRS that wants to comply also with the disclosure requirements in IFRS 82, should specifically disclose the extent of verification provided by the performance of mandatory assurance.

10. If the metric has been developed by the entity, the disclosure requirements in paragraph 50 of IFRS S1 will apply.

11. Paragraph 80(1) of ESRS 2 requires disclosure of methodologies used to define targets including alignment of targets with international policy goals where applicable. For climate targets, international policy goals are deemed to be applicable in ESRS.

12. Paragraph 34(a) of IFRS S2 requires disclosure of whether the target and methodology for setting the target has been validated by a third party. Paragraph BC149 of the Basis for Conclusions on IFRS S2 provides additional explanation on the requirement, clarifying that 'validation' in IFRS S2 is only in reference to whether and how a climate-related target has been tested and confirmed by a third party in relation to the latest climate science. Paragraph 34(e) of ESRS E1 requires disclosure of whether the targets have been externally assured. Entities applying IFRS S2 and ESRS should ensure to provide disclosures in this area that meet the requirements of both sets of standards. In ESRS E1 targets are defined as supporting the objectives of the Paris Agreement. Sustainability statements prepared applying ESRS are mandatorily assured. For entities applying ESRS the validation of the methodology and its consistency with the latest climate science would be considered as part of the assurance process of the target itself.

3 Impact of Sustainability-Related Aspects on IFRS Financial Reporting

3.1 Connectivity of Sustainability and Financial Reporting Information

In the course of Art. 19a (1) CSRD, it was determined at the EU level that sustainability reporting as a non-financial statement must in the future be made as a separate section in the management report, which means that it is subject to the same preparation and publication requirements as financial reporting (Borcherding & Engels, 2023). At the same time, it must also be ensured that the information in sustainability reporting is consistent with the other reports in corporate reporting (in particular the (consolidated) financial statements) and that redundant information must be presented in a comprehensible manner by means of references (Baumüller, 2023).

Even if the IFRS SDS do not specify where sustainability reporting must be located (IFRS S1.60), it was stated that sustainability reporting is part of financial reporting and that integration in the management report is conceivable in certain jurisdictions (for example within the EU). In addition, consistent information between sustainability and financial reporting is essential in accordance with IFRS S1.21 in conjunction with IFRS S1 B39 ff. Connectivity between sustainability reporting and financial reporting must be presented transparently and comprehensibly in the sustainability reporting as well as in the notes to the financial reporting (IFRS S1.21 and IFRS S1.62f).

This means that information on sustainability-related aspects in the (IFRS) financial statements must be consistent with the information in the sustainability report in the management report (IDW, 2021) regardless of the accounting standards applied (IFRS/local national GAAP) and sustainability standards (IFRS SDS/ESRS).

3.2 Importance of Climate-Related Aspects for Financial Reporting

Sustainability aspects are therefore not only relevant for non-financial sustainability reporting but also have an impact on the information published as part of financial reporting. For this reason, the IFRS Foundation published the learning materials "Effects of climate-related matters on financial statements" in July 2023 immediately after the publication of IFRS S1 and S2. The aim is to remind users and stakeholders of IFRS financial reporting once again[6] that there are long-standing requirements in IFRS accounting standards to consider the effects of climate-related matters in financial reporting if these are deemed to be material (IASB, 2023).

The fact that sustainability-related aspects will have an impact on IFRS financial reporting is also reflected in the audit priorities of the European Securities and Markets Authority (ESMA) in the course of enforcement audits. For example, ESMA has been requiring consistent disclosures on climate-related aspects in IFRS financial statements since 2021, in particular on climate-related targets such as emissions reduction and decarbonisation. For financial statements for 2023, the focus has been set on the disclosure of accounting policies for emissions trading and renewable energy certificates. In addition, issuers are to disclose details of power purchase agreements (PPAs), including price conditions, volumes, and accounting methods. In addition to the disclosure requirements, there is also a focus on the consideration of climate risks in the valuation of non-financial assets (ESMA, 2023b).

[6] The learning materials, which exemplify the consistent application of the requirements in the IFRS accounting standards, were published for the first time in November 2020.

Even if the IFRS accounting standards do not contain a specific standard or direct references to sustainability issues, the IFRS are based on a principles-based approach. The aim of IFRS accounting is to provide information about an entity's financial position, financial performance, and cash flows that is useful to the primary users of financial reporting (investors and creditors) (IAS 1.9). In this context, sustainability aspects can also become relevant for financial reporting, especially if they are or could become financially significant. This can be relevant both for the measurement of individual items in the IFRS financial statements and for disclosure requirements in the notes. The assessment of the influence of sustainability factors must be made on the basis of all relevant facts and circumstances and is often at the discretion of the reporting company. In practice, it must therefore be ensured - as described above - that there is consistency between the information in the sustainability reporting and the financial reporting - i.e. the possible effects of climate-related risks and opportunities, for example, are also reflected accordingly in the financial reporting and vice versa (IDW 2021).

In March 2023, the IASB launched a project aimed, among other things, at improving the presentation of climate-related risks in IFRS financial statements and increasing the appropriateness of recognising these risks in relation to the carrying amounts of assets and liabilities. The project will also examine whether IFRS learning materials can address these. However, it will not develop a new IFRS standard on climate-related risks or provide comprehensive application guidance for IFRS to reflect climate-related risks and opportunities, as this would contradict the principle orientation of IFRS. Furthermore, the project does not aim to extend the objectives of IFRS financial statements, change definitions of assets and liabilities, or develop accounting requirements for pollution pricing mechanisms. Material information, i.e. information that can influence the decisions of the main users of financial statements (such as investors and creditors), should be included in financial reporting in accordance with IFRS principles.

If sustainability issues have a material financial impact on a company, for example through climate risks, social responsibility, or governance issues, they could be considered reportable under these principles. Based on publications by the IFRS Foundation, which focus on the impact of climate-related aspects on financial reporting, which also generally considers ESG risks and their impact on IFRS financial reporting, the following section discusses potential impacts on financial reporting that may affect recognition, measurement and disclosure requirements, with a particular focus on climate-related aspects.

3.3 Impact of Climate Change on Line Items in IFRS Statement of Financial Position

The impact of climate change on financial reporting under the International Financial Reporting Standards (IFRS) is profound and wide-ranging, affecting numerous aspects of financial disclosures. The implications extend across various IFRS items, highlighting the necessity for entities to carefully evaluate and disclose the effects of climate change on their financial statements.

Beginning with IAS 1, Presentation of Financial Statements, climate change introduces significant considerations in the valuation of assets and liabilities, potentially altering financial statements substantially. This standard is also impacted by the uncertainty surrounding the going concern assumption, as financial strains from climate change could challenge an entity's ability to continue operating. Furthermore, climate change amplifies sources of estimation uncertainty, influenced by unpredictable future economic conditions. (EY, 2023)

3.3.1 Effects on PPE, Intangible Assets and Investment Property

Property, plant and equipment (PPE), and intangible assets are recognised in accordance with IAS 16 and IAS 38. Investment property is property held for capital appreciation or to earn rentals in accordance with IAS 40.7.

Climate-related aspects can be expenses for changing or adapting business activities and business operations, including research and development, and therefore also affect the aforementioned assets.

Due to climate policy developments, climate policy aspects can also lead to new disposal, restoration, dismantling, and similar obligations for property, plant and equipment, or financial real estate. These are to be presented as subsequent acquisition or production costs of existing assets, provided they fulfil the general capitalisation requirements. In addition, (subsequent) acquisition costs that are capitalised in accordance with the component approach and depreciated separately are also conceivable. Examples include the installation of climate-neutral heating systems, building shading and greenery, or energy management systems.

Risks and opportunities related to climate change may prompt businesses to change their business models, reorganise their operations, invest in new sustainable technologies, or develop more sustainable products for their portfolios. This might lead to an increase in research and development activities, thus in the increase of research expenses and the increase of capitalised development expenses. (Haberl-Arkhurst & Sternisko, 2020) Development expenses can be capitalised if, after the development phase, an intangible asset is produced that can be used or sold by the company, which use or sale will generate economic benefits for the organisation (IAS 38.57). If there is no asset arising from research, then expenditures shall be recognised according to IAS 38.54.

For property, plant and equipment, intangible assets, and investment property measured at cost, the estimated residual value and expected useful life of an asset must be reviewed at least once a year (see IAS 16.51, IAS 38.102, and IAS 40.56 in conjunction with IAS 16.51). Changes that may result from climate-related issues must be taken into account in the amount of depreciation and amortisation in the current and subsequent periods, and any resulting changes in estimates must be disclosed in the notes (see IAS 8.39). Climate-related aspects can influence the estimated residual value and the expected useful life of assets, for example, due to technological progress such as the development of (new) more climate-friendly technologies or change in the use of a carbon-intensive asset due to lower customer demand. However, legal restrictions such as the ban on combustion engines or shifts in demand behaviour (see IDW, 2021), for example, increased demand for electric vehicles or recycled products that cannot be produced with existing assets, can also limit the useful potential of already capitalised property, plant and equipment and intangible assets. This can lead to reduced useful lives and residual values. An example of this is presented in the consolidated financial statements of Hapag-Lloyd AG:

> *"The provisional assessment of the impact of new environmental regulations on the economic viability and efficiency of some older vessels particularly affected by these regulations resulted in a recalculation for these vessels in the third quarter of 2021 and thus a shortening of their estimated remaining useful lives by one to five years. The rules for implementing these provisions have now been clarified, permitting these vessels to remain in use for longer. Therefore, these vessels are now to be decommissioned later than had been assumed in the previous year. Due to the*

individual extension of their useful life by one to three years, this improved EBIT both in the second half and for the 2022 financial year as a whole in the amount of EUR 77.0 million. The effect for Q4 2022 amounts to EUR 38.5 million. The effect will be reversed in the three complete consecutive financial years from 2023 onwards. However, the general useful life of vessels remains unchanged at 25 years." (IFRS consolidated financial statements of HAPAG-Lloyd AG 2022, p. 163).

When testing for impairment in accordance with IAS 36, climate-related aspects can be indications of possible impairment (Haberl-Arkhurst & Sternisko, 2020). In connection with the impairment test, external indicators such as changes in market value or changes in the interest rate that affect the discount rate of future cash flows, or internal indicators such as technological obsolescence or the implementation of a more climate-friendly corporate strategy that result in lower cash flows from use and sale, can be an indication of the impairment of individual assets as well as individual or several cash-generating units (CGUs) including goodwill (IAS 36.9 and IAS 36.12). The recoverable amount, which is the higher of value in use (IAS 36.30 et seq.) and net realizable value (IAS 36.28 et seq.), is used as a benchmark for impairment (IAS 36.18). In the absence of observable market prices, model-based valuation methods (often discounted cash flow (DCF) methods) are used to measure the value in use and net realizable value of CGUs (PwC, 2022). Even if the classification in the fair value hierarchy is based on the lowest level of inputs (according to IFRS 13 as level 3 for significant unobservable inputs), observable inputs should be maximized in the valuation and unobservable inputs minimized. If no market prices are available, the fair value measurement at Level 3 must reflect how a market participant would determine the value of the CGU. When determining the value at Level 3, it is essential to consider assumptions that include market participants' perspectives on climate risks or opportunities.

Sustainability-related aspects can influence cash flows, for example through shifts in demand behaviour or higher payouts such as higher insurance costs, for example to take certain assets or construction measures to protect against extreme weather events, but also a CO2 tax. With regard to climate-related aspects that affect future cash flows, industry forecasts or regulatory requirements must be taken into account in any case (PwC, 2022, FAQ 5.141.4).

When determining the value in use, it should be noted that expansion investments and other investments to improve profitability as well as future - not yet mandatory - restructurings in accordance with IAS 36.44 are not considered. On the other hand, in accordance with IAS 36.49, capital expenditure that enables the economic benefits of an existing asset to be maintained at the current level must be recognised (IDW, 2021). Construction measures that serve to protect the assets and maintain the economic benefit of the assets currently recognised at the reporting date must be taken into account. Such considerations are also to be taken into account at the CGU level, for example, expansion investments that include future positive cash flows from new business areas are not to be taken into account for the calculation of the value in use in order to compensate for negative cash flow developments in existing business areas (Buchberger & Richter, 2023).

When determining the fair value less costs to sell (level 3) during the impairment test in accordance with IAS 36, and when opting to measure property, plant and equipment, intangible

assets[7] or investment property[8] at fair value, it is essential to consider expansion investments and performance improvements. However, the measurement must be carried out from the perspective of the market participants (see IFRS 13.12 in conjunction with IAS 13.22).

Sustainability risks will also affect the creditworthiness of borrowers in the future. Borrowers with higher sustainability risks therefore bear higher capital costs, which are also reflected in the discount rate. However, when calculating the value in use or fair value (level), it must be considered that climate-related financing risks may not be considered twice and are therefore reflected either in the cash flows or in the discount rate (IAS 36.56).

The perpetuity is also of particular importance, as it represents the value of an asset or CGU after the detailed planning phase. It can be assumed that the perpetuity, in particular the growth rate defined therein, is strongly influenced by the effects of climate change and other ESG factors on the business model (IDW, 2021).

It should be noted that, in accordance with IAS 36, disclosures must also be made on events and circumstances that led to the recognition of an impairment loss as well as disclosures on significant assumptions used in estimating the recoverable amount and possible changes to these assumptions (IAS 36.132 in conjunction with IAS 36.134). However, this information in the IFRS financial statements must also be consistent with the non-financial information in the management commentary. This is exemplified by the disclosures on impairment testing in the IFRS financial statements and the disclosures on impairment risks in the sustainability statement in the management commentary of BASF SE (ESMA, 2023a).

Disclosure in the Notes of the IFRS financial statements	**Non-financial information in the management commentary**
14 Intangible assets (...) Goodwill "*The fundamental transformation of the automotive industry will have a significant impact on the emissions catalyst business, which belongs to the Catalysts (excluding battery materials) cash-generating unit. Because there were no material changes in planning assumptions from the previous year, the growth rate for perpetual annuity remained unchanged at -0.7%. In the planning period, the demand for catalysts is still expected to remain stable as a result of higher environmental standards. In the medium term, the transition from combustion*	**Impairment risks** *(...) "Climate policies are also causing fundamental changes in the automotive industry, one of BASF's key customer industries. The transition to electromobility will have a long-term negative impact on the emissions catalyst business. This development was accounted for in the adjustment of the growth rate for the goodwill impairment test and did not lead to an impairment. Other BASF businesses will benefit from this transformation; for example, demand for innovative lightweight components and battery materials will grow."* (BASF 2022 Annual Report, p. 164).

[7] In accordance with IAS 16.29ff and IAS 38.72ff, property, plant and equipment and intangible assets can also be measured at fair value, with changes in value above amortized cost being recognized in other comprehensive income (OCI).

[8] According to IAS 40.30 et seq. for subsequent measurement companies can choose to use to assess their investment properties at amortized cost or at fair value.

Disclosure in the Notes of the IFRS financial statements	Non-financial information in the management commentary
engines to electromobility will lead to a steady decline in demand." (BASF 2022 Annual Report, p. 242). "(...) *After determining the recoverable amounts of the cash-generating units, it was found that deviations from the key assumptions classified as possible for all units except for the Catalysts (excluding battery materials) and Surface Treatment units allocated to the Surface Technologies segment would not result in the carrying amounts of the units exceeding their recoverable amounts*." (BASF 2022 Annual Report, p. 243)	
* emphasis of the authors in bold	

Table 3.3.1.1 – Disclosure in the Notes to the IFRS financial statements and the related Non-financial information in the management commentary

3.3.2 Right-of-use Assets and Lease Liabilities

Climate-related measures can lead to significant changes in right-of-use assets and the associated lease liabilities. A change in the utilisation or expected utilisation of leased assets, for example due to sustainability-related regulatory requirements or corporate objectives, can have a significant impact on accounting. In accordance with IAS 36.14, right-of-use assets must be regularly tested for impairment. If a lessee plans to reduce the use of leased assets, for example, to achieve climate-neutral production processes, any contractual adjustments (for example shortening the term or cancellation options) in accordance with IFRS 16.44 ff. lead to a modification of the right-of-use asset and the lease liability on the liabilities side. If a lessee decides not to use a leased asset for its entire term without formally amending the contract, this may require an impairment test in accordance with IAS 36 as well as a reassessment of the amortisation period of the right-of-use asset, as stipulated in IFRS 16.31 in conjunction with IAS 16.51 (IDW, 2021).

Climate-related factors can influence the accounting treatment of right-of-use assets and leases to the extent that lease payments that are directly dependent on hours of sunshine or wind strength are not automatically considered quasi-fixed within the meaning of IFRS 16.27(a) and IFRS 16.B42, even if there is a high probability of occurrence. If the payments for a lease, such as for a solar or wind power plant, depend entirely on the amount of electricity produced (for example payment per kWh based on solar radiation or wind conditions), these are considered variable lease payments. They are therefore not included in the measurement of the lease liability and the right-of-use asset, even if it is highly probable that a certain annual electricity production can be assumed based on the expected weather conditions (IDW, 2021).

When assessing whether a customer is entitled to obtain significant economic benefits from the use of an asset, by-products such as green electricity certificates must also be taken into account. According to IFRS 16.B9(a), in order to control the use of an asset (for example a

solar or wind power plant), a customer must be able to derive the majority of the economic benefits from it. According to IFRS 16.B21, this includes not only the primary output (electricity) but also all by-products, which according to IFRS 16.BC118 explicitly include green electricity certificates generated using the asset. A lease and therefore also the capitalisation of a right-of-use asset and, conversely, the recognition of a lease liability is not required if several parties share the economic benefits. This could be the case if one party receives the electricity and another the green electricity certificates and the certificates are material (IDW, 2021).

3.3.3 Inventories

The impact of climate-related aspects on the measurement of inventories can be seen in several respects. The measurement of inventories in accordance with IAS 2.9 in conjunction with IAS 2.6 requires inventories to be recognised at the lower of cost and net realisable value. Net realisable value is defined as the estimated selling price in the ordinary course of business less the estimated costs of completion and the estimated costs necessary to make the sale (IAS 2.6). All relevant factors must be considered when estimating the net realisable value. This includes factors that may be caused by climate change. Examples are

- Changes in legal regulations are likely to lead to a decline in demand.
- Significant weather events that have led to physical damage to inventories.
- A decline in demand due to a change in consumer behaviour (EY, 2023).

These climate-related aspects are particularly important as they can have a significant impact on the realisable sales revenue of the inventories. For example, inventories may no longer meet environmental standards and therefore no longer be sold, or at least sales prices may fall (IASB, 2023). It is crucial that companies include these factors in their valuation to ensure a realistic and true representation of inventory values in their balance sheet (IDW, 2021).

The acquisition or production costs can also be influenced by climate-related aspects. The following example illustrates how short-term, climate-related supply bottlenecks affect the acquisition costs of raw materials, while at the same time negatively impacting the operating result due to short-term abnormally low production or idle plants.

> Example: *A company mainly relies on inland waterway transport for the procurement of raw materials. A summer drought lowers the water level in the rivers, which restricts shipping. This results in supply bottlenecks and production losses due to delayed deliveries as well as increased transport costs, as transport with lorries is now necessary. Despite these bottlenecks, the fixed production overheads remain unchanged. It is not possible to adjust sales prices. Although the company anticipates reduced capacity in the coming months, the normal capacity of the production facilities and the long-term production plan remain unchanged. In accordance with IAS 2.13, the fixed overheads per production unit do not increase as the allocation of overheads is based on normal capacity of the production facilities. The overheads not allocated due to lower production or unused capacity are recognized as an expense in the respective period. The higher transport costs are to be recognized as part of the cost of the raw materials in accordance with IAS 2.11. However, if a fall in the price of the finished goods in which the raw materials are included indicates that the production costs of the finished goods exceed the net realizable value, the raw materials and supplies must also be written down to the replacement cost (IAS 2.32).*

It is also possible that sustainably produced raw materials, consumables, and supplies or merchandise lead to higher purchase prices, thereby increasing the manufacturing costs in the supply chain. If the increased costs cannot be passed on to customers at one stage of the value chain, the higher purchase prices of raw materials and supplies can also lead to a write-down of the finished products or merchandise.

> Example: *A manufacturer of high-quality kitchen appliances such as dishwashers and refrigerators uses "green steel" in its production to reduce its ecological footprint. This steel is produced in compliance with higher environmental and social standards, which leads to higher acquisition costs than when using conventional steel. However, the company finds itself in a highly competitive market in which consumers are not prepared to pay higher prices for more environmentally friendly products. Therefore, the company cannot fully pass on the increased material costs to its customers. In this case, it is therefore necessary to examine whether the finished goods in stock on the reporting date are still recoverable and, if necessary, whether an impairment loss to the net realizable value in accordance with IAS 2.28 should be recognized. Regarding the raw material "green steel" on stock, it must be clarified whether the acquisition costs of the "green steel" are higher than the replacement cost on the reporting date.*

However, it is also conceivable that not only climate-related risks but also climate-related opportunities have an impact on production costs. This is because, in accordance with IAS 2.13, if demand increases due to climate awareness and the associated increase in normal capacity, the amount of fixed overheads attributable to each unit of production decreases. The fixed overheads are therefore distributed across more units produced in the event of abnormally high capacity of the production facilities, which potentially reduces unit costs. This change in production dynamics has the following effect on the measurement of the cost of inventories.

> Example: *A company operating in the renewable energy sector specializes in the manufacture of inverters. Due to a growing global awareness of climate change and the resulting political decisions to promote renewable energy and photovoltaic systems, the company is experiencing a significant increase in demand for its products. To meet this increased demand, the company is increasing its production capacity by expanding its production facilities and introducing more efficient manufacturing technologies. This leads to a higher capacity of the production facilities, as the plants now run continuously at a higher capacity. Assuming the fixed costs do not increase, the amount of fixed overhead allocated to each unit of production decreases, leading to lower manufacturing costs per unit.*

3.3.4 Financial Assets and Liabilities

Financial instruments, governed by IFRS 9, are subject to valuation adjustments due to market fluctuations stemming from climate-related risks. This affects both the measurement and disclosure requirements, emphasising the need for entities to assess and communicate their exposure to climate-related financial risks (Haberl-Arkhurst & Sternisko, 2020). Climate-related risks affecting financial assets include the increased price risk of investments or the increased credit risk stemming from the default of debtors (KPMG, 2023).

For financial assets that are classified as debt instruments and measured at amortised cost or changes in value in other comprehensive income in subsequent measurement, IFRS 9 requires impairment losses to be recognised based on the expected credit losses. Climate-related factors can influence the credit default risk for lenders. For example, forest fires, floods or political

and regulatory changes can have a negative impact on business activities and therefore on a borrower's ability to fulfil its debt obligations. At the same time, the value of collateral (for example real estate) can also be negatively affected by sustainability-related factors, which also increases the credit risk.

For initial recognition, the impairment and thus the expected loss is calculated based on the 12-month credit default risk. The financial asset is allocated to stage 1 of the impairment model in accordance with IFRS 9 based on its credit rating during initial measurement. In case of a significant increase in the credit default risk, the impairment is recognised based on the lifetime default risk and it is reclassified to stage 2. Whether the credit default risk has changed significantly must be assessed on the basis of current and forward-looking information (IFRS 9.5.5.11, IDW, 2021). Changes in the credit default risk over the next twelve months can be a reasonable approximation of the changes in the default risk related to the term (IFRS 9.B5.5.13). In the case of changes caused by macroeconomic or other factors (such as sustainability-related risks) that could significantly influence the default risk over the (remaining) term, a longer observation period should be used (IFRS 8.B5.5.14; IDW, 2021).

With regard to sustainability-related risks, a distinction can be made between two main types of risk: Physical risks result from extreme weather events such as floods, heatwaves, and forest fires as well as from long-term changes in climatic and ecological conditions, for example rising sea levels and changes in regional average temperatures.

Transitional risks arise from adapting to new framework conditions due to physical risks. These include political measures such as the rise in the price of fossil fuels and the promotion of alternative technologies, as well as social expectations that influence demand (IDW, 2021).

When assessing a significant increase in credit default risk, it is necessary to consider an appropriate observation period that accounts for the effects of both physical risks and transition risks.

Hence, it should be kept in mind that sustainability-related aspects can influence the borrower's future economic scenarios and thus lead to a significant increase in risk and therefore reclassification to stage 2. However, climate-related aspects could already influence the assessment of creditworthiness in stage 1 or lead to reclassification in stage 2 (IASB, 2023). In any case, it will be essential to include climate-related aspects in credit risk modelling.

Regarding financial debt, such as green bonds used to finance environmentally friendly projects like investments in renewable energies or projects aimed at increasing energy efficiency, there are typically post-issuance reporting obligations. These obligations include impact reporting in addition to reporting on the allocation of funds. At the same time, early termination rights (covenants) are often provided for, which include compliance with sustainability-related aspects such as compliance with certain environmental and sustainability standards or sustainability indicators (for example share of renewable energies in the issuer's energy mix or a certain proportion of women in top management). The mere existence of sustainability-related covenants can also lead to disclosure obligations in IFRS financial statements, even if these covenants have not been breached (IDW, 2021). In accordance with IFRS 7.31, companies are obliged to prepare information on financial instruments in such a way that the users of the financial statements can assess the nature and extent of the risks to which the company is exposed through these financial instruments at the time of the report.

In the case of financial liabilities that are linked to sustainability criteria - as promoted by the EU in particular as part of the Green Deal - not only are cancellation rights linked to compliance with certain sustainability criteria, but the contractual payments (such as interest and/or repayment) usually also depend on one or more ESG ratings and/or the company's own sustainability indicators (CAPEX, OPEX, revenues). The financing costs can therefore fall or rise with the improvement or deterioration of these sustainability ratings.

3.3.5 Government Grants

In accordance with IAS 20, the following aspects must be considered when recognising government grants granted in the context of climate protection or other sustainable considerations. Grants for assets must either be recognised as deferred income or by deducting the grant from the carrying amount of the asset in accordance with IAS 20.24.

If grants are recognised as deferred income they are released to the income statement over the useful life of the asset. As the carrying amount of the asset remains unchanged, amortisation is also reduced. If the grant is deducted from the acquisition or production cost of the asset, it is recognised in profit or loss through a reduced depreciation amount over the useful life of the asset. In accordance with IAS 20.39, disclosures must also be made regarding the nature and extent of government grants recognised in the financial statements (IDW, 2021).

3.3.6 Provisions and Contingent Liabilities

Sustainability-related aspects can have an impact on provisions and contingent liabilities. Business activities can cause environmental damage that triggers accounting obligations in accordance with IAS 37. In accordance with IAS 37.14, provisions must be recognised if there is a present obligation from past events, an outflow of resources is probable, and the amount of the obligation can be reliably estimated.

Possible examples of sustainability-related provisions include removal or recultivation obligations. Removal or recultivation obligations arising from the construction of an asset must be capitalised as part of the acquisition or production costs of the respective asset. Meanwhile, environmental damage caused by ongoing business activities is recognised immediately in profit or loss.

According to IAS 37.48, future events that may affect the amount of a provision must be recognised if there is objective evidence that they will occur. Due to the uncertainties associated with climate change, companies should collect and provide sufficient information to explain how climate-related factors are included in the measurement of provisions and contingent liabilities (Bura & Leiner, 2023).

Legal obligations arising from laws and contracts (such as disposal obligations)[9] but also constructive obligations triggered by public pressure in the fight against climate change or other sustainable aspects can also lead to the recognition of provisions as liabilities (Bura & Leiner, 2023). Provisions from constructive obligations must be recognised if companies publicly announce environmental or decommissioning measures, for example in connection with press releases on the remediation of a site. Companies must regularly check whether such public

[9] See also IFRIC 6 ”Liabilities arising from Participating in a Specific Market - Waste Electrical and Electronic Equipment“ for details on accounting for disposal obligations.

announcements or statements, including those in the annual or sustainability report, give rise to new constructive obligations in accordance with IAS 37.10 (IDW, 2021).

According to IAS 37.22 and IAS 37.50, climate-related planned legislative changes should only be recognised as a provision if the law is virtually certain. In view of the general uncertainty regarding the definitive adoption of laws (EY, 2023), provisions for obligations associated with a change in the law should not be recognised as at the reporting date until the law has been finalised (IDW, 2021). Nevertheless, it is advisable to closely monitor developments in legislation and regulatory changes to determine whether there are requirements that could make it necessary to recognise provisions (ESMA, 2023a).

In the course of climate-related aspects, onerous contracts may also arise for which a provision must be recognized in accordance with IAS 37.10 if the unavoidable costs of fulfilling contractual obligations exceed the expected economic benefits. In accordance with IAS 37.68, unavoidable costs reflect the lower of the cost of fulfilling a contract and potential costs for non-fulfilment (for example penalties, compensation). No provision is required if an onerous contract can be terminated without incurring costs (IAS 37.67). In any case, a contract is to be classified as onerous, not only if it is uneconomical due to current selling prices, but also if more environmentally friendly materials or processes due to increased stakeholder interest in climate change mean that contracts previously considered profitable are expected to be non-profitable at the measurement date (EY, 2023).

> Example: *Eight months ago, a construction company concluded a contract with a supplier from a non-EU country for the purchase of thermal insulation material that is specifically suitable for the construction of skyscrapers. Due to new EU regulations, which stipulate stricter environmental standards for building materials, this material was categorized as environmentally harmful and its use in construction is now forbidden.*
> *No delivery had been made at the reporting date. The supplier insists on full fulfilment of the contract or a penalty payment as at the reporting date. From the contractor's perspective, a provision must be recognized. The amount of the provision is recognized at the lower of the unavoidable costs of fulfilling the contract (purchase price of the outstanding delivery) and the penalty payment resulting from non-fulfilment (ESMA, 2023).*

In accordance with IAS 37, a provision for restructuring measures due to climate-related factors (for example closure of high-emission business areas) must be recognised if it is planned and monitored by management and represents either a significant change to the company's business area or the way in which the business is operated and the general recognition requirements as defined in IAS 37.71ff in conjunction with IAS 37.14 are met in their entirety (Reinke & Müller 2023).

It should be noted that it is not permitted to recognise provisions for expected declines in sales in accordance with IAS 36.63 that result from damage to the company's image - for example, due to misrepresentations in sustainability reporting (IDW, 2021). This also applies to future lost profits or operating losses for similar reasons. However, in accordance with IAS 36.65, the expectation of such declines in revenue may be an indicator of the need for an impairment test in accordance with IAS 36.

3.3.7 Deferred Tax Assets and Liabilities

Deferred tax assets, as accounted for under IAS 12, Income Taxes, are also susceptible to climate change risks. A company's downward revision of its future profitability estimates, influenced by climate risks, could lead to a reduction in the amount of deferred tax assets recognised, indicative of lower expected earnings. (EY, 2023)

ESG aspects influence accounting policies and valuations, for example through shortened useful lives and impairment of assets. These changes lead to changes in the IFRS carrying amounts and possibly to temporary differences and corresponding IFRS and tax (carrying) amounts, which have an impact on deferred tax assets and liabilities (IFRS Foundation, 2023).

3.3.8 Biological Assets

Biological assets, as defined by IAS 41 are also possibly impacted by climate-related risks. Biological asset is defined as a living animal or plant, that is measured at fair value less costs to sell in IAS 41.12. These assets can also be heavily impacted by climate change related factors.

For instance, extreme weather events, such as flooding of landscapes, can lead to loss of agricultural land and destruction of crops, lowering the fair value of these assets. Similarly, forest fires could destroy vast tracts of timberlands, directly reducing the stock of biological assets available for sale. Pest infestations pose another serious threat, as they can severely damage crops and plantations, diminishing the quality and quantity of the produce, thus impacting the fair value estimation. Harvesting losses, often intensified by adverse weather conditions or natural disasters, can lead to reduced yields, further influencing the financial outcomes for businesses dependent on these assets.

In addition, according to IAS 41.53 if such a climatic event or disease happens, leading to a material income or expense, the nature and the amount of that item are to be disclosed according to IAS 1.

3.4 Impacts on the Profit and Loss Statement

Apart from balance sheet items, climate-related impacts have a wide range of effects on the profit and loss statements of companies as well. In the following sections, the items of a profit and loss statement will be listed where the impacts are the most significant. Viewing the costs according to function allows an overview that is most used in the group-level financial statements of companies.

3.4.1 Revenues

Climate risks can significantly impact a company's revenue in various ways, particularly for products and services considered environmentally harmful. Below are examples specific to the Scandinavian context, including ideas that could help increase revenue.

Climate risks can lead to a decrease in demand for certain products or services, especially those seen as environmentally harmful. However, there are also opportunities for increasing revenue through sustainable practices.

Fossil Fuels:

- Reduced Demand: Due to stricter climate regulations and a societal shift towards renewable energy, the demand for fossil fuels such as oil and gas may significantly decline.
- Direct Impact: This reduced demand would directly decrease revenue as fewer products are sold.
- Revenue Increase Opportunity: Investing in renewable energy projects and transitioning to clean energy solutions can open new revenue streams and align with the global shift towards sustainability.

Automotive Industry:

- Demand Shift: With increasing environmental awareness and regulatory measures, consumers might prefer electric vehicles (EVs) over internal combustion engine vehicles.
- Product Line Adjustment: Automotive manufacturers may need to adjust their product lines, involving significant investment in new technologies and potential revenue losses from conventional vehicles.
- Revenue Increase Opportunity: Developing and marketing electric and hybrid vehicles can capture the growing market for sustainable transportation and increase revenue.

Consumer Goods:

- Preference for Sustainable Products: Consumers might increasingly favour products that are sustainably produced, reducing demand for less environmentally friendly alternatives.
- Revenue Impact: Companies not adapting to this shift might see a decline in sales and revenue.
- Revenue Increase Opportunity: Launching eco-friendly product lines and emphasising sustainable production practices can attract environmentally conscious consumers and boost sales.

Timber and Paper Products:

- Sustainable Forestry: Companies engaged in timber and paper production might face reduced demand for products that are not sustainably sourced.
- Regulatory Compliance: Stricter regulations on deforestation and forest management practices can lead to higher costs and lower revenue if companies fail to meet new standards.
- Revenue Increase Opportunity: Certifying products as sustainably sourced and investing in sustainable forestry practices can enhance brand reputation and demand for products.

Seafood Industry:

- Impact of Overfishing and Climate Change: Climate change affects marine ecosystems, impacting fish populations and leading to stricter fishing quotas.
- Revenue Impact: Reduced fish stocks and higher regulatory compliance costs can decrease revenue for companies in the fishing industry.

- Revenue Increase Opportunity: Adopting sustainable fishing practices and diversifying into aquaculture can ensure a steady supply and meet consumer demand for sustainably sourced seafood.

Companies might be forced to modify existing contracts to comply with climate-related requirements, affecting revenue recognition. However, proactive steps can also create opportunities.

- Adapting to Regulations: To meet new climate regulations, companies may need to alter the terms of their contracts, leading to changes in the timing and amount of revenue recognised.
- Impact on Long-term Contracts: Long-term contracts might need to be renegotiated, potentially resulting in lower revenue if the new terms are less favourable.
- Revenue Increase Opportunity: Proactively incorporating sustainability clauses into contracts can enhance long-term partnerships and attract clients who prioritise environmental responsibility.

3.4.2 Cost of Sales

The implications of climate change on the cost of sales, as reported under IFRS, are multifaceted and can influence financial reporting in significant ways. Costs of sales, which generally include direct costs attributable to the production of goods sold by a company, can be affected by climate-related factors through various changes.

Increased Direct Production Costs

Climate risks can lead to increased costs in several areas:

- Raw Material Costs: Extreme weather conditions and climate-related supply chain disruptions can increase the costs of raw materials. For example, droughts affecting agricultural yields or floods impacting mining operations can drive up the prices of essential inputs.
- Energy Costs: As companies transition to more sustainable energy sources, initial costs may rise. Although these might decrease in the long term, short-term transitions can increase production costs.
- Compliance Costs: New environmental regulations may necessitate changes in production processes to meet stricter standards, increasing compliance costs.

Changes in Inventory Valuation

Climate-related factors can impact the valuation of inventories:

- Lower of Cost and Net Realisable Value (NRV): Inventories may need to be written down if they no longer meet environmental standards or if demand for certain products decreases due to climate awareness.
- Obsolete Stock: Products that are not environmentally friendly may become obsolete faster, necessitating more frequent inventory write-downs.

Impairment of Assets

Assets used in the production process may be subject to impairment due to climate risks:

- Property, Plant, and Equipment (PPE): Climate risks can lead to increased wear and tear or the need for frequent upgrades to meet environmental standards, potentially shortening the useful lives of these assets and leading to higher depreciation expenses or to an impairment according to IAS 38.
- Intangible Assets: Investments in non-sustainable technologies may become impaired as demand shifts towards greener alternatives.

Provisions and Contingent Liabilities

Climate change can lead to the recognition of provisions and contingent liabilities, affecting costs:

- Environmental Provisions: Companies may need to recognise provisions for environmental restoration, clean-up costs, or compliance with new regulations.
- Onerous Contracts: Contracts that become unprofitable due to increased costs or decreased revenue potential related to climate risks may require provisions for anticipated losses.

Insurance Costs

Higher insurance premiums to cover risks associated with extreme weather events or to insure against potential environmental risks can increase the cost of sales.

Research and Development Costs

The shift towards sustainable practices may result in increased research expenses. Companies might invest heavily in exploring new methods, approaches, materials, and processes, which result in higher research costs. The research costs are recognised as an expense. According to IAS 38 regulations, when these efforts lead to development costs and the creation of prototypes for sale or internal use, which are expected to provide probable future benefits, self-generated intangible assets can be recognised. This recognition is in line with IAS 38, which stipulates that such assets should be amortised over their useful lives when the asset is available for use and tested for potential impairment to ensure their carrying amount does not exceed their recoverable amount.

3.4.3 Administration Costs

Impairment and Depreciation
Climate change can necessitate changes in the expected useful life and residual value of assets used for administrative purpose due to technological obsolescence or regulatory changes, impacting the depreciation charged to administrative expense (IAS 16.51, IAS 38.102). Example: Stricter environmental regulations might shorten the useful life of certain equipment, increasing depreciation expenses in the short term.

Regulatory Compliance and Reporting
Increased regulatory requirements for sustainability reporting can drive up administrative expenses. The need for enhanced disclosure and compliance with environmental regulations (as per IAS 1) requires additional administrative resources and systems. Example: Costs

associated with the implementation of new compliance software or hiring sustainability reporting specialists.

3.4.4 Selling Expenses

Marketing and Promotional Activities
Adapting to climate opportunities often involves marketing new sustainable products. The increased costs of marketing and promotional activities aimed at highlighting green credentials impact selling expenses. Example: Campaigns promoting eco-friendly products or services, or costs associated with obtaining eco-label certifications.

Customer Support and Education
There may be an increase in selling expenses due to the need to educate customers on the benefits of sustainable products and services. This includes customer support teams, training programs, and informational materials.

Distribution and Logistics
Climate risks may impact logistics and distribution costs. For instance, extreme weather conditions can disrupt supply chains, necessitating alternative logistics solutions which can be more expensive. Example: Additional costs incurred due to rerouting logistics channels or using more expensive, environmentally friendly shipping options.

3.4.5 Finance Costs

Climate-related risks also impact financing costs. Different physical and transitional risks increase default risks, which in turn can increase the cost of financing due to heightened risk as per IFRS 9, which addresses the classification and measurement of financial instruments.
However, financial liabilities linked to sustainability criteria, if managed effectively, could decrease financing costs, as entities may benefit from favourable borrowing rates for meeting certain sustainability performance targets.

Non-operating results, or financial income, encompass various elements such as gains or losses on investments, interest income or expenses, and other non-operating revenues or expenses. Understanding the implications of climate risks and opportunities on these line items is crucial for accurate and comprehensive financial reporting.

Gains and Losses from Investment Properties

- Gains or losses arising from changes in the fair value of investment properties are recognised in profit or loss. Climate risks can lead to impairment losses if the fair value decreases significantly due to expected higher costs or reduced income from the property.
- Climate-related opportunities, such as government incentives for green buildings, can increase the fair value, resulting in fair value gains.

Financial Income from Investments

Climate risks and opportunities can substantially affect the value of financial investments, including equity and debt instruments. Key impacts include:

- Fair Value Adjustments: Investments in companies or industries heavily impacted by climate change (for example fossil fuels) may face declining valuations due to

regulatory changes, shifts in consumer behaviour, and physical climate risks. Conversely, investments in green technologies and sustainable companies can increase in value if the demand for environmentally friendly products increases.
- Impairment of Financial Assets: Under IFRS 9, companies must assess the expected credit losses on their financial assets. Climate-related risks, such as extreme weather events or regulatory changes, can increase the credit risk of borrowers, leading to higher impairment charges.
- Hedge Accounting: Climate-related volatility can affect the effectiveness of hedging instruments. Companies must ensure that their hedging strategies remain effective under IFRS 9.

Interest Income and Expense

Climate change can influence interest income and expenses through:

- Variable Interest Rates: Green bonds or sustainability-linked loans might have variable interest rates tied to achieving specific environmental, social, and governance (ESG) targets. Failure to meet these targets can result in higher interest expenses, while success can lower them.
- Credit Risk Adjustments: Climate risks can affect the creditworthiness of debtors, leading to changes in the interest rates applied to loans and bonds. This can impact both interest income (from lending) and interest expense (from borrowing).

Gains or Losses on Disposal of Assets

Disposal of assets affected by climate change can lead to gains or losses in the financial income section:

- Asset Disposals: Companies might need to dispose of assets that are no longer viable due to climate regulations or physical risks. This can result in significant gains or losses depending on the market conditions and the book value of the assets at the time of disposal.
- Investment Divestitures: Divesting from carbon-intensive investments in favour of sustainable alternatives may lead to gains or losses, reflecting the changing market valuations and strategic realignments.

Foreign Exchange Gains or Losses

- Climate change can also influence foreign exchange rates. Climate-related economic disruptions could cause volatility in foreign exchange markets, impacting the translation of foreign operations and resulting in foreign exchange gains or losses in financial income.

3.5 Conclusions on Impacts

From the perspective of the IASB and the ISSB, climate-related risks and opportunities are increasingly influencing the financial performance and therefore entity value of a company. This requires consistent consideration of these aspects in financial reporting. The challenge for companies lies in the coherent integration of sustainability information into financial reports to present a holistic picture of the company's performance. At the same time, consistency with the information in the sustainability report must be ensured. Globally active EU companies are

faced with the task of optimising their reporting processes and systems and aligning them to meet the requirements of sustainability reporting while at the same time effectively managing the interactions between sustainability and financial reporting.

The financial consequences of climate change are extensive, affecting the sustainability of business models, thus the going concern, asset valuations, impairment considerations and elements of profitability by posing significant uncertainty. The values of property, plant and equipment, right-of-use assets, inventories, financial assets and liabilities, government grants, provisions, deferred tax assets and liabilities, and biological assets all need to be monitored and adjusted to reflect environmental and sustainability considerations and their profit-bearing ability for business operations. For several assets impairment calculations might become necessary more often due to the physical and transitional risks of climate change, while other items are affected by cost increases.

As the circumstances change in the physical, regulatory, and technical landscapes businesses must remain informed and adaptable to navigate the challenges efficiently.

Building upon the exploration of how sustainability-related aspects influence IFRS financial reporting, the subsequent chapter shifts focus to the specific role of climate scenarios in climate-related reporting. This transition guides from the sustainability reporting concepts to the practicalities of planning for the future with the help of climate scenarios. As we examine the impact of these scenarios, we will see how they inform risk management and investment decisions, projecting potential future financial outcomes under varying climate conditions. This analysis is crucial for companies to anticipate, mitigate, and adapt to climate-related risks, thereby enhancing their resilience and strategic planning.

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1.

3.7 Appendix: Impacts of climate change on the financial statements

Balance sheet item	**Property, plant and equipment, Intangible assets, Investment property**										
Climate-related risks	Introduction of new climate-policies resulting in new disposal, restoration, or dismantling		Research and development to develop new more sustainable products and technologies	Technological advancements towards more climate-friendly technologies	Change in demand phase out existing assets	Legal restrictions on polluting technologies	Changes in market value	Changes in the interest rate that affect the discount rate of future cash flows	Technological obsolescence	Implementation of a more climate-friendly corporate strategy	Climate-related financing risks
Impact on balance sheet	Increased subsequent acquisition or production costs	Increased depreciation costs	Increase in research costs and capitalised development costs	Change in the estimated residual value and useful life of assets	Change in the estimated residual value and useful life of assets	Change in the estimated residual value and useful life of assets	Impairment calculation	Impairment calculation	Impairment calculation	Impairment calculation	Impact on the discount rate for fair value calculations

Balance sheet item	**Presentation of Financial Statements**		**Right-of-use assets and lease liabilities**			**Inventory**			**Financial assets and liabilities**		
Climate-related risks	Uncertainty in the going concern	Sources of estimation uncertainty	Change in the expected utilisation of the asset due to sustainability related regulatory requirement or corporate objectives	Dependence of lease payments on variable environmental factors	Distribution of economic benefits from green energy production	Changes in regulations meaning that inventories do not meet environmental standards	Extreme weather events causing physical damage to inventories	Decline in demand due to change in consumption habits	Different physical and transitional risks increasing default risks	Damage of collateral from extreme weather events	Financial liabilities linked to sustainability criteria
Impact on balance sheet			Amendment of contract or impairment testing becomes necessary	Variable lease payments are not part of the lease liability and the right-of-use asset	The recognition of a lease liability is not required if several parties are sharing the economic benefits from the asset	Inventories becoming stranded or reduction in sales prices	Inventory obsolescence and write-offs	Inventories becoming stranded or reduction in sales prices	Impairment based on default risk	Increase in credit risk	Impact on financing costs

Balance sheet item	**Government grants**	**Provisions, contingent liabilities, contingent assets**					**Deferred tax assets and liabilities**	**Biological assets**		
Climate-related risks	Government grants granted for sustainability-related causes	Removal or recultivation obligations	Uncertainties stemming from climate change	Climate-related legislative changes	Onerous contracts resulting from non-viability from new environmental standards or stakeholder preferences for sustainability	Restructuring measures due to climate-related factors (e.g. high-emission business areas)	Sustainability aspects prompting changes in the carrying amount of assets	Flooding, forest fires	Pest infestation	Harvesting losses
Impact on balance sheet	To be recognised either as deferred income, and later released yearly to the income statement, or deducted from the carrying amount of the asset, which reduces depreciation costs	Capitalised as part of the acquisition or production costs	Inclusion of climate-related uncertainties in the measurement of provisions and contingent liabilities.	Provisions for penalties for not meeting climate-related targets or not complying with regulation	Provisions for contracts that become onerous due to non-viability from new environmental standards or stakeholder preferences for sustainability.	Provisions for significant restructuring measures	Differences in tax base and carrying amount resulting in deferred tax assets or liabilities	Impact on fair value calculations	Impact on fair value calculations	Impact on fair value calculations

Table 3.7.1 Impact of climate change on items of the balance sheet

Income statement item	**Revenues**				**Cost of sales**							
Climate-related risks	Reduction or shift in market demand and consumer preferences	Changes in contract terms to comply with climate regulations	Renegotiation long-term contracts under new terms	Stricter regulation related to sustainability	Research and development to develop new more sustainable products and technologies	Investments in renewable technology	Extreme weather events	New regulations requiring companies to do environmental restoration, or clean-ups	Impairment of PPE, intangible assets, biological assets, and financial assets based on the risks listed in the table above	Inventories no longer meeting environmental standards or demand for them decreases, rendering them obsolete	New regulations	Disruption of supply chains, extreme weather conditions
Impact on income statement	Lower sales revenue from unsustainably sourced, fossil fuel-based products	Altered timing and amount of revenue recognition, potentially reducing short-term revenue	Reduced long-term revenue and potential penalties or costs associated with contract renegotiation	Decreased revenue if the company fails to comply, potential reduction of profitability	Increase in research costs	Increase in the short-term, but decrease in long-term energy cost	Higher insurance premiums to cover the risks	Provisions will need to be recognised	Increase in impairment losses	Inventory write-downs	Increasing compliance costs	Increase in costs of production or acquisition

Income statement item	**Administration costs**		**Selling expenses**			**Finance costs**						
Climate-related risks	Impairment, of property, plant and equipment, intangible assets, biological assets, and financial assets based on the risks listed in the table above	New regulations	Need to highlight the merits of the new, sustainable products	Need to educate customers on the benefits of sustainable products	Disruption of supply chains due extreme weather conditions creates need for new logistics solutions	Different physical and transitional risks impacting the value of investment properties	Divestiture from carbon-intensive investments and investments in sustainable companies	Climate impact on debtor creditworthiness	Variable interest rates linked to ESG targets	Need to dispose of assets that are no longer viable due to climate regulations or physical risks	Economic disruptions influencing foreign exchange rates	Damage of collateral from extreme weather events
Impact on income statement	Increase in impairment losses	Increasing compliance and reporting costs	Increased marketing costs	Increased selling costs	Increased distribution costs	Gains or losses arising from changes in the fair value of investment properties are recognised in profit or loss.	Gains or losses reflecting market valuations and strategic realignment towards sustainable alternatives.	Changes in interest rates on loans and bonds due to adjusted credit risk.	Interest income and expenses fluctuate based on success or failure to meet ESG targets.	Significant gains or losses	Foreign exchange gains or losses impacting financial income due to volatility in foreign exchange markets.	Increase in financing cost due to heightened risk

Table 3.7.2 Impact of climate change on items of the income statement

4 Climate Scenarios: Sources, Content and Applications

4.1 Introduction

Climate change presents an unprecedented challenge to the global community, necessitating comprehensive strategies to understand, mitigate, and adapt to its impacts. In this context, climate scenarios emerge as crucial tools for policymakers, businesses, and financial institutions. They offer a systematic methodology to envision the potential trajectories of climate evolution and its myriad consequences. This article aims to delve into the intricacies of climate scenarios, examining the landscape of providers, the methodologies employed in constructing these scenarios, and their multifaceted applications.

By scrutinising the different sources and constructions of climate scenarios, we gain insight into the underpinnings of scenario reliability and relevance. Further, we explore how various sectors apply these scenarios to navigate the complexities of climate risk, integrate climate-related considerations into decision-making processes, and report on sustainability with greater precision. The synthesis of such knowledge not only aids in enhancing the robustness of climate risk assessment but also in steering the global financial architecture towards a more sustainable and resilient future. Through this analysis, the article contributes to the academic discourse on climate risk management and supports the operationalisation of climate scenario insights in supervisory frameworks and corporate strategies.

As we delve further into the practical applications of climate scenarios, we acknowledge the imperative role they play in guiding companies through the labyrinth of climate-related risks and opportunities. The introduction of the TCFD's recommendations marked a significant stride towards an organised approach to addressing climate change within the financial sector. These recommendations, distilled into the themes of Governance, Strategy, Risk Management, and Metrics & Targets, offer a blueprint for companies to navigate the complex dynamics of climate risk disclosure and strategy formulation.

Scenario analysis, as endorsed by the TCFD, is not merely an exercise in forecasting but a strategic tool for resilience building. It prompts organisations to contemplate a spectrum of potential future states and to strategize accordingly, ensuring preparedness for a variety of plausible futures. This analytical approach has been embraced across industry verticals, from the fossil fuel sector to agriculture, each utilising it to buffer against specific climate-induced uncertainties.

The utility of scenario analysis is further augmented by the expectations set forth by the emerging European Sustainability Reporting Standards (ESRS) and the revised IFRS standards, which stipulate the incorporation of climate-related risks and opportunities into financial statements. This regulatory evolution underscores the growing necessity for robust scenario analysis in the corporate reporting process.

The article progresses to dissect the attributes of effective scenarios, emphasising the need for scenarios to be plausible, distinctive, consistent, relevant, and challenging. The integrity of these scenarios is bolstered by transparent documentation, expert peer reviews, and the readiness to adapt to new information. Moreover, the democratisation of scenario access is vital for enabling a broad spectrum of stakeholders to engage with and leverage these tools for informed decision-making.

Further, we present a critical analysis of the scenario development process within companies, which involves setting clear objectives, establishing strong governance structures, and conducting iterative reviews to refine these scenarios. The disclosure process, intrinsic to corporate transparency, demands a strategic communication of scenario analysis outcomes, informed by an acknowledgment of their inherent predictive limitations.

In the ensuing section, we will examine the array of scenarios summarised in the provided table, scrutinising their characteristics, and identifying reputable climate data sources that inform these scenarios. Such examination is pivotal for report preparers adhering to the IFRS Sustainability standards, serving as a compass for navigating the terrain of climate data and its implications for sustainability reporting.

4.2 Scenario Analysis

The TCFD recommends the use of climate scenarios to evaluate a company's risks and opportunities. Climate scenarios are analytical tools that model potential future outcomes based on various assumptions. These scenarios help organisations understand how different outcomes might impact their operations and aid in developing resilient strategies, governance structures, and risk management. It's essential to stress that these scenarios are not predictions; they represent possible pathways of future development (TCFD, 2020).

In various industries, scenario analysis plays a vital role. For instance, oil and gas companies use it to assess the impact of climate change. Insurance companies employ scenarios to estimate climate-related risks and inform their underwriting practices. Utility companies use climate scenarios to evaluate potential damage to their infrastructure, while car manufacturers assess the impact of policy changes on their operations and products. Similarly, agriculture companies consider climate scenarios to understand how climate change and extreme weather events affect production and supply chains. Financial institutions use them for risk assessment in lending decisions, and technology companies and retailers incorporate climate scenarios to address supply chain risks.

Effective scenarios exhibit attributes like plausibility, distinctiveness, consistency, relevance, and challenge (TCFD, 2020). Transparent documentation is crucial, making it clear how scenarios are developed, what assumptions they rely on, and which models inform them. Furthermore, scenarios should be accessible to the public, researchers, and policymakers, with user-friendly platforms enhancing usability. Peer reviews by experts in the relevant field ensure quality and credibility. Comprehensive scenarios cover various climate variables, impacts, and sectors, enabling users to assess different dimensions of climate change. To remain relevant and accurate, periodic updates are essential, adapting to changing environmental conditions and unforeseen events.

Scenario analysis is becoming increasingly important and widespread, as both the ESRS and the new IFRS standards require using it when incorporating climate related risks and opportunities in the financial statements.

The process of scenario analysis in companies involves performing, interpreting, and disclosing results. To conduct scenario analysis effectively, companies set objectives, establish governance, assemble teams, assess climate risks, and define scenarios. Afterward, they evaluate the impacts on their business and identify responses. Given the evolving nature of climate change, periodic updates and process revisions are essential. In the disclosure process,

companies decide what information to share, communicate the results effectively, and apply insights from the analysis, while being transparent about the uncertainties and limitations in the predictive capacity of scenarios. (TCFD, 2020.)

Scenarios consider various parameters and assumptions, such as discount rates, carbon pricing, energy sources, commodity prices, economic variables, demographics, efficiency, geography, technology, policy, and climate sensitivity.

In the next section, we look deeper into the different scenarios included in the table below and their characteristics and introduce some climate data sources that inform these scenarios, which we deem useful for the preparers of reports based on the IFRS Sustainability standards.

Climate scenarios - Overview			
Scenario	Description	Website	Database links
IPCC – RCP	Emission scenarios based on GHG concentration levels	ipcc.ch/	*https://tntcat.iiasa.ac.at/RcpDb/dsd?Action=htmlpage&page=about*
IPCC – SSP	Socio-economic scenarios taking into account population and economic growth	ipcc.ch/	*https://tntcat.iiasa.ac.at/SspDb/dsd?Action=htmlpage&page=10*
IEA	Scenarios on the future of energy-use	iea.org/	https://www.iea.org/data-and-statistics/data-sets
NGFS	Scenarios for the financial sector that include both physical and transition risks	ngfs.net/en	*https://data.ene.iiasa.ac.at/ngfs/#/workspaces* *https://climate-impact-explorer.climateanalytics.org/*

Table 4.2.1 Overview of Climate Scenarios

4.3 Sources of Scenarios

4.3.1 IPCC – RCP

The Representative Concentration Pathways (RCPs) were jointly developed by the Intergovernmental Panel on Climate Change (IPCC), the International Institute for Applied Systems Analytics (IIASA), and the Integrated Assessment Model Consortium (IAMC). These pathways were integrated into the IPCC's Fifth Assessment Report in 2014. Each of these four scenarios is designed to encompass a spectrum of potential greenhouse gas (GHG) concentrations in the atmosphere by the year 2100. The nomenclature of RCP reflects its characteristics: "Representative" denotes that each pathway accounts for various trajectories leading to the same concentration levels, while "Pathway" emphasises the significance of the route taken to achieve the specified concentration level. These scenarios have gained widespread recognition and are globally utilised for both research and business purposes, primarily due to their utility in defining emission trajectories that can be employed to project potential future climate conditions.

The RCP scenarios are distinguished by labels such as RCP2.6, RCP4.5, RCP6, and RCP8, which correspond to the magnitude of radiative forcing (like 4.5 W/m2). RCP2.6 serves as a baseline scenario aligning with the global objective of constraining global warming to below

2°C (as close approximation to the Paris Climate Goals of 1.5 Degrees warmer in comparison to pre-industrial temperatures). In contrast, RCP4.5 and RCP6 represent intermediate scenarios, while RCP8.5 represents a high-emissions scenario associated with a global warming projection exceeding 4°C. The RCPs are instrumental in the field of physical climate science, allowing models to anticipate how the climate may evolve under varying levels of GHG concentrations.

In the following, let us introduce a few examples:

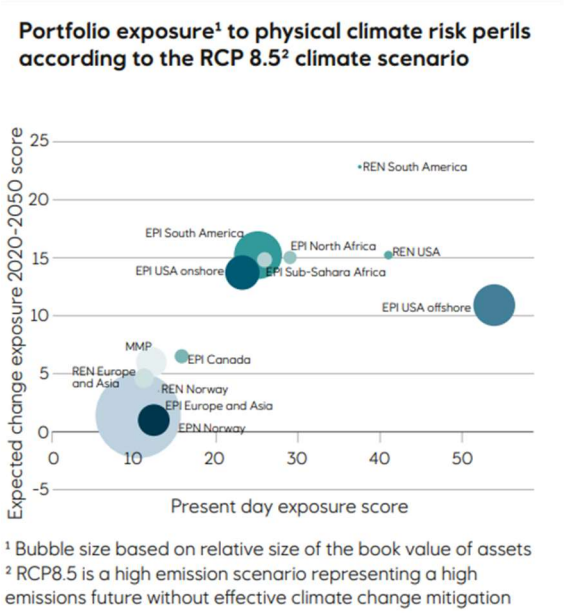

Figure 4.3.1.1 Equinor uses the RCP scenarios to model their asset exposure to climate related perils. (Equinor ASA, 2023, p.76)

To extract data on GHG concentration levels and emissions from different sources connected to the scenarios a database is available for the public. The database enables users to search for climate indicators, such as greenhouse gas (GHG) concentrations, radiative forcing, and GHG emissions categorised by emission sources, across various scenarios.

For instance, users can query CO2 emissions from land use changes under different RCP scenarios, including historical data:

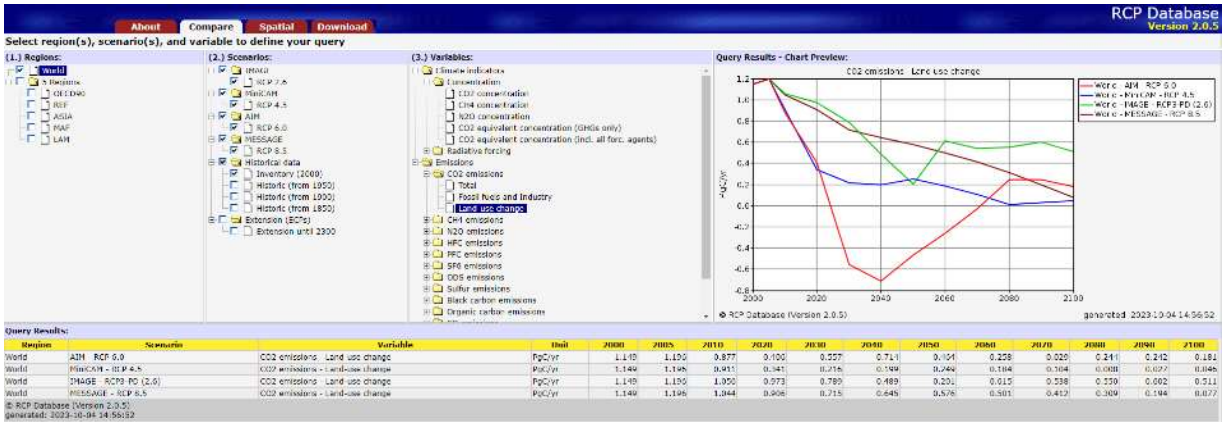

Figure 4.3.1.2 Example query on the CO2 emissions from land use change under different RCP scenarios

Moreover, the database offers geospatial data on emissions, allowing users to visualise this information on maps.

For example, users can request data on methane emissions from grassland burning under the RCP 4.5 scenario for the year 2040:

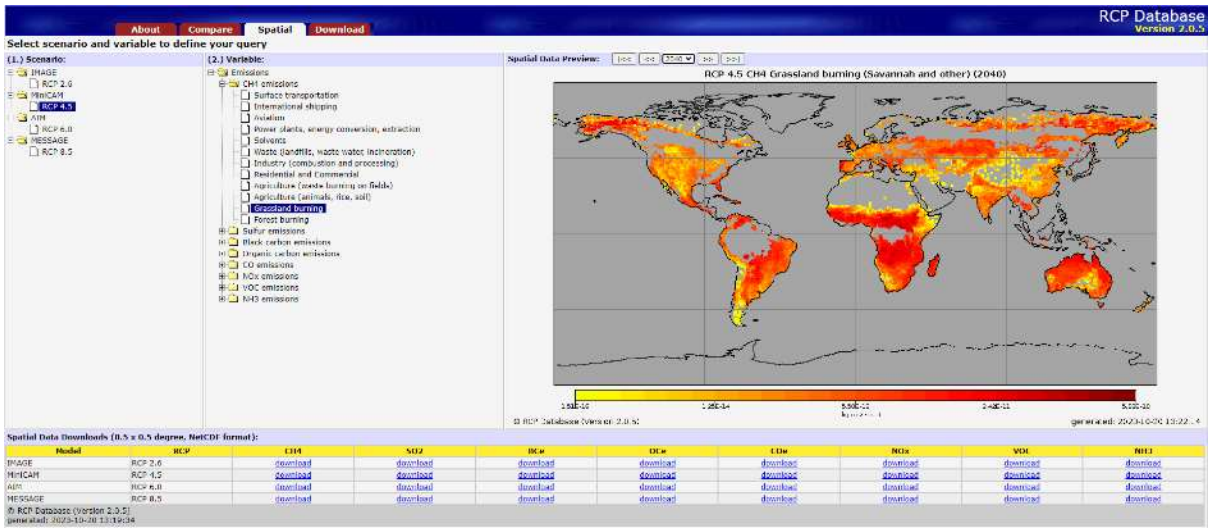

Figure 4.3.1.3 Example query on geospatial data on grassland burning under RCP4.5 scenario in 2040

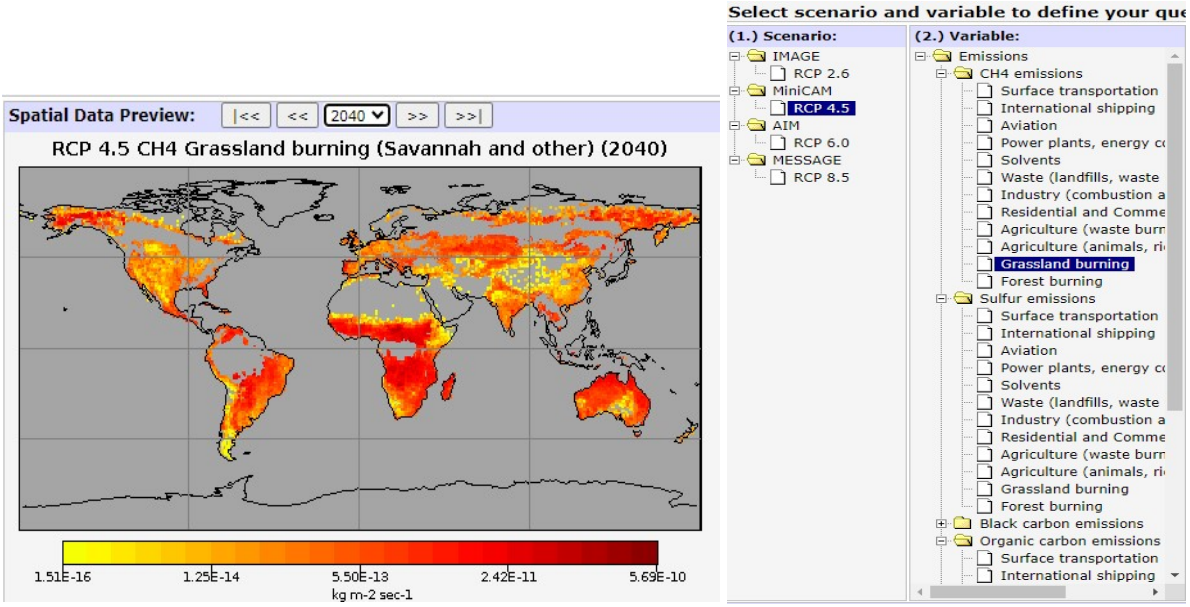

Figure 4.3.1.4 Details of the preceding query

Registered users can access the data download function. Multiple datasets are accessible, encompassing information on GHG concentrations and future emissions. Geospatial data is presented in the netCDF format, enhancing its utility for various applications.

It is noteworthy that the RCP climate scenarios play a foundational role in elucidating distinct emissions pathways and the associated climatic consequences. The European Union (EU) Taxonomy leverages this scientific knowledge to assess the environmental sustainability of economic activities and investments within the context of climate objectives and the transition toward a low-carbon, climate-resilient economy.

However, while the RCP scenarios play a crucial role in modelling future climate conditions and are extensively utilised in various applications, it is essential to recognise that the RCP scenarios solely encompass data pertaining to concentration levels and furnish insights into the future of the physical environment. These scenarios do not encompass information concerning socio-economic factors, technological advancements, or the regulatory landscape (TCFD, 2020). This limitation necessitates the integration of supplementary data sources to provide a more comprehensive assessment of the complex interplay between climate and societal factors.

The database for RCP scenarios is available at:
https://tntcat.iiasa.ac.at/RcpDb/dsd?Action=htmlpage&page=about

4.3.2 IPCC - SSP

Scenario descriptions:
https://tntcat.iiasa.ac.at/SspDb/static/download/ssp_suplementary%20text.pdf

In conjunction with the RCP scenarios, the Intergovernmental Panel on Climate Change (IPCC), the International Institute for Applied Systems Analytics (IIASA), and the Integrated Assessment Model Consortium (IAMC) in collaboration with the climate modelling community developed the Shared Socioeconomic Pathways (SSPs). These pathways were subsequently incorporated into the Sixth Assessment Report by the IPCC. The primary objective of SSPs is to complement the RCP scenarios by providing more comprehensive narratives about potential future socioeconomic developments. They offer different outcomes that mirror diverse socioeconomic changes, driven by global cooperation, inequality, technology transfer, and societal preferences regarding consumption.

To enhance the understanding of future climate scenarios, the IPCC and its partners, including IIASA and IAMC, introduced the Shared Socioeconomic Pathways (SSPs). These pathways are designed to complement the RCP scenarios and provide a richer narrative regarding potential socioeconomic developments. By including various socioeconomic changes and accounting for factors like global cooperation, inequality, technology transfer, and societal preferences, the SSPs offer a more holistic view of future possibilities.

The five distinct SSP scenario storylines include sustainable development (SSP1), middle-of-the-road development (SSP2), regional rivalry (SSP3), inequality (SSP4), and fossil-fuelled development (SSP5). These scenarios are anchored in key drivers of change, such as population shifts, variations in economic activity as measured by GDP per capita, and urbanisation trends. These factors are then translated into quantitative measures encompassing aspects like energy usage, land use patterns, and greenhouse gas emissions. It's important to note that among the SSP scenarios, there is now a specific low emissions scenario, SSP1-1.9, in alignment with the objectives of the Paris Agreement to restrain global warming to below 1.5°C.

Within the database, users can access information related to expected changes in GDP and population, with data available at both the country and regional levels. Additionally, historical data regarding the urban population share is provided. It's important to be aware that population projections stem from multiple institutions, offering users various data sources and options for analysis.

Through the IAM scenarios, users can access a wealth of information, either on a global or regional scale, providing insights into various key variables, including GDP, energy usage,

land use patterns, emissions, climate projections, agricultural data, economic indicators, and technological trends. This extensive dataset offers valuable visual representations through graphs and is available for download in Excel format following user registration. Users may also choose to download graphs in PNG or Scalable Vector Graphics formats.

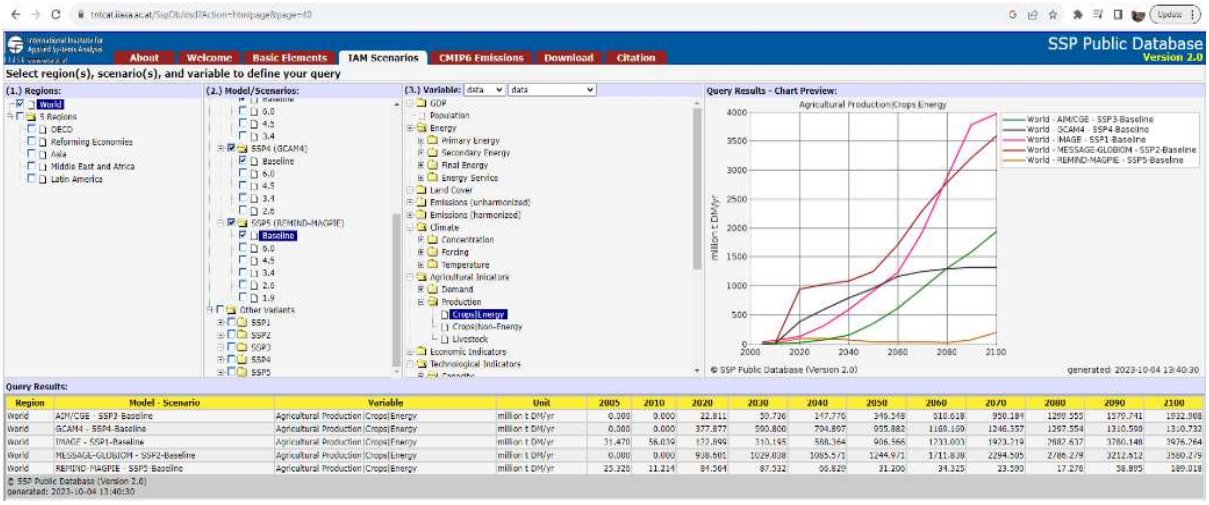

Figure 4.3.2.1 Example query energy crop production in the world according to different SSP scenarios

Nevertheless, while users can benefit from exploring the above-mentioned scenarios, it is important to recognise that while these scenarios offer valuable insights into the potential future socioeconomic and environmental developments, they do not account for the dynamic nature of climate policy changes and their potential impacts. National and global climate policies play a crucial role in shaping future climate outcomes, and their absence from these scenarios underscores the need for additional analysis and consideration of policy factors in conjunction with the provided projections.

The database for SSP scenarios is available at:
https://tntcat.iiasa.ac.at/SspDb/dsd?Action=htmlpage&page=10

4.3.3 IEA

The International Energy Agency (IEA) annually publishes its World Energy Outlook, a comprehensive document outlining scenarios related to the future of energy consumption and emissions. These scenarios are shaped by a confluence of factors, including economic and population growth, energy prices, and technological costs. They are extensively utilised by companies operating within the energy sector and also serve as valuable resources for investment professionals (Alova & Thomas, 2022).

For instance, Equinor, a Norwegian energy company employs IEA scenarios to subject its portfolio to stress testing, assessing its performance against these scenarios. The results are expressed as the Net Present Value after tax (NPV) within the WEO scenarios, relative to Equinor's own commodity price assumptions (Equinor ASA, 2023, p.75):

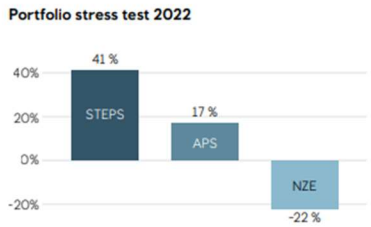

Figure 4.3.3.1 Change in Equinor's NPV under different scenarios

ExxonMobil, an American oil and gas company, one of the biggest players in its field utilises IEA scenarios to forecast supply and demand dynamics in the oil and natural gas sector (Exxon Mobil Corporation, 2023, p.46):

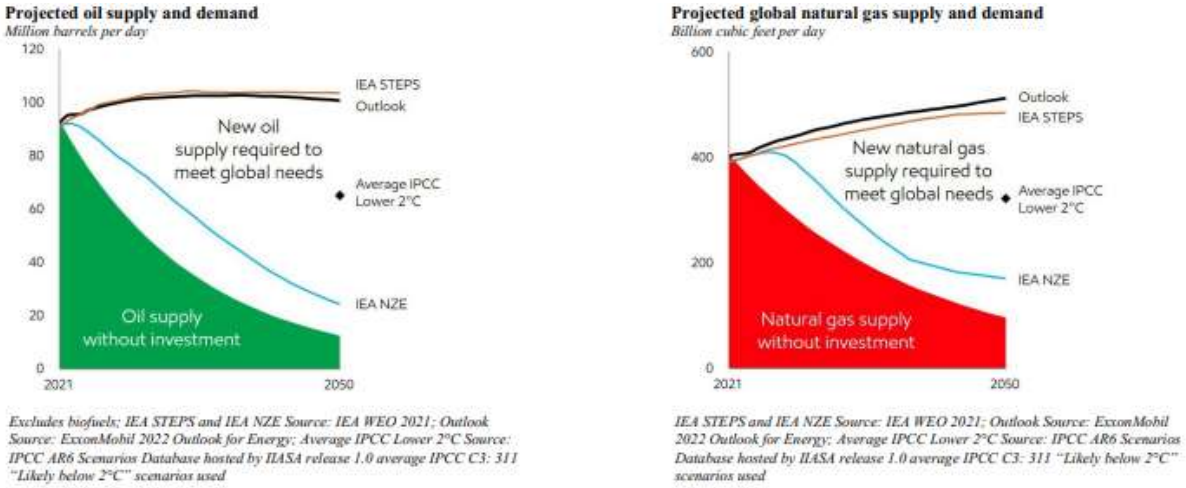

Figure 4.3.3.2 Demand and supply projections based on the IEA scenarios (Exxon Mobil Corporation, 2023, p.46)

Similarly, Shell relies on commodity price estimates derived from IEA scenarios to conduct sensitivity analyses, and TotalEnergy is another entity that makes use of these scenarios for various applications. (Shell plc, 2023; TotalEnergies SE, 2022)

The data provided within the IEA scenarios is notably comprehensive. The report delineates three distinct scenarios, which are updated annually. The first scenario, known as the Net Zero Emissions by 2050 (NZE), outlines a trajectory aimed at curbing global temperature rise to remain below 1.5°C compared to pre-industrial levels. The second scenario, the Announced Pledges Scenario (APS), encompasses all governmental targets and commitments, regardless of their policy support. To assess the alignment of these pledges with actual policies and measures, the IEA introduces the Stated Policies Scenario (STEPS) (IEA, 2022).

The scenario data is downloadable from the IEA website in .csv format and the files contain world data about all three scenarios on energy supply and consumption and other selected variables for the years 2030, 2035, 2040 and 2050 and CO2 emissions and energy demand from different energy carriers (for example biofuels, coal, crude oil…) used for different purposes (for example buildings, electricity generation, industry…) for key countries and regions for the years 2030 and 2050. The extended dataset (available for a fee) includes more comprehensive information about the APS and STEP scenarios, supplemented with figures about investments, capacity, fossil fuel prices, technology costs and assumptions and air pollution data. These scenarios together help to model aspects of energy supply, demand, and access to clean energy

on a global scale and explore the necessary policies and investments to achieve overarching global objectives. (IEA,2023)

It is worth noting, however, that while the IEA scenarios play a pivotal role in shaping strategies for various energy-related stakeholders, it is crucial to acknowledge some limitations of these scenarios. Namely, that the IEA's energy modelling does not encompass integrated considerations of the implications on land use and the broader economy. These factors remain outside the scope of the IEA's modelling efforts.

The free database is available at the following link: https://www.iea.org/data-and-statistics/data-product/world-energy-outlook-2023-free-dataset-2, while the extended database is at https://www.iea.org/data-and-statistics/data-product/world-energy-outlook-2023-extended-dataset .

4.3.4 NGFS

NGFS scenarios play a vital role in climate scenario analysis by encompassing both physical and transition risks, aligning with disclosure requirements set by TCFD and IFRS. Compared to IEA scenarios, NGFS scenarios offer a broader scope, covering policy and technical aspects while incorporating macroeconomic climate damages. NGFS scenarios utilise three models, enhancing precision and reducing modelling uncertainty (NGFS, n.d.).

Central and investment banks utilise NGFS scenarios to assess their portfolios, as they help manage climate- and environment-related risks in the financial sector and promote a sustainable economy transition (Alova & Thomas, 2022, p3).

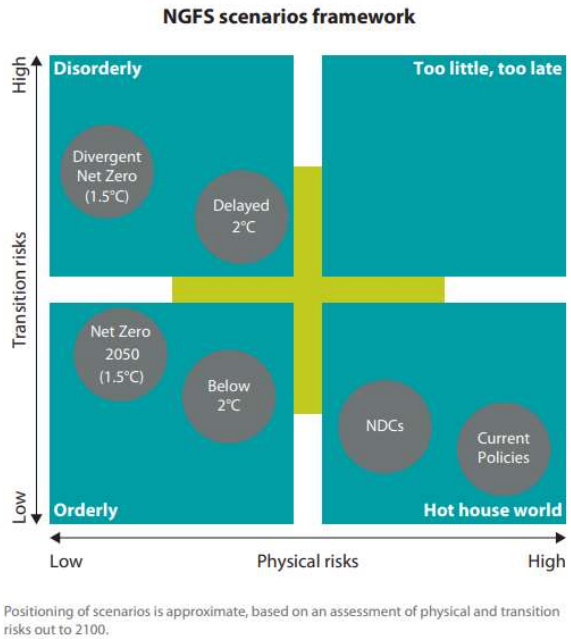

Figure 4.3.4.1 Source: NGFS, 2022, p.7

The NGFS developed a set of scenarios that describe possible futures of Orderly transition, Disorderly transition, and Hot house world based on when and how transition to a lower-carbon economy starts. Orderly transition scenarios assume that the goals of the Paris Agreement are met with the help of emissions reductions started early and progressively, which leads to low physical and transmission risks. Somewhat similarly, disorderly transition scenarios also

assume reaching the Paris Agreement targets, however, they project much rockier progress due to inefficient measures in the early years, which lead to the need for a much more rapid increase in emissions prices. The third option, the hot house world scenario means that only current policies are implemented, thus the Paris goals are not met.

NGFS scenarios include three main scenarios: Orderly Transition, Disorderly Transition, and Hot House World. These scenarios reflect different outcomes based on the pace and effectiveness of the transition to a low-carbon economy. Orderly Transition aligns with Paris Agreement goals, with early emissions reductions leading to lower risks. Disorderly Transition envisions a bumpier path to these goals, while Hot House World assumes current policies prevail, leading to fewer transition risks but more physical risks. This will cause lower carbon prices and lower transition risks, but much more physical risks.

Short-term scenarios

While most climate scenarios concentrate on mid- and long-term risks of climate change, NGFS aims to cover the risks – both physical and transitional – that may appear in the next 3-5 years. The new element of these scenarios is that they combine a certain level of mitigation stringency with relevant short term business cycle shocks and dynamics. Thus the 3-5 years' time horizon is relevant to central banks, supervisors and financial institutions to assess the resilience of the financial sector and grasp the non-linearity of physical climate impact. Even more, the short-term scenarios also attempt to link macro-economy shocks to climate shocks. Short-term scenarios also facilitate climate stress testing related to prudential/financial stability and macroeconomic impact assessments related to monetary policy and provide insights into transmission channels.

The narratives are based on the appearance of policy risks and the response of households, firms, and the financial system to them.

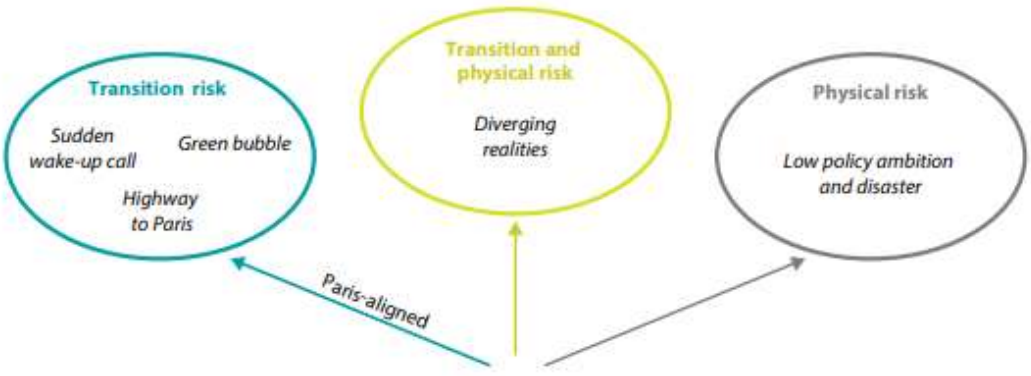

Figure 4.3.4.2 Source: NGFS, 2023

Short-term scenarios hold particular value as they explore the translation of climate shocks into macro-financial shocks. These scenarios, presented in NGFS reports, identify various transition shocks, encompassing policy stringency, international coordination, technology or technological progress shocks, and preference shocks. In addition to transition shocks, NGFS scenarios consider the impact of natural disasters and rising expectations of such events, which can lead to abrupt economic shocks.

However, it's essential to note that short-term scenarios exclude chronic physical risks, as these have already been influenced by past climate mitigation efforts, making it challenging to estimate their effects on business cycle shocks. The primary aim of NGFS short-term scenarios is to establish connections between climate shocks and macro-financial variables, even if these links are not always explicit.

For instance, carbon prices directly affect energy prices, which, in turn, impact energy companies. Moreover, the potential early obsolescence of infrastructure due to the phase-out of fossil fuels can also impact energy companies. In terms of physical shocks, natural disasters can harm local economies by damaging physical assets, triggering migration, affecting the labour force, and increasing food and commodity prices.

It's crucial to recognise that fiscal and monetary policy decisions play a significant role in how climate shocks influence the real economy, leading to what are known as macro-financial second-round effects.

NGFS short-term scenarios are well-suited for climate stress testing, a mandatory practice for financial sector regulators. These scenarios aid in evaluating potential near-future events, a task for which long-term scenarios have proven inadequate. Short-term scenarios also facilitate policy-compliant analysis and risk assessment (NGFS, 2023).

Phase 4 Scenarios

While short-term scenarios focus on the next 3-5 years, delving into the intricacies of climate shocks and their macro-financial implications, Phase IV scenarios, introduced in November 2023, take a broader perspective, examining the long-term impacts of climate change under updated conditions and policy considerations. With the continuously high emissions, the delayed implementation of climate policies, and the war in Ukraine having unfavourable effects on energy systems, the review of scenarios became inevitable. Considering the lack of availability of Carbon Capture and Storage (CCS) technologies, the use of these methods is not considered in the Phase IV scenarios. The newly adjusted scenarios thus consider the orderly transition scenarios more disorderly, while the hothouse world scenarios now expect fewer physical risks thanks to the latest advancements in climate policy.

However, the NGFS states that reaching the goals of the Paris Agreement of keeping global warming levels under 1.5 degrees Celsius is still possible, even though it will require ambitious effort. To support this goal, a new orderly “Low Demand” Scenario was designed, where behavioural changes (particularly reducing energy demand by electrification and increased reliance on renewables), less progressive (shadow) carbon prices, and technological developments would lead the transition.

In addition to the “Low Demand” Scenario, the NGFS included a Too-little too-late type of scenario in Phase IV. This is the Fragmented World Scenario, which describes a future, where climate policies are implemented too late, with large geographical differences, so that the efforts of some countries are inhibited by other countries’ inaction. In the scenario all these factors lead to both high physical and transition risks.

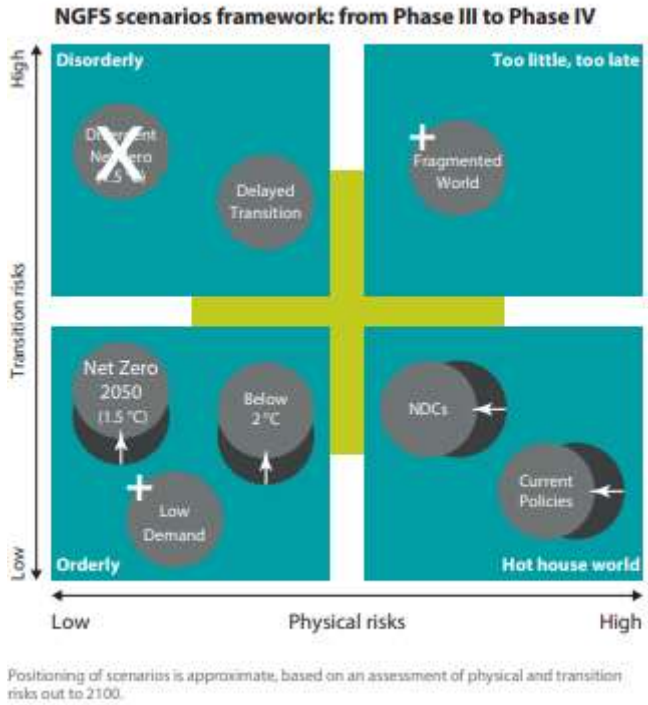

Figure 4.3.4.3 Phase IV Scenarios (NGFS, 2023, p.20)

Besides the new scenarios, the new phase report also contains data on the macro-economic impacts of climate change: how the different physical (acute and chronic) and transition risks affect the GDP under different scenarios and the development of inflation, unemployment, interest rates and carbon and energy prices.

However, the report offers limited discussion of micro-financial impacts, with the exception of how transition policies may lead to increased production costs and how financial uncertainties resulting from climate change could reduce consumption. This, in turn, creates a demand-side impact on companies (NGFS, 2023).

Data sources by the NGFS

Moving from the exploration of scenario narratives, let's now shift our attention to the various data sources that the NGFS relies on to support these detailed climate scenarios.

The Climate Impact Explorer provides users with the means to investigate the physical risks stemming from climate change at the continental, national, and regional levels. These risks encompass both acute and chronic categories. Acute risks involve economic perils, such as the annual expected damage resulting from river floods or tropical cyclones, as well as hazard-specific threats like the annual land fraction exposed to river floods, crop failures, or wildfires. Chronic physical risks pertain to agriculture, climate, freshwater availability, and labour productivity.

The Explorer offers various scenarios, including RCP2.6, RCP4.5, RCP6, RCP8.5, NGFS Current Policies, NGFS Net-Zero 2050, and NGFS Delayed Transition. It enables users to compare different scenarios and their associated global warming levels, with data presented in graph format as a time-series and in grid format on maps. The data is also available for download in .csv format.

Transition risk data, on the other hand, is accessible through the Scenario Explorer, an intuitive web-based interface designed to visualise time-series data and facilitate data download in various formats.

In addition to adding new scenarios, updating the existing ones, and the macro-economic prospects, the NGFS also added a new tool to access scenario data: the NGFS Data Engagement and Transparency Tool, also known as the EnTry. It includes a demo, a Quick Query Tool & Parameter Guide and a Report Template that helps the users to build their own Python codes to analyse the scenario data with the pre-defined templates. The codes work in any python environment, among others in Google Colab, thus installing new software for running the queries is not necessary. (NGFS,2023)

The data for the Phase IV scenarios is available at https://data.ene.iiasa.ac.at/ngfs/#/downloads

4.4 Other Data Sources

https://climate-adapt.eea.europa.eu/en/knowledge/european-climate-data-explorer

Another data source is the Copernicus Climate Change Service, which operates as a thematic information service under the Copernicus Earth Observation Programme. Its primary objective is to furnish consistent climate change information and facilitate the European Union's adaptation and mitigation initiatives. It achieves this by offering access to climate impact data and related information through its Climate Data Storage (CDS). This valuable resource is designed to be used by both businesses and policymakers, enabling them to access impact data across various sectors and geographic regions. This data empowers them to make well-informed decisions, create innovative products, and develop new applications. Notably, the Service ensures that this data is consistently high in quality and freely accessible through application programming interfaces (APIs). Moreover, it extends technical support and training opportunities to its database users.

The provision of a versatile Toolbox, accessible upon registration, facilitates the utilisation of CDS data for application development, particularly for individuals with basic proficiency in Python. This practicality is supported by a comprehensive set of tutorials and guides, ensuring users can confidently navigate the database, leveraging its extensive capabilities. Upon registering on the website, users gain access to a versatile Toolbox that enables them to utilise CDS data for creating applications, all without the need for powerful computing resources or extensive storage capacity. Basic proficiency in Python is sufficient for crafting applications, with tutorials and how-to guides readily available to assist users in getting started and building the necessary skills for interacting with the database. The Application Gallery further enriches the user experience by offering practical examples of pre-existing applications (Copernicus Climate Change Service, n.d.).

For exploring flood risks in Helsinki for our case study the application “European hydrology and climate data explorer” provides invaluable data. The application provides users with climate impact indicators about water quality and water quantity. Results are displayed on a map, thus providing information both about large-scale differences across the continent and on a detailed small region level as well. The map allows for interactive selection of location and setting the different parameters from drop-down menus: Indicator type, Impact indicator, Climate models, Hydrological model, Time period and Emissions scenario (Copernicus Climate Change Service, n.d.).

The application is based on two datasets. One contains temperature and precipitation data (both historical and projections up to 2100). The meteorological data is provided for fixed periods of 30 years (2011-2040, 2041-2070 and 2071-2100) and it is downscaled with the help of regional climate models to a 5 km resolution. The application combines the meteorology data with hydrology related climate impact indicators. The hydrology data is also provided for fixed periods of 30 years (2011-2040, 2041-2070 and 2071-2100) and it is downscaled with the help of regional climate models to a 5 km resolution. The underlying datasets are available from the Copernicus database, however as the data is in an NC file format, so the handling might be challenging to the average user (Copernicus Climate Change Service, 2021).

4.5 Climate Models

4.5.1 Climada

https://wcr.ethz.ch/research/climada.html

CLIMADA serves as a quantitative modelling platform, offering users the capability to investigate physical climate risks and gauge the economic repercussions stemming from climate change. This model provides an extensive dataset encompassing various aspects, including climate hazards, types of exposure, and resultant impacts. Additionally, it incorporates a financial model and a comprehensive framework to evaluate adaptation strategies. CLIMADA enables the assessment of the cost-benefit ratio associated with specific risk mitigation measures, thus contributing to climate adaptation efforts. The model affords global coverage of significant climate-related extreme weather events, presented at a spatial resolution of 4 kilometres through a data API. Notably, it covers hazards like tropical cyclones, river floods, droughts, European winter storms, with plans to incorporate wildfire data in the near future. Furthermore, the open-source model is freely accessible on Github, implemented in Python, and supported by an extensive array of technical documentation and tutorials. Importantly, it allows users a high degree of customisation, permitting the utilisation of their data, whether for a complete analysis or specific portions, thereby enabling tailored applications to address their unique business needs.

4.5.2 CLIMCYCLE

https://www.climcycle.com/

As for Climcycle, it is a software solution designed to assist companies in preparing ESG-related reporting and analyses, offering multiple modules to cater to various needs. It relies on the Python codes provided by the Climada Climate Model. Among its applications, it proves useful for companies seeking to conduct an ESG stress test using regulatory methodologies. The stress test relies on practical input data and climate scenarios from the Network for Greening the Financial System (NGFS). This software computes and evaluates the impact on credit risk parameters across different climate scenarios, accounting for both physical and transitional risks. Climcycle is adept at assessing the eligibility of bank transactions in accordance with the EU Taxonomy and their potential to enhance the Green Asset Ratio (GAR). Additionally, it streamlines the compilation of GAR disclosures through templates aligned with the EU Taxonomy Regulation. Furthermore, Climcycle offers the means to calculate financed emissions, employing the globally accepted PCAF method. Notably, the

software aids companies in fulfilling ESRS disclosure requirements by providing double materiality assessments and an analysis of physical climate risks.

4.5.3 CGIAR Climate Security Observatory

https://cso.cgiar.org

CGIAR is a global consortium that unites international research organisations with a focus on food security. Within this collaborative framework, they have established the Climate Security Observatory (CSO), which functions as a decision support tool. Its primary objective is to provide valuable assistance to a wide array of stakeholders, including researchers, policymakers, and practitioners, in comprehending and addressing security risks associated with climate change. This is essential because the intricate interdependencies between climate, the environment, the economy, socio-economic dynamics, and political and institutional structures mean that exacerbations in climate events can have detrimental impacts on each of these domains. Consequently, the aggravation of climate-related issues amplifies pre-existing vulnerabilities within food systems, escalates conflicts among marginalised populations, and places additional stress on overall peace and security.

The SCO's mission revolves around the provision of localised, context-specific data concerning the role of climate change as a catalyst for security threats in vulnerable countries. The platform serves as a valuable resource for examining potential conflict zones, the underlying causes of conflicts, identifying vulnerable population groups, and evaluating the prevailing climatic conditions in affected African nations. Furthermore, the platform offers access to a rich repository of data, metrics, and knowledge that shed light on the intricate interplay between conflict, climate factors, and socio-economic determinants. Users also have the capability to download relevant data from the site for their specific needs and research purposes.

4.6 Conclusion

This chapter has thoroughly examined the role of climate scenarios in addressing risks posed by climate change. Climate scenarios, by offering a range of possible future outcomes, allow businesses, policymakers, and financial institutions to anticipate and mitigate risks effectively. By presenting the major providers of climatehttps scenarios, the methodologies behind them and the differences between each set of scenarios, the chapter highlighted their importance and the possibilities for their utilisation, further aided by the addition of some possible data sources.

Primarily, it is evident that the majority of earlier climate scenarios have a predominant focus on evaluating physical risks while overlooking transition risks. However, this paradigm has undergone a shift with the emergence of NGFS scenarios, which deliberately incorporate various transitional risks into their framework.

Secondly, a noteworthy innovation within the NGFS scenario set is the inclusion of short-term scenarios alongside the conventional long-term projections, thereby facilitating assessments and stress testing in the immediate future.

Thirdly, the challenge of establishing connections between climate change effects and financial impacts for companies is acknowledged, and NGFS takes a significant step in addressing this challenge by introducing transmission channels that establish links between these two elements.

Overall, the set of scenarios covers a vast array of aspects of climate change by elaborating on the changes in the physical environment and the social aspects. This comprehensiveness of the scenarios provides an invaluable tool for businesses to identify both transitional and physical risks they will need to combat in the future. Their utility is enhanced by the software solutions building on the data provided by the scenarios. These observations collectively underscore both the strengths and limitations inherent in the current landscape of climate scenario analysis.

In conclusion, while climate scenarios are not predictive models, their strategic value lies in their ability to provide structured insights into potential future states. This enables organisations and governments to prepare more effectively for the challenges ahead, ensuring resilience and adaptability in the face of an uncertain climate future. As we continue to harness the power of scenario analysis, it remains a cornerstone of informed decision-making in the quest to mitigate climate risks and steer towards a sustainable future.

After outlining the conceptual framework of climate scenarios, the next chapter pivots towards the practical implementation and how climate scenarios and reporting frameworks are used within Nordic companies. Chapter 5 illustrates how theoretical models are integral to evaluating and addressing climate-related risks in business operations. This shift from theoretical to practical emphasises the necessity of applying climate scenarios in strategic decision-making processes, highlighting their relevance in mitigating climate change impacts on business sustainability and resilience.

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5 How Nordic Companies talk about Climate Risk

5.1 Introduction

The primary objective of the analysis was to provide an overview of the current sustainability reporting practices employed by Nordic companies and to gain insight into their approaches to addressing climate change and their reporting practices.

EU regulation, IFRS Sustainability Standards (S2), and ESRS E1 collectively mandate companies to transparently disclose information related to climate and environmental risks, challenges, and opportunities. This includes discussing the financial impacts of climate change on their business operations, outlining strategies for both adapting to and mitigating the effects of climate change, disclosing measures taken to align with global climate goals such as those outlined in the Paris Agreement, and providing comprehensive and transparent insights into how climate change affects their operations, including risks and opportunities. This entails reporting on various facets such as climate change impacts, decarbonisation efforts, and strategies aligned with the Paris Agreement's objectives. By adhering to these mandates, companies can enhance the quality and comparability of their sustainability reporting, providing stakeholders with valuable information to assess their resilience to climate-related risks and their contributions to sustainability goals. Through such comprehensive reporting, companies ensure transparency about their efforts to address climate-related risks and contribute to global climate action.

Building upon this regulatory landscape, the overarching goal of this chapter is to assess the comparability of sustainability strategies and reports among different companies within the context of climate risk disclosure. By examining how companies discuss the financial impacts of climate change, outline adaptation and mitigation strategies, and disclose measures taken to meet global climate goals as well as how these new regulations have impacted their reporting, this analysis aims to determine the landscape of how Nordic companies talk about climate risk. Through this assessment, insights will be gained into the consistency and comprehensiveness of sustainability reporting practices, as well as possible risks and opportunities with the reporting landscape itself, facilitating a deeper understanding of companies' resilience to climate-related risks and their contributions to broader sustainability objectives.

The methodology employed in this study encompasses a comprehensive approach to understanding sustainability reporting practices among Nordic listed companies, with a specific focus on climate risk disclosure. We adopted a structured methodology centred around four main perspectives: companies' views on climate-related challenges and risks, the quantification of these risks, the impact of new EU regulations on climate risk management, and the implementation of decarbonisation strategies. These perspectives were chosen based on their fundamental importance in assessing companies' sustainability efforts. The study began with data collection, including the analysis of sustainability reports from 29 Nordic firms and conducting seven open dialogue interviews with industry representatives. Thematic coding played a pivotal role in analysing both the dataset and interview transcripts, facilitating systematic evaluation across dimensions such as reporting approach, financial impact assessment, risk management, and governance integration. The analysis progressed through deductive, iterative, and inductive approaches, ensuring a comprehensive understanding of sustainability integration within Nordic firms' reporting practices. Through this methodology, the study aims to provide insights into the comparability of sustainability strategies and reports among different companies, shedding light on key themes and trends within the sustainability reporting landscape.

5.2 European Union Sustainability Reporting Regulations

European Union Regulations on Sustainability Reporting have undergone significant evolution in recent years, driven by the imperative to foster sustainability and accountability within the corporate landscape. At the forefront of this evolution are the Corporate Sustainability Reporting Directive (CSRD) and the European Sustainability Reporting Standards (ESRS). These regulations, integral to the EU's broader sustainability strategy encapsulated in the EU Green New Deal, emphasise the integration of sustainability into corporate governance structures. They mark significant progress in enhancing transparency and accountability in sustainability reporting.

These frameworks aim to integrate sustainability into corporate governance by providing stakeholders with reliable and comparable information on environmental, social, and governance (ESG) practices. Under the CSRD, large capital firms are mandated to incorporate sustainability reporting into their financial statements, ensuring comprehensive consideration of the entire value chain and adherence to the structure outlined in the ESRS.

Within the ESRS framework, Section E1 holds particular significance, focusing on climate adaptation and mitigation, in alignment with the EU's commitment to the Paris Agreement. It emphasises the identification and assessment of climate-related risks and opportunities, integration into risk management, business model considerations, strategic planning, use of scenario analysis, targets and performance indicators, governance and oversight, and external impact and engagement.

In parallel, the European Union Taxonomy Regulation serves as a crucial instrument to promote sustainable investments by classifying economic activities based on their environmental sustainability. This classification system categorises activities into primary, transition, and enabling activities, each contributing to environmental sustainability in different ways. To qualify as sustainable, activities must substantially contribute to one of six environmental objectives outlined in the EU Taxonomy, without significantly harming others. This regulation also requires entities to disclose key performance indicators reflecting their performance regarding sustainable economic activities.

The integration of ESRS and EU Taxonomy disclosures is essential for companies to align with regulatory requirements and demonstrate their commitment to sustainability. Specifically, the ESRS E1 transition plan for climate change requires quantification of companies' alignment with the Paris Agreement goals and the EU Taxonomy criteria, including investments in transition activities, key performance indicators, and adherence to taxonomy criteria. Overall, these regulations emphasise transparency and measurability in disclosing climate impacts, supporting companies' efforts to mitigate risks, capitalise on opportunities, and transition to a low-carbon economy. The quantification of climate impacts in the ESRS E1 transition plan for climate change focuses on providing transparent and measurable information about the company's efforts to mitigate climate risks and transition to a low-carbon economy while considering their impact on capital costs, cash flows, and ultimately the company's value.

5.3 Methodology

5.3.1 Methodological Perspective

The sustainability reporting landscape among Nordic listed companies exhibits a diverse approach to climate risk disclosure. To effectively analyse this landscape, we employed a structured methodology focused on four main perspectives. These perspectives centred around companies' views on climate-related challenges and risks, the quantification of these risks, the impact of new EU regulations on climate risk management, and the implementation of decarbonisation strategies. By categorising our analysis according to these perspectives, we aimed to provide a comprehensive understanding of how companies approach sustainability reporting. These four perspectives also guided our open dialogue interviews and which topics were discussed during the interviews.

The choice of these four perspectives for the analysis stems from their fundamental importance in understanding how companies address climate-related issues within their sustainability reporting practices. Firstly, examining companies' views on climate-related challenges and risks provides insight into their awareness and perception of environmental issues, which is crucial for assessing their commitment to sustainability. Secondly, assessing the level of financial quantification of these risks allows for a deeper understanding of the potential financial implications and the level of preparedness to address them. Thirdly, understanding the impact of new EU regulations on climate risk management is essential given the evolving regulatory landscape and its implications for corporate governance and reporting obligations. Lastly, analysing the implementation of decarbonisation strategies sheds light on companies' proactive efforts to reduce their carbon footprint and transition towards more sustainable practices. Together, these perspectives offer a holistic view of companies' sustainability initiatives, providing valuable insights into their strategic priorities and long-term sustainability goals.

5.3.2 Data Collection

In the pursuit of an understanding of sustainability integration within Nordic firms, a methodological framework combining samples from written reports with open interviews was used.

The first step was sampling Nordic firms' annual and sustainability reports from 2022 and 2023. The final sample comprised reports from 29 companies operating across diverse industries, including real estate, energy, industry, financial services, telecommunications, and utilities. These companies were purposefully sampled from Nasdaq Nordic’s Large Cap list of listed companies, to ensure that the companies were similar enough in terms of their impact on climate and their preparedness for sustainability reporting. Companies were chosen based on their representation across sectors and the salience of their sustainability reporting practices. The selection aimed to achieve theoretical sampling, prioritising the richness of insights over completeness. This sample formed the foundation for an exhaustive exploration of sustainability practices, providing profound insights into Nordic firms' strategic imperatives regarding sustainability reporting. Appendix I presents a matrix summarising the findings derived from the sample of sustainability reports.

Industry	Company	Annual and Sustainability report analysed for years	
Energy	Neste	2022	
	OX2	2022	
	Vestas	2022	
Financials	Danske Bank	2022	
	Handelsbanken	2022	
	Industrivärden	2022	
	Sampo Group	2022	
	Storskogen	2022	
	Topdanmark	2022	
	Tryg	2022	
Industrials	Alfa Laval	2022	
	AssaAbloy	2022	
	Atlas Copco	2022	
	Instalco	2022	
	Lindab	2022	
	Marel	2022	
	Schouw	2022	
	Sdiptech	2022	
	Skanska	2022	
	Vaisala	2022	
Real Estate	Atrium Ljungberg	2022	
	Castellum	2022	
	Catena	2022	
	Citycon	2022	
	Kojamo	2022	
	SBB Norden	2022	
	Wihlborg	2022	
Telecommunications	Ericsson	2022	
Utilities	Orsted	2022	2023

Table 5.3.2.1 List of Nodic listed companies whose sustainability reports were included in the analysis

The second step was inviting sustainability experts of companies also listed on the Nasdaq Nordic Large Cap list to discuss their views, both as individual experts as well as representatives of their companies, on how Nordic companies view and discuss climate risks. The sample consisted of seven interviews with industry representatives from Sweden and Denmark representing various sectors such as real estate, energy, and industry. These interviews offered nuanced perspectives on sustainability integration across organisational levels. Each interview lasted between 35 min and 50 min each and were all recorded. The interviews were conducted as open dialogue interviews through teams which were transcribed and subsequently analysed. All interviews were anonymised before analysis.

The interviews were followed up with an email request for additional information. By conducting initial interviews and subsequently following up with the interviewees over time, we adopt a longitudinal approach as well.

Interviewee	Industry	In the industry since	Current position	Career background	Education
Interviewee 1	Energy	2018	Environment and Climate Change Manager	Consulting, Climate reporting	BEng Civil and Environmental Engineering, MSc Sustainable Development
Interviewee 2	Real Estate	2015	Head of Sustainability	Structural engineer, Sustainable business developer (carbon LCA focus), Head of Sustainability, Consulting/advisory	BSc Economics, MSc Civil engineer
Interviewee 3	Real Estate	2021	Chief Sustainability Officer	Consulting, Sustainability controller	BSc Environmental Management, MSc Management
Interviewee 4	Industrials		Senior Sustainability Manager	Consulting, CSR	BA Philosophy, MA Applied Philosophy
Interviewee 5	Real Estate	2017	ESG Controller	Sustainability and ESG	MSC Business and Economics
Interviewee 6	Industrials	2010	Head of Sustainability	Engineer, Operations and Sustainability Analyst, Sustainability Manager	BEng in Mechanical Engineering, MSc in Sustainable Energy Systems
Interviewee 7	Industrials	2021	Loss Prevention and ERM	Technical consultant, Risk engineering, Risk consultant, Risk management	MSc Chemical Engineering, PGCert Environmental Techniques, Certified Risk Management Professional (RIMAP)

Table 5.3.2.2 List of interviewees and their backgrounds

5.3.3 Data Evaluation

Our analysis began with a keyword analysis of our sample of 29 sustainability reports. It comprised a predefined set of 47 keywords categorised into seven distinct categories, encompassing areas such as frameworks used, climate change, sustainability risks, scenarios, financial impact, time frames, remuneration, governance, and assurance. Subsequently, the same keywords were applied to analyse the seven interview transcripts, ensuring consistency in our approach.

As the analysis progressed during the interview analyses, we moved on to deductive analysis to establish which keywords emerged from the interview transcripts. The number of keywords expanded to 71, with the inclusion of two additional categories: data and metrics, and decarbonisation. This was due to the interview transcripts being analysed for additional keywords iteratively so that all new arising keywords were analysed from all separate transcripts. This expansion underscores the comprehensive nature of the analysis, which sought to capture a broad range of topics relevant to sustainability reporting and climate risk disclosure. By systematically categorising and analysing keywords and the related interview quotes, the study aimed to gain a nuanced understanding of the various aspects of sustainability reporting practices among Nordic listed companies, shedding light on key themes and trends within the field.

Finally, the interview transcripts were further analysed inductively, to see which topics arose from them independently. These findings were then categorised according to the four main perspectives identified: companies' views on climate-related challenges and risks, quantification of risks, the impact of new EU regulations on climate risk management, and implementation of decarbonisation strategies. Ten distinct topics emerged, which were then categorised under the four main perspectives identified earlier. For example, under the perspective of companies' views on climate-related challenges and risks, topics such as "Organisational Perception and Approach to Climate Change", "Risk Management and Strategy Development", “Geographical and Supply Chain Considerations” “Transitional Risks and Competitive Considerations” and “Collaboration and Community Engagement” were identified. Similarly, topics like "Financial Implications and Investment Opportunities" and “Data and Technology Utilisation” were categorised under the perspective of the quantification of these risks. Two topics, "Regulatory Compliance and Reporting" and "Corporate Engagement and Transparency," fell under the impact of the new EU regulations perspective. Lastly, the perspective of decarbonisation strategies included the topic "Decarbonisation".

Through combining different qualitative approaches and data streams, the methodological framework ensured a multifaceted comprehension of sustainability practices, encapsulating not only the manifested reporting but also the latent motivations and challenges encountered by these firms.

5.3.4 Thematic Coding

Thematic coding emerged as a pivotal tool in dissecting both the dataset and interview transcripts, facilitating systematic analysis across multiple dimensions of sustainability integration.

Thematic coding involved the systematic evaluation of several critical dimensions of sustainability integration within Nordic firms' reporting practices. The process encompassed coding for reporting approach, financial impact assessment, risk management, and governance integration. Specific keywords were strategically chosen to align with each thematic category. Thematic coding was not utilised for certain aspects such as determining reporting format or assurance levels, as these were evaluated based on direct observation and analysis. Instead, thematic coding proved instrumental in analysing dimensions such as the quantification of financial impacts, discourse on climate change, identification of risks, consideration of timeframes, scenario planning, and integration into remuneration and governance structures.

Notably, thematic coding proved instrumental in analysing several critical dimensions of sustainability integration. For instance, the quantification of the financial impacts of climate change was assessed by first examining companies' Global Reporting Initiative (GRI) and/or Task Force on Climate-related Financial Disclosures (TCFD) reports. Subsequently, sustainability reports were reviewed to identify mentions of financial impacts, such as impacts on accounting line items or portfolios, either in approximate sums or percentages. This process revealed varying levels of disclosure regarding the financial implications of climate change across the sampled companies. It was noted that many companies provided little to no information about the financial implications of climate change.

Similarly, thematic coding was employed to assess companies' discourse on climate change within the text to gauge the extent of companies' acknowledgement and engagement with this critical issue. Furthermore, mentions of physical and transition risks were examined, including known transition risks such as market and reputation risks, even when not explicitly connected to sustainability.

Additionally, the review encompassed mentions of timeframes, assessing whether companies provided information on short-, medium-, and long-term perspectives. Keywords related to scenarios, such as RCP, NGFS, and IEA, were scrutinised to evaluate the incorporation of scenario planning into companies' sustainability strategies.

Furthermore, thematic coding was utilised to assess the integration of sustainability into remuneration practices and governance structures. Mentions of sustainability in connection with remuneration, the terms compensation, incentive, and bonus were evaluated, with specific attention given to the clarity and specificity of these mentions. Similarly, mentions of sustainability in connection with governance structures, operative structures, management, and board responsibilities were reviewed to determine the depth of integration at various organisational levels. Overall, thematic coding provided a structured approach to analysing and interpreting data, enabling a comprehensive assessment of sustainability integration within Nordic firms' reporting practices.

Thematic coding guided the analysis of interview transcripts, initially following a deductive approach using predefined keywords based on the existing methodological perspective and those used in the sustainability reports analysis. This deductive reasoning facilitated the identification of emerging new keywords and topics, ensuring the capture of essential aspects of sustainability reporting from the interviews. Keywords were identified and iteratively analysed to capture emerging topics and perspectives. The interviews were first analysed deductively, focusing on keywords used in sustainability report analysis. Subsequently, an iterative process was employed to identify new keywords arising from each transcript.

Through iterative examination of the data, we remained open to emerging themes and insights that might not have been anticipated initially. This inductive reasoning allowed us to uncover nuanced perspectives, latent motivations, and unexpected challenges encountered by Nordic firms in their sustainability reporting practices. By allowing the data to speak for itself, we gained a deeper understanding of the complexities and dynamics within the sustainability reporting landscape, beyond what was predefined by our deductive approach.

By structuring our analysis around these four main perspectives, we aimed to provide a comprehensive overview of how Nordic listed companies approach sustainability reporting and

climate risk disclosure. This structured approach allowed us to identify key trends, challenges, and opportunities in the sustainability reporting landscape, providing valuable insights for stakeholders and decision-makers alike. The following chapters present a review of the results as structured by the four perspectives; how companies view climate-related challenges and risks, whether the risks are quantified, how they view new EU regulations regarding climate risks to impact them, and whether they have implemented a decarbonisation strategy.

5.4 Climate Risk Communication Findings

Companies communicating their climate and sustainability risks is ever-growing in importance for several critical reasons. Firstly, stakeholders increasingly demand transparency regarding environmental impact and sustainability efforts, fostering trust and emphasising a company's commitment to accountability. Simultaneously, the regulatory landscape is expanding globally, with more countries either implementing or considering mandatory climate disclosure requirements. Compliance with these regulations is crucial to avoid potential legal and financial repercussions, reflecting a global effort to standardise reporting practices.

Investor decisions are now influenced by sustainability factors, particularly among socially responsible investors, with transparent communication playing a significant role. Effective identification and communication of climate-related risks contribute to robust risk management, encompassing physical, transitional, and liability risks. Additionally, conveying a commitment to sustainability can confer a competitive advantage, as consumers increasingly prefer environmentally conscious businesses.

There is a notable global shift towards greater emphasis on sustainability factors in corporate reporting, with companies increasingly prioritising sustainability considerations, especially in climate and sustainability realms, as integral components of their reporting and overarching corporate strategies. Regulatory compliance, exemplified by initiatives such as the IFRS sustainability reporting standards and the European Sustainability Reporting Standards, is playing a significant role in shaping reporting practices.

Furthermore, the rise of frameworks like the Task Force on Climate-related Financial Disclosures (TCFD) underscores the need for consistent and comparable information regarding climate-related risks and opportunities. Investor expectations are evolving rapidly, with stakeholders demanding transparency and concrete actions regarding climate-related issues. This growing influence is driving companies to proactively enhance their reporting practices, aligning them with investor expectations and global trends in sustainability reporting. Ultimately, proactive addressing of climate and sustainability risks positions companies to adapt to changing market conditions and regulatory landscapes, contributing to sustained success and long-term viability.

The systematic review of the sustainability reports as well as the interviews revealed varying levels of disclosure and engagement across companies, highlighting areas of strength and opportunities for improvement.

5.4.1 Perception of Climate Risks and Challenges

This section delves into the findings from the perception of climate risks and challenges. We begin by examining the frameworks used, followed by discussions on climate change, climate risks, and finally climate scenarios.

When analysing sustainability reports through a keyword-based method, it became evident that companies are increasingly aligning with established frameworks such as the EU Taxonomy, Keyword-based analysis of sustainability reports indicates an increasing trend among companies to align their reporting with established frameworks such as the EU Taxonomy, GRI, and TCFD. Notably, organisations like Neste and Orsted are going beyond these standards by incorporating additional frameworks such as SASB, demonstrating a heightened commitment to comprehensive reporting practices.

In the deductive analysis of interviews, similar patterns emerge, with organisations widely adopting reporting frameworks, particularly emphasising climate-related disclosures. There is also a notable emphasis on aligning reporting practices with international standards and upcoming regulations. However, the extent of implementation varies across organisations, with some demonstrating comprehensive alignment while others acknowledge gaps in their adherence to standards. For instance, one interview highlighted a lack of group-level TCFD-related analysis, indicating room for improvement in reporting practices.

> *"So since 2021 we've adopted the TCFD framework. … So to date what we've done is looking at a high-level [analysis] from a group perspective. So we carry out a number of scenario analyses. So you know what would be the situation for [company] in 2030, 2050, if we have a two-degree, a three-degree, or a four-degree world? And what those potential impacts and opportunities are for the group." (Interview 6)*

> *"We have not from a group perspective done TCFD-related analysis of the risk of climate change … But we are also in a process of strengthening our general enterprise risk management, which is something that has not been done much of at a group level." (Interview 4)*

Inductive insights from interviews provide further detail on how organisations perceive and address climate-related challenges. There is a shared emphasis on integrating climate risks into risk management processes, utilising frameworks such as the EU Taxonomy, GRI, and TCFD as essential tools for understanding and addressing these risks effectively. Organisations stress the importance of proactive measures to mitigate climate-related risks and capitalise on emerging opportunities, reflecting a growing awareness of the importance of sustainability initiatives.

> *"The expectations on [company] to assess risks, any risks and opportunities and strategy have increased. Alongside that, commenting on market developments, expectations of stakeholders on companies including [company] regarding sustainability have increased." (Interview 1)*

Analysing sustainability reports and interviews with organisational representatives reveals varying degrees of urgency and commitment among companies toward addressing climate change. Upon further analysis of keywords in sustainability reports, a clear trend emerged regarding how companies address climate change. Many acknowledge it as a significant global challenge with varying degrees of urgency. While some, like Alfa Laval and Atrium Ljungberg, emphasise the need for substantial changes, others such as Citycon and Tryg express concerns over the impact of climate change on their operations. Some companies, like Lindab and Neste, outline specific actions and commitments, such as joining Science Based Targets or emphasising renewable solutions. Despite variations in approaches, the overarching goal

remains consistent: to integrate climate considerations into business strategies and operations comprehensively.

The deductive analysis of interviews highlights two key themes: a consistent emphasis on sustainability, particularly regarding climate change, and recognition of its broad relevance across different sectors within organisations. Interviewees discuss how climate change impacts various aspects of their organisations, such as biodiversity, property management, and investments, suggesting a growing awareness of its importance.

Inductive reasoning across interviews underscores the importance of integrating climate risks into risk management processes. Despite variations, there's consensus on strategic approaches concerning climate risks and opportunities, including data-driven decision-making and addressing transition risks. Interviewees anticipate increased attention to sustainability driven by regulatory changes and evolving market dynamics, highlighting the importance of proactive climate risk management and strategic adaptation in navigating the evolving landscape of sustainability.

> *"I think it's interesting to see moving forward what the implications actually will be. ... But in terms of climate risk and transitional risks, I think definitely that that taxonomy has mapped out what is in general the bigger risks." (Interview 3)*

> *"I also think that our goal in terms of net positive biodiversity will be having blue and green solutions around our properties, both in terms of creating attractive properties, large working places, but also to create more physically resilient properties." (Interview 3)*

> *"We have a template to facilitate and ensure we uphold some sort of standard in our climate scenario analysis and then we have included risk mitigation actions. ... We're looking at blue-green solutions, delaying runoff when it comes to and avoiding flooding, but also erosion or damage to roads" (Interview 1)*

The examination of sustainability reports and interviews revealed nuanced approaches among companies in addressing climate-related risks. Some companies explicitly delineate these risks, highlighting examples ranging from extreme weather conditions to regulatory changes. Others refrain from mentioning climate-related risks, indicating potential gaps in risk assessment and disclosure practices. The analysis of sustainability reports through keyword-based methods unveils diverse strategies among companies in confronting climate-related risks. Notably, entities like Atrium Ljungberg and Catena meticulously outline these risks, ranging from extreme weather events to regulatory shifts. Atrium Ljungberg underscores the potential impact of weather extremities on their properties, emphasising the necessity for adaptive measures. Conversely, some firms, such as OX2, abstain from mentioning climate-related risks in their reports, suggesting potential gaps in their risk assessment practices. Similarly, companies like Schouw address climate impacts without explicitly tackling associated risks, signalling a need for heightened transparency and specificity in their reporting.

Transitioning to deductive reasoning for analysing the interviews reveals enlightening perspectives on various facets of climate-related risks and their management within organisations. Interviews shed light on the multifaceted approach organisations take in managing climate-related risks, considering factors such as proactive risk analysis,

geographical and supply chain considerations, and collaboration and community engagement. Interviewees accentuate the integration of climate risks into broader risk management frameworks and alignment with customer demands and market trends. For instance, Interviewee 1 illustrates proactive risk analysis to prioritise risks based on factors like location and impact, ensuring effective mitigation strategies. Interviewee 3 emphasises the influence of customer demands for sustainability considerations in property management and investments, stressing the importance of organisational alignment with market expectations.

> *"We found the ways to, based on the defined time of the project, the location, the country and so on, look at temperature increase and precipitation because those are the two areas that impact us the most. And even if our assessment to meet demands of the market and the EU taxonomy are higher, that assessment could be used in a screening to eliminate unsuitable locations earlier or bring up the need for dialogue earlier." (Interview 1)*

> *"We're at this stage where also our customers are increasing their own demands, which makes it even easier for us to also incorporate or makes it easier for our regional managers to sort of understand that this is also something they must have on the table when they discuss rent or other sort of adjustments within the property." (Interview 3)*

Moreover, these insights are complemented by the findings through inductive reasoning, by shedding light on transitional risks and competitive considerations related to climate change. Interviewees delve into various themes, including risk management and strategy development, highlighting the integration of climate risks into enterprise risk management frameworks. They also discuss geographical and supply chain considerations, emphasising challenges in quantifying climate risks and the importance of sustainable supply chain management. Lastly, collaboration and community engagement emerge as crucial aspects, stressing interdisciplinary collaboration and engagement with municipalities and communities to develop comprehensive strategies.

> *"The company's very extensive so geographically it's everywhere. So that's one of the first challenges also that we've had because we're not confined to a single region. So that's one of the things that makes things sometimes a bit more complex, especially when you look at regulations and compliance." (Interview 7)*

> *"So saying, OK, there is a risk from raw materials and that is both in a medium, but very much in a long-term. How to assess that?" (Interview 4)*

> *"So I think that the asset managers working locally need to be involved and see, use this risk assessment to evaluate each individual asset. And, and I think they need to do it themselves, not have consultants make a report and so on. But they need to update them and learn about the risks. They will need to talk to the municipalities to find ways to mitigate these risks on like a bigger level than on a property level, like together with the whole community." (Interview 2)*

Lastly, the analysis of sustainability reports and interviews highlighted discrepancies in how companies approach climate scenario planning. While some actively integrate climate scenarios into their assessments, others notably omit any mention. The analysis of

sustainability reports using keyword-based methods exposes a significant divergence in companies' approaches to climate scenario planning. While entities like Atrium Ljungberg, Marel, Neste, and Sampo Group actively integrate climate scenarios into their assessments, drawing from sources such as NGFS, IEA, and scientifically founded scenarios, others like Citycon, Topdanmark, and Atlas Copco notably overlook any mention of climate scenarios in their reports. This contrast highlights varying levels of transparency and commitment among organisations regarding climate scenario planning.

Transitioning to deductive reasoning, interviews shed light on two primary facets: scenario analysis and modelling, and specific climate-related frameworks and initiatives. Throughout the sessions, there's a consistent emphasis on leveraging a diverse range of scenarios, including Representative Concentration Pathways (RCPs) and Shared Socioeconomic Pathways (SSPs), to evaluate potential future climate-related risks and opportunities. Interviewees underscore the importance of considering various scenarios to inform decision-making accurately. For instance, Interviewees elaborate on the utilisation of RCP and SSP scenarios for climate modelling and risk assessment, highlighting the practical application of these methodologies. Although not explicitly mentioned in all interviews, references to Representative Concentration Pathways (RCPs) and Shared Socioeconomic Pathways (SSPs) indicate a broader consideration of socioeconomic factors in climate scenario analysis.

> *"We have RCPs, but we have actually a lot of different scenarios. So we have for the 1.5 I think we have maybe three or four different scenario that is classified as 1.5. and the same for 2, 3 and I think 4 and 5. And then there is one that is called SSP370 and SSP585." (Interview 2)*

Contrarily, the inductive approach, while not explicitly spotlighting scenarios, provides nuanced insights into organisations' perceptions and responses to climate-related challenges and risks. While some scenarios are referenced, reiterating their significance from the deductive perspective may not add substantial value. Instead, through the inductive analysis style, the interviews offer a comprehensive understanding of organisations' strategies and objectives concerning climate-related issues. For instance, interviewees delve into their organisations' perception of climate challenges, focusing on aspects such as the impact of climate change on existing assets, comprehension of external regulations, and sustainability demands. These insights complement the broader understanding gleaned from the top-down analysis, providing a holistic view of organisations' involvement in climate scenario planning and broader sustainability endeavours.

> *"I would say like for it because we also report according to the TCFD. And then we use the scenarios RCP 8.5 and 2.6. So those are the scenarios we use for that. We've conducted and screened the entire portfolio for physical risks for each asset and those are the two scenarios we used. It was conducted a couple of years ago. This year we will redo or update the analysis with also RCP 4.5." (Interview 5)*

In summary, the analysis of sustainability reports and interviews reveals companies aligning with frameworks like the EU Taxonomy, GRI, and TCFD, with some exceeding these standards. There are variations in implementation, indicating room for improvement. Companies show varying levels of urgency in addressing climate change, with discrepancies in climate scenario planning approaches. The keyword-based analysis of sustainability reports highlights trends in companies aligning with established frameworks and discrepancies in

addressing climate-related risks, whereas deductive analysis of interviews emphasises the widespread adoption of reporting frameworks and variations in implementation across organisations. On the other hand, the inductive analysis of interviews provides detailed insights into how organisations perceive and address climate-related challenges, stressing the integration of climate risks into risk management processes. Despite these differences, all methods converge on the importance of proactive measures to mitigate climate-related risks and the need for comprehensive reporting practices aligned with international standards. Overall, organisations employ diverse strategies to manage climate risks, emphasising the importance of proactive risk management amid evolving regulatory and market landscapes.

5.4.2 Quantification

Through different analysis and reasoning styles, a comprehensive understanding of how companies address climate-related financial risks and opportunities emerges.

Starting with keyword-based report analysis, a broad range of approaches to quantifying financial impacts emerges. Some companies, like Atrium Ljungberg and Castellum, offer detailed insights into direct financial effects, while others, such as Alfa Laval and Instalco, provide more general mentions without numerical details. These disparities reflect varying levels of transparency and readiness among companies in addressing climate-related financial risks.

Transitioning to the deductive analysis approach of the interviews, three key sub-topics surface. Firstly, interviewees discuss the challenges of accurately quantifying financial impacts, highlighting efforts to assess revenue loss and project delays due to climate-related events. Secondly, they emphasise the increasing integration of sustainability into decision-making processes, citing investments in energy fields and adjustments in property management as examples. Lastly, interviewees explore conducting double materiality analyses to comprehensively assess the financial implications of sustainability initiatives and risks, alongside financing opportunities.

> *"A damage to the physical assets is going to imply a loss in profit, a loss in production. Then with that physical damage there's a translation into downtime days and then we can calculate how long it's going to take to recover our sites or to get to the production again or in what percentage. So that's the model we're polishing now is how we go from the physical asset damage to the actual loss in monetary terms. But basically, we're going to have these losses and then we're going to have of course to calculate some CapEx OpEx cost on that because we're going to have to spend money to recover the production from other places." (Interview 7)*

> *"We're currently doing the double materiality analysis." (Interview 5)*

Conversely, an inductive analysis approach of the interviews provides nuanced insights into financial implications and investment opportunities associated with climate risks. Interviewees stress the importance of monetising climate risks for executive understanding and prioritisation, alongside challenges in integrating these risks into traditional financial models. Despite variations in approaches, there's a shared recognition of increasing investor interest in sustainability performance and transparency, emphasising the need for robust methodologies to quantify and disclose climate risks.

"And part of that would be to quantify the risks in terms of like what would cost us in terms of, you know, fixing the damages that are made. And but also in terms of you know how much? How would it affect the value of our assets? Would an asset that is exposed to high risk would that asset perhaps have a lower value or would it affect the value as it is now?" (Interview 5)

"When we dug into it, [a percentage amount] of our ownership by capital ownership, investors were either part of the UN principles for responsible investment or the Net Zero alliance, and they had strongly indicated that they would require us to commit to science based targets within the next, you know, 2, 3, 4 years. So we saw it if we were early and adopted that early, one, that would satisfy the investor requests, but there's also opportunity. If you're early to something, you can use it to your competitive advantage. You can use it to reduce your cost, reduce your risk. And then from opportunity side, it can make you more relevant to your customers." (Interview 6)

In terms of the metrics and data used when assessing and quantifying climate impacts, the analysis of sustainability reports reveals a notable variation in how companies address climate-related risks, particularly regarding the timeframe. While some, like Alfa Laval and Marel, provide specific timeframes ranging from short to long term, others, exemplified by Atrium Ljungberg and Castellum, offer more general indications or no specific timeframe at all. This diversity underscores differing methodologies and reporting practices across organisations. Notably, entities like Catena and Vestas outline precise timeframes, with Catena adhering to the TCFD framework and Vestas specifying mid-term and long-term targets. Conversely, companies like Ericsson and Wihlborg define time horizons, while Sampo Group and Sdiptech discuss effects without specifying timeframes, highlighting varying levels of specificity in addressing climate-related risks.

With the deductive reasoning approach, interviews shed light on time frame considerations and risk assessment across short, medium, and long terms. There's a comprehensive approach to risk management, aligning with frameworks like the EU Sustainable Finance Disclosure Regulation (ESRS) and encompassing short, medium, and long-term perspectives. Despite uncertainties surrounding medium and long-term risks, specific time frames such as 2030 and 2050 are considered within the context of climate-related analysis, reflecting a forward-looking approach. Risk assessment discussions encompass various scenarios, including different climate scenarios like Representative Concentration Pathways (RCPs) and Shared Socioeconomic Pathways (SSPs), illustrating the breadth of considerations.

"We're discussing at the moment whether we should adjust the time horizons that are defined in CSRD or if we should go for the pre-set that they recommend, but it's also allowed to adjust if it's the more relevant and it's we're leaning towards it being more relevant to have longer time horizons, but we're also looking at the industry as such and how other players at the market are doing." (Interview 5)

Conversely, with the inductive reasoning approach, the interviews offer insights into topics such as Geographic Information System (GIS) integration, challenges related to model and solution overload, and the adoption of certifications and science-based targets (SBT) for climate action. Interviewees stress the importance of incorporating climate layers into GIS systems for assessments and decision-making. Challenges related to model overload are

highlighted, emphasising the need to prioritise tools effectively. Additionally, the adoption of certifications and science-based targets emerges as a key strategy for emissions reduction. Interviews delve into the utilisation of data and technology, focusing on external expertise, challenges in data collection and analysis, and technological infrastructure challenges. While approaches and perspectives vary, the significance of leveraging data and technology for managing climate-related risks is emphasised across interviews.

> *"We find different regulations that are colliding. So for example to, now I get very specific, but for example, to define a new construction as taxonomy aligned, it has to fulfil certain criteria and one criteria is that it has to have a lower degree of chemicals that are close to the people that are going to be in the building. And the taxonomy has criteria on, I don't know, say two or three decimals whereas the chemical regulation of Sweden is not as detailed, meaning that we cannot use the product sheets to claim that the chemical is OK to use in this amount." (Interview 5)*

> *"I must admit that I get emails almost daily about new models and solutions that I find it hard to have an overview and be able to prioritise, whether we need to invest in something." (Interview 1)*

5.4.3 Decarbonisation

While the report analysis was conducted without specific decarbonisation keywords, however, related keywords surfaced in the interview transcripts, revealing the significance of decarbonisation efforts in organisational strategies, thus allowing the deductive reasoning analysis of interviews to highlight comprehensive sustainability commitments across organisations. Conversely, the inductive reasoning approach provided insights into specific decarbonisation strategies and challenges faced by organisations, underscoring the complexity and diversity of approaches to achieving sustainability goals.

In the deductive reasoning approach, interviews highlighted key themes related to sustainability and climate action. These included carbon footprint reduction, climate resilience, renewable energy adoption, decarbonisation strategies, supply chain sustainability, circular economy principles, and energy performance certificates. Interviewees expressed commitment to measuring and reducing their company's carbon footprint, emphasising strategies aimed at decarbonisation. Discussions also centred on supply chain sustainability challenges and efforts to engage with suppliers. The interviews depicted a holistic commitment to sustainability across various business operations.

> *"We of course have a minimum that we require the businesses to report; scope 1 and 2 emissions very soon, scope 3 as well. All of that is sort of a minimum. But we would like not to go that much further than the minimum for all of our businesses. Because you can naturally, if we say all of them have to have science based target commitments, then you suddenly have a business with the revenue of 17 million and then you have one with 2 … Or maybe you have one company with the 5000 tons of CO2 emissions and one with 80, right, so. There are very huge differences between the businesses and therefore it's much more up to them themselves." (Interview 4)*

Conversely, the inductive reasoning approach under "decarbonisation" explored various aspects of organisations' efforts to reduce carbon emissions and achieve sustainability targets.

Common themes included decarbonisation strategies, setting targets, and engaging in sustainable practices across supply chains. Challenges related to decarbonising emissions from project construction were discussed, along with efforts to engage suppliers in sustainable practices and enhance energy efficiency measures. Differences emerged in approaches to setting decarbonisation targets and addressing scope 3 emissions reporting, reflecting the complexity of organisational strategies.

> *"So we're committed to science based targets. So that's to have our scope one and two, reduce by 50% by 2030 and scope 3 by 28%. So for scope one and two, that's a little bit more mature. So what we do is we have a formal reporting process. So we carry a quarterly sustainability reporting at the end of each quarter, then that the COO for each of our divisions and the head of sustainability for each division presents on their performance for the quarter, the year to date. ... Scope 3 is a bit of a different animal it represents around 99% of our total emissions. So you know if you consider we have [thousand] sites, [a couple hundred] factories in [tens of] countries and that's 1% of our footprint, it gives you a bit of an idea of the magnitude of our scope 3. It's much more than just our operations. It's innovation, it's product management, commercial side of the business, supply management, super relevant logistics and transport. So it's incredibly important that we have a very much cross functional approach to that." (Interview 7)*

5.4.4 New EU Regulations Regarding Climate Risks

The sustainability report analysis delved into the alignment of remuneration structures with climate sustainability targets across various companies, employing a keyword-based examination. Companies were classified into low, medium, and high alignment categories based on the extent of sustainability metrics integration into their compensation frameworks. Notable findings revealed leaders and laggards in this aspect, with firms like Alfa Laval and Atrium Ljungberg falling into the low alignment category due to minimal integration, while Marel, Neste, Sampo Group, and Skanska showcased robust alignment with sustainability goals.

In the low alignment category, companies like Alfa Laval and Atrium Ljungberg displayed limited incorporation of sustainability metrics into their remuneration policies. Alfa Laval primarily emphasised financial criteria in its remuneration policy, devoid of explicit sustainability targets, while Atrium Ljungberg opted for fixed salaries without performance-related remuneration.

Moving to the medium alignment category, companies such as Catena, Castellum, and Citycon showed partial integration of sustainability metrics into their compensation structures. For instance, Castellum's variable remuneration aimed at fostering long-term value creation and sustainability initiatives, tied to predetermined growth and share price objectives, while Citycon included sustainability as one of the performance metrics in its short-term incentive plans.

Conversely, firms in the high alignment category, including Marel, Neste, Sampo Group, and Skanska, demonstrated robust integration of sustainability targets into their compensation frameworks. For example, Neste's long-term incentives plan allocated measures based on greenhouse gas impact, reflecting a strong sustainability commitment. Sampo Group

incorporated environmental, social, and governance (ESG) criteria into variable compensation programs, ensuring alignment with sustainable development goals, while Skanska linked variable cash remuneration to both financial and non-financial performance, reinforcing alignment with sustainability objectives.

The deductive and inductive reasoning approaches in the analysis did not prominently feature remuneration-related topics. In the deductive reasoning approach based on interviews, there was a lack of substantial information on sustainability initiatives, remuneration, compensation, incentives, or bonuses. While the interviews focused on keywords related to these topics, detailed findings or discussions were not provided, suggesting that these areas may not have been central to the conversations. Similarly, the inductive reasoning approach also did not highlight remuneration, as it was not mentioned in the interviews. This consistency with the findings from the deductive reasoning analysis underscores the limited emphasis placed on remuneration-related topics during the interviews. In the follow-up information requests, the responses varied, however there were some similarities. At some companies, sustainability goals are linked to remuneration, while at others' the remuneration practices do not include a sustainability aspect. Not all interviewees provided additional information to the follow-up question asked.

Transitioning to governance, the report analysis, employing a keyword-based approach, scrutinised sustainability governance practices across various companies, revealing varying degrees of integration categorised as medium and high. Companies with medium-level integration, like Alfa Laval and Atrium Ljungberg, show moderate awareness of sustainability within their governance structures, acknowledging it at the board level without specific outlined actions. In contrast, companies with high-level integration, such as Catena and Vestas, demonstrate a more comprehensive approach where sustainability permeates decision-making at all levels. For example, Vestas has a dedicated Sustainability Committee coordinating cross-functional initiatives, while OX2's Sustainability Committee focuses on various sustainability objectives and risks. Castellum integrates sustainability into internal regulations and operations, while Neste maintains separate functions for sustainability and corporate affairs with dedicated oversight and integration into general risk management.

In the top-down deductive reasoning approach, based on analysed interview transcripts, two key subtopics emerged: integration of sustainability into governance and management, and stakeholder engagement and collaboration. Interviews highlighted efforts to establish sustainability committees, integrate sustainability considerations into decision-making processes, and engage stakeholders across functions. Collaborative approaches involved co-creating strategies and solutions with colleagues from diverse backgrounds and engaging stakeholders such as regional managers, customers, suppliers, and investors. Additionally, discussions centred on involving the community or municipality in risk mitigation efforts and conducting stakeholder analyses to understand their perspectives and expectations.

> *"We have now set formal quarterly progress and performance reviews where the COO and CTO for each division will present to. So we have a science based target score team and so I chair that with the head of our supply management innovation and then support from our controller function as well. We also have an executive team steering committee. So that's made-up of our groups, CFO, the CTO, and then the acting chair*

of our Operations Board. So each quarter the Divisional CTO and COO will present their divisional action plan to the Steering committee." (Interview 6)

"The things that have been most valuable are co-created or based on discussions with others working with other aspects than climate. Because I'm a, you know, sustainability professional, I come from the environmental field, I need to learn a lot about how others work with risks and finances. In the same way that our controllers and the other roles at the company need to understand and learn about the climate. It's very easy to think that they need to learn this, but I also need to learn about why processes look the way they do. So I can understand where it's appropriate and meaningful and effective to include climate." (Interview 1)

Conversely, the bottom-up inductive reasoning focused on corporate engagement, transparency, and accountability in addressing sustainability and climate-related issues. While there were commonalities across interviews regarding the importance of stakeholder engagement, transparency, and accountability, differences in approaches and perspectives emerged. Some interviewees emphasised stakeholder pressure, particularly from investors, while others focused on challenges related to transparency and reporting. Discussions highlighted efforts to transparently address stakeholder concerns through reporting and strategy formulation, as well as challenges related to transparent methodologies in ESG ratings and potential risks associated with disclosing detailed climate risk data. Overall, the interviews collectively underscored the importance of stakeholder engagement, transparency, and accountability in corporate responses to sustainability and climate-related challenges, reflecting the evolving landscape of investor relations and reporting practices.

"But I mean we more, in [company], we say that if it's not coming directly from the pressure from stock market, then it should be more the businesses looking at their different stakeholders, looking at the customers. Are they asking for this. Looking at their competitors, are they much further ahead." (Interview 4)

Finally, the report analysis categorises companies based on the level of assurance provided for their sustainability reports, revealing varying approaches to ensuring credibility and reliability. Companies like Alfa Laval and Atrium Ljungberg offer limited assurance, with procedures in place to comply with defined criteria set by the Board of Directors or Executive Management. For instance, Citycon's limited assurance statement confirms the absence of material modifications needed for environmental information in their Sustainability Accounts. Conversely, companies like Marel and Tryg provide no assurance information in their reports.

In contrast, Neste, Sampo Group, and Vestas provide limited assurance statements, signifying compliance with specific reporting criteria and standards through rigorous procedures. Similarly, Ericsson and Handelsbanken offer limited assurance statements, indicating adherence to criteria defined by the Board of Directors and Executive Management. Geographical variations influence the extent and nature of assurance provided, reflecting differences in legislation and reporting standards.

The top-down deductive reasoning approach, derived from interviews, underscores the importance of assurance and audit processes in ensuring the credibility of sustainability reports. Interviewees advocate for third-party assurance and rigorous auditing to enhance the reliability and trustworthiness of disclosed information. For example, Interviewee 6 highlights the role of

third-party assurance, indicating a commitment to accuracy and credibility. Interviewee 5 discusses the difficulty of the process of beginning the verification of sustainability reports and the limited assurance provided by auditors, emphasising the scrutiny applied to those who begin disclosing.

> *"So we did a gap analysis with our auditors between what we're doing now with GRI and CSRD to see, OK, where are we falling short across all of the indicators. In addition, we carried out an external assurance or a light audit of our sustainability report from 2022 because we knew that from 2024 our annual and sustainability report would need to be combined and also externally verified by our auditors." (Interview 6)*

> *"For instance, we have not had any assurance on any of our ESG KPIs beforehand. A lot of other companies in our size or a little bit larger, they have tested out limited assurance on some KPIs earlier. Stuff like that just makes it a bit harder for us because then it hits full hammer next year with all of the different metrics having to be assured." (Interview 5)*

Conversely, Standardisation and Transparency emerge as critical considerations. Interviewees call for standardised frameworks to streamline reporting practices and enhance comparability across organisations. Interviewee 3 stresses the need for consistency and clarity in sustainability disclosures through standardised reporting. However, challenges arise due to the lack of established frameworks, as discussed by Interviewee 4, who mentions difficulties in aligning reporting practices without standardised guidelines.

> *"So those things are very important to find a common ground and being transparent in methodologies which I think will be more easy when everyone's reporting fully" (Interview 3)*

> *"Businesses are kind of choosing what elements to report on, choosing how to do it. They're choosing what kind of, if they're rated by this ESG rating agency, then of course they focus on this and then you end up with a very large report or something. Because you needed to satisfy here and there. Of course it's good to have a more standardised approach. It's good to have an approach that are more in line with the financial reporting in terms of comparability, comprehensiveness. … But at the same time, I think that a lot of companies also think that it is introduced in a very, very swift manner or very, very fast. Because we had many years to practise financial reporting. And then we actually haven't, almost did not receive the defined version of the [sustainability] standard before we had to prepare reporting for the year after. So I mean, that's one of the issues I see." (Interview 4)*

Moreover, transparency is emphasised as essential in sustainability reporting. Interviewees highlight the importance of transparently disclosing climate-related risks and opportunities. Interviewee 7 underscores the significance of transparency and disclosure, emphasising the engagement with legal support to analyse regulations and ensure compliance.

> *"I'm not involved, but I know our sustainability team also has contact with some kind of juridic or legal company that supports with the analysis to make sure we don't miss anything." (Interview 7)*

The employing of inductive reasoning in the analysis of the interviews provided insights into how the experts viewed the impact of new EU regulations and corporate engagement and transparency. Regarding regulatory compliance and reporting, interviewees stressed the need to adopt frameworks like the Task Force on Climate-related Financial Disclosures (TCFD) recommendations to formalise strategies for climate action ahead of forthcoming EU regulations such as the Corporate Sustainability Reporting Directive (CSRD) and the EU Taxonomy. They highlighted the importance of standardised approaches and transparent methodologies to enhance the credibility and comparability of sustainability reporting. Additionally, interviewees recognised the opportunities for innovation and market leadership arising from these regulations while anticipating challenges in interpreting and aligning different standards and regulations.

> *"But also our customers are going to tell us you need to do this right or you're not going to be my supplier anymore. So it's kind of feeding itself somehow. So I think that's and that's very good. I mean its making things move and it's also pushing for innovation much more than it's always, I mean that that's the good part. Of course, we deal with competition. We have competitors from other countries who have to comply with none of these. But still, I mean as a company the company has this principle that we want to do things right and that's part of." (Interview 7)*

In terms of corporate engagement and transparency, interviewees acknowledged the rising expectations of stakeholders, especially investors and shareholders, regarding sustainability and climate-related issues. They emphasised the necessity of engaging with stakeholders to effectively address climate risks and opportunities. Discussions revolved around challenges related to transparency and reporting, including the need for more transparent methodologies in Environmental, Social, and Governance (ESG) ratings and the potential risks associated with disclosing detailed climate risk data. Interviewees also highlighted efforts to ensure compliance with reporting standards and regulatory requirements through external assurance and audits of sustainability reports. Overall, while approaches varied among interviewees, there was a collective recognition of the crucial role of stakeholder engagement, transparency, and accountability in corporate responses to sustainability challenges, reflecting the evolving landscape of investor relations and reporting practices.

5.5 Discussion

5.5.1 Comparability

The analysis of sustainability reports and interviews reveals a nuanced landscape wherein companies exhibit varied approaches to addressing climate-related risks and challenges. Firstly, discrepancies are evident in how companies align their reporting with established frameworks. While some adhere to standards such as the EU Taxonomy, Global Reporting Initiative (GRI), and Task Force on Climate-related Financial Disclosures (TCFD), others surpass these requirements by incorporating additional frameworks like the Sustainability Accounting Standards Board (SASB). This discrepancy indicates varying levels of commitment and transparency in reporting practices.

Secondly, inconsistencies emerge in the level of detail provided regarding climate-related risks. Some companies meticulously delineate these risks, including detailed assessments and scenario planning, while others provide minimal or no mention, potentially indicating gaps in

risk assessment and disclosure practices. This disparity underscores challenges in accurately comparing approaches across organisations and assessing the true extent of climate-related risks within company operations.

Furthermore, variations in urgency and commitment towards addressing climate change further contribute to the lack of comparability. While some companies emphasise the need for substantial changes and outline specific actions and commitments, others express concerns without detailing corresponding measures. This discrepancy in approach highlights the diversity of perspectives within the sustainability landscape and underscores the need for standardised reporting practices to enable meaningful comparisons and benchmarking.

Regarding quantification, significant differences emerge in how companies quantify and address climate-related financial risks. Some provide detailed insights with numerical data, enabling stakeholders to assess the financial implications of climate risks more effectively. In contrast, others offer more general mentions without specific numerical data, reflecting varying levels of transparency and readiness among companies to disclose financial impacts.

Interviews with organisational representatives further underscore these disparities, revealing challenges in accurately quantifying financial impacts and inconsistencies in reporting methodologies. Differences in the metrics and data used for assessing and quantifying climate impacts further complicate comparability, making it challenging for stakeholders to evaluate the financial implications of climate-related risks across organisations.

When considering decarbonisation strategies and reporting, the analysis highlights several aspects contributing to a lack of comparability. While both deductive and inductive reasoning approaches discuss decarbonisation efforts, differences emerge in the depth and specificity of reporting. This complexity reflects the diverse nature of organisational strategies and the lack of uniformity in target-setting methodologies, making it difficult to compare companies' progress towards decarbonisation goals accurately.

Moreover, the implementation of new EU regulations exacerbates comparability issues, as variations in sustainability metrics integration, governance structures, assurance practices, and geographical influences further complicate the landscape. Despite calls for standardised frameworks to enhance comparability, challenges persist due to the lack of established guidelines and difficulties in aligning reporting practices across jurisdictions and industries.

In conclusion, the analysis underscores the urgent need for standardised reporting practices and frameworks to facilitate comparability across sustainability reports. By establishing clear guidelines and metrics, stakeholders can make more informed decisions, hold companies accountable for their environmental impact, and drive progress towards a more sustainable future.

5.5.2 Quantification

The analysis of annual and sustainability reports underscores a critical observation: the limited quantification of financial impacts associated with climate risks across companies. While some firms provide detailed assessments, others offer only generalised implications, hindering stakeholders' ability to assess the true financial implications of climate change comprehensively. This inconsistency in quantification levels and methodologies highlights the pressing need for greater standardisation and transparency in sustainability reporting.

Some companies stand out for their commendable efforts in quantifying climate impacts, albeit with varying levels of detail. Catena, for instance, illustrates the potential impact on rental income should a portion of their property value become obsolete. Similarly, Atrium Ljungberg is notable for being the sole company providing quantified climate impacts for multiple line items, addressing both transition and physical risks distinctly. However, the majority of companies fail to provide specific numerical data, making it challenging for stakeholders to gauge the extent of financial risks accurately.

This lack of clarity not only affects investors' decision-making processes but also hampers efforts to compare companies' resilience to climate change and incentivise sustainable practices effectively. Moreover, the absence of standardised reporting frameworks exacerbates the issue, leading to inconsistencies and challenges in comparing sustainability reports across companies. Without clear guidelines and metrics, stakeholders are left with incomplete information, hindering the integration of climate risk considerations into investment strategies and decision-making processes.

In conclusion, the limited quantification of financial impacts associated with climate risks poses significant challenges for stakeholders, investors, and regulatory bodies alike. Addressing this issue requires concerted efforts towards greater standardisation, transparency, and harmonisation of methodologies across companies and industries to facilitate informed decision-making and drive progress towards sustainability goals. By establishing clear guidelines and metrics, stakeholders can make more informed decisions, hold companies accountable for their environmental impact, and foster the transition towards a more sustainable future.

5.5.3 Connection to Strategy

The analysis illuminates a significant discrepancy between companies' sustainability initiatives and their overarching corporate strategies across several critical dimensions, including governance structures, remuneration alignment, perception of climate risks, quantification practices, and response to new EU regulations.

When examining the integration of sustainability into governance structures and remuneration alignment, it becomes evident that companies employ varied approaches, indicating a lack of systematic integration with corporate strategy. While certain companies exhibit a robust integration of sustainability considerations throughout their governance frameworks and compensation structures, others demonstrate only partial or minimal incorporation. This variance raises pertinent questions about the extent to which sustainability concerns are prioritised in strategic decision-making processes across different organisations.

In terms of the perception of climate risks, despite efforts to align reporting practices with international standards such as the EU Taxonomy, GRI, and TCFD, there emerges a conspicuous gap between reporting and strategic actions. Although many companies acknowledge climate risks within their reports, they often fail to translate these risks into actionable strategies that are fully aligned with broader business goals. This gap underscores the need for companies to more effectively integrate climate risk assessments into their strategic decision-making processes to enhance their resilience and adaptability to environmental challenges.

Similarly, the analysis of how companies quantify climate-related financial risks reveals notable inconsistencies and a lack of strategic alignment. While some companies provide detailed assessments of the financial implications of climate change, the integration of these insights into strategic decision-making remains unclear. This disconnect highlights the necessity for companies to better align their quantification practices with overarching strategic objectives to bolster their resilience to climate-related financial risks and capitalise on emerging opportunities.

Furthermore, the discussion surrounding new EU regulations sheds light on a lack of explicit connection between sustainability practices and broader strategic goals. While companies may adhere to regulatory reporting standards, there is limited evidence of how these practices contribute to achieving strategic sustainability outcomes. This disconnect suggests that companies may not be fully leveraging their sustainability efforts to drive meaningful and impactful outcomes that are closely aligned with their strategic objectives.

In summary, the findings underscore the critical imperative for companies to bridge the gap between their sustainability initiatives and corporate strategy. Achieving this alignment necessitates not only the integration of sustainability considerations into governance structures, remuneration policies, and reporting practices but also the incorporation of climate risk quantification and regulatory compliance efforts into broader strategic decision-making processes. By fostering greater alignment, companies can enhance their resilience to climate risks, drive sustainable growth, and create enduring value for all stakeholders involved.

5.5.4 Reasonable Assurance

The analysis reveals significant shortcomings in the reasonable assurance provided by different companies' sustainability reports across various dimensions, including the perception of climate risks, quantification practices, and response to new EU regulations.

In terms of the perception of climate risks, inconsistencies in reporting practices, limited transparency, and discrepancies in climate scenario planning contribute to doubts about the reliability and usefulness of sustainability reports. While some companies demonstrate alignment with reporting frameworks, such as the EU Taxonomy, Global Reporting Initiative (GRI), and Task Force on Climate-related Financial Disclosures (TCFD), others show gaps in adherence, suggesting a lack of uniformity and reliability in reporting practices. For instance, entities like Neste and Orsted are embracing additional frameworks like the Sustainability Accounting Standards Board (SASB), indicating a commitment beyond basic reporting compliance. However, the failure of some companies to explicitly address climate-related risks in their reports and integrate them into their strategic decision-making processes further undermines the credibility of their sustainability disclosures.

Regarding quantification practices, disparities in how companies quantify financial impacts, challenges in accurately assessing these impacts, and inconsistencies in reporting timeframes contribute to uncertainties about the accuracy and reliability of the reported financial data. While some companies provide detailed insights into direct financial effects, others offer more general mentions without numerical details, indicating a lack of standardised reporting practices. Despite recognising the importance of monetising climate risks, there is limited evidence of how these insights translate into strategic decision-making processes, indicating a disconnect between understanding financial implications and integrating them into broader

strategic objectives. Furthermore, interviewees highlight challenges related to data collection and analysis, including model overload and technological infrastructure challenges, indicating potential limitations in companies' capabilities to collect, process, and analyse data accurately, raising concerns about the reliability of the reported financial information.

Concerning the response to new EU regulations, varying approaches to assurance, challenges in standardisation and transparency, and inconsistencies in reporting practices further erode stakeholders' confidence in the reported sustainability information. Some companies offer limited assurance or provide no assurance information at all, raising questions about the credibility and reliability of the reported data. Moreover, the lack of standardised frameworks and transparent methodologies hinders the assurance process and contributes to inconsistencies in reporting practices. Interviewees advocate for standardised frameworks to streamline reporting practices and enhance comparability across organisations, underscoring the importance of establishing clear guidelines and methodologies to improve the credibility and reliability of sustainability reporting.

Overall, the findings underscore the urgent need for companies to enhance the reasonable assurance provided by their sustainability reports. This necessitates improvements in reporting practices, greater transparency, standardisation of frameworks and methodologies, and more robust integration of climate-related risks into strategic decision-making processes. By addressing these shortcomings, companies can bolster stakeholders' confidence in sustainability reporting and contribute more effectively to addressing sustainability challenges.

5.6 Conclusions

The detailed analysis of sustainability reports and interviews with organisational representatives across Nordic companies reveals a multifaceted approach towards addressing climate risks and opportunities. Companies are increasingly aligning their reporting with established frameworks such as the EU Taxonomy, GRI, TCFD (and soon CSRD/ESRS), demonstrating a commitment to structured and standardised reporting practices. This alignment not only helps in standardising approaches but also assists in enhancing transparency and accountability in climate-related disclosures.

The examination of sustainability reports through keyword-based methods unveils that companies like Neste and Orsted are taking proactive steps by incorporating additional frameworks like SASB. This suggests a heightened commitment to comprehensive reporting practices with international comparability. The analysis reveals a trend of organisations focusing significantly on climate-related disclosures, integrating these into their broader risk management and strategic frameworks. However, the extent of implementation varies, indicating that while some organisations show comprehensive alignment with these standards, others acknowledge gaps in their adherence.

Interview analyses, both deductive and inductive, provide insights into how organisations perceive and address climate-related challenges. There is a shared emphasis on integrating climate risks into risk management processes, utilising frameworks as essential tools for understanding and addressing these risks effectively. Organisations stress the importance of proactive measures to mitigate climate-related risks and capitalise on emerging opportunities, reflecting a growing awareness and active engagement in sustainability initiatives.

Furthermore, the in-depth interviews reveal varying degrees of urgency and commitment among companies towards addressing climate change. While some organisations, like Alfa Laval and Atrium Ljungberg, emphasise the need for substantial changes, others such as Citycon and Tryg express concerns over the impact of climate change on their operations. This varied response highlights the differing perceptions and strategic approaches companies are taking towards managing climate risks.

From the deductive analysis of interviews, two key themes emerge: a consistent emphasis on sustainability, particularly regarding climate change, and recognition of its broad relevance across different sectors within organisations. Companies discuss how climate change impacts various aspects of their operations, from biodiversity and property management to investments, suggesting a growing awareness of its importance and the need for integrated responses.

In terms of scenario planning, the analysis shows that some companies actively integrate climate scenarios into their assessments, while others notably omit any mention. This divergence underscores the varying levels of transparency and commitment among organisations regarding climate scenario planning. Throughout the interviews, there's a consistent emphasis on leveraging a diverse range of scenarios to evaluate potential future climate-related risks and opportunities, indicating a strategic approach to climate risk management.

From this comprehensive analysis, three distinct answers emerge to the question of how Nordic companies disclose and embed climate risks in their reports:

1. Framework Alignment and Integration: Nordic companies disclose climate risks by aligning their reporting with established international and regional frameworks such as the EU Taxonomy, GRI, and TCFD and are in the process of implementing the new CSRD/ESRS standards with some, such as Orsted, already aligning to ESRS. This alignment is further enhanced by some companies adopting additional frameworks like SASB, indicating a thorough approach to disclosure that surpasses basic compliance and allows for international comparability with a distinct investor focus. This structured alignment facilitates a more detailed and accountable disclosure of climate risks, making the reports not only comprehensive but also comparable across different organisations.
2. Strategic and Operational Integration: Climate risks are not only reported but are also increasingly embedded into the strategic and operational frameworks of companies. This integration is evident from the extensive use of climate-related disclosures in risk management processes and strategic decision-making. Companies utilise these disclosures to guide their responses to climate change, from risk mitigation to seizing new opportunities presented by the shifting environmental landscape. This shows that climate risk disclosure is becoming a central component of corporate strategy, affecting various levels of decision-making within organisations.
3. Active Engagement and Scenario Analysis: The disclosure and embedding of climate risks are characterised by active engagement through scenario analysis and forward-looking assessments. Companies employ a variety of climate scenarios to anticipate potential impacts and plan accordingly. This proactive approach not only helps in preparing for future risks but also in aligning business strategies with sustainable practices. Scenario analysis thus plays a crucial role in how companies understand,

disclose, and integrate climate risks into their broader business operations and strategic planning.

Despite the above-mentioned concerted effort to align with and exceed established reporting frameworks, discrepancies in the extent of implementation and in the depth of strategic integration highlight gaps that need addressing.

First, while many companies exhibit a formal alignment with frameworks, the actual integration into strategic operations and decision-making varies. Some companies are identified as only partially embedding these frameworks into their risk management and strategic processes, indicating a need for more comprehensive integration. Enhancing this integration could involve mandatory training for decision-makers on the implications of climate risks and the benefits of deeper framework integration, ensuring that climate considerations are central to all strategic decisions.

Second, the variability in the urgency and depth of climate scenario planning suggests another area for improvement. Although some companies actively use scenario analysis to anticipate future risks, others lack detailed scenario planning. This inconsistency could be mitigated by establishing stronger regulatory requirements for climate risk assessments and scenario planning, ensuring that all companies adhere to a minimum standard of foresight in their sustainability reporting.

Last, the findings suggest a general lack of comparability and quantification in disclosures, which can obscure stakeholders' understanding of a company's true climate risk exposure and resilience. To address this, regulatory bodies could develop more stringent guidelines for climate-related disclosures, including specific metrics for quantification and a standardised format that facilitates direct comparison across companies and industries.

Looking forward, there is an evident need for standardised, comprehensive, and integrated approaches to climate risk reporting and management. As regulatory frameworks like the EU Taxonomy and the CSRD/ESRS evolve, companies should strive to close these gaps by working on a genuine strategic alignment of their business models with their sustainability goals and by that drive meaningful progress in corporate responses to climate challenges.

5.7 Appendix I: Findings derived from Sustainability Reports

Company	Alfa Laval	AssaAbloy	Atlas Copco
Separate/ integrated report	integrated	standalone	integrated
Frameworks used	CDP, EU Taxonomy, GRI, TCFD,	CDP, EU Taxonomy, GRI, TCFD,	CDP, EU Taxonomy, GRI
Quantification of financial impacts of CC	None.	Yes. As % of annual turnover for each risk (p17)	"Omission: The assessment of climate-related risks and their financial implications has started at divisional level. However, the outcome is not yet consolidated and disclosed in quantitative terms outside the organisation." (p140)
Assurance	limited	limited	limited
How do they talk about climate change?	"With climate change, the world is facing its biggest challenge in modern times" (p5) "There is a growing realization among communities, businesses and citizens that the world needs to make major changes in order to manage climate change." (p10) "Climate change can lead to increased costs and constrain production." (p154)	"Climate change and more extreme weather conditions further emphasise the need for robust and reliable products." (p2) "Climate change continues to present one of the biggest threats we face globally. " (p16)	"Climate change is high on both our own and many of our customers' agendas." (p33) "Climate change presents a huge threat to society and in 2021, we significantly raised our ambitions by committing to reducing the greenhouse gas emissions throughout our value chain in line with the goals of the Paris Agreement." (p42) "As a leading industrial innovator and global supplier, Atlas Copco can play a role in combating climate change." (p51)
Mention of physical and transitional risks	The terms are not mentioned, but some risks are named.	The terms are used and examples are mentioned.	The term physical climate risk is mentioned.
What risks exactly	"Climate change can lead to **increased costs** and **constrain production**. Water scarcity in the supply chain or at our sites can constrain production. **Cost of energy or carbon emissions can increase** due to climate legislations. However, the biggest risks are connected to **climate change** **and extreme weather** in our exposed operations and supply chains in North America, China and India. Although all sites can be affected, these three regions stick out in the medium (5–10y) to long term (10–40y).."(p154)	RCP 6 risks: "Coastal factories at risk of flooding • Supply chain uncertainty • Materials availability • Customer expectation • Ability to get insurance • Higher costs for emissions" RCP 2.6 risks: "Availability of low-carbon materials • Need to upgrade and retrofit older sites • Carbon taxes and market regulations • Customer expectation • M&A in higher risk geographies • Energy quality and availability"	Transitional risks: market shift toward a low-carbon economy, climate and energy policy sharpening, "increased energy prices and taxes, and regulations related to CO2 or other greenhouse-gas emissions" Physical risks: changing weather patterns, rising sea level, water scarcity (p131)
Timeframe for the risks	"During 2022 Alfa Laval has conducted a holistic risk assessment looking at how climate change will affect Alfa Laval's financial result (short term 0–5y, medium term 5–10y and long term 10–40y)."(p154)	No timeframes defined.	No timeframes defined.
Climate scenarios	No climate scenarios mentioned.	RCP 2.6 and 6	No scenarios mentioned.
Remuneration aligned with climate sustainability targets	No	No	High
Details	No mention specifically in the remuneration policy. "The STI plan awards shall be based on mainly financial criteria. The criteria shall be designed so as to contribute to the company's business strategy and long-term interests." (A&SR p189)	"One thing on the governance side where we want to see more engagement is in ESG. We believe there is a lack of a link between ESG factors and the KPIs for the variable compensation. We have assessed this issue as an area of improvement for the remuneration committee. We believe having some ESG KPIs built-in to the long-term incentive program will help to improve efficiency." (SR p45)	"The remuneration shall consist of base salary, variable compensation, possible long-term incentives (personnel options), pension benefits and other benefits. The variable compensation is limited to a maximum percentage of the base salary and is linked to predetermined and measurable criteria which can be financial or non-financial. Non-financial criteria for 2022 has been to reduce the Group's CO2 emissions." (AR p54) "The following describes the various guidelines in determining the amount of remuneration:• Base salary is based on competence, area of responsibility, experience and performance. • Variable compensation is linked to predetermined and measurable criteria which can be financial or non-financial. Non-financial criteria for 2022 has been to reduce the Group's greenhouse gas emissions in line with the Group's science-based targets. The variable compensation is maximized to 80% of the base salary for the President and CEO, 60% for Business Area Presidents, and 50% for other members of Group Management." (AR p83"
Sustainability integrated into governance structure.	Somewhat	Somewhat	Medium
Details	Sustainability included on group management level within operational control (A&SR p103)	Board of director's duties include: "identifying how sustainability issues impact risks to, and business opportunities for, the company," (SR p53)	The President and CEO is also responsible for ensuring that the organisation works towards achieving the targets for sustainable, profitable growth. The business areas are responsible for developing their respective operations by implementing and following up on strategies and objectives to achieve sustainable, profitable growth. Atlas Copco's risk management approach follows the Group's decentralised structure. Local companies are responsible for their own risk management, which is monitored and followed up regularly, e.g. at local board meetings. Group functions for legal, insurance, sustainability, treasury, tax, controlling and accounting, provide policies, guidelines and instructions regarding risk management.
Assurance level	Statutory sustainability report	Statutory sustainability report	Statutory sustainability report
Conclusion	Based on the limited review performed, nothing has come to our attention that causes us to believe that the Sustainability Report is not prepared, in all material respects, in accordance with the criteria defined by the Board of Directors and Executive Management.	our examination of the statutory Sustainability Report is different and substantially less in scope than an audit conducted in accordance with International Standards on Auditing and generally accepted auditing standards in Sweden. We believe that the examination has provided us with sufficient basis for our opinion.	Based on the limited assurance procedures we have performed, nothing has come to our attention that causes us to believe that the Sustainability Report is not prepared, in all material respects, in accordance with the criteria defined by the Board of Directors and Executive Management. A Statutory Sustainability Report has been prepared.
Examination/assurance in accordance with	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000 (Revised), FAR's recommendation RevR12, International Standard Quality Control ISQC 1	Prepared in accordance with FAR's recommendation RevR12	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000 (Revised), FAR's recommendation RevR12, International Standard Quality Control ISQC 1, Code of Ethics for Professional Accountants issued by the IESBA

Company	Atrium Ljungberg	Castellum	Catena
Separate/ integrated report	integrated	integrated	integrated
Frameworks used	CDP, EU Taxonomy, GRI, TCFD,	CDP, EU Taxonomy, GRI, TCFD	EU Taxonomy, GRI, TCFD
Quantification of financial impacts of CC	o "FINANCIAL IMPACT OF CLIMATE RISKS and opportunities" (**p.139**) impact of climate change on: operating costs, project costs, investment needs, revenue (as a result of lower demand and lower occupancy rates), energy prices, repair and maintenance costs and opportunities (not detailed). The cost of climate action is not specified ("We have made an omission in this report relating to the costs of actions to manage any risks. We are working on producing this, but do not have a complete report yet.	a list of climate change impact on financial performance (p118), estimation of reduction in rental income and total property value (p66)	no quantification, just general mentioning of areas (e.g. investments, operating and maintenance costs) (p.99)
Assurance	limited	limited	limited
How do they talk about climate change?	"As part of our work on urban development, we look at the possibilities of adding green and blue structures to manage extreme weather linked to climate change." (p68) "Our main sustainability risks involve the supplier chain, climate change, the environment and energy, bribes/corruption, and health and safety." (p132)	"Castellum supports the scientific evidence that human activity is accelerating climate change" (p65) o "Climate change poses a great risk to humanity from a global perspective." (p116) "From a corporate perspective, climate change implies a risk of" (P116)	"Climate change is driving the need for efficient commerce and is also contributing to increased vulnerability." (p12)
Mention of physical and transitional risks	The terms are used and examples are mentioned.	The terms are used and examples are mentioned.	The terms are used and examples are mentioned.
What risks exactly	Physical: "Extreme weather conditions such as higher water levels, torrential rain, storms and large temperature fluctuations…" Transitional:"Extensive political, legal, technical and market-related changes", "Stricter requirements on energy consumption and climate impact…" (p68)	Physical risks: Flooding from oceans, lakes and watercourses, from torrential rains, Heat stress, Ground stability (landslides and erosion), Snowfall (p65) Transition risks: "In addition, environmental policy decisions could impact Castellum, especially in the form of increased taxes or necessary investments." (p116)	Physical risks: Acute risks: Floods, Extreme heat/extreme cold, Wildfires, Storms and increased precipitation; Long-term risks: Temperature fluctuations, Altered precipitation patterns, Sea level rise; Transition risks: Regulatory risks: (Legislation, CSRD, EU taxonomy); Technical risks: Investments required to adapt properties to both physical and transition risks; Market and brand risks: Higher costs for energy and building materials, Brand and reputation (p96)
Timeframe for the risks	No timeframes defined.	No timeframes defined.	TCFD timeframe: short-term: <5 years, medium-term: 5-30 years, long-term 30-80 years.(p99)
Climate scenarios	They use climate scenarios to manage climate impact (p68) (The scenarios used are not specified)	IPCC, RCP	RCP, SSP
Remuneration aligned with climate sustainability targets	No	Somewhat?	Somewhat?
Details	"Remuneration payable to the senior executive management team, including the CEO, comprises a fixed salary. No variable salary or performance-related remuneration will be payable." (SR p73)	"Variable remuneration of this kind is intended to promote long-term value creation and sustainability initiatives in the Group. Variable remuneration in accordance with the earnings and share price-related incentive plan, which cannot exceed the annual fixed salary in any given year, is determined by the extent to which objectives set in advance regarding growth in income from property management per share, and share price trend, are achieved as well as how individually determined factors have developed. The previously determined targets pertaining to variable remuneration must be clearly linked to the business strategy and Castellum's long-term value creation, including its sustainability initiatives." (A&SR p127)	"Company must be able to recruit and retain qualified employees, so that the Company can successfully implement its business strategy and to safeguard the Company's long-term interests, including its sustainability goals. " (remuneration report p2)
Sustainability integrated into governance structure.	Yes	Yes	Yes
Details	"The executive management and Board evaluate our sustainability risks at least every two years. The Board of Directors has overall responsibility for risk management, while the operational work has been delegated to the CEO and the various business areas. Our main sustainability risks involve the supplier chain, climate change, the environment and energy, bribes/corruption, and health and safety. The construction and property industry is an at-risk industry in terms of bribes and corruption. Our risks in the supplier chain include the environment, human rights and social issues. The entire construction industry contains risks associated with health and accidents, for example during demolition work and putting up scaffolding." (SR p132)	Sustainability integrated into internal regulations (A&SR p120); "Provides guidelines for how sustainability initiatives in the Group are to be pursued. The work must promote sustainable development and be broken down into specific measurable goals as well as being an integral and natural part of operations and based on participation and commitment." (A&SR p130), "The Board works continually to update its collective knowledge in sustainable development and the field of ESG." (A&SR p121)	"Sustainability forms a natural part of our operations and is managed through our internal environmental management system that comprises shared policies and guidelines, measurable targets and direct action plans. … Cooperation between different departments internally ensures that Catena lives up to its social and environmental standards. All employees receive compulsory basic training in Catena's sustainability work as part of our onboarding process." Sustainability cooperates directly with CEO/managements and also with different departments (property management, treasury/finance, business and property development, HR) (SR p64)
Assurance level	Statutory sustainability report	Statutory sustainability report	Statutory sustainability report
Conclusion	Based on the limited assurance procedures we have performed, nothing has come to our attention that causes us to believe that the Sustainability Report is not prepared, in all material respects, in accordance with the criteria defined by the Board of Directors and Group Management.	Based on the limited assurance procedures we have performed, nothing has come to our attention that causes us to believe that the Sustainability Report, is not prepared, in all material respects, in accordance with the criteria defined by the Board of Directors and Executive Management.	Based on the limited assurance procedures we have performed, nothing has come to our attention that causes us to believe that the sustainability report is not prepared, in all material respects, in accordance with the criteria defined by the Board of Directors and Group Management.
Examination/assurance in accordance with	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000 (Revised), FAR's recommendation RevR12, International Standard Quality Management ISQM 1	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000 (Revised), FAR's recommendation RevR12, International Standard Quality Control ISQC 1	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000 (Revised), FAR's recommendation RevR12, International Standard Quality Control ISQC 1

Company	Citycon	Danske Bank	Ericsson
Separate/ integrated report	integrated	standalone	integrated
Frameworks used	EU Taxonomy, GRI, TCFD	EU Taxonomy, TCFD	EU Taxonomy, GRI, SASB, TCFD
Quantification of financial impacts of CC	no quantification of financial risks and opportunities stemming from climate change	Some quantification as Proportion of lending activities materially exposed to physical and transitional risks (p26) and opportunities, such as "Facilitated sustainable financing since 2019", "Assets under management in Article 9 funds" and "Investments in the green transition" (p26)	no quantification of financial impacts of climate change
Assurance	limited	limited	limited
How do they talk about climate change?	"We have recognised physical and transitional climate change risk as a key sustainability-related risk for the company." (p24)	"The transition needed to address the risks of climate change and biodiversity loss will require a profound transformation of the global economy, not least in terms of how we produce and consume energy." (p5) "Climate change is a source of both value creation and destruction across industries, companies and investment portfolios" (p28)	" Ericsson's technology is a key lever for fighting climate change and an enabler of greater social inclusion" (p4) "Over the coming decades, the world will face unprecedented challenges such as mitigating and adapting to climate change and making sure everyone on the planet can partake in the digital economy and society" (p196)
Mention of physical and transitional risks	The terms are used and examples are mentioned.	The terms are used and examples are mentioned.	The terms are used and examples are mentioned.
What risks exactly	"For example, extreme weather conditions and regulation implemented to mitigate and adapt to climate change can increase energy, maintenance and construction costs. (Finanical review, p36)	"Relevant physical risks are also identified, especially for our property portfolio. Flooding risk is the primary physical risk hazard to be taken into consideration in the Nordic countries." (P24, annual report) "Climate risk pertains to transition risks, which are the risks associated with shifting to a low-carbon economy" (p171, annual report)	Transition: "Increased costs due to carbon emissions pricing" Physical: Input shortages due to water stress, Disruptions caused by severe weather events (p17)
Timeframe for the risks	No timeframes defined.	No timeframes defined.	"For the purpose of this analysis, Ericsson defined short-, medium-, and long-term time horizons as up to 2025, 2025-30, and beyond 2030 respectively." (P17)
Climate scenarios	None.	NGFS and IEA scenarios	NGFS scenarios
Remuneration aligned with climate sustainability targets	Yes	Yes	yes
Details	"Alongside financial metrics, sustainability is one of the performance metrics in the remuneration of the employees' short-term incentive plans." (SR p40)	"In 2022, we continued our efforts to integrate sustainability-related KPIs into our performance management framework. Members of the ELT and senior leaders all have a sustainability-related KPI in their short-term incentive programme with reference to our 2023 Group Sustainability Strategy targets. This includes our targets related to sustainable finance and climate change. The KPI is approved by the Board of Directors upon review by the Board of Directors' Remuneration Committee." (SR p19)	"Short-term variable compensation (STV) Setting clear and relevant objectives for the Executive Team that are in line with Ericsson's strategy and sustainable long-term interest." (AR p182 / remuneration report p3)
Sustainability integrated into governance structure.	Somewhat	Yes	Yes
Details	"At Citycon, the Board of Directors, the CEO, and Chief Information Officer are responsible for sustainability matters. The CEO has the ultimate responsibility for the successful implementation of the Group's sustainability strategy. The Chief Information Officer reports on sustainability matters and strategy implementation to the Board of Directors' Audit and Governance Committee on a quarterly basis." (SR p40)	"A dedicated team has been established to enhance the strategic focus on sustainability compliance. To reflect the cross-cutting nature of sustainability, the new team ensures coordination across the various sustainability related dimensions of the work that Group Compliance undertakes." (SR p30)	"Within the Company, a dedicated Sustainability and Corporate Responsibility unit is responsible for developing and implementing relevant strategies, policies, steering documents, targets, and processes. Environmental, social, and economic performance is continuously measured and monitored, and is regularly subject to external assurance to ensure accuracy and reliability. The Board of Directors oversees the Company's sustainability and corporate responsibility strategy, and the Executive Team provides strategic guidance through various steering boards and committees. The Board receives reports on risks and performance annually, or more often as needed." (A&SR p 150 / corporate governance report p 2)
Assurance level	Limited assurance statement	Limited assurance statement	Statutory sustainability report
Conclusion	Based on our procedures and the evidence obtained, we are not aware of any material modifications that should be made to the environmental information in Sustainability Accounts 2022 for the period 1.1-31.12.2022, in order for it to be in accordance with the Criteria	Based on the procedures performed and the evidence obtained, nothing has come to our attention that causes us not to believe that the ESG performance data on page 48 in the Sustainability Report 2022 for the year ended 31 December 2022, has been prepared, in all material respects, in accordance with the Reporting principles. Furthermore, nothing has come to our attention that causes us not to believe that Danske Bank A/S has offset its consolidated CO2 emissions for 2022, as stated on page 43 in the Report.	Based on the limited assurance procedures we have performed, nothing has come to our attention that causes us to believe that the Sustainability Report, is not prepared, in all material respects, in accordance with the criteria defined by the Board of Directors and Executive Management. In our opinion, the selected information in the Sustainability Report which has been subject to our reasonable assurance procedures has, in all material respects, been prepared in accordance with the criteria defined by the Board of Directors and Executive Management
Examination/assurance in accordance with	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000 (Revised), International Standard Quality Control ISQC 1	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000 (Revised), Assurance Engagements on Greenhouse Gas Statements (ISAE 3410), International Standard Quality Control ISQC 1	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000 (Revised), FAR's recommendation RevR12

Company	Handelsbanken	Industrivärden	Instalco
Separate/ integrated report	integrated	Integrated	integrated
Frameworks used	EU Taxonomy, GRI, TCFD	CDP, EU Taxonomy, GRI, TCFD	EU Taxonomy
Quantification of financial impacts of CC	no quantification of financial impacts of climate change	no quantification of financial impacts of climate change	no quantification of financial impacts of climate change
Assurance	limited	limited	limited
How do they talk about climate change?	"Effective climate work cannot be achieved by acting alone: climate change is a global problem requiring co-operation and cross-border solutions." (p38) "Climate change is one of the greatest challenges of our age." (p62) "The Bank notes, however, that it is not operating in isolation, and that climate change is a global problem requiring co-operation and global solutions." (p63)	"In order to evaluate and, where needed, exert influence in these areas, Industrivärden analyses sustainability aspects such as governance and leadership, business culture, resource efficiency, climate impact, organisation and diversity." (p81)	"Adaptations to climate change and smart building solutions are strong trends." (p4) "Our assessment is that changes in the climate and environment do not pose a threat in the short term, but could over the long term." (p.50) "climate-smart" solutions by the company
Mention of physical and transitional risks	The terms are used and examples are mentioned.	The terms are used and examples are mentioned.	The terms are used and examples are mentioned.
What risks exactly	Physical: "extreme weather events, as well as rising sea levels, coastal erosion and similar consequences" (p43) Transition: "changes to legislation, changes in the demand for products and services, changed customer behaviour or other structural shifts" (p43)	Physical risks: "Disruptions caused by extreme weather events – impacts in supply chains, on transports, own production and property holdings (acute risk) – Permanent changes in the climate and environment – higher average temperatures, rising sea levels and changed precipitation patterns – higher costs for climate adaptation measures, impact on asset values (chronic risk) – Shortages/depletion of critical raw materials (chronic risk), Transition risks: – Rising costs due to imposition of carbon emissions regulations and taxes (policy and regulatory risk) – Higher costs for reporting and compliance (policy and regulatory risk) – Limitations in a company's operations due to regulations of ownership rights/use (policy and regulatory risk) – Slow and/or unpredictable permitting processes (policy and regulatory risk) – Inability to develop the products, solutions and offerings needed for transition to a low-emissions economy – adaptation and limitation of impact (technological risk) – Supply and pricing of renewable energy, raw materials, water and transport (market risk) – Changed preferences and behaviors among customers (market risk) – Inability to live up to requirements and expectations from the company's stakeholders (reputational risk) (p86)	"Physical risks include such things as flooding from extreme weather and natural disasters. Economic risks include such things as lack of resources, changed environmental legislation and taxes as well as increased prices for materials and energy." (p50)
Timeframe for the risks	No timeframes defined.	No timeframes defined.	No timeframes defined.
Climate scenarios	"climate scenarios provided by the Swedish Meteorological and Hydrological Institute (SMHI)." (p45), "Based on various climate scenarios" (p116)	No specific scenarios mentioned.	No climate scenarios mentioned.
Remuneration aligned with climate sustainability targets	No	Somewhat?	somewhat?
Details	"The employees at our branches who meet customers are not eligible to receive variable remuneration – no bonuses or commissions – and thus have no personal financial incentive to offer customers a certain service or product." (A&SR p10) "Approximately only 1 per cent of the Group's employees are eligible to receive performance-based variable remuneration." (A&SR p39) "Oktogonen is Handelsbanken's scheme for collective profit-sharing, based on a common corporate goal where all employees contribute to the success of the Bank. Allocations to the profit-sharing scheme are subject to Handelsbanken achieving its corporate goal." (A&SR p 70)	No mention specifically, general mentions such as "Successful and sustainable execution of the Company's mission, objective and strategy for capitalising on the Company's long-term interests requires that the Company can recruit and retain qualified employees. ... The criteria shall be formulated so that they have a clear coupling to value creation for the Company and promote the Company's mission and sustainable execution of the Company's long-term interests." (AR p67)	"A successful implementation of the company's business strategy and the safeguarding of the company's long-term interests, including its sustainability agenda, presupposes that the company can recruit and retain qualified employees. … The variable cash remuneration must be linked to pre-determined, measurable criteria, which can be financial, or non-financial. ... The criteria must be designed in such a way to promote the Company's business strategy and long-term interests, including the sustainability agenda." (A&SR p66)
Sustainability integrated into governance structure.	Somewhat	Somewhat	Somewhat
Details	"The Chief Sustainability and Climate Officer is also the Chair of Handelsbanken's Sustainability Committee, which was formed in 2010. The Sustainability Committee analyses the sustainability work undertaken by the Group and, where necessary, takes on a co-ordinating role. Potential problems and business opportunities are highlighted, and pre-emptive plans of action are established. Decision-makers from both the business operations and central departments make up the Sustainability Committee. Several of the members are also part of the Bank's executive management." (A&SR p42)	Sustainability issues are mentioned as one of the Board's responsibilities "In addition, the Board continued to discuss and evaluate the portfolio companies' approach to sustainability and other matters such as energy, electrification and digitalisation." (AR p55), Sustainability included on executive management level; "Head of Corporate Communications and Sustainability" (AR p59)	Sustainability issues are mentioned as one of the Board's responsibilities; "The following are examples of items that the Board has dealt with at its meetings: ... Significant issues relating to optimisation of capital structure, share splits, financing, dividends, investments, acquisitions and sustainability work." (A&SR p60)
Assurance level	Limited assurance statement	Statutory sustainability report	Statutory sustainability report
Conclusion	Based on the limited assurance procedures we have performed, nothing has come to our attention that causes us to believe that the Sustainability Report is not prepared, in all material respects, in accordance with the criteria defined by the Board of Directors and Executive Management.	A statutory sustainability report has been prepared.	A statutory sustainability report has been prepared.
Examination/assurance in accordance with	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000 (Revised), International Standard Quality Management ISQM 1	Prepared in accordance with FAR's recommendation RevR12 and International Standards on Auditing (ISA)	Prepared in accordance with FAR's recommendation RevR12 and International Standards on Auditing (ISA)

Company	Kojamo	Lindab	Marel
Separate/ integrated report	standalone	integrated	integrated + ESG report
Frameworks used	EU Taxonomy, GRI, TCFD	EU Taxonomy, GRI, TCFD	TCFD
Quantification of financial impacts of CC	no quantification of financial impacts of climate change, just mention of financial items (p30)	no quantification, just general mentioning of areas (p.70)	no quantification of financial impacts of climate change
Assurance	limited	limited	No information.
How do they talk about climate change?	"Climate change and the related extreme weather phenomena and other physical risks have an impact on our properties" (p29) "If the physical risks related to climate change were to materialise…" (p30) We respond to the challenges created by climate change by...." (p36)	"we raised our ambitions further with our announcement to join Science Based Targets, to develop targets and plans that really help reduce global warming and mitigate climate change." (p52)	"Our environmental training focuses on improving employees' general understanding of how they can impact important environmental themes such as climate change, water quality and biodiversity" (p162)
Mention of physical and transitional risks	The terms are used and examples are mentioned.	The terms are not mentioned, but some risks are named.	The terms are used and examples are mentioned.
What risks exactly	Physical: sea-level rise, flooding, heavy rainfall, significant variations in annual temerature, snowfall Transitional: changes in legislation, technology and market situation	"Climate change in the form of increased warming, storms, droughts and other climate effects" (p66)	"Emerging regulations on limitation of greenhouse gas emissions, increased cost of raw materials and rising temperature are mentioned. (p22, ESG report)
Timeframe for the risks	No timeframes defined.	No timeframes defined.	Short-term < 3yrs, Medium-term 3-10yrs, Long-term >10yrs. (ESG Report, p22)
Climate scenarios	No climate scenarios mentioned.	There are two scenarios, no mention of the source.	NGFS Scenarios
Remuneration aligned with climate sustainability targets	No	No	Yes
Details	No mention specifically in the remuneration policy. General mentions of " assesses the fulfillment of the STI´s performance measures in relation to the targets based on the company´s reporting" (remuneration report p3)	No mention specifically about sustainability targets and remuneration; "Short-term variable cash salary should be based on the executive's performance relative to individually established targets aimed at fostering the company's business strategy and long-term interests. ... Long-term variable cash salary should be linked to financial performance targets reflecting the company's value growth over a three-year period." (A&SR p57)	"Our progress made in 2022: 30% of employees have an ESG incentivised pay component (started in 2021)" (SR p31)
Sustainability integrated into governance structure.	Somewhat	Somewhat	Yes
Details	"The responsibility for the organisation of risk management - including climate risks - rests with the board of directors. ... The sustainability steering group discusses the targets set for sustainability and climate efforts and progress towards those targets." (AR p29)	Sustainability is mentioned to be included under the internal control function, but not for example in the responsibilities of the board; "The responsibilities of the Board of Directors also include establishing strategies, targets and internal control instruments, resolving particularly important matters, issuing financial reports, as well as assessing the operational management and ensuring that succession planning is in place" (A&SR p 54)	Sustainability is integrated on different levels of the governance structure (SR p32) from Board of directors "Reviews and agrees on Sustainability and climate strategy", to the executive board (monitors and challenges sustainability roadmap), and from CEO's office sustainability team (coordinates and monitors ESG metrics and targets) to sustainability and ESG committee (represents all functions, reviews and makes recommendations to the executive board)
Assurance level	Limited assurance statement	Statutory sustainability report	No assurance
Conclusion	Our conclusion has been formed on the basis of, an is subject to, the matters outlined in this report. We believe that the evidence we have obtained is sufficient and appropriate to provide a basis for our conclusions. Based on the procedures performed and the evidence obtained, as described above, nothing has come to our attention that causes us to believe that the information subject to the assurance engagement is not prepared, in all material respects, with reference to the GRI sustainability reporting standards.	A statutory sustainability report has been prepared.	No mention of assurance in the sustainability report. In annual report auditor's report "The Board of Directors and CEO are responsible for the other information. The other information comprises the information included in the Annual Report of the Group, but does not include the Consolidated Financial Statements and our auditor's report thereon. Our opinion on the Consolidated Financial Statements does not cover the other information and we do not express any form of assurance conclusion thereon." (p204)
Examination/assurance in accordance with	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000 (Revised), International Standard Quality Management ISQM 1, Code of Ethics for Professional Accountants issued by the IESBA (p 86)	Prepared in accordance with FAR's recommendation RevR12	None

Company	Neste	Orsted	OX2
Separate/ integrated report	integrated	standalone	integrated
Frameworks used	CDP, EU Taxonomy, GRI, SASB, TCFD	CDP, EU Taxonomy, GRI 207: Tax standard only, TCFD	GRI
Quantification of financial impacts of CC	no quantification of financial impacts of climate change besides "The climate related assumptions in the [impairment] calculations include the demand increase in the Renewable Products, which is positively affecting the sales margin and nominal growth rate assumptions." (p206)	no quantification of financial impacts of climate change	no quantification of financial impacts of climate change
Assurance	limited	limited	limited
How do they talk about climate change?	"Climate change is already affecting every country on every continent, and the responsibility for taking action is shared by us all." "Neste provides the polymers and chemicals industries with renewable and circular solutions that help mitigate climate change," "creating solutions that aim at combating climate change to build a better future"	"From extreme heatwaves across Europe to the devastating floods in Pakistan, the effects of climate change continued to leave their clear marks across the globe." (p4), "Our nature is under increasing pressure from human consumption and pollution, as well as the consequences of climate change." (p19)	"Climate change and large-scale biodiversity loss are two interconnected global crises. To create a resilient world, we need to prevent climate change and at the same time enrich biodiversity." (p40)
Mention of physical and transitional risks	The terms are used and examples are mentioned.	The terms are not mentioned, but some risks are named.	These terms are not mentioned.
What risks exactly	"Identified **transition risks** relate to regulation limiting the competitiveness of renewable fuels or narrowing the eligibility of key raw materials. A steep decline of fossil fuel demand could also be seen as a transition risk for Neste's current business. Risks related to accelerated alternative technology development have also been identified." (p165) "Both acute **physical risks**, such as extreme weather events, or chronic physical risks, such as changes in precipitation patterns or rises in sea level, may cause disruptions in our supply chain and the availability of different raw materials, as well as operating issues or damages to Neste's sites." (P165)	"Our assets and operations are exposed to both direct and indirect effects from climate change. Direct impacts include physical damage from extreme weather events. Indirect impacts include disruptions to our supply chains and potentially supply shortages." (p10)	No climate or sustainability related risks are mentioned.
Timeframe for the risks	No timeframes defined.	No timeframes defined.	No timeframes defined.
Climate scenarios	IEA scenarios used	No scenarios mentioned.	No climate scenarios mentioned.
Remuneration aligned with climate sustainability targets	Yes	Yes	No
Details	" Similarly, Neste's commitment to our strategic sustainability targets is also reflected in our long-term incentives plan where 20% of measures are based on our combined Greenhouse Gas impact." (AR p140)	" In 2022, we strengthened ESG criteria in our Group Executive Team's short-term incentive remuneration scheme, giving them the same weight as financial KPIs." (SR p6) "To ensure that all teams work towards our common goals, we use a combination of ambitious sustainability KPIs, including CDP climate score, reductions in our scope 1-2 emissions intensity, and gender diversity." (SR p38)	No mention specifically about sustainability targets and remuneration; "The Group has an annual bonus scheme under which employees can receive an amount up to a maximum of one fixed monthly salary provided that the company meets its financial and operational targets for the year in question. In addition, there are individually agreed bonus schemes." (A&SR p93)
Sustainability integrated into governance structure.	Yes	Yes	Yes
Details	"Sustainability and Corporate Affairs" is a separate function with their own VP within internal support functions (AR p120). "The Company's safety, financial and operational performance as well as sustainability and compliance matters were regularly monitored by the Executive Committee." (AR p127) Sustainability risks are integrated into general risk management. (AR p138)	Sustainability is present throughout the governance structure, from board of directors to global functions and regions; "Sustainability criteria are a key decision driver in our asset project model. … Sustainability is embedded in the mindsets and behaviours of all employees." (SR p37) "We want sustainability and integrity to be integrated into processes and decision-making across our organisation. Ørsted's Board of Directors is the highest authority to oversee our sustainability work, while the Group Executive Team is accountable for our sustainability programmes, with specialist support from appointed committees." (SR p43)	Under Board of Directors is the Management under which is the Sustainability committee. The Sustainability committee focuses on Foundation for good governance, Positive contributions to climate and nature, Sustainable leadership and Local engagement. ... Relevant sustainability-related risks are discussed on an ongoing basis by both the Board and management. OX2 is a member of several organisations with the aim of contributing to sustainable development. (A&SR p107)
Assurance level	Limited assurance statement	Limited assurance statement	Statutory sustainability report
Conclusion	Our conclusion has been formed on the basis of, and is subject to, the matters outlined in this report. We believe that the evidence we have obtained is sufficient and appropriate to provide a basis for our conclusions. Based on the procedures performed and the evidence obtained, as described above, nothing has come to our attention that causes us to believe that the information subject to the limited assurance engagement is not presented, in all material respects, in accordance with the GRI Sustainability Reporting Standards. In accordance with the terms of our engagement, this independent limited assurance report on the Selected Numerical Sustainability Information has been prepared for Neste Corporation in connect with reporting to Neste Corporation and for no other purpose or in any other context.	Based on the procedures we performed and the evidence we obtained, nothing came to our attention that causes us not to believe that the consolidated ESG statements in the 2022 annual report of Ørsted A/S are prepared, in all material respects, in accordance with the applied accounting policies developed by Ørsted A/S as stated on pages 156-161. This conclusion is to be read in the context of what we state in the remainder of our report.	A statutory sustainability report has been prepared. Stockholm, March 28, 20
Examination/assurance in accordance with	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000 (Revised), International Auditing and Assurance Standards Board IAASB, International Standard Quality Control ISQC 1, Code of Ethics for Professional Accountants issued by the IESBA (p 117)	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000 (Revised), Assurance engagements on greenhouse gas statements (3410), International Standard Quality Management ISQM 1, Code of Ethics for Professional Accountants issued by the IESBA	Prepared in accordance with Annual Accounts Act, FAR's standard RevR 12 (p 162)

Company	Sampo Group	SBB Norden	Schouw
Separate/ integrated report	Standalone	integrated	standalone (integrated from 2024)
Frameworks used	EU Taxonomy, GRI, TCFD, SASB	CDP, GRI, TCFD	EU Taxonomy
Quantification of financial impacts of CC	no quantification of financial impacts of climate change	no quantification of financial impacts of climate change, as they deem that they are not exposed to risks of CC: "About 97 percent of the portfolio is classified as very low risk or better in terms of physical risks, and 98 percent is classified as low risk or better in terms of transition risks." (p44)	no quantification of financial impacts of climate change
Assurance	limited	limited	No information.
How do they talk about climate change?	"Paying attention to climate change and the efficient management of climate risk were among our focus areas." (p5) "Sustainability-related risks, including climate change, are a part of Sampo Group's overall risk management."(p15) "Therefore, the Sampo Group companies take ESG issues (including climate change) into account when assessing... " (p16)	"Climate change and climate adaptation entail risks for societies and for properties" (p42) "SBB seeks to act vigorously on climate change and has therefore adopted a target of climate positivity throughout the value chain by 2030, with this being an important element in SBB's promise to build a better society." (p42)	Climate change not mentioned, they talk about climate impact. "However, our impact also extends to securing work for some 15,000 employees round the world, being a responsible taxpayer, manufacturing products that make a difference in society and contributing to the green transition by reducing our climate impact and resource consumption." (p4) "The companies of the Schouw & Co. Group are required to manufacture their products efficiently in terms of resource consumption and climate impact." (p6)
Mention of physical and transitional risks	The terms are used and examples are mentioned.	The terms are used and examples are mentioned.	These terms are not mentioned.
What risks exactly	"Investments are particularly exposed to physical risks in the form of losses incurred from extreme weather events. The transition to a low-carbon society, with potentially increasing environmental and climate regulation, more stringent emission requirements, and changes in market preferences, could in turn cause transition risks for the Group's investments" (p17)	"Physical risks include rising sea levels, more extreme weather events and more heat waves, causing risks for particularly vulnerable groups." (p42) "Risks in adaptation include amended regulations, shifting demand for premises and housing, as well as changing modes of transport and travel habits." (p42)	Risks the company may face stemming from CC aren't mentioned, they write about the climate impacts of the company.
Timeframe for the risks	"Environmental issues and climate change are factors that are expected to have a mid- and long-term effect on Sampo Group's businesses" (p17)	No timeframes defined.	No timeframes defined.
Climate scenarios	IEA scenarios used	"scientifically founded scenarios, such as IAM, GCAM4, SSPs and ECMWF"	No specific scenarios mentioned.
Remuneration aligned with climate sustainability targets	Yes	Yes	No
Details	At Sampo Group both quantitative and qualitative criteria are used for assessing performance. Most employees (including all senior executives), who participate in variable compensation programmes have ESG criteria linked to their variable compensation, thereby supporting the sustainable development of the business. ... ESG targets have also been integrated into the Group CEO's STI programme. The ESG targets are updated every year as part of the annual planning process. (SR p108)	"Regional managers have been assigned with setting bonus targets linked to SBB's sustainability targets, e.g. reduced energy consumption and green leases." (A&SR p54)	"Members of the Executive Management may be eligible for an annual cash bonus, currently determined at the discretion of the Board of Directors. The annual cash bonus is intended to align the interests of the individual Executive Management members with the Company's short-term objectives. Payout of the cash bonus is therefore subject to the individual member meeting targets related to the company's achievements of budgeted results, financial ratios and other measurable personal financial or non-financial performance targets which in aggregate reflect and support the Company's short-term objectives" (remuneration report p8)
Sustainability integrated into governance structure.	Yes	Somewhat	No
Details	BoD have the ultimate oversight, Group CEO assists the Board in overseeing, Group CFO directs the Sustainability Unit, which in turn develops and coordinated group level sustainability work, including targets. Each subsidiary is actively involved and they have their own internal sustainability governance structures (SR p11)	"The Sustainability Committee is responsible for reviewing and monitoring the continuity and progress of work on sustainability objectives, management of sustainability risks, and compliance with the Sustainability Code and with the Code of Conduct." (A&SR p75)	Sustainability is not mentioned on parent company level beyond "Ambitions for 2030: Invest in and facilitate innovation for sustainability" (SR p7) and "Growth is a goal anchored in the Schouw & Co. organisation, both organic and acquisitive. In 2022, we made some significant and transformative acquisitions, but it is likewise very important to future-proof our competitive strength and dedicate adequate resources to invest in innovation, sustainability and resilience. All of the Group's businesses take responsibility and have a structured approach to strengthening ESG activities" (SR p4)
Assurance level	Limited assurance statement	Statutory sustainability report	No assurance
Conclusion	Based on our procedures and the evidence obtained, we are not aware of any material modifications that should be made to the sustainability information for the period 1 January–31 December 2022, in order for it to be in accordance with the Criteria.	Based on the limited assurance procedures we have performed, nothing has come to our attention that causes us to believe that the Sustainability Report is not prepared, in all material respects, in accordance with the criteria defined by the Board of Directors and Executive Management.	No auditor's report included in the sustainability report nor mentioned in the annual report. In the annual report it is stated that "What we have audited The Consolidated Financial Statements and Parent Company Financial Statements of Aktieselskabet Schouw & Co. for the financial year 1 January to 31 December 2022 comprise income statement and statement of comprehensive income, balance sheet, statement of changes in equity, cash flow statement and notes, including summary of significant accounting policies for the Group as well as for the Parent Company. Collectively referred to as the "Financial Statements"."Management is responsible for Management's Review. Our opinion on the Financial Statements does not cover Management's Review, and we do not express any form of assurance conclusion thereon."
Examination/assurance in accordance with	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000, International Standard Quality Control ISQC 1, Code of Ethics for Professional Accountants issued by the IESBA	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000, FAR's recommendation RevR12, International Standard Quality Control ISQC 1	None

Company	Sdiptech	Skanska	Storskogen
Separate/ integrated report	integrated	integrated	integrated
Frameworks used	EU Taxonomy, GRI, TCFD	EU Taxonomy, GRI, TCFD	EU Taxonomy, GRI, TCFD from 2023-2024
Quantification of financial impacts of CC	(p58), there are effects on specific financial items listed, but no quantification	no quantification of financial impacts of climate change	no quantification of financial impacts of climate change
Assurance	limited	limited	limited
How do they talk about climate change?	"Macro trends such as climate change" (p12) "Climate change is one of the greatest long-term challenges of our age" (p12)	"Climate change is and will be a key business defining factor in the coming decades. Addressing climate change involves scaling innovative solutions in energy, increased efficiency, materials and much more.", "Climate change has exposed an urgent need to address and improve the resilience of urban areas." (p14) , "The effects of climate change put pressure on society..." (p83)	"global challenges such as climate change" (p16) o "Climate change is one of the major challenges of our time" (p36)
Mention of physical and transitional risks	The terms are used and examples are mentioned.	The terms are used and examples are mentioned.	These terms are not mentioned.
What risks exactly	Physical: rising average temperatures, higher water levels and flooding, storms, Transitional: increased fuel prices/green-house gas emissions, extended emissions reporting obligation, regulation of existing products and services, reporting and compliance requirements for third party providers, Failed investments in new/old technologies, Transition to lower emissions technologies, Altered customer behaviour, Stigmatisation of the sector (p58-59	Transition: Policy and legal • Enhanced reporting and public disclosure requirements, e.g. CSRD,EU Taxonomy; • Mandates on energy performance (energy performance of buildings directive)• Cost of carbon, Technology: New technologies and innovations needed to meet climate targets.; Market: • Changing customer expectations • Changing competitor landscape • New markets and opportunities; Reputation: • Increased scrutiny from stakeholders including e.g. customers,regulators, media, NGOs, investors • Increased stakeholder expectations; Physical: Acute: • Increased frequency and intensity of extreme weather events; Chronic: • High average outdoor temperatures • Alterations in sea levels, weather patterns and ecosystems	Sustainability risks listed: not meeting climate targets, "Business ethics and sustainability governance", "The risk of an inadequate ESG due diligence process for acquisitions if risk factors have not been properly identified." (p62)
Timeframe for the risks	"We need to increase our readiness to deal with regulatory changes in the coming decade" (p56)	No timeframes defined.	No timeframes defined.
Climate scenarios	RCP 2.6 and 8.5	NGFS and IEA scenarios	No climate scenarios mentioned.
Remuneration aligned with climate sustainability targets	Yes	Yes	Somewhat
Details	"All CEOs within the Sdiptech Group, which has a Short-Term-Incentive-Program, including Sdiptech's management team, have incentives linked to sustainability-related goals." (AR p6) "In our model, the CEO must have the same objectives as their business area manager. That is why the CEO's remuneration is linked to the achievement of targets in their own subsidiary. Organic profit growth is always an important target, but there are always complementary targets, such as e.g. environmental and equality goals." (AR p17)	"The performance criteria for the President and CEO's variable remuneration have been selected to deliver Skanska's strategy and to encourage behavior which is in the long-term interest of the Company and the Group. In the selection of performance criteria, the strategic objectives and short- and long-term business (A&SR p 58). Otherwise the same criteria is applied to the president and CEO as is for the Senior Executive Remuneration; "The variable cash remuneration shall take into account both financial and non-financial performance. The outcome in relation to predetermined and measurable financial targets shall determine the total (financial) bonus potential, i.e., the financial targets shall be the basis of the total bonus potential. This outcome may be reduced depending on the outcomes of the non-financial targets. The variable cash remuneration must be based on results in relation to established targets and be designed to increase the alignment between the shareholders and senior executives of the company. ... The non-financial targets shall be set to support the business strategy and long-term interests, including sustainability, by for example being clearly linked to the business strategy or sustainability. The non-financial targets should together represent 50 percent of the total bonus which means that the total bonus outcome may be reduced with up to 50 percent if the non-financial targets are not met." (A&SR p 179)	General mention of "Variable cash remuneration is intended to award the meeting of predetermined and measurable criteria that promotes the Company's business strategy and long-term interests, including the Sustainability Policy." (A&SR p52)
Sustainability integrated into governance structure.	Somewhat	Somewhat	Somewhat
Details	"Sdiptech's Group executive consists of the CEO, the Group's CFO, two business area managers, the head of the Group's acquisition function and the head of the Group's sustainability work, a total of six people … The executive team meets twice a month to discuss the performance and financial position of the Group and its business units, as well as issues relating to strategy, performance monitoring, forecasting and business development. Its duties also include issues related to acquisitions, joint projects, sustainability work, the Group's financial reporting, communication with the stock market, internal and external information, and coordination and monitoring of safety, environment and quality" (AR p75)	"As of November 2021, the EVP Sustainability and Innovation has been part of the Group Leadership Team." (A&SR p 94) "In 2022, the Board held seven meetings, including its statutory meeting. ... The more important issues dealt with by the Board during the year included monitoring operations, review and approval of the interim reports and year-end report, strategic review of Skanska, as well as cybersecurity, internal control, risk management, ethics and compliance, and sustainability matters, including climate and health and safety." (A&SR p43)	The boards duties include broadly sustainability (evaluations, adoptions and updating of sustainability targets, identifying the impact of sustainability issues (A&SR p48)
Assurance level	Statutory sustainability report	Limited assurance statement	Statutory sustainability report
Conclusion	A sustainability report has been prepared.	Based on the limited assurance procedures performed, nothing has come to our attention that causes us to believe that the greenhouse gas, health and safety, energy, and waste reporting for the financial year ending on 31 December 2022 is not, in all material aspects, prepared in accordance with the specified criteria.	A statutory sustainability statement has been prepared.
Examination/assurance in accordance with	Prepared in accordance with Annual Accounts Act, FAR's standard RevR 12	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000, International Standard Quality Control ISQC 1	Prepared in accordance with Annual Accounts Act, FAR's standard RevR 12

Company	Topdanmark	Tryg	Vaisala
Separate/ integrated report	standalone	standalone	integrated
Frameworks used	CDP, EU Taxonomy, TCFD	EU Taxonomy, TCFD	EU Taxonomy, GRI
Quantification of financial impacts of CC	no quantification of financial impacts of climate change	Not much, the only quantitative data is on weather-related claims.	no quantification of financial impacts of climate change
Assurance	No information.	No information.	limited
How do they talk about climate change?	"Action speaks louder than words, also when addressing climate change which affects us all." (p3) "Sustainability-related risks, including climate change risk, have been part of our overall risk management for several years. (p12) "For an insurance company, climate change poses a business risk, as it can lead to increased claims costs." (p38) "We want to contribute with solutions that both benefit our customers and reduce climate change, " (p45)	"In a world faced by climate change…" (p4) "central player in battling climate change," (p11) "The impact of climate change is significant and a cause of concern for Tryg's customers and for society." (p22)	"global challenges, such as climate change mitigation and adaptation" (p4) 2The impacts of climate change are being felt across the globe." (p6), "Of the many megatrends where Vaisala plays a key role, the most strategic ones for Vaisala are climate change" (p11) "Climate change is one of the most significant challenges humankind has faced." (p11)
Mention of physical and transitional risks	The terms are used and examples are mentioned.	The terms are used and examples are mentioned.	These terms are not mentioned.
What risks exactly	"Physical risks Climate change Natural disasters, storms, cloudbursts tsunamis etc. Major fires caused by drought/climate change Transition risks Disruption/ Increase in sharing economy Legal requirements" (p73)	"Extreme weather events such as flooding, cloudbursts, storms, rising sea levels and heatwaves represent physical risks"(p23) "Regulation One of the main transitional risks is associated with developments in climate-related policies and regulation" (p24)	"Climate change has been assessed to increase the likelihood of certain risks" (p86)"Natural disaster, epidemic (other than COVID-19), civil unrest, terrorism" (p87) "Business continuity risks related to suppliers" (p87)
Timeframe for the risks	"In 2023, our commitment to SBTi means that we will work on defining both short-term goals (not exceeding 10 years) and long-term goals" (p70)	No timeframes defined.	No timeframes defined.
Climate scenarios	No climate scenarios mentioned.	No climate scenarios mentioned.	No climate scenarios mentioned.
Remuneration aligned with climate sustainability targets	Yes	Yes	Somewhat
Details	"Our remuneration policy for group executive management and other selected employees in senior management ensures the integration of sustainability into our business, so the set objectives support sustainable development of the business. More precisely, this means that the result criteria for our cash- and share-based short-term incentive programme include sustainability initiatives." (SR p11)	"To strengthen governance and anchoring, targets related to sustainability and ESG are included in the incentive programmes for members of Tryg's Executive Board" (SR p11). ESG-linked pay for Executive Board is 6,25% in year 2022 (SR p46)	"In 2022, the maximum short-term incentive (STI) for the President and CEO was 72% of annual base salary. STI was based on predefined performance criteria, which were Vaisala's EBITA (50% weight), Vaisala's net sales development (45% weight) and ESG (in 2022 the criteria was diversity) (5% weight)." (AR p85)
Sustainability integrated into governance structure.	Yes	Somewhat	Somewhat
Details	ESG responsibilities are included from Board of Directors level (approve ambition level, policies, a member appointed to focus specifically on sustainability), to Group Executive Management/CFO (C-level responsibility), Sustainability forum (three executives, three general managers + head of group management support and sustainability, works as an advisory board, responsible for action plans, reviews policies), Corporate sustainability team (implements new projects, ESG ratings, analyses and assesses SDGs) and Business divisions in Group functions (integrate sustainability into division strategy, processes, decision making, etc.) (SR p11)	"Tryg's Sustainability & ESG Board is a preparatory body supporting the decision-making process of Tryg's Executive Board on the strategic direction of our sustainability ambitions, including environmental and climate-related issues." (SR p22)	"Vaisala's Board of Directors changed the name of its Remuneration and HR Committee to People and Sustainability Committee. The Committee focuses on long-term development regarding employees and sustainability, adding sustainability to the top management's targets." (AR p8)
Assurance level	No assurance	No assurance	Limited assurance statement
Conclusion	No mention of assurance in the sustainability report. In annual report auditor's report "The consolidated financial statements are prepared in accordance with the International Financial Reporting Standards as adopted by the EU and additional Danish disclosure requirements for listed financial institutions and the parent company financial statements are prepared in accordance with the Danish Financial Business Act"	Mentioned that "As part of PwC's assurance report on Tryg's annual report for 2022, PwC has performed a consistency check of the management review, including Tryg's Sustainability report. This report represents our statutory statement on sustainability, gender diversity at management level and data ethics" (p 3), but no actual assurance/auditor's report provided	Based on procedures we have performed and the evidence we have obtained, nothing has come to our attention that causes us to believe that Vaisala Oyj's Sustainability Reporting for the reporting period ended 31 December 2022 is not properly prepared, in all material respects, in accordance with the Reporting criteria.
Examination/assurance in accordance with	None	None	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000 (Revised), International Standard Quality Management ISQM 1, Code of Ethics for Professional Accountants issued by the IESBA

Company	Vestas	Wihlborg
Separate/ integrated report	standalone	integrated
Frameworks used	EU Taxonomy, TCFD (in the Annual report)	EU Taxonomy, GRI, TCFD
Quantification of financial impacts of CC	no quantification of financial impacts of climate change	no quantification of financial impacts of climate change
Assurance	limited	limited
How do they talk about climate change?	“The dual threats of catastrophic climate change and energy scarcity” (p6) “Mitigating global climate change by accelerating green energy transition is our freatest positive sustainability impact and core to our purpose as a business” (p27)	"In pace with climate change and the occurrence of extreme weather conditions, the need to climate-proof our properties has increased." (p40) "Climate change means that we must adapt our properties to new physical conditions in the form of more extreme weather conditions, flooding and an increased risk for damp and mould damage, but we must also adapt operations to the changes that take place in the market and in society as a result of climate change." (p140)
Mention of physical and transitional risks	The term physical climate risk is mentioned.	The terms are used and examples are mentioned.
What risks exactly	"Through extreme weather events and temperatures, climate change has the potential to impact our assets, operations and supply chains. The transition to a low-carbon economy also brings change through extensive policy, legal, technology, and market developments. " (Annual report, p51)	Physical: "Property damage as the result of downpours, rising sea levels, landslides and erosion Shorter technical lifespans of constructions and building production due to weather impact Reduced demand for properties in risk areas Energy shortages as the result of increased societal demand" (p141) Transitional: "Increased regulations and taxes concerning energy, emissions, land use and construction norms The need for increased investments in new or renovated energy-efficient properties Reduced demand for older properties with lower energy and climate performance" (p141)
Timeframe for the risks	Mid-term: until 2025, long-term: 2030 (for for emissions targets, p28)	"In the long term (5–10 years and beyond)" , "In the short and medium term (the next 3–5 years) (p140)
Climate scenarios	No specific scenarios mentioned.	RCP 2.6 and 8.5
Remuneration aligned with climate sustainability targets	Somewhat?	No
Details	"Our annual salary reviews are linked to performance evaluation to help us achieve strong alignment between performance, pay, and external environment" (SR p49) "Remuneration of Executive Management is related to the result of Vestas' financial and sustainable performance through incentives." (Remuneration report p2)	" Consequently, Wihlborgs does not offer any variable remuneration linked to financial targets or measurable sustainability goals. We feel it is more important to get the entire organisation working on, for example, sustainability issues." (A&SR p10)
Sustainability integrated into governance structure.	Yes	Yes
Details	Sustainability is integrated on different levels of the governance structure; below the BoD and Executive Management is the Sustainability Committee (Chaired by GSVP). It prioritises, oversees and coordinates cross-functional sustainability initiatives. Implementation of sustainability in all functional areas by appointed sustainability leads. The following functions are represented; investor relations, Compliance & CSR, Sustainability, People & Culture, Service, Sales, Procurement, Quality, Safety & Environment, Global Supply Chain & Transport and Power Solutions. (SR p22)	Sustainability is integrated on different levels of the governance structure; "Wihlborgs’ Board of Directors and Group Management have important roles in sustainability management The Board adopts the Wihlborgs strategy, to which sustainability is integral, as well as the Group’s goals, which include clear and fixed-time sustainability goals linked to Wihlborgs’ sustainability framework. The preparation of and responsibility for goal fulfilment rests with Group Management, which delegates the operational work with individual goals to the organisation’s relevant functions. Property management and project operations are responsible for the implementation of activities that result in goal fulfilment. In terms of sustainability efforts, they are supported by the central sustainability department and other Group executive functions." (A&SR p134)
Assurance level	Limited assurance statement	Statutory sustainability report
Conclusion	Based on the procedures we performed and the evidence we obtained, nothing came to our attention that causes us not to believe that the Sustainability key figures stated on page 14 in the 2022 annual report for the period 1 January - 31 December 2022 of Vestas are prepared, in all material respects, in accordance with the accounting policies developed by Vestas as stated on pages 151 - 153.	Based on the limited assurance procedures we have performed, nothing has come to our attention that causes us to believe that the Sustainability Report, is not prepared, in all material respects, in accordance with the criteria defined by the Board of Directors and Executive Management.
Examination/assurance in accordance with	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000 (Revised), Assurance engagements on greenhouse gas statements (3410), International Standard Quality Management ISQM 1, Code of Ethics for Professional Accountants issued by the IESBA	Prepared in accordance with International Standard on Assurance Engagements (ISAE) 3000 (Revised), FAR's recommendation RevR12, International Standard Quality Management ISQM 1

Table 5.7.1 Matrix summarising the findings derived from the sample of sustainability reports from the year 2022

6 Quantifying Risks and Opportunities

In the realm of assessing the financial impacts of climate change, various quantifying methods are at our disposal, each carrying its own set of strengths and limitations. The subsequent discussion dives into the nuances of these mathematical models, highlighting their advantages, disadvantages, and ideal use cases within the context of connecting TCFD scenarios to IFRS line items. Every mathematical model serves a purpose, and the choice of model depends on several factors, including the specific climate risks and opportunities under examination, the availability of data, and the relevant IFRS line items affected (Moneva & Ortas, 2010). Companies often resort to a combination of models to provide a more comprehensive assessment of climate-related financial impacts, ensuring a holistic approach to risk management and decision-making (Decker & Lesser, 1993).

Quantifying risks and opportunities involves using scenario analysis to estimate the financial impact of climate-related risks and opportunities under different climate scenarios. This step can be achieved using various mathematical and modelling techniques:

1. Define climate scenarios (see TCFD): Start by selecting a set of climate scenarios, which typically include different levels of global warming (for example, 1.5°C, 2°C, and higher warming scenarios). These scenarios should be aligned with the Intergovernmental Panel on Climate Change (IPCC) pathways or other relevant sources, such as the International Energy Agency (IEA) or Network for Greening the Financial System (NGFS).
2. Develop key assumptions and parameters: Identify the key assumptions and parameters that will drive the financial impact of climate-related risks and opportunities. These could include factors such as changes in temperature, precipitation, extreme weather events, carbon pricing, technological advancements, and shifts in consumer preferences.
3. Choose modelling techniques: Depending on the nature of the risks and opportunities, select appropriate modelling techniques to quantify the financial impact. Some common techniques include:

    a. Econometric models: These models use historical data to estimate relationships between economic variables, such as the impact of temperature changes on crop yields or energy demand (Baez & Tweed, 2013).

    b. Integrated assessment models (IAMs): These models simulate interactions between the economy, energy systems, and climate to estimate the costs and benefits of different climate policies (Mayes & Myers, 2015).

    c. Input-output models: These models analyse the interdependencies between different sectors of the economy, capturing the cascading effects of climate risks and opportunities through supply chains (Barnett, 1995).

    d. Agent-based models (ABMs): These models simulate the behaviour of individual agents (for example firms, households) to study the emergence of macro-level phenomena, such as the diffusion of low-carbon technologies or the response of financial markets to climate policies (New & Hulme, 2000).

4. Model calibration and validation: Calibrate the chosen models using historical data, expert judgment, or a combination of both. Validate the models by comparing their outputs against observed data or benchmarking against other models (Babonneau et al., 2012).
5. Run the scenarios: Input the climate scenarios, assumptions, and parameters into the models to generate estimates of the financial impact of climate-related risks and opportunities. This might involve estimating the impact on revenues, costs, asset values, or cash flows under each scenario.
6. Monte Carlo simulations: To account for uncertainties in the assumptions and parameters, perform Monte Carlo simulations by randomly sampling from probability distributions for each input variable. This will provide a range of possible outcomes and help quantify the uncertainty around the financial impacts (New & Hulme, 2000).
7. Analyse the results: Aggregate and analyse the results to draw insights on the potential financial impact of each climate scenario. This could involve calculating the mean, median, and percentiles of the distribution of outcomes, as well as conducting sensitivity analysis to identify key drivers of the results.

By following these steps, companies can quantify the financial impact of climate-related risks and opportunities on specific IFRS items under different climate scenarios using mathematical and modelling techniques. This will provide a solid foundation for integrating climate considerations into their financial statements and disclosures.

In assessing the financial impacts of climate change, various quantifying methods can be employed, each with its strengths and limitations. The following table 6.1 provides a summary of the mathematical models, along with their advantages, disadvantages, and ideal use cases in the context of connecting TCFD scenarios to IFRS financial statements.

Type of Model	**Advantages**	**Disadvantages**	**Use Case**	**Source Link**
Econometric models	Based on historical data, providing a strong empirical foundation. Can capture relationships between climate variables and financial outcomes. Relatively simple and straightforward to implement.	Assumes that historical relationships will persist in the future, which may not always hold true. Limited in capturing non-linear or complex relationships. Requires sufficient historical data for accurate estimation.	Ideal for situations where historical data is available and can reliably capture the relationship between climate variables and financial outcomes (e.g., impact of temperature changes on energy demand, or precipitation changes on agricultural yields).	ineteconomics.org
Integrated assessment	Simulates interactions between the economy, energy systems, and climate. Can estimate	Often complex and computationally intensive. Requires a high level of expertise	Ideal for analysing economy-wide transition risks and opportunities, such	pik-potsdam.de

Type of Model	Advantages	Disadvantages	Use Case	Source Link
models (IAMs)	costs and benefits of different climate policies. Allows for a comprehensive analysis of transition risks and opportunities.	to develop and interpret. May have limitations in capturing local or sector-specific impacts.	as the impact of carbon pricing or renewable energy adoption on the overall economy.	
Input-output models	Captures interdependencies between different sectors of the economy. Can estimate the cascading effects of climate risks and opportunities through supply chains. Relatively easy to implement using readily available input-output tables.	Assumes fixed relationships between inputs and outputs, which may not hold under changing conditions. Limited in capturing dynamic responses or feedback effects. Requires consistent and reliable input-output data.	Ideal for assessing the indirect impacts of climate risks and opportunities on a company's supply chain and related sectors.	ibid
Agent-based models (ABMs)	Simulates the behaviour of individual agents to study the emergence of macro-level phenomena. Can capture non-linear, adaptive, and complex interactions between agents. Allows for a high level of customisation to represent specific contexts or sectors.	Can be complex, computationally intensive, and require a high level of expertise. Results may be sensitive to assumptions about agent behaviour and interactions. Requires extensive data on agent characteristics and behaviour.	Ideal for examining the micro-level behaviour and responses of firms, households, or other agents to climate risks and opportunities (e.g., diffusion of low-carbon technologies, financial market responses to climate policies).	comses.net

Table 6.1 Model type, (dis)advantages and use cases

Each mathematical model has its advantages, disadvantages, and ideal use cases in connecting TCFD scenarios to IFRS financial statements. The choice of the model depends on the specific climate risks and opportunities being assessed, the type of data available, and the relevant IFRS line items affected. Companies may also consider using a combination of models to provide a more comprehensive assessment of climate-related financial impacts. Specifically, we explore how exactly this can be done by running simulations.

Expert estimates are great to address uncertainties in each of the models when data is scarce or the relationships between variables are too complex to be captured by quantitative models. They can be used in various ways, including informed assumptions, the Delphi method, expert elicitation, and model calibration and validation (see table 6.2):

Type of Estimate	Description
Informed assumptions	Experts can provide informed assumptions for specific parameters or relationships in the models, based on their experience and understanding of the subject matter.
Delphi method	This structured method involves gathering and synthesising expert opinions through a series of questionnaires and feedback rounds to arrive at a consensus estimate. Particularly useful for complex, uncertain, or poorly understood climate risks and opportunities.
Expert elicitation	Experts can be asked to provide probability distributions for uncertain parameters or assumptions, which can then be used as inputs for Monte Carlo simulations.
Model calibration and validation	Expert estimates can be used to calibrate or validate models when historical data is insufficient or unreliable.

Table 6.2 Expert estimates

Monte Carlo simulations can be employed with each of the previously discussed mathematical models to help address uncertainties in the assumptions and parameters of the experts. They can generate a range of possible outcomes by randomly sampling from probability distributions, providing more robust results for decision-making (Baez & Tweed, 2013) (see table 6.3).

Model	Assumptions and Uncertainties	Monte Carlo
Econometric models	Uncertainties may arise from the coefficients and parameters estimated using historical data.	Monte Carlo simulations help overcome these uncertainties by generating a range of possible outcomes through random sampling from the probability distributions of coefficients and parameters. This quantification of uncertainty provides more robust results for decision-making.
Integrated assessment models (IAMs)	Numerous assumptions, such as technological progress, policy developments, and socioeconomic factors.	Monte Carlo simulations can be applied to overcome these uncertainties by randomly sampling from the probability distributions of these assumptions, generating a range of potential scenarios. This allows for a better understanding of the uncertainty around the costs and benefits of different climate policies and the financial implications for companies.
Input-output models	Uncertainties can arise from changes in the relationships between different sectors, technological progress, or policy interventions.	Monte Carlo simulations help address these uncertainties by sampling from the probability distributions of these factors to produce a range of possible outcomes. This provides insights into the cascading effects of climate risks and opportunities through supply chains under various conditions.
Agent-based models (ABMs)	Uncertainties involve agent behaviour, interactions, and characteristics.	Monte Carlo simulations can overcome these uncertainties by sampling from the probability distributions of these factors to explore a wide range of possible scenarios. This

Model	Assumptions and Uncertainties	Monte Carlo
		allows for a more comprehensive understanding of the emergent phenomena and financial impacts.

Table 6.3 The use of Monte Carlo Simulations

The Monte Carlo Simulation emerges as a standout method for addressing the inherent uncertainty and variability in climate risk assessment. This approach excels in generating a distribution of potential outcomes based on probabilistic inputs, allowing for the consideration of a wide range of scenarios and their likelihoods, thereby providing a robust foundation for decision-making and risk management. Furthermore, the Monte Carlo Simulation method facilitates the integration of expert estimates into the modelling process, enhancing the depth and accuracy of the analysis. By leveraging insights from experts in various fields related to climate risk assessment, this collaborative approach ensures that the simulation reflects the most up-to-date knowledge and understanding of climate risks, empowering stakeholders to make informed decisions.

6.1 Monte Carlo Simulations

We chose the Monte Carlo Simulation method because of its ability to address the inherent uncertainty and variability in climate risk assessment. By generating a distribution of potential outcomes based on probabilistic inputs, it allows us to capture a wide range of possible scenarios and their likelihoods. This approach provides a more robust foundation for decision-making and risk management, enabling us to better understand the financial implications of climate change and develop more effective strategies to mitigate its impacts. In addition to its capacity to address uncertainties, the Monte Carlo Simulation method also facilitates the incorporation of expert estimates into the modelling process (Barnett, 1995).

Experts in various fields related to climate risk assessment, can provide valuable insights into key parameters and their potential ranges. By integrating these expert estimates into the simulation, we can enhance the accuracy and realism of the model's inputs, thereby improving the credibility of the results. This collaborative approach ensures that the simulation reflects the most up-to-date knowledge and understanding of climate risks, enabling stakeholders to make informed decisions based on comprehensive and reliable analyses. Moreover, by iteratively refining the model based on feedback from experts and stakeholders, we can continuously enhance its predictive power and applicability, thus strengthening our ability to proactively manage climate-related financial risks (Babonneau et al., 2012).

Following this, and to quantify the impact of climate risks on the financial risks through the economic transmission channels, Monte Carlo Simulations (MCS) seem well suited. Beyond their utility in comprehending individual extreme scenarios for risk factors, their most significant benefit is that they allow determining probability distributions within extremes and thus make these manageable (Gentle, 2003). An MCS involves conducting a large number of random experiments on aggregated equity, profit and loss, or cash-related statements based for example on selected climate scenario data, expert inputs, and market estimations (Smirnova, 2020). This allows conclusions to be drawn about the future development of relevant operating figures within well-defined, and calculable confidence intervals, creating a much narrower range than the usual best/worst-case figures. (Baez & Tweed, 2013)

The Monte Carlo simulation is a powerful statistical technique used to model a wide range of possible outcomes for a given set of variables. In the context of climate change, it allows companies to explore a multitude of scenarios for different economic transmission channels, each representing a different combination of climate-related factors and their potential impacts on a company's operations, finances, and strategic decisions. By running thousands of simulations, the Monte Carlo method provides a more comprehensive view of the potential financial impacts posed by climate-related risks and opportunities. It helps to quantify the uncertainty associated with these economic transmission channels, allowing companies to assess the likelihood and severity of various outcomes. (Decker & Lesser, 1993)

Moreover, it offers insights into how different variables interact and influence one another. Furthermore, the Monte Carlo framework enables the additional simulations of exogenous shocks, such as a pandemic, disruptions in the supply chain, or significant fluctuations in the price of CO2 certificates. This can add significant value for companies seeking to forecast and navigate through volatile conditions. (Mayes & Myers, 2015)

Therefore, in climate-related scenario planning and risk assessment following TCFD recommendations, Monte Carlo Simulations provide a robust quantitative framework to ascertain the potential impacts of climate risks on a firm's financial posture. This technique is particularly adept at navigating the complexities and uncertainties inherent in climate science and its economic ramifications (New & Hulme, 2000). By performing MCS, firms can better comprehend the multifaceted nature of climate risks and their transmutation into financial risks through various economic transmission channels as detailed before.

In summary, Monte Carlo Simulations provide an indispensable tool for firms engaged in climate-related scenario analysis and financial risk assessment. It empowers companies to make more informed decisions and develop robust strategies for climate risk management. By employing this method, firms can navigate the intricate nexus of climate and financial risks, thereby fostering a more resilient and sustainable operational framework in the face of a changing climate. It goes beyond simple risk assessment, offering a nuanced understanding of the complex interplay between climate change and a company's financial performance (Barnett, 1995). This quantitative approach not only enhances preparedness but also helps companies seize opportunities for sustainable growth in an increasingly climate-conscious world. Through the integration of advanced computational techniques, climate science, and financial modelling, MCS provides a rigorous, data-driven foundation for assessing and mitigating climate-related financial risks in alignment with regulatory guidelines and stakeholder expectations.

6.2 Background to the DCF

The Discounted Cash Flow (DCF) method is a valuation technique used to estimate the value of an investment based on its expected future cash flows. The method is grounded in the principle that the value of money decreases over time. Let us start first with a detailed explanation of the DCF method along with the mathematical formulas involved to later connect to these variables in the debate around climate risk and opportunity impacts.

Due to the growing recognition of climate risks and opportunities in financial decision-making, it is of utmost importance to recognise the importance of these variables in DCF calculations. Investors and companies increasingly acknowledge that climate change can significantly affect

future cash flows through regulatory changes, physical risks, and evolving market dynamics. Understanding the DCF method and incorporating climate-related factors into this analysis is crucial for accurate valuation and strategic planning. This approach allows stakeholders to better assess the long-term sustainability and profitability of investments within the context of a rapidly changing climate landscape.

The general formula for DCF is:

$$DCF = \sum \left(\frac{}{C} F_t (1 + r)^t \right)$$

Where:

- (DCF) is the discounted cash flow or present value of the Cash flow in period (t)
- (CFt) is the cash flow in period (t)
- (r) is the discount rate
- (t) is the time period

Components of the DCF

Forecasted Cash Flows (CF)
Companies estimate future cash flows, generally using the free cash flow to the firm (FCFF) or free cash flow to equity (FCFE). The formulas for these are:

$$FCFF = EBIT \times (1 - TaxRate) + Depreciation - ChangesinWorkingCapital - CapitalExpenditure$$

$$FCFE = FCFF - Interest \times (1 - TaxRate) + NetBorrowing$$

Where:

- (EBIT) is earnings before interest and taxes
- (Tax Rate) is the corporate tax rate
- (Depreciation) is the depreciation expense
- (Working Capital) is the company's working capital
- (Capital Expenditure) is the company's capital expenditure
- (Interest) is the interest expense
- (Net Borrowing) is the net borrowing during the period

Discount Rate (r)
The discount rate can be calculated using the Weighted Average Cost of Capital (WACC) for FCFF or the required rate of return for equity investors for FCFE. The WACC formula is:

$$WACC = \left(\frac{}{E} V \times Re \right) + \left(\frac{}{D} V \times Rd \times (1 - TaxRate) \right)$$

Where:

- (WACC) is the weighted average cost of capital
- (E) is the market value of equity
- (V) is the total market value of equity and debt
- (Re) is the cost of equity
- (D) is the market value of interest-carrying debt
- (Rd) is the cost of debt

The cost of equity (Re) can be calculated using the Capital Asset Pricing Model (CAPM):

$$Re = Rf + \beta \times (Rm - Rf)$$

Where:

- (Re) is the cost of equity
- (Rf) is the risk-free rate
- (β) is the beta coefficient
- (Rm) is the expected market return

Time Period (t)
The time period refers to the number of periods into the future when the cash flows are being projected.

Terminal Value
After forecasting the cash flows for a specific period, a terminal value is calculated to account for all the cash flows beyond that period. It can be calculated using the Gordon Growth Model:

$$TV = \frac{}{C}F_{n+1}(r - g)$$

Where:

- (TV) is the terminal value
- (CFn+1) is the cash flow in the first year beyond the projection period
- (r) is the discount rate
- (g) is the perpetual growth rate

After calculating the present value of the forecasted cash flows and the terminal value, these values are summed to find the total enterprise value (+/- non-operating capital, such as financial assets) in the case of FCFF or equity value in the case of FCFE. It is a comprehensive method that integrates various financial metrics and projections to estimate the value of an investment. It is widely used in financial analysis and corporate finance for investment appraisal and business valuation (Moneva & Ortas, 2010, Oded & Michel, 2007).

By integrating the climate scenarios and potential economic transmission channels as per the Appendix, let us have a further look at the potential influences of climate risks and opportunities on the DCF in our expanded, holistic model of how climate risks and opportunities affect enterprise value via economic transmission channels and financial risks and opportunities. This more granular model, as showcased in Figure 6.2.1, demonstrates how the micro and macro implications of physical and transition climate risks and opportunities affect financial risks and opportunities. The model encompasses how the scenario analysis process develops and shows that the implications of climate risks and opportunities influence the DCF components; cash flow, cost of capital, and the growth rate, ultimately impacting enterprise value.

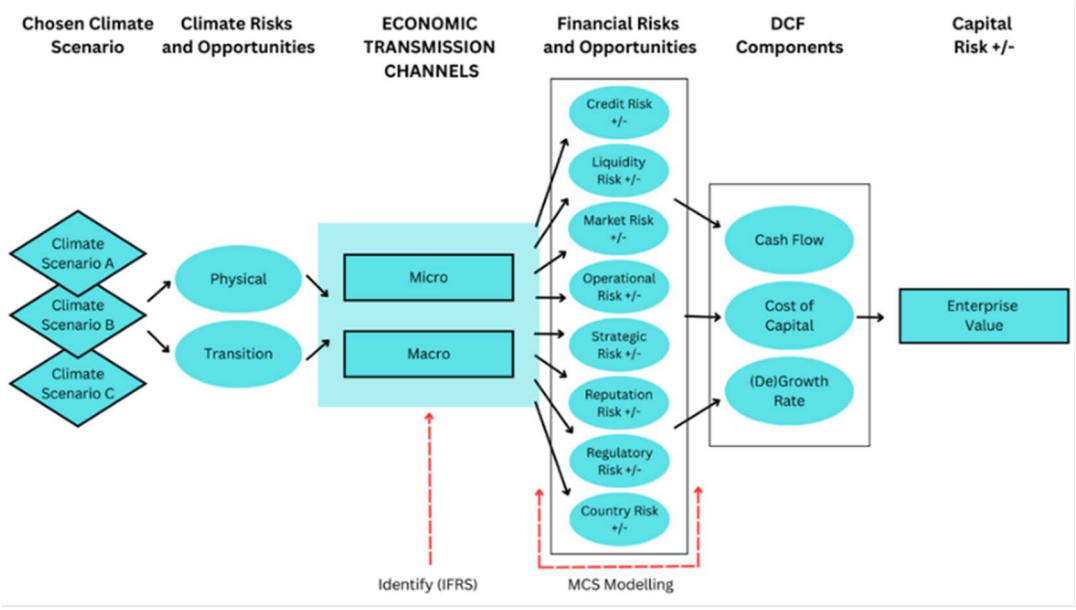

Figure 6.2.1 The Impact of Climate-related Economic Transmission Channels on DCF Components. Source authors

To illustrate the effectiveness of Monte Carlo Simulation in action, a fictive real estate company scenario can be employed. By applying actual TCFD climate scenarios to this case, the econo-financial modelling approach can demonstrate how these models can be utilised to showcase a reportable impact on the valuation of IFRS line items and overall company valuation. Through this case study, stakeholders can witness firsthand the practical application and benefits of integrating Monte Carlo Simulation with expert estimates in navigating the complex landscape of climate change and its financial implications.

In the latter chapters about the fictive case study, we will elaborate our thinking on the example of the DCF-based Enterprise value as a well-established practice and integrated case combining various aspects of financial statements and prognoses. By applying advanced Monte Carlo Simulations, we will illustrate how the climate risks may impact the cash flow planning as well as the discount rate and growth factors for terminal value.

In conclusion, the combination of Monte Carlo Simulation (MCS) and Discounted Cash Flow (DCF) analysis provides a robust framework for assessing the financial impacts of climate change on a firm's financial posture. MCS enables the quantification of uncertainties, while DCF analysis offers insights into long-term financial implications. While these methods offer valuable tools for decision-making and risk management, it's crucial to acknowledge their limitations, such as reliance on accurate input data and assumptions. Nonetheless, by leveraging insights from both methodologies, companies can make more informed decisions and develop resilient strategies for climate risk management and sustainable growth.

6.3 References

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7 The Impact of Climate Risks on Enterprise Value

7.1 Introduction

As the urgency of addressing climate change intensifies, the new IFRS sustainability disclosure standards S1 “General Requirements for Disclosure of Sustainability-related Financial Information” and S2 “Climate-related Disclosures”, effective January 1, 2024, adopted by the International Sustainability Standards Board (ISSB), present a regulatory imperative for global entities to disclose climate-related risks and opportunities (IFRS, 2023a). The aim of this chapter is to shed light on the effects of climate risks and opportunities on company valuation based on IFRS financial ratios, particularly for non-financial companies. Implications for the financial sector are straightforward, as capital providers address the systemic dimension of climate risks and opportunities in their investments (see for example D’Orazio, 2023; Sääskilahti, 2023; TCFD, 2017). As climate risks manifest in two primary domains, namely physical risks from global warming and the potential transition to a low-carbon economy, it becomes crucial to understand their multifaceted impact on financial landscapes.

Climate risks manifest in two primary domains: transition risks and physical risks from global warming such as extreme weather events, rising sea levels, and changes in agricultural zones, which include supply chain disruptions and resource scarcity (TCFD, 2021; O'Dwyer & Unerman, 2020, IPCC, 2019). Transitional risks pertain to the financial and operational challenges that arise as economies and industries shift towards lower-carbon technologies and sustainable practices. Companies may face increased costs of compliance, potential asset devaluation, and competitive disadvantages if they fail to adapt promptly (TCFD, 2021). Physical climate risks have an impact on the financial situation by causing direct asset damages, leading to production interruptions and thus to a decline in sales, but also by driving up insurance costs or ongoing operating expenses to protect assets, for example (Wang et al., 2023). However, the shift to a carbon-free or at least low-carbon economy could also require significant changes in policy, legislation, technology, markets, and consumer perception, which in turn entail transitional risks (transition risks) (McGlade & Ekins, 2015) and involve market shifts and compliance costs which, as with climate risks, have an impact on (future) cash flows (TCFD, 2021; O'Dwyer & Unerman, 2020). Physical and transition risks impact the financial forecasts and therefore have a direct effect on the enterprise's valuation (Dong et al., 2021). Therefore, an entity must be able to address, mitigate and manage climate-related risks (Wang et al., 2023; Subramaniam et al., 2015). However, climate-related effects do not only include risks (Gasbarro et al., 2017). It is also important for entities to manage the opportunities that arise from adopting sustainable practices, such as operational resilience and market positioning, which also impact (future) cash flows (Gasbarro et al., 2017; Subramaniam et al., 2015).

If climate-related risks and opportunities have an impact on the (future) financial cash flows of a company, the information is relevant to stakeholders, especially capital providers (Schiemann & Sakhel, 2019). Therefore, the disclosure of information regarding climate-related risks and opportunities is critical to bridging the information gap between the reporting company and its stakeholders (Thai et al., 2022). A main objective of sustainability disclosure standards such as the Task Force on Climate-related Financial Disclosures (TCFD) or the above-mentioned IFRS S1 and S2 is that companies evaluate and disclose the climate effects, advocating for a quantitative assessment of climate scenarios. While the TCFD recommendations also duly

address the financial implications of climate risks, their primary focus diverges from that of IFRS S1 and S2, emphasising the assessment and response to climate-related risks and opportunities in a company's strategy and risk management. Under IFRS S1 and S2 however, the mandate to connect climate-related risks and opportunities to its financial statements (see IFRS S1.3, S1.21, S1.B39-B44) is clearly stated, for example in IFRS S1.B44(a): (IFRS, 2023a)

> *"an explanation of the combined effects of the entity's sustainability-related risks and opportunities and its strategy on its financial position, financial performance and cash flows over the short, medium and long term."*

Furthermore, IFRS S2 holds in its objectives (1): "… information … that is useful to primary users of general-purpose financial reports" and (2): "… affect the entity's cash-flows, its access to finance or cost of capital over the short, medium or long term." As the enterprise value calculations are often based on the discounted cash flow method (DCF henceforth), which relies on future cash-flow prognosis, the cost of capital, and future prospects for its discount rate, it becomes clear that users of S1 and S2 will need to provide information about the influence of climate-related risks and opportunities on the enterprise value. In an earlier draft of S2 (March 2022), that still relied on lists instead of general principles (see (1) and (2) above), this was even enumerated in (a) "… the effects of significant climate-related risks and opportunities on the entity's enterprise value" (IFRS, 2023b).

In response to the imperative for organisations to address climate-related effects and the need to assess them in enterprise valuation, we undertake an exploration that extends the discussion to encompass simulations of climate risks and opportunities. This exploration will be complemented by stress tests utilising science-based scenario data from sources such as the Intergovernmental Panel on Climate Change (IPCC) and Network for Greening the Financial System (NGFS). Such simulations might play a vital role for various stakeholders, including banks, asset managers, and entities serving purposes from capital allocation to impairment testing and strategic planning. We also take a closer look at the link between climate risks and economic and financial impacts and risks, to showcase how different economic strategies, choices or shocks can have broader consequences in the surrounding society. We aim to explore what these economic transmission channels could look like for non-financial companies. By understanding the economic transmission channels through which climate-related risks turn into financial risks, the chapter aims to develop a robust framework for integrating climate risk into financial forecasting and enterprise valuation to guide micro-economic decision-making.

The chapter addresses a critical gap in existing climate risk models that focus primarily on macroeconomic factors. A fictitious company from the real estate industry is used as a case study, based on financial data in IFRS financial statements and internal assumptions of Nordic real estate companies. By seamlessly integrating historical and forecast data, the model facilitates company valuation. With regard to climate risk, in particular flooding, two scenarios are currently being developed and their impact on IFRS items described. However, the quantification of the scenarios and thus the impact on the company value is still pending. In order to increase the robustness of the integration of climate risks into the company valuation, the chapter advocates the use of Monte Carlo simulations. This method aims to quantitatively assess the impact of climate risks on enterprise value by dynamically evaluating factors such as the valuation of assets, revenues and expenses and capital expenditure in a discounted cash

flow (DCF) model. While a comprehensive quantification of the impact of climate risks on enterprise value for the example company is not yet possible, the chapter presents a framework that forms the basis for operationalising the impact of climate risks on financial figures and enterprise valuation.

Against this backdrop, we address the following research questions:

- *How do climate risks and opportunities, specifically transition risks and physical risks, impact the financial figures and enterprise value of non-financial companies?*
- *What might be a robust framework for integrating climate risk into financial forecasting and enterprise valuation?*

The chapter is structured as follows: First, we look at the new IFRS sustainability standards S1 and S2 and examine their objectives, concepts, and implications. We then examine the climate risks and opportunities, investigate the relevant scenario providers and introduce the concept of economic transmission channels to understand the intricate link between climate risks and economic and financial impacts at both micro and macro levels. Following this, we explore the application of climate scenario planning, guided by TCFD principles and integrated with validated parameters, which is essential for companies to navigate the intricate interplay between climate dynamics and financial performance. We then present a fictitious real estate company and create two scenarios for the climate risk of flooding, showing the impact of the scenarios and presenting a robust framework to integrate climate risks into enterprise valuation. Finally, we give an outlook on the practical applicability of such integrated models in various areas.

7.2 IFRS Sustainability Standards

The IFRS sustainability disclosure standards have been introduced in chapter 2 and sustainability impacts on IFRS financial reporting in chapter 3.

As introduced in chapter 2, the primary objective of the IFRS sustainability standards, specifically IFRS S1 and S2, is to facilitate comprehensive and comparable reporting on companies' sustainability-related risks and opportunities, tailored to industry specifics for investor decision-making. These standards apply to companies reporting under IFRS, with transition relief provisions for first-time reporters (IFRS S1.E5, S1.E3, S2.C4). The two key standards are IFRS S1, which sets the General Requirements for the Disclosure of Sustainability-related Financial Information, and IFRS S2, which focuses on climate-related disclosures. Both standards cover four key areas: governance, strategy, risk management, and metrics and targets.

IFRS S1 outlines general requirements for sustainability-related financial information, including the scope and extent of required disclosures (IFRS S1.E5, S1.E3, S1.37). It emphasises principles such as materiality, proportionality, and reporting without undue cost or effort. Materiality is defined in a sector-specific manner, based on guidelines from the SASB (IFRS S1.17, S1.B26, S1.B20, SASB, n.d.).

The primary objective of IFRS S2 is to mandate entities to disclose information about their climate-related risks and opportunities that are pertinent to users of general-purpose financial reports. Such information aims to assist these users in making decisions related to providing resources to the entity. IFRS S2 outlines specific requirements for disclosing information that

could reasonably be expected to affect an entity's cash flows, access to finance, or cost of capital in the short, medium, or long term. These are collectively referred to as "climate-related risks and opportunities that could reasonably be expected to affect the entity's prospects" (IFRS S2.2). The standard applies to two categories of climate-related risks: physical risks and transition risks, as well as climate-related opportunities available to the entity (IFRS, 2023b).

The standard is structured around four key areas:

1. Governance: processes, controls, and procedures used to monitor, manage, and oversee climate-related risks and opportunities.
2. Strategy: The entity's strategy for managing these risks and opportunities.
3. Risks and Opportunities: Processes employed to identify, assess, prioritise, and monitor climate-related risks and opportunities, including their integration into the entity's overall risk management process.
4. Metrics and Targets: The entity's performance metrics in relation to its climate-related risks and opportunities, which include progress towards any set climate-related targets and any targets mandated by law or regulation.

For companies reporting under these standards for the first time, transition relief measures are in place. Specifically, these entities are only required to report on climate-related risks and opportunities and are exempt from disclosing comparable information for the preceding period (IFRS S1.E3, S1.E5). Additionally, initial exemptions concerning Scope 3 emissions are granted; companies are not obligated to disclose these emissions in the first annual reporting period and may use alternative methods to the GHG Protocol for measuring GHG emissions (IFRS S2.C4). These transition provisions aim to give companies an additional year to prepare for comprehensive sustainability-related financial information reporting. The overarching goal of these IFRS standards is to facilitate comparable and comprehensive reporting tailored to industry specifics, focusing on materiality, proportionality, and avoiding undue cost or effort (IFRS S1.37). Both standards aim to facilitate comparable and comprehensive reporting tailored to industry specifics, meeting the informational needs of investors (IFRS S1.37). In the context of IFRS sustainability standards "materiality" is a pivotal concept. According to IFRS S1, materiality encompasses factors that could notably impact a company's prospects, including effects on cash flows, access to finance, and the cost of capital (IFRS S1.17, S1.B26). The IFRS S standards therefore focus on the disclosure of sustainability-related information that is primarily important for investment decisions (Baumüller & Leitner-Hanetseder, 2023). The IFRS S standards also introduce the notion of sector-specific materiality, allowing the definition of materiality to vary depending on the industry in which a company operates (IFRS S1.B20). This sector-specific approach is aligned with the definitions provided by the Sustainability Accounting Standards Board (SASB, n.d.), and companies can utilise the SASB's Materiality Finder to support their materiality judgments. This nuanced approach to materiality ensures that disclosures are both comprehensive and relevant, tailored to the specific risks and opportunities faced by companies in different sectors.

The Financial Stability Board (FSB) has announced the completion of the Task Force on Climate-related Financial Disclosures (TCFD) work, stating that the ISSB Standards, particularly IFRS S2, are built upon the recommendations of the TCFD (Chua et al., 2022) and mark the culmination of TCFD's efforts. Companies adhering to IFRS S2 will meet TCFD recommendations, making it unnecessary to apply both sets of standards. IFRS S2 includes

additional requirements, such as industry-based metrics and disclosures about the planned use of carbon credits and financed emissions. While TCFD recommendations remain available for use – providing excellent guidance for example on climate risk scenario planning – the IFRS Foundation will now monitor companies' climate-related disclosures. The ISSB Standards, which build on SASB Standards, and as stated before make use of the sophisticated sector-materiality guidance of SASB (SASB, n.d.), aim to reduce the fragmentation in sustainability reporting. Companies using IFRS S1 and S2 will also meet TCFD recommendations, as they are fully incorporated into ISSB Standards. Responsibility for SASB Standards now lies with the ISSB, which plans to maintain and evolve them. Given the structural similarities and interconnectedness among IFRS S2 and TCFD, this ensures the future expandability of IFRS S standards along the high-level structure of governance, strategy, risk management, and metrics and targets.

The IFRS Sustainability Disclosure Standards (SDS), including IFRS S1 and S2, play a vital role in addressing climate change challenges for companies globally. They aim to provide stakeholders with consistent sustainability data, aligning corporate disclosures with broader sustainability goals. The emergence of the ISSB and the issuance of these standards mark significant milestones toward establishing universally applicable sustainability reporting norms. Challenges remain in endorsement and integration with existing frameworks, but efforts are underway to ensure interoperability, especially with the European Sustainability Reporting Standards (ESRS).

Critics advocate for a broader approach to sustainability reporting beyond financial materiality, considering impacts on stakeholders and sustainable development goals. Integration of sustainability reporting into financial frameworks, like IFRS, is complex but essential, particularly with initiatives like the EU's Corporate Sustainability Reporting Directive (CSRD). Climate-related aspects increasingly impact financial reporting, requiring companies to assess and disclose implications across different financial statement elements. Harmonising sustainability and financial reporting is crucial for providing stakeholders with a comprehensive view of a company's performance and resilience to climate-related risks.

7.3 Impact of Climate Risks and Opportunities

Starting from the broader context of IFRS sustainability standards, in particular IFRS S1 and S2, which lay the foundation for comprehensive reporting, we now dive into the multi-layered area of climate scenarios. Given the uncertainties surrounding climate risks and opportunities, the development of assumptions and scenarios to analyse the future financial impact of climate risks is unavoidable (Campiglio et al., 2023; Tingey-Holyoak & Pisaniello, 2021). Therefore, various established organisations provide publicly available climate scenarios and data for corporate and modelling use. The scenarios offer different narratives regarding plausible future outcomes, with varying granularity and focus areas. For example, the IPCC offers two sets of scenarios: the Representative Concentration Pathways (RCPs), which focus on future greenhouse gas concentration pathways (RCPs, 2009), and the Shared Socio-economic Pathways (SSPs), which outline potential socio-economic development futures, including factors like population and gross domestic product (GDP), growth, global collaboration levels, and disparities between developed and developing countries (IPCC, n.d.; Gao, 2023). Additionally, the IEA provides scenarios related to future energy use, primarily relevant to energy sector companies. Furthermore, the NGFS scenarios, designed for central banks and

financial institutions, offer scenario narratives concerning policy and technical developments and provide a model of how climate risks translate into financial/economic risks. Most of this data can be downloaded freely and accessed via APIs (application programming interfaces), meaning they can be easily integrated into vendor-specific software and models. These models furnish a clearer comprehension of the nexus between assorted climate-related parameters, climate risks, and financial risks. Excellent examples of open-source models may be found on the webpages of the ETH Zurich, the Economics for Climate Adaption methodology, and the Climada software. Increasingly such scenario data and models acknowledge the transition risks, while still predominantly embracing physical climate risks like storms or severe flooding.

Looking at climate scenario providers as outlined above, it has to be noted that the provided scenarios often overlook additional critical elements that could affect future cash flows and risk assessments. These potential gaps in climate scenarios can lead to a significant underestimation of climate-related risks and opportunities and therefore influence company valuation further. First, there is a tendency to overlook the non-linear nature of climate impacts (Tol et al., 2004), including the potential for abrupt 'tipping points'. These tipping points can drastically alter the risk profile within a short period (see for example Lenton et al., 2008). Secondly, the degradation of natural capital, such as biodiversity loss and ecosystem collapse, can have additional profound effects on economies and, by extension, on company valuations (Obst, 2015). Moreover, the impact of geopolitical shifts and wars, which are likely to become more frequent as resource scarcity intensifies due to climate change, is rarely factored into financial projections (Evans, 2011). These events can for example instantly disrupt global supply chains and markets, leading to significant economic volatility (Ngoc, 2022). Another area of concern is the integration of actions by non-governmental organisations (NGOs) and shareholder activism (Guay et al., 2004). These groups are increasingly influencing company policies and practices towards more sustainable operations (Flammer et al., 2021). The impact of such, difficult to foresee, activism on company performance is yet to be fully integrated into climate risk models. In essence, to enhance the reliability and usefulness of climate scenarios in company evaluation, there is a pressing need to incorporate a broader range of climate-related risks and factors. These include the non-linear dynamics of climate impacts, the valuation of natural capital, geopolitical and social stability, and the increasing role of civil society in shaping corporate responses to climate challenges. Addressing these gaps will allow for a more comprehensive and realistic assessment of how climate risks could influence future cash flows and company valuations (Monasterolo, 2020). While the debate in this chapter is about how to infer risks on a company level based on existing climate scenario data, we must not forget to scrutinise and continuously improve the scenarios themselves in order to derive robust impacts on company valuation.

A more company-specific approach necessitates a discernment of the link between climate risks and economic and financial impacts and risks (Funk, 2003), for both physical as well as transition climate risks. Examining the intricate interplay of climate risks and financial impacts involves a comprehensive analysis of their manifestations in a company's financial statements. Emphasising a microeconomic perspective, our work delves beyond the macro level, establishing a foundation for a holistic modelling approach to elucidate the microeconomic linkages between climate risks and the economic and financial landscape of businesses.

Climate-related risks and opportunities exert a direct and multifaceted influence on a company's financial performance, with repercussions extending across its comprehensive

income statement, balance sheet, and cash flow statement. This impact arises from the intricate mechanisms of climate-related risks and opportunities through their influence on the financial implications for companies and societies, both at micro and macro levels. The consequences are observable in various facets of a company's financial landscape, encompassing revenues, operating costs, asset valuations, and financing conditions. Figure 7.3.1 visually portrays a broad overview of these connections, as outlined by the TCFD (TCFD, 2021).

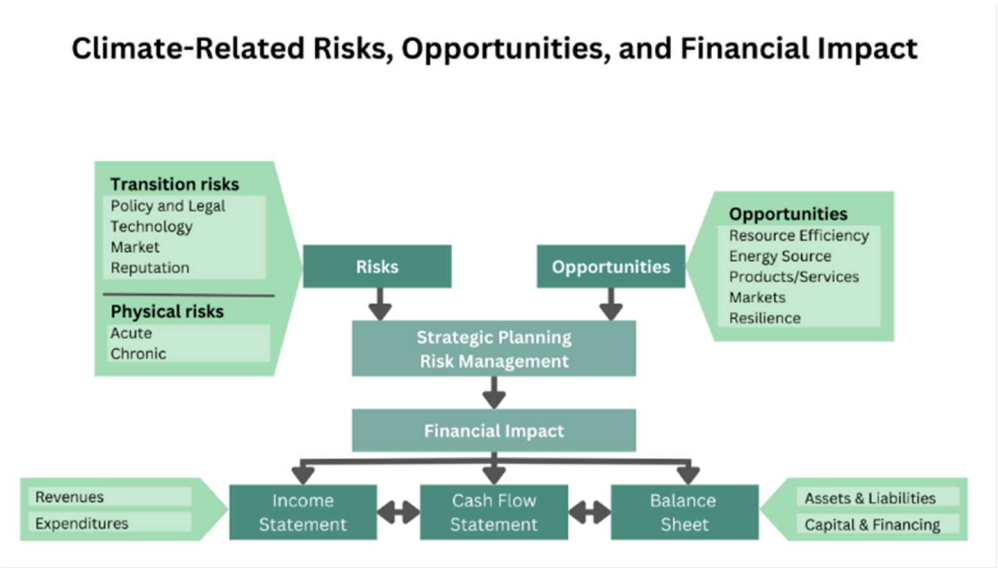

Figure 7.3.1 Climate-Related Risks, Opportunities, and Financial Impact, Source: TCFD, 2021

However, figure 7.3.1 does not delve into the intricate and precise mechanisms linking the climate parameters and the diverse range of financial impacts they can trigger. It is essential to recognise that climate-related risks and opportunities do not exist in isolation; instead, their impact on companies is a complex, multifaceted interplay (Campiglio et al, 2023). To bridge this knowledge gap and cultivate a more comprehensive understanding, we introduce the concept of economic transmission channels in this chapter, which denotes the link between climate risks and economic and financial impacts and risks. These channels, which are inspired by the Network for Greening the Financial System's (NGFS) concept, are being expanded to focus on corporate-level financial risks and serve as the dynamic conduits through which climate factors, be they physical or transitional, interact with economic and financial systems.

By exploring these economic transmission channels in greater detail as we do later in this chapter, we can dissect the specific pathways through which climate risks and opportunities manifest themselves across different sectors, industries, and markets. This deeper understanding empowers organisations to grasp the nuances of how climate dynamics can influence their financial well-being and strategic decision-making. Ultimately, this concept offers a more holistic perspective on the intricate relationship between climate and finance, allowing businesses to proactively adapt to an ever-changing climate landscape and seize opportunities for sustainable growth.

Exploring the link between climate risks and economic and financial impacts and risks helps elucidate the complexities of the connections and how climate parameters can lead to various financial outcomes. These climate parameters, which pertain to physical and transition climate impacts, can manifest as either risks or opportunities, contingent on many factors. The key to grasping this distinction is recognising that financial risk is not inherently negative; it can

encompass both potential downsides and upsides. By comprehending these multifaceted dynamics, businesses can navigate the intricate landscape of climate-related risks and seize the potential rewards of sustainable practices or the ever-changing climate.

For instance, in recent years, the viability of renewable energy sources like solar, wind, and hydropower has surged due to regulatory adaptations and shifting consumer preferences related to climate change mitigation (WEF, 2022). This transition toward cleaner energy sources poses significant risks to traditional fossil fuel assets, especially as governments and businesses worldwide are committing to ambitious targets for clean energy adoption. Simultaneously, it offers substantial growth opportunities for companies engaged in renewable energy technologies and infrastructure.

As with IFRS S2, climate-related topics are increasingly recognised as a significant factor to be integrated into a comprehensive analysis of risks and opportunities within a company. Although there is no definitive classification of individual climate risk categories, a practical and sensible approach involves categorising them into two primary risk categories, physical and transition risks. Additionally, a third category that we look at encompasses climate-related opportunities:

Physical risks refer to the direct impact of climate change on a specific company, such as extreme weather events or chronic changes such as rising sea levels that may impact various aspects, including resource scarcity and physical damage to assets, but even more prominently the supply chain, long-distance procurement, and overall logistics. These are typically identified at the company level by considering specific scenarios such as the RPC of the IPCC on regional levels, or by considering sector and industry-specific factors. Alongside the acute extreme weather event risks, chronic impacts have to be considered as well, such as sea level rises or general implications of increased average temperature (Campiglio, 2023; TCFD, 2021).

Transitional risks, which are indirect risks, stem from the expected impacts of climate-related regulatory and policy changes as well as expectations towards new technology on the one hand and the changes to the broader microeconomic (for example, consumer preferences) and macroeconomic (for example, inflation, sectoral supply and demand) environment on the other. These risks amongst others encompass regulatory, tax, and legal risks, as well as changes in individual markets and industries, such as carbon taxes or consumer preference changes (micro level) and the overall economy (macro level). In the most severe cases, regulatory changes might result in stranded assets, leading to the complete devaluation of previously valuated assets like oil fields or coal mines, with potential shocks at both the micro and macroeconomic levels (TCFD, 2021).

Finally, **climate-related opportunities** indicate areas where sustainable actions can yield positive operational and financial benefits for a company. The opportunities generally relate to increased resource efficiency, the development of new products and services, and improved climate resilience but may also stem even from a disrupted market perspective, for example, in supply chains or energy markets. Opportunities are therefore closely related to physical and transition risks, which underline the need for an integrated modelling approach (TCFD, 2021).

7.4 Climate Scenario Planning and Simulation

Climate scenario planning and simulation are essential components in addressing the risks posed by climate change. As outlined in Chapter 4, these tools provide policymakers,

businesses, and financial institutions with systematic methodologies to envision potential climate trajectories and their consequences. This section delves into the strategic value of climate scenarios, their application across various sectors, and the critical role they play in enhancing climate risk assessment and fostering a sustainable future. The discussion underscores the importance of plausible, consistent, and accessible scenarios in enabling effective decision-making and resource allocation, thereby safeguarding and potentially enhancing enterprise value amidst evolving climate challenges.

As previously discussed in chapter 4, it is imperative to explore the role and importance of climate scenarios in addressing the risks posed by climate change. Climate change presents an unprecedented challenge to the global community. There is a necessity for comprehensive strategies to understand, mitigate, and adapt to its impacts. Climate scenarios are crucial tools for policymakers, businesses, and financial institutions, offering a systematic methodology to envision potential trajectories of climate evolution and its consequences. There is a strategic value to climate scenarios in providing structured insights into potential future states, enabling organisations and governments to prepare effectively for climate-related challenges. As the scenario analysis framework evolution is ongoing, they have a critical role in mitigating climate risks and steering towards a sustainable future.

Chapter 4 delved into the landscape of providers and methodologies used in constructing climate scenarios in more detail, shedding light on the underpinnings of scenario reliability and relevance. It examines how various sectors apply these scenarios to navigate climate risks, integrate climate considerations into decision-making processes, and report on sustainability with greater precision. The synthesis of such knowledge is portrayed as essential for enhancing climate risk assessment robustness and steering the global financial architecture towards sustainability. In terms of the attributes of effective scenarios, chapter 4 highlights the importance of plausibility, distinctiveness, consistency, relevance, and challenge. Transparent documentation and accessibility are also emphasised as crucial factors in ensuring scenario integrity and usability.

Particular emphasis is placed on the practical applications of climate scenarios, especially within the financial sector, following the introduction of the Task Force on Climate-related Financial Disclosures (TCFD) recommendations. These recommendations, distilled into themes like Governance, Strategy, Risk Management, and Metrics & Targets, provide a blueprint for companies to navigate climate risk disclosure and strategy formulation strategically. Various sources of climate scenarios are explored, including the IPCC's Representative Concentration Pathways (RCPs) and Shared Socioeconomic Pathways (SSPs), IEA scenarios, and NGFS scenarios. The NGFS's introduction of short-term scenarios and Phase IV scenarios, along with its focus on transmission channels, are highlighted as significant advancements in climate scenario analysis, addressing both physical and transitional risks.

The relevance of climate scenario planning and simulations on the impact of climate change on enterprise value is profound. Effective climate scenarios enable enterprises to better anticipate and manage risks associated with climate change, thereby protecting and potentially enhancing their value. By incorporating robust climate scenario analysis, organizations can make informed decisions, allocate resources more efficiently, and develop resilient strategies that mitigate adverse impacts while capitalizing on emerging opportunities. This proactive approach not only safeguards enterprise value but also aligns with the broader goals of

sustainability and long-term economic stability. Thus, the insights and methodologies discussed in chapter 4 are essential for any entity aiming to navigate the complexities of climate change and its implications for enterprise valuation.

7.5 Economic Transmission Channels

Climate-related risks can have substantial implications, both in terms of risks and opportunities, for the stability of financial systems (Grippa, et.al. 2019). These risks are not isolated events, as is shown in figure 7.5.1; rather, they are interconnected with various economic factors, creating a web of economic transmission channels through which climate risks can impact financial stability. These economic transmission channels serve as mechanisms that illustrate how different economic strategies, choices, and external shocks can have broader consequences in society. In this context, the evaluated mechanism is that of the impact of climate risks on financial risks.

Understanding the economic transmission channels related to climate risks is pivotal for comprehending the interconnectedness of these risks with the broader economy. These channels elucidate the pathways through which climate events and changes can lead to financial risks for both individual companies and households as well as the macroeconomy.

The economic transmission channels of climate risks encompass both micro-level and macro-level impacts. At the micro level, climate risks can directly affect individual businesses, resulting in financial consequences such as increased costs, decreased revenue, and physical damage. These impacts can be felt in various sectors, from real estate and insurance to industries and even the service sector. At the macro-level, the consequences of climate risks ripple through the economy, influencing key factors like consumer behaviour (Thøgersen, 2021), inflation (Yusifzada, 2023), and sectoral supply and demand dynamics (Auffhammer, 2018).

To gauge the extent of these economic transmission channels and their implications, scenario analysis proves to be a valuable tool. Scenario analysis entails the evaluation of potential impacts under different modelled scenarios, considering factors such as the severity of climate events, regulatory changes, and technological advancements (TCFD, n.d.). By simulating these scenarios and assessing their potential outcomes, it becomes possible to estimate the financial risks that may arise. This process not only aids in quantifying the impact but also assists in identifying strategies for mitigating climate-related financial risks and capitalising on potential opportunities in the changing landscape of the economy (Duinker et al., 2007).

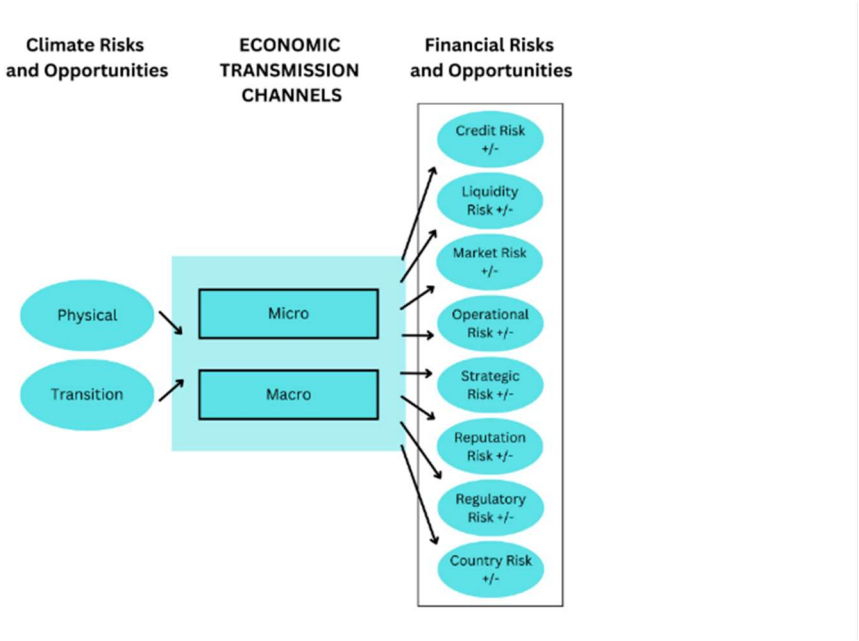

Figure 7.5.1 Source: authors, inspired by NGFS and adapted to cover corporate-level financial risks

Quantifying the impacts of economic transmission channels, both at the macro and micro levels, holds paramount significance, as the IFRS S2 standard underscores. IFRS S2 mandates the measurement of the financial effects stemming from climate-related risks and opportunities across short-, medium-, and long-term horizons. Through comprehensive simulations, it is possible to uncover and anticipate potential challenges that might emerge in the future due to these risks. Equally significant is the assessment of immediate versus long-term effects on business models.

Over time, the risk profile of a business model or strategy can fluctuate in response to the evolving economic and environmental landscape, and the company's ability to mitigate these risks can be a critical factor. Another critical consideration is whether short-term risks may translate into long-term financial implications, and vice versa. This prompts an inquiry into whether the impact will be symmetrical or if there will be discrepancies in timing and magnitude.

At a granular level, cash flows and cost of capital are susceptible to climate-related impacts (Kling et al., 2021). Together with strategic considerations, these factors can culminate in business model risks. Furthermore, the evolving landscape of climate impacts and their repercussions over time may lead to companies within the same industries or engaged in similar business models, to experience shared micro-level implications. This could trigger an escalating macro-level domino effect, rendering an entire industry or business model less attractive and influencing broader economic trends. Recognising these intricate dynamics is essential for companies to navigate the multifaceted terrain of climate risks and opportunities and proactively adapt to emerging challenges.

Understanding these dynamics is pivotal for companies as they seek to adapt and innovate in an increasingly climate-conscious world. The ability to assess how climate risks and opportunities intersect with financial outcomes across different timeframes, industry sectors, and risk types is essential for informed decision-making and strategic planning.

These climate-related risks are directly linked to the various financial risks of a company. The NGFS calls these links "Economic Transmission Channels," subsuming micro- as well as macroeconomic and financial factors (see Figure 7.9.2). These channels illustrate how climate risks translate into financial risks (see Table 7.9.1 in the Appendix for in-depth examples).

When it comes to NGFS modelling approaches, a clear focus is set on the macro level, as macroeconomic models are embedded in the model suites, deriving macro-financial impacts of physical as well as transition variable pathways (NGFS, n.d.). However, two shortcomings can be identified with only macro in mind: First of all, many of the identified macro-variables are micro-economically founded, i.e., changes in the behaviour of businesses and households determine macro-level effects. As measures that influence these variables, as well as adaptations of economic behaviour, take effect on the micro level, a solid modelling of the micro level is the key to an integrated perspective. Second, directly deriving corporate financial KPI values from the macro level, even at a sectoral level, might have its pitfalls without an additional layer, which allows a view of economic transition channels from a microeconomic perspective.

7.6 Exploring Climate Scenario Planning as per TCFD guidelines

In an evolving regulatory and environmental landscape under the new IFRS sustainability standards, advancing the discourse on climate risk assessment to a quantifiable and actionable realm is imperative. The TCFD offers standardised guidelines for elucidating and reporting climate-related risks and opportunities (TCFD, 2021). This framework facilitates companies in not only disclosing the potential financial impacts of prevailing and prospective climate risks but also in assessing the resilience of their business strategies under various climate-related scenarios. The meticulous scenario analyses and subsequent action planning are instrumental in fostering a robust governance culture, strategic alignment, and risk management apropos climate exigencies (TCFD, 2017).

Embracing the TCFD framework and melding it with validated scenario parameters, like those delineated by the IPCC or the NGFS, engenders a pragmatic guide for navigating the complex interplay of climate dynamics and financial performance. This amalgamation aids in examining various RCPs and discerning the multifaceted impacts across different temperature escalation trajectories. The nuanced differentiation between physical and transitional risks in diverse climate scenarios informs strategic adjustments requisite for aligning business models with regulatory expectations and sustainable practices.

Integral to this discourse is the comprehensive identification and assessment of climate risks and opportunities pertinent to the company. This exercise, ideally transcending departmental silos, cultivates a heightened awareness of both company-wide and specific climate risks. Subsequent assessment of these risks, vis-à-vis the company's strategy, processes, assets, and liabilities, lays the foundation for crafting cogent mitigation strategies. These strategies resonate with the overarching risk culture and policy directives, thereby enhancing the organisational readiness and response to climate adversities.

Albeit the challenges posed by the diversity in data maturity and the lack of established heuristics, the journey towards a quantitative assessment of climate risks, although nascent in certain aspects, has been gaining traction. Climate risks, predominantly long-term, necessitate a recalibration of risk analysis frameworks to aptly reflect the temporal disparities as compared

to operational risks. Databases like the EU Copernicus are already facilitating access to data on physical climate impacts under various RCPs, enriching the empirical basis for informed decision-making. Financial institutions are leveraging such data for nuanced risk assessments, particularly concerning real estate assets and lending portfolios. A granular understanding of economic transmission channels, as previously discussed, further augments the analytical rigour by elucidating the pathways through which climate risks transmute into financial risks, as reflected in various financial statements under the IFRS framework.

For instance, a company that proactively invests in CO2 reduction measures as part of its sustainability strategy may face negative short-term effects on profitability and liquidity. Simultaneously, such actions can mitigate longer-term cost risks. Conversely, a "late transition" - i.e., continuing production and business operations without making the strategically necessary adjustments to emissions - may have a positive impact on the financial situation in the short term. Still, in the long term, it may represent a significant increase in risk that could jeopardise the company. While the predictive range of scenario analyses can be extensive, the staked-out event space offers significant added value for orientation.

A scenario analysis conducted according to the TCFD recommendations includes eight steps (TCFD, 2021). It commences with the definition of objectives and scope, emphasising the importance of clear goals and objectives to ensure that identified scenarios genuinely impact the company's operations as anticipated. Subsequently, a multidisciplinary team comprising experts from various departments is assembled to identify relevant scenarios in alignment with the specified objectives. This includes customising selected scenarios to the company's unique context and conducting a financial impact assessment for each scenario. The team also participates in interpreting the scenario analysis results, which are subsequently integrated into decision-making processes. The last step involves the disclosure of scenario analysis results in financial reports and sustainability disclosures, per TCFD guidelines.

To achieve coherent and relevant scenarios, companies can utilise integrated scenarios (UNEPFI, 2021). These involve combining publicly available scenarios from reputable sources with company-specific scenarios tailored to their characteristics, commitments, and business models. It is crucial to encompass both micro and macro risks and opportunities, considering their impacts on both levels. Neglecting either the micro or macro dimension significantly diminishes the scenario integrity and the depth and likelihood of potential outcomes. For instance, failing to recognise the macro-level impact of socioeconomic changes while considering micro-level shifts in consumer preferences would render the analysis incomplete and unreliable.

When carrying out the scenario analysis, it is essential however to also consider the varying expectations and disclosure requirements of different standard-setting entities. For example, while IFRS S2 specifically mandates the disclosure of industry-based metrics (IFRS S2.28b), the TCFD suggests that companies consider providing cross-industry forward-looking metrics (TCFD, 2017). Another example of a distinction lies in the requirement for companies to disclose their planned use of carbon credits in IFRS S2 (IFRS S2.36e), which is not mentioned in the TCFD recommendations.

As has been established, the assessment of economic transmission channels necessitates the use of scenario analysis, a crucial tool for understanding the potential impacts of climate risks and opportunities on financial systems. However, traditional climate scenario analysis often

lacks the granularity required for a thorough quantification and modelling of these impacts. To achieve a more robust and quantitative assessment of the financial implications, a method like the Monte Carlo simulation becomes essential. This technique allows for a more comprehensive exploration of various possible scenarios and their associated financial outcomes, providing a more accurate and nuanced understanding of the risks and opportunities posed by climate change.

7.7 Conclusion

Climate risk and opportunity simulations and stress tests are instrumental in assessing the resilience and adaptability of organisations in the context of environmental change. As suggested by the Task Force on Climate-related Financial Disclosures and taken up by the IFRS S2 and supported by science-based scenario data for example from the IPCC or NGFS, these analyses offer insight into how different climate-related parameters, both physical and transition risks (such as CO2 and energy prices), could impact asset and enterprise value. In this chapter, we show how climate-related risks may impact the IFRS financial figures and the factors in the DCF valuation method based on economic transmission channels. In addition, we propose a framework for integrating climate risk into financial forecasting and enterprise valuation

The contributions of this chapter revolve around the financial implications of climate as well as the economic transmission channel risks to non-financial companies, and laying the groundwork for the integrating of climate risks into financial forecasting and enterprise valuation. This foundation is usable for moving from climate scenario data via the economic transmission channels to actual impact on financial statements and enterprise value. This established a framework for further analysis tools.

A resulting Excel tool, which is currently under construction, based on the framework might have numerous application areas,

Some of the numerous application areas where the findings can prove themselves useful are listed in the following paragraphs. The list is certainly not exhaustive but gives a good starting point.

1. Banks: Stress tests can identify asset-class vulnerabilities tied to climate-related events, enabling prudent capital allocation and risk mitigation strategies. Regulatory bodies are increasingly incorporating climate stress tests in the financial sector's prudential oversight and disclosure requirements.
2. Assets: For asset managers and institutional investors, these simulations can inform strategic allocation by pinpointing assets that are particularly sensitive to climate-related risks (for example, real estate) or conversely, ones that could benefit from a transition to a lower-carbon economy.
3. Cash-Generating Units (CGUs): For businesses, evaluating CGUs under various climate scenarios aids in more accurate impairment testing. This is particularly critical for industries such as energy, agriculture, and real estate where asset utility along the value chains may be substantially impacted by environmental conditions.
4. Enterprise Valuations: Climate variables need to be integrated into cash flow projections and discount rates as well as terminal (de)growth rates. By doing so, investors can better estimate the future value of their investments.

5. Going Concern Judgements: The viability of a business as a going concern can be more precisely evaluated by considering its ability to withstand both physical and transitory climate risks. This impacts not only management's internal assessment but also audit opinions and investor perception, also during restructuring and M&A activities.

These simulations and stress tests can thereby serve multiple stakeholders: they guide internal management decisions, inform investors, and facilitate regulatory oversight. The complexity and interdependencies of climate risks make these tools not only advisable but increasingly essential for robust financial reporting and strategic planning.

As we delve into the intricacies of assessing climate-related risks and their impacts on enterprise valuation, it becomes evident that the intersection of climate change and financial performance is a complex and dynamic landscape. The illustrative case study presented in Chapter 8 offers a glimpse into the process of evaluating the effects of climate risks, particularly focusing on the real estate sector. Real estate assets, integral to urban infrastructure and economic activities, are not only vulnerable to climate change but also contribute to environmental impacts. Through this lens, we begin to unravel the multifaceted nature of both physical and transitional climate risks and their implications for corporate value. In the subsequent chapters, we will further explore the methodologies for quantifying these risks, including probabilistic elements and simulation techniques, to provide a comprehensive understanding of the financial implications of climate change for businesses.

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7.9 Appendix: Economic Transmission Channels

Financial risks and opportunities	Physical Climate Risks	Transition Climate Risks
	- Extreme weather events, such as flooding, cyclones, and wildfires. - Chronic changes in weather patterns, including increasing temperatures and sea levels.	- Policy and regulation - Technology - Market - Reputation
Credit risk	*Micro-level economic transmission channel examples:* - Severe weather events, like hurricanes or floods, can in the short-term damage a company's infrastructure and disrupt its operations, leading to short-term financial losses that may affect its ability to service its debts. - Physical risks can cause some physical damage to assets or even make some areas inoperable resulting in increased impairment costs and early retirement of some assets. Similarly, having to cover the costs for the financing of damage repairs can result in liquidity risk. - Over time, physical sustainability risks like sea-level rise can cause properties or assets to depreciate, reducing the collateral value for loans secured against them, and leading to increased default risk. *Macro-level economic transmission channel examples:* - The probabilities of financial default of a company due to exposure within sectors or geographies vulnerable to physical risk may be impacted, e.g., through lower collateral valuations in physical assets as a result of increased flood risk or rising sea levels. This can lead to widespread defaults in that industry, impacting the financial stability of lenders with significant exposure. - Over time, an increase in the frequency and severity of physical sustainability events can lead to credit rating downgrades for countries or regions, affecting the credit risk and the creditworthiness of companies operating within those areas.	*Micro-level economic transmission channel examples:* - Rapid changes in local environmental regulations can in the short-term lead to increased compliance and operating costs for companies, reducing their cash flows and making it harder to meet their debt obligations. - Regulatory changes may affect the cost of capital, influencing a company's liquidity and credit risk. Regulatory changes might also result in stranded assets. This can lead to the devaluation of inoperable assets that have previously been highly valuated, such as oil fields or coal mines. - As insurance premiums rise due to increased climate-related risks, companies might face higher overhead costs, reducing profitability and their capacity to service debt. - Both in the short and long term, regulatory and market changes affect customers, suppliers, and business partners, possibly leading them to default on payments, which leads to decreased revenue and overall cashflow issues. - Energy efficiency standards due to higher technological expectations and possibilities may trigger substantial adaptation costs and lower corporate profitability, which may lead to a higher probability of default as well as lower collateral values. *Macro-level economic transmission channel examples:* - In the long term, a large-scale and abrupt shift towards sustainability may trigger systemic financial risks, leading to a cascading effect on the creditworthiness of financial institutions and businesses, especially if they are exposed to carbon-intensive industries. - Changes in income and employment levels in an economy can influence consumer behavior. Losses in available income reduce purchase

Financial risks and opportunities	Physical Climate Risks	Transition Climate Risks
		power in general, while behavioral changes may adapt the marginal propensity to consume. Both affect a company's revenue and credit risk. - Regulatory changes can affect the cost of capital, as well as the dynamics of markets for funding sources in general. This changing environment influences a company's liquidity and credit risk, which is especially relevant for financial institutions.
Liquidity risk	*Micro-level economic transmission channel examples:* - Sudden and severe climate-related events, such as wildfires or hurricanes, can damage a company's physical assets. This can lead to immediate cash outflows to repair or replace these assets, putting pressure on liquidity. - Over the long term, climate change and physical sustainability risks can lead to the depreciation of assets. This reduction in asset value can limit a company's ability to use these assets as collateral for loans, affecting their access to liquidity. *Macro-level economic transmission channel examples:* - As lenders become more concerned about physical sustainability risks, they may charge higher interest rates for loans to compensate for the heightened risk affecting short-term borrowing costs. - Persistent physical sustainability risks can contribute to long-term economic slowdowns, reducing the overall availability of credit in the economy and affecting liquidity.	*Micro-level economic transmission channel examples:* - Sudden changes in government policies, such as the imposition of carbon taxes or stricter emissions standards, can lead to immediate compliance costs for companies, affecting their liquidity as they need to allocate resources to meet new regulations. - Over time, businesses operating in carbon-intensive industries may experience long-term liquidity risks as the value of their stranded assets, such as coal mines or fossil fuel reserves, diminishes, potentially leading to liquidity constraints and financial difficulties. *Macro-level economic transmission channel examples:* - The sudden introduction of carbon pricing mechanisms or carbon taxes can result in short-term shocks to the cost structures of entire industries, impacting their liquidity and profitability. - Over the long term, transition sustainability risks can lead to structural changes in markets as sustainable investments become more popular, while high-carbon industries face difficulties accessing liquidity, potentially leading to market imbalances.
Market risk	Interest rate risk *Micro-level economic transmission channel examples:* - As physical sustainability risks become more apparent, investors may demand a premium to compensate for the higher default risk associated with companies operating in sectors vulnerable to these risks. This premium can	Interest rate risk *Micro-level economic transmission channel examples:* - Companies may experience increased short-term borrowing costs if investors demand higher yields for bonds or loans issued by firms with perceived sustainability risks. - Over the long term, companies that fail to adapt to sustainability trends may find themselves at a competitive

Financial risks and opportunities	Physical Climate Risks	Transition Climate Risks
	impact short-term borrowing costs. - The long-term effects of physical sustainability risks, such as sea-level rise, can lead to property devaluation, reducing the collateral value of assets. This reduction may result in higher long-term borrowing costs due to reduced asset quality. *Macro-level economic transmission channel examples:* - Central banks may respond to physical sustainability risks with short-term adjustments in monetary policy. For example, they may lower interest rates to stimulate economic recovery after a natural disaster, potentially affecting short-term market interest rates. - As investors become more risk-averse due to growing awareness of physical sustainability risks, they may seek safer investments, leading to lower demand for riskier assets and potentially higher long-term interest rates for such assets. Currency risk *Micro-level economic transmission channel examples:* - In the short term, extreme weather events and supply chain disruptions caused by physical sustainability risks in foreign countries can lead to fluctuations in import costs for companies. This can affect the profitability and competitiveness of businesses relying on imported goods or raw materials. - Sudden physical sustainability events, such as natural disasters, can lead to increased foreign exchange rate volatility, impacting the short-term profitability of companies engaged in international trade. *Macro-level economic transmission channel examples:* - Short-term physical sustainability risks, such as natural disasters, can disrupt supply chains and lead to reduced exports or imports,	disadvantage, affecting their long-term revenue and cash flow potential. *Macro-level economic transmission channel examples:* - Short-term fluctuations in the green bond market, which is often tied to sustainability performance, can affect the cost of financing for companies engaged in sustainable initiatives. - Transition sustainability risks can contribute to long-term economic shifts, which may affect the overall level of interest rates and monetary policy. These changes can have long-term implications for borrowing costs and access to credit. Currency risk *Micro-level economic transmission channel examples:* - Short-term currency risk can arise from trade tariffs or restrictions imposed due to differences in environmental and sustainability standards. These measures can affect the cost of imports and exports and have immediate financial implications for companies engaged in international trade. - Over the long term, the implementation of carbon pricing mechanisms can affect the competitiveness of companies and industries. Companies facing higher carbon-related costs may struggle to maintain profitability, leading to a potential decline in the value of the local currency. - Companies that invest in long-term green technologies and sustainable practices may benefit from reduced operating costs and increased competitiveness. This can positively

Financial risks and opportunities	Physical Climate Risks	Transition Climate Risks
	affecting currency demand and exchange rates. - Persistent physical sustainability risks can lead to long-term changes in the economic stability of countries, affecting their currency values and trade balances over time.	impact the local currency over the long term. *Macro-level economic transmission channel examples:* - In the short term, shifts in government policies and international agreements related to sustainability can lead to currency fluctuations, impacting exchange rates and the cost of imports and exports - Over the long term, countries that successfully transition their economies to be more sustainable may experience economic growth and increased foreign direct investment, leading to a strengthening of the local currency.
	Commodity risk *Micro-level economic transmission channel examples:* - Short-term physical sustainability risks, like sudden weather fluctuations or natural disasters, can lead to increased price volatility in commodity markets, affecting the profitability of businesses that use these commodities as inputs. - The long-term impact of physical sustainability risks, such as water scarcity or land degradation, can lead to reduced availability of key resources, driving up commodity prices and affecting the long-term cost structures of businesses. - Companies in industries with high exposure to physical sustainability risks, such as fossil fuels, may face long-term risks related to the transition to a low-carbon economy, which can impact the demand and value of certain commodities. *Macro-level economic transmission channel examples:* - Sudden and severe physical sustainability risks, like natural disasters or geopolitical events, can lead to short-term global supply disruptions, affecting commodity prices and availability on a macroeconomic scale. - Persistent physical sustainability risks can lead to long-term resource constraints and declining	Commodity risk *Micro-level economic transmission channel examples:* - As consumers and investors increasingly favor sustainable and eco-friendly products, companies producing commodities that do not meet these criteria may experience immediate shifts in demand, affecting their sales and profitability. - As sustainability-conscious companies invest in greener technologies and processes, those in traditional industries may face medium-term challenges as they adapt or face obsolescence, affecting their commodity production and pricing. *Macro-level economic transmission channel examples:* - In the short term, changes in consumer preferences and behavior driven by sustainability concerns can impact demand for various commodities, affecting prices and market dynamics. - Over the medium term, companies and countries may reconfigure their supply chains to source commodities sustainably, which can affect the medium-term pricing and availability of certain commodities. - Long-term energy transition plans, such as a shift from fossil fuels to renewable energy sources, can significantly impact the prices and demand for commodities like oil and coal.

Financial risks and opportunities	Physical Climate Risks	Transition Climate Risks
	commodity reserves, which can impact the overall availability of key resources. - In the long term, businesses may shift toward sustainable and green supply chains, reducing their reliance on commodities with high sustainability risks and affecting global commodity demand.	
Operational risk	*Micro-level economic transmission channel examples:* - Extreme weather events, such as hurricanes, floods, or wildfires, can cause immediate short-term disruptions to a company's operations, leading to production halts, supply chain interruptions, and potential damage to infrastructure. - Companies may face medium-term challenges in their supply chains due to chronic changes in weather patterns. This can result in delays in sourcing raw materials, increased transportation costs, and the need for adjustments to supply chain strategies. - Over the long term, chronic changes in weather patterns can contribute to the depreciation of assets, such as real estate or infrastructure, affecting their overall value and necessitating strategic decisions regarding asset management. *Macro-level economic transmission channel examples:* - Short-term physical sustainability events, such as natural disasters, can disrupt markets and industries, leading to operational disruptions and financial instability at a macroeconomic level. - Medium-term impacts may include challenges for the insurance industry as increased frequency and severity of extreme weather events lead to higher claims and adjustments in insurance pricing, affecting businesses across sectors. - Persistent physical sustainability risks can drive long-term economic transformation, with macroeconomic impacts on industries, jobs, and government policy objectives as regions adapt	*Micro-level economic transmission channel examples:* - In the short term, new sustainability regulations or policy changes may require companies to invest in compliance efforts, which can increase operating costs and reduce short-term profitability. - Companies relying on suppliers or partners that do not comply with sustainability standards may face short-term supply chain disruptions, affecting their ability to meet customer demand. - Over the medium term, companies may need to invest in new technologies and processes to meet sustainability targets, which can lead to increased operational expenses. - The long-term impact of transition sustainability risks, such as the shift away from fossil fuels, can lead to asset stranding, where certain assets, like coal mines or oil reserves, lose their value and become obsolete. - Over the long term, companies may face challenges in attracting and retaining talent if they are not seen as environmentally or socially responsible, affecting long-term operational capabilities. *Macro-level economic transmission channel examples:* - Short-term transition sustainability risks, such as abrupt policy changes or market fluctuations related to the transition to a low-carbon economy, can lead to market disruptions and increased volatility. - Over the medium term, governments and regulatory bodies may implement new policies and incentives to drive sustainability, which can lead to industry-wide operational changes and challenges. - Persistent transition sustainability risks can drive long-term economic transformation, leading to shifts in the

Financial risks and opportunities	Physical Climate Risks	Transition Climate Risks
	to changing weather patterns and environmental conditions. - Over the long term, chronic changes in weather patterns may contribute to resource scarcity, affecting industries dependent on specific resources and leading to macroeconomic shifts in supply and demand dynamics.	structure of economies and the industries that thrive or decline.
Strategic risk	*Micro-level economic transmission channel examples:* - Short-term physical sustainability risks, such as extreme weather events, can disrupt operations, causing immediate supply chain interruptions, production delays, increased costs for repairs, and revenue losses for individual companies. - Businesses may need to make medium-term strategic decisions about diversifying supply chains, adopting new technologies, or relocating operations to mitigate sustainability risks, impacting their long-term business models. - The long-term impact of physical sustainability risks, such as rising sea levels, can lead to asset stranding, where infrastructure or real estate becomes unusable, requiring companies to make substantial write-downs and strategic adjustments. *Macro-level economic transmission channel examples:* - Short-term economic disruptions may occur in regions affected by extreme weather events, leading to decreased productivity, increased unemployment, and potential strain on government resources to address immediate needs. - Over the medium term, there may be strategic shifts in economic sectors as certain industries become more or less viable due to chronic changes in weather patterns. This could impact employment, investment, and economic growth in affected regions. - As investors and markets incorporate long-term sustainability risks into their valuations, industries with high sustainability risks may	*Micro-level economic transmission channel examples:* - In the short term, companies may face immediate costs associated with complying with new environmental regulations and sustainability standards. This can impact their profitability and strategic planning. - Short-term shifts in consumer preferences and increased awareness of sustainability may lead companies to adapt their product and service offerings to meet these changing demands or risk losing market share. - Companies may need to differentiate themselves through sustainable practices to maintain a competitive edge, making medium-term strategic changes in areas like branding and product development. - Long-term strategic impacts can include the need to invest in research and development for sustainable technologies, such as renewable energy or carbon capture, as the global economy transitions toward cleaner alternatives. *Macro-level economic transmission channel examples:* - Changes in environmental and sustainability policies can create short-term uncertainty for businesses, affecting strategic planning and investment decisions. - Over the medium term, companies may have access to green financing and investments, presenting opportunities for strategic shifts toward sustainable business models. - A long-term strategic impact may involve the complete transformation of certain industries, such as fossil fuels, into sustainable alternatives, requiring long-term planning and adaptation. - The transition to sustainability can lead to long-term shifts in global trade patterns, affecting strategic

Financial risks and opportunities	Physical Climate Risks	Transition Climate Risks
	experience a reduction in market capitalisation and investor interest. - Long-term shifts in global economic interdependence may occur as countries strategically respond to physical sustainability risks. New alliances and collaborations could emerge, impacting international trade and geopolitical relationships.	considerations related to supply chains and market access.
Reputation risk	<u>*Micro-level economic transmission channel examples:*</u> - Short-term physical sustainability risks, such as extreme weather events, can lead to operational failures or incidents that are highly visible to the public, resulting in immediate reputational damage. - Companies facing difficulties in adapting to changing weather patterns may struggle to maintain consistent product quality or availability. This can lead to medium-term reputation damage as customers may perceive the company as unprepared or insensitive to environmental challenges. - The long-term impacts of repeated extreme weather events can shape the overall perception of a company's commitment to sustainability and resilience. If a company is perceived as not taking sufficient action to address climate-related risks, its long-term brand image and reputation may suffer. <u>*Macro-level economic transmission channel examples:*</u> - Short-term physical sustainability events, like natural disasters, can disrupt markets, affecting multiple companies and industries, which can lead to potential reputational damage on a macroeconomic scale. - Over the medium term, persistent sustainability risks within an industry can harm the collective reputation of all companies within that sector, making it more challenging for them to attract customers and investors. - Industries and regions experiencing a negative impact	<u>*Micro-level economic transmission channel examples:*</u> - In the short term, if a company is seen as engaging in greenwashing (i.e., misleadingly presenting an environmentally friendly image), its reputation can be quickly tarnished. Customers, investors, and stakeholders may become distrustful if they believe a company's sustainability efforts are insincere. - Over the medium term, companies that fail to make genuine progress in sustainability may face consumer boycotts or activism from environmentally conscious customers, which can harm their reputation and market share. - Persistent reputational damage due to sustainability concerns can lead to long-term legal and litigation risks, including lawsuits related to environmental issues. - In the long term, companies with poor sustainability records may struggle to attract and retain top talent, particularly among younger generations who prioritise working for socially responsible organisations. <u>*Macro-level economic transmission channel examples:*</u> - Companies facing scrutiny from regulators over their sustainability practices or claims may experience short-term reputational damage and increased regulatory risks. - Over the medium term, sustainability-conscious consumers may shift their preferences toward companies with strong sustainability records, leading to market segmentation and impacting the competitive landscape. - Over the long term, industries with high sustainability risks, such as those engaging in the use of fossil fuels, may face increasing market exclusion

Financial risks and opportunities	Physical Climate Risks	Transition Climate Risks
	from chronic changes in weather patterns may face long-term reputation challenges on the global stage. Their ability to address climate-related physical risks can influence how they are perceived in international forums and impact operational as well as investment relationships.	and a lack of access to capital, affecting the long-term viability of those sectors.
Legal / Regulatory risk	*Micro-level economic transmission channel examples:* - Higher risk premium for insurance, as a response to higher susceptibility to physical risks, e.g., flooding. - Short-term legal risks may include fines or penalties for companies that fail to comply with emergency regulations related to extreme weather events, leading to operational disruptions and financial losses. - Over the medium term, regulatory bodies may introduce new or revised environmental standards in response to chronic changes in weather patterns. Companies may need to adapt their operations to meet these evolving standards, incurring costs for equipment upgrades or process modifications. - Over the long term, there may be an increase in climate-related litigation. Companies may face legal challenges from stakeholders, communities, or governments seeking compensation for damages related to physical climate risks. *Macro-level economic transmission channel examples:* - Insurance companies will not underwrite risks in certain affected regions. - In the short term, governments may provide economic stimulus or relief measures to address the aftermath of physical sustainability risks, which can have regulatory implications for businesses and industries. - Changes in regulations and policies related to sustainability risks can disrupt markets, leading to medium-term economic	*Micro-level economic transmission channel examples:* - Higher risk premium for insurance, because of flooding risk. - Short-term regulatory changes aimed at addressing transition sustainability risks, such as emissions reduction mandates, can lead to immediate compliance costs for companies, affecting profitability. - Companies may need to reallocate capital and investments to meet new sustainability regulations, which can have medium-term impacts on their financial performance and strategic planning. - Transition risk drivers may affect the viability of some business lines and lead to strategic risk for specific business models if the necessary adaptation is not implemented. An abrupt revaluation of the business model, e.g., due to asset stranding, may reduce the value of companies' assets and properties, thereby affecting company value. - Over the medium term, evolving regulations can restrict or ban certain products or services linked to sustainability risks, potentially leading to revenue losses for affected companies. - The long-term impact of regulatory changes can drive technological transformation in industries, requiring companies to invest in new processes and equipment to meet sustainability standards. - In the long term, industries with high sustainability risks, like fossil fuels, may face transition risks as governments implement long-term regulations aimed at reducing carbon emissions, leading to a shift in business models and profitability. *Macro-level economic transmission channel examples:*

Financial risks and opportunities	Physical Climate Risks	Transition Climate Risks
	instability and affecting companies in various industries. - In the long term, governments may participate in global agreements and initiatives to address sustainability risks, resulting in long-term regulatory changes that affect international trade, supply chains, and industries.	- Short-term regulatory changes related to transition sustainability risks can lead to market volatility, affecting investor sentiment and capital flows at a macroeconomic level. - Sudden regulatory changes can impose short-term compliance costs on entire industries, impacting their profitability and financial stability. - Medium-term regulatory changes can have economic impacts, such as shifts in industry competitiveness or employment levels, affecting the overall economic landscape. - In the long term, evolving global sustainability regulations can impact supply chains, affecting the macroeconomic balance of trade and economic relationships between countries.
Country risk	*Micro-level economic transmission channel examples:* - Companies in vulnerable regions may experience short-term operational failures, supply chain interruptions, and property damage, resulting in repair and reconstruction costs due to physical sustainability risks, impacting their ability to meet customer demand and fulfill orders. - Over the medium term, resource scarcity due to physical risks can lead to increased operational costs for companies in affected regions, affecting profitability and competitiveness. - The long-term impact of chronic changes in weather patterns, such as rising sea levels, can lead to the depreciation of coastal properties and infrastructure, affecting property values and collateral quality. *Macro-level economic transmission channel examples:* - Regions experiencing extreme weather events, such as hurricanes or floods, may face short-term economic shocks, with declines in local economic activity, employment, and potential government intervention for recovery. - Over the medium term, industries reliant on local ecosystems, such	*Micro-level economic transmission channel examples:* - Over the medium term, changing consumer preferences and national regulatory pressures can lead to shifts in local market demand, impacting companies' product portfolios and profitability. - Businesses may need to make medium-term investments in new technologies and processes to comply with evolving national sustainability regulations, affecting their cost structures and competitive positions. - Over the long term, geographical shifts in labor markets may occur as industries adapt to sustainability transitions. This can lead to workforce challenges and the need for retraining employees. *Macro-level economic transmission channel examples:* - In the short term, abrupt sustainability transitions can lead to market volatility, impacting industries and businesses across geographical regions, and potentially causing economic instability. - Over the medium term, sustainability transitions can result in the transformation of entire sectors, with geographical regions specialising in specific industries or technologies, affecting regional economies. - In the long term, international trade patterns may shift as countries and regions adapt to sustainability

Financial risks and opportunities	Physical Climate Risks	Transition Climate Risks
	as agriculture or tourism, may face economic decline due to chronic changes in weather patterns, affecting the overall economic health of the region. - Changes in resource availability and increased costs related to physical risks can contribute to medium-term inflationary pressures, affecting the overall cost of living for residents. - Persistent physical sustainability risks can drive long-term economic transformation as governments implement comprehensive policies to address these risks. This transformation can affect industries, jobs, and the overall economic structure of a country. - The long-term impact of chronic weather changes can lead to shifts in the real estate market, with properties in less vulnerable areas gaining value, while those in high-risk zones experience reduced demand and value. - In the long term, countries that successfully manage sustainability risks and transition to more sustainable practices can gain global economic influence and maintain stronger international trade relationships.	transitions, impacting the geographical distribution of trade hubs and logistics networks.

Table 7.9.1 Economic transmission channels. Source: authors, based on their field experience and substantiated by the TCFD

8 Illustrative Case Study

8.1 Introduction

The illustrative and fictitious case presented provides a preliminary insight into the process of assessing the effects of climate-related risks and opportunities on enterprise valuation. In this illustrative case, we examine the impact of climate risks, in particular flooding, on the financial performance of a fictional listed Nordic real estate company. Utilising a five-year cash-flow projection based on IFRS cash-flow statements, coupled with a subsequent Discounted Cash Flow (DCF) evaluation, we illustrate an enterprise valuation for the company. Due to data availability, the starting point for the enterprise value calculations is the end of 2023, implying that 2024 figures are already forecasts in our model. In the following, we select two climate scenarios from the IPCC, (RCP 2.6 and RCP 8.5), encompassing both transitory and physical risks and demonstrate their impacts on IFRS items.

It is noteworthy that quantifying the impact of climate risks on corporate value involves two core probabilistic elements. The first stochastic component is the determination of the probability of a natural disaster, as well as its severity. Relevant data is available through scenario sources, such as the RCP scenarios, and is not endogenously modelled within our framework. The second probabilistic element and central modelling component is the estimated financial impact of natural disasters at a certain severity level. These will be modelled on a Monte Carlo basis, whereas the relevant distribution parameters have to be deducted from expert estimations.

This case study highlights how climate change materialises in different risks for a company which then translates to financial impacts. The assets of the real estate industry, comprising of commercial properties, are critical assets in several aspects. Real estate in general provides space to live for individuals and is part of infrastructure for businesses. Real estate has an impact on shaping cities, land use and on the general functionality and character of our built environment. Developing and owning infrastructure has economic implications as well, as real estate is part of many private and institutional investors' portfolio, and transactions related to it, such as building, buying, selling, and renting is a driver of economic activities. However, the real estate industry is vulnerable to climate change in many ways, while the industry itself also has a significant impact on nature and the environment, which makes it a potent example for illustration of the multitudes of both physical and transitional climate risks.

8.2 Case Study "EREL"

Example Real Estate Ltd. (EREL) is one of the largest real estate companies in the Nordic region. EREL owns, develops, manages, and rents out commercial real estate properties. For the sake of illustration, all financial figures are fictitious, and any resemblance to existing companies is coincidental. Similarly, the assumptions made in the creation of a DCF and valuation models for the company are largely based on general trends in the industry or broader macroeconomy. The company began operations in 1985 and has a long history of owning and developing properties in the southern of Sweden. To model the impact of flooding risk, attention is directed towards the presumed major holdings of the company and the city where they are located.

The case company EREL got listed on the NASDAQ Nordic stock exchange in 2006 and prepares its financial statements according to the International Financial Reporting Standards (IFRS).

EREL's most significant real estate assets are situated in the southern part of Sweden and the headquarters and thus the management functions are located in Stockholm. The company has significant real estate holdings in the quickly developing Stockholm region. Within the region, EREL has property both in domestic areas and close to the coastline of the Baltic Sea. While the sea-, river- or lakeside locations are considered as attractive location from the tenant's viewpoint, it makes the portfolio increasingly vulnerable to climate-related risks.

The following table provides a comprehensive overview of EREL's property portfolio.

Property ID	Location	Postal Code	Region	Environment	Acquisition Cost (in million EUR)	Acquisition Date	Fair Value at 31.12.2023 (in million EUR)
1	Malmö, Västra Hamnen	211 15	Southern Sweden	Coastal	15	15.04.1985	85
2	Lund, Central	222 23	Southern Sweden	Domestic	20	30.03.1987	108
3	Helsingborg, Ocean Boulevard	252 67	Southern Sweden	Coastal	30	25.08.1989	125
4	Trelleborg, Strandgatan	231 42	Southern Sweden	Coastal	40	18.05.1992	142
5	Ystad, Gamla Staden	271 50	Southern Sweden	Domestic	50	10.11.1994	160
6	Gothenburg, Älvsborg	414 70	Southern Sweden	River close	60	05.09.1996	182
7	Stockholm, Norrmalm	111 53	Stockholm	Domestic	75	15.12.1998	205
8	Karlskrona, Borgmästaregatan	371 34	Southern Sweden	Coastal	85	20.02.2001	228
9	Växjö, Storgatan	352 31	Southern Sweden	Lake close	100	28.07.2003	245
10	Kalmar, Larmtorget	392 32	Southern Sweden	Coastal	115	17.06.2005	262
11	Jönköping, Västra Storgatan	553 15	Southern Sweden	Lake close	130	30.04.2007	279
12	Norrköping, Drottninggatan	602 24	Southern Sweden	River close	140	15.03.2009	291

Property ID	Location	Postal Code	Region	Environment	Acquisition Cost (in million EUR)	Acquisition Date	Fair Value at 31.12.2023 (in million EUR)
13	Uppsala, Kungsgatan	753 21	Central Sweden	Domestic	150	10.05.2011	302
14	Örebro, Köpmangatan	702 10	Central Sweden	River close	160	25.08.2012	313
15	Eskilstuna, Fristadstorget	632 20	Central Sweden	Lake close	170	20.11.2014	325
16	Södertälje, Storgatan	151 72	Stockholm	River close	180	29.02.2016	336
17	Stockholm, Södermalm	116 45	Stockholm	Domestic	190	18.09.2017	348
18	Stockholm, Östermalm	114 41	Stockholm	Domestic	195	22.05.2019	356
19	Oslo, Frogner	260	Norway	Lake close	200	03.10.2021	365
20	Helsinki, Kallio	530	Finland	Coastal	200	15.06.2022	370
Total					**2 305**		**5 028**

Table 8.2.1 EREL's property portfolio

Environment Category	Fair Value at 31.12.2023 (in million EUR)	Percentage of Total Fair Value
Coastal	2,080	41.40%
Domestic	1,760	35.00%
River Close	970	19.30%
Lake Close	218	4.30%
	5,028	**100 %**

Table 8.2.2 Summary of Fair Value Distribution of EREL's properties

The fair value in Stockholm and Surrounding Areas is 2,775 million EUR (55.2% of total fair value) and the fair value in Other Regions: 2,253 million EUR (44.8% of total fair value)

As a listed company, EREL uses the IFRS standards to prepare its annual financial reports. From 2024, EREL will also start applying the requirements of the IFRS Sustainability Disclosure Standards. The IFRS Sustainability Disclosure Standards require companies to disclose sustainability information in their annual reports. Thus, the report should provide information to the company's investors about climate-related risks and opportunities.

EREL's total revenue comes mostly from rental income, while a minor percentage originates from invoicing expenses, such as heating, electricity, water, and sewage to customers. The

revenue of the company was growing rapidly, thanks to the newly built or acquired premises. The growth is expected to continue, fuelled by both the increase of the m² of owned space and by the hikes in the price of rentals. EREL's main costs for the company property include costs related to the upkeep of the properties, such as repair and maintenance. The company operates with a 70-72% gross margin, and the maintenance costs of the company are kept at a relatively steady rate compared to the revenues. The maintenance costs include electricity and heating costs, which increased significantly in the last few years due to the price hikes and volatility caused by external geopolitical and market conditions. However, the price increases for maintenance costs could be passed on to customers, so there was no impact on EREL's gross profit.

EREL's most important asset in the balance sheet is "investment properties". According to the International Financial Reporting Standards (IFRS), the measurement of investment properties is governed by the International Accounting Standard (IAS) 40 "Investment Property". An Investment Property under IAS 40 is defined as property, including land or buildings, held for the purpose of earning rentals or for capital appreciation, rather than for use in the production or supply of goods and services, or for sale in the ordinary course of business.

IAS 40 provides an accounting option to choose between "at cost" and "fair value" methods for the subsequent measurement of investment properties. Measuring at cost means that the company determines the value of the investment property by considering depreciation for properties and possibly impairment for land and property according to IAS 36. The fair value method involves determining the fair value of the investment property at the end of each reporting period. Fair value gains and losses from fair value measurement are recognised in the profit and loss statement, in accordance with IFRS 18. Specifically, fair value gains and losses for subsequent measurement of investment properties should be presented in the profit before financing and tax. This "new" subtotal must be presented in the P&L statement from fiscal year 2027 onwards. Fair value measurement under IAS 40 is defined according to IFRS 13 as the price at which the asset could be sold in a fair transaction between knowledgeable and willing parties, reflecting current market conditions. The fair value method includes the market's assumptions about the specific investment property, considering associated risks and opportunities. To better reflect the current market conditions related to these properties, EREL uses the fair value method to account for its investment properties. The selected model must be applied consistently for all investment properties.

8.3 Case Study Tasks

At the last annual shareholder meeting the four members of the board faced many inquiries about sustainability and climate-related issues from investors, especially about compliance with the upcoming sustainability regulation, the IFRS Sustainability Standards. The investors are also worried about the risks that climate change may impose on EREL's operations, but the board could not provide sufficient answers about the extent of those risks and their effects on their company operations. Hence, due to this demand from investors, the board decided to delve into the topic to find out the extent of the risks and use the analysis as a foundation for a mitigation and adaptation strategy. You, as the new Chief Sustainability Officer (CSO) of EREL, are tasked with providing an in-depth analysis of the climate-related risks of the company exploring both the operational and the financial impacts. In your analysis, the board expects that you and your team handle the following tasks:

Task 1: What science-based sources can EREL use to identify potential scenarios for the impacts of climate change? Please select two contrasting climate-related scenarios for EREL. Based on these, identify the climate risk for the Stockholm region in which EREL operates. To identify the climate-related risk for the Stockholm region consider the information of the Swedish Meteorological and Hydrological Institute.

Note: Have a look at the previous chapter on IPCC climate scenarios. You can find the information of Swedish Meteorological and Hydrological Institute (SMHI) in the Appendix I. Prepare a management summary for the C-Level including the key results of analysis.

After the management summary was sent to C-level executives, a C-level management meeting was held to discuss any steps further. The CSO presented the climate risks that they identified with the sustainability team. The presentation turned out to be really insightful and made the other managers start thinking about its implications. The CFO grew particularly worried, as she realised that the impacts of climate change would indeed have multifaceted implications on the financial performance of EREL. Therefore, your team was asked to answer the following questions.

Task 2: Use the economic transmission channels to analyse the multifaced ways for each scenario, especially the identified climate risks. Going more into detail: How does the identified climate risk "flooding" impact the financial performance of EREL?

Note: Prepare a PowerPoint presentation and use the list of transmission channels presented in Chapter 7.9 Appendix.

Following the CSO's detailed presentation on climate risks, the C-level executives at EREL are now fully engaged with the pressing need to address the potential impacts of climate change on the company's financials. Recognising the urgency of these threats - which are neither abstract nor distant but immediate risks – the C-level team is poised to take strategic action.

To effectively address these challenges, the executives have decided to concentrate on the scenario RCP 8.5, which predicts significant environmental changes due to high emissions throughout the 21st century. This scenario is particularly relevant as it helps anticipate more extreme and frequent climate events that could impact business operations and financial stability.

A steering committee has been formed, bringing together leaders from finance, operations, sustainability, and other critical departments. Their primary task at this stage is to identify which financial statement line items are most vulnerable to climate-related risks under the RCP 8.5 scenario. The committee's responsibilities include:

Task 3: Which IFRS-line items are affected by the RCP 2.6 and RCP 8.5 scenarios and the identified transmission channels? Calculate the impact on Equity and Operating Profit as well as Profit before Tax for the years 2024-2028 using the following assumptions. Find reasons why each line item is affected this way.

Note: Use the assumptions below and Excel "Climate-related Risks on Income Statement and Balance Sheet" file.

The Excel file consists of several data sheets. For the purpose of this task, have a look at the data sheet "EREL Basis Scenario" and the "Data input" sheets. The results are displayed on the "Financial Data RCP 2.6 and 8.5" sheet as new financial statements for each Scenario.
To examine the impact of climate change, the figures of the estimated impacts (in %) need to be inserted into the "Data input" sheet in the excel model. It is important to note, that the impact of climate change needs to be combined with the preexisting forecast, so the expected impacts of climate change need to be added to the correct value linked from the correct year and line item from the "EREL Basis Scenario" sheet. This is particularly important, because the "Financial Data RCP 2.6 and 8.5" sheet overwrites the data from the "EREL Basis Scenario" sheet, if any figure is input to the same year and line item on the "Data Input" sheet. On the "Data Input" sheet the required inputs are the line items affected, the year those are affected and a percentage of change compared to the base scenario. The financial statement line items and the years can conveniently be chosen from drop-down lists.

Our assumptions for this case on the balance sheet and profit and loss line items in comparison to the baseline scenario are as follow:

Income Statement (%)					
Parameter	***2024***	***2025***	***2026***	***2027***	***2028***
Rental income	*+7.70*	*+7.91*	*+8.12*	*+8.34*	*+8.55*
Property costs	*+28.00*	*+28.00*	*+28.00*	*+28.00*	*+28.00*
Other income	*+1.00*	*+1.00*	*+1.00*	*+1.00*	*+1.00*
Central administration and marketing	*+2.50*	*+2.50*	*+2.50*	*+2.50*	*+2.50*
Depreciation and impairment	*+5.00*	*+5.00*	*+5.00*	*+5.00*	*+5.00*
Interest income	*+4.00*	*+3.50*	*+3.00*	*+2.50*	*+2.00*
Share in results of joint ventures	*+10.00*	*+10.00*	*+10.00*	*+10.00*	*+10.00*
Interest expense	*+3.48*	*+2.98*	*+2.48*	*+1.98*	*+1.48*
Interest expense leasing	*+3.80*	*+3.80*	*+3.80*	*+3.80*	*+3.80*
Dividends	*+30.00*	*+30.00*	*+30.00*	*+30.00*	*+30.00*

Table 8.3.1 Assumptions on income statement changes without climate impact

Balance Sheet (%)					
Parameter	***2024***	***2025***	***2026***	***2027***	***2028***
Intangible assets	*+2.00*	*+1.80*	*+1.60*	*+1.40*	*+1.20*
Investment properties	*+2.00*	*+2.00*	*+2.50*	*+2.50*	*+2.50*
Property, plant and equipment	*+2.50*	*+2.50*	*+2.50*	*+2.50*	*+2.50*
Non-current receivables	*+3.00*	*+3.00*	*+3.00*	*+3.00*	*+3.00*
Trade and other receivables	*+3.35*	*+3.35*	*+3.35*	*+3.35*	*+3.35*
Changes in prepaid expenses and accrued income	*+6.8.*	*+6.80*	*+6.80*	*+6.80*	*+6.80*
Non-current interest bearing liabilities	*+1.00*	*+0.50*	*+0.50*	*-0.50*	*-1.00*
Provisions	*+1.00*	*+1.00*	*+1.00*	*+1.00*	*+1.00*
Other non-current liabilities	*+1.00*	*+1.00*	*+1.00*	*+1.00*	*+1.00*
Current tax liabilities	*+1.00*	*+1.00*	*+1.00*	*+1.00*	*+1.00*

Trade and other payables	*+6.91*	*+6.91*	*+6.91*	*+6.91*	*+6.91*
Other current liabilities	*+1.00*	*+1.00*	*+1.00*	*+1.00*	*+1.00*

Table 8.3.2 Assumptions on balance sheet changes without climate impact

Changes in the RCP 2.6 scenario (%)					
Parameter	***2024***	***2025***	***2026***	***2027***	***2028***
Property costs (as % of Rental income)	*+6.00*	*+5.5.*	*+5.00*	*+1.50*	*+1.50*
Depreciation and impairment	*+0.50*	*+0.50*	*+0.50*	*+0.50*	*+0.50*
Investment properties due to fair value measurement	*+2.00*	*+3.00*	*+3.00*	*+4.00*	*+4.00*
Intangible assets	*+0.08*	*+0.08*	*+0.08*	*0.00*	*0.00*
Property, plant, and equipment	*+20*	*+20*	*0.00*	*0.00*	*0.00*
Non-current interest-bearing liabilities	*+12*	*0.00*	*0.00*	*0.00*	*0.00*
Interest expense	*+0.33*	*+0.34*	*+0.42*	*+0.69*	*+0.7*

Table 8.3.3 Assumptions on financial statement changes under the RCP 2.6 scenario

Changes in the RCP 8.5 scenario (%)					
Parameter	***2024***	***2025***	***2026***	***2027***	***2028***
Rental income	*-3.00*	*-3.00*	*-3.00*	*-3.00*	*-3.00*
Property costs	*+0.80*	*+0.90*	*+0.10*	*+1.10*	*+1.20*
Investment properties	*-0.10*	*-0.10*	*-0.10*	*-0.20*	*-0.20*
Other non-current liabilities	*+0.10*	*+0.10*	*+0.10*	*+0.10*	*+0.10*
Other current liabilities	*+0.10*	*+0.10*	*+0.10*	*+0.10*	*+0.10*

Table 8.3.4 Assumptions on financial statement changes under the RCP 8.5 scenario

Regarding its investment properties, EREL is expected to continue acquiring new properties and investing in its buildings by upgrading windows and different fixtures in its buildings in the base scenario. The assumptions of the RCP 2.6 scenario are based on the expectations that EREL will start investing heavily in upgrades to make its properties compliant with updated building codes and make them more energy efficient, for example by installing additional solar panels on roofs, where possible. In the RCP 2.6 scenario EREL is planning to invest an additional 300 million EUR in its investment properties during the years 2024-2027, so 75 million EUR more in each year compared to the base scenario.

The additional investment of the RCP 2.6 scenario will be financed by an external loan, raising the value of non-current interest-bearing liabilities. Furthermore, EREL also plans on upgrading its headquarters to be more energy efficient and switching to renewable energy. The energy-efficiency measures, such as insulating the walls and the roof of the building will require a significant upfront investment compared to the current value of the Property, Plant, and Equipment line item. The company is also committed to investing in software to monitor climate risks affecting each of its properties. These software investments are planned for the next two years, worth 100,000 EUR/ year.

In the RCP 8.5 scenario, the most destructive effects of climate change do not materialise in the short-term forecast, so EREL estimated only a very slight change in the items of the financial statements until 2028.

The steering committee convened multiple times, pouring over detailed financial statements, environmental reports, and scenario projections. Their discussions were intense, as they debated the potential impacts of rising sea levels, increased frequency of extreme weather events, and regulatory changes aimed at curbing emissions. Every department head brought insights to the table, painting a comprehensive picture of how these factors could affect the company's operations, costs, and revenues.

The findings were sobering. The committee identified several key IFRS line items that would be significantly impacted by climate risks. This raised further alarm among the C-level executives as well as the board members when the findings were presented to them. What are the implications of climate-related risks on entity value? The CSO together with the CFO were asked to evaluate and integrate these insights into the financial forecasting and valuation process. The task at hand is to:

Task 4: Illustrate the differences in enterprise valuation for the company EREL using a five-year cash-flow projection based on IFRS line items and DCF calculations that include climate-related risk impacts. Please compute the WACC and select the Beta using the respective sheets. Complete the DCF models for each of the three scenarios: without climate impact, RCP 2.6 and RCP 8.5. Determine the different growth rates for each scenario required for the multi-stage DCF calculation.

Note: Please use the provided Excel file "DCF Model incl. multistage"

Focus on integrating your assumptions and completing your calculations on "WACC EREL" for the WACC calculation, "SHV EREL" and "SHV-impact" for the DCF calculations, and "Multistage DCF model" for the changing growth rates.

The "WACC EREL" sheet contains the logic behind computing the WACC. Fill in the missing figures and calculate the WACC.

The "Beta calculation for EREL" sheet contains different calculations for the Beta factor. Please choose the one you find most suitable.

Fill in the DCF calculation on the sheet "SHV EREL" by linking to the "EREL Basis Scenario" sheet. Fill the DCF calculation on "SHV-impact" sheet similarly, by linking to the "Financial Data RCP 2.6 and 8.5" sheet.

Input the growth rates you determined per each scenario on the "Multistage DCF model" sheet. Keep in mind the difference in how the RCP 2.6 and RCP 8.5 scenarios are assumed to evolve, and how they relate to the base scenario. There should be some variation in the growth rates between the scenarios.

Recognising the complexities and uncertainties inherent in predicting climate-related risks, the steering committee emphasised the importance of implementing a Monte Carlo simulation. This statistical technique allows for the modelling of various scenarios and the assessment of their potential impacts on EREL's financial performance. By simulating thousands of possible

outcomes, the Monte Carlo simulation provides a robust framework to quantify the probabilistic nature of climate risks.

Task 5: Implement a Monte Carlo Simulation on the annuity growth rates in Stage 1 and the Terminal Value process for each of the three scenarios: without climate impact, RCP 2.6 and RCP 8.5. Use the different growth rates from Task 4 for the multistage DCF calculation as the basis. Elaborate proposals for distribution assumptions for the growth rate variables and outline how you can determine distribution parameters. Apply Lumivero @Risk functionalities in Microsoft Excel to set up the simulation. Compute statistics and create charts of the resulting distributions for the enterprise values, as well as the distribution parameters of the growth rate. How can this information contribute to an advanced decision-making process?

Note: Please use the provided Excel file "DCF Model incl. multistage – MC Simulation"

Turn to the worksheet "Multistage DCF model", where you find annuity growth rate values for both stages for all three scenarios, as well as the resulting enterprise values.

Before specifying distribution and distribution parameters for the growth rates, discuss why a three-point distribution might be suitable for tasks where information is most of the time limited to expert estimates.

Try to find expert interview partners, and find out what the expert's proposal would be for deviations of the growth rates from the baseline scenario in most optimistic / pessimistic business and economic environments. Note these values as MIN/MAX parameters for the @Risk simulation (if no expert information is accessible, you might use the factors 0.7 (MIN) and 1.3 (MAX) for the baseline growth rates for each scenario).

For all 6 growth rates in the worksheet "Multistage DCF model", specify a triangular distribution with the parameters deducted from the expert interviews.

As a next step, define enterprise values in each scenario as simulation output parameters.

Perform a Monte Carlo simulation with 10.000 runs and analyse the simulation outputs. Create statistics as well as distribution charts for each of the scenarios and compare results with respect to risks and opportunities of the respective scenarios.

Compare the simulation results of the two climate scenarios and comment on what can be learned from the statistics in order to support management decisions on adaption and mitigation strategies.

8.4 Case Study Solutions

8.4.1 Solution Task 1

What science-based sources can EREL use to identify potential scenarios for the impacts of climate change? Please select two contrasting climate-related scenarios for EREL. Based on these identify the climate risk for the Stockholm region in which EREL operates. To identify the climate-related risk for the Stockholm region consider the information of the Swedish Meteorological and Hydrological Institute.

Climate Scenarios are analytical tools that model potential future outcomes based on various assumptions, for example on greenhouse gas emissions, population growth, development in GDP or upcoming regulations. Companies can use climate scenarios to assess the impact of climate change on their activities including potential damage to their infrastructure, disruption of production or supply chains, and the impact of new regulations on their operations and their products. There are various providers of climate scenarios, such as the IPCC, which supports two sets of scenarios, the Shared Socioeconomic Pathway (SSP) scenarios, and the Representative Concentration Pathways (RCP). While the SSPs provide a comprehensive narrative on socioeconomic changes, the RCPs describe physical changes in the Earth's atmosphere, namely the concentration of greenhouse gases.

In exploring the potential impacts of climate change and the effectiveness of mitigation strategies for EREL, we utilised various IPCC RCP scenarios. Each RCP scenario is based on unique assumptions related to population growth, economic development, energy use, land use, and technological change. Therefore, it's necessary to select IPCC RCP scenarios, serving as a framework to adjust impact parameters for subsequent calculations.

The Representative Concentration Pathways (RCPs) are climate scenarios used in the Intergovernmental Panel on Climate Change (IPCC) reports. The RCPs describe different climate futures, all of which are considered possible depending on the volume of greenhouse gases (GHGs) emitted in the years to come.

The four RCPs, named after their possible radiative forcing values by the year 2100, are:

- RCP2.6: Assumes that global annual GHG emissions (measured in CO2-equivalents) peak between 2010-2020, with emissions declining substantially thereafter. This scenario aims to keep global warming likely below 2 Celsius above pre-industrial temperatures. As a comparison, global warming reached an estimated 1.27 °C in March 2024 (Copernicus Data Store, 2024).
- RCP4.5: A stabilisation scenario where policies are implemented to stabilise radiative forcing at 4.5 Watt per square meter in the year 2100 without ever exceeding that value. It represents a moderate level of mitigation efforts to reduce GHG emissions.
- RCP6.0: A scenario where emissions peak around 2080, then decline. In this scenario, radiative forcing stabilises at 6.0 Watt per square meter shortly after 2100 without additional climate policies.
- RCP8.5: The highest greenhouse gas emissions scenario, often referred to as the "business-as-usual" scenario, assuming that no policies are put in place to limit GHG emissions. It leads to a radiative forcing of 8.5 Watt per square meter by 2100.

Following the IPCC RCP scenario selection, the initial input required from the business is a qualitative narrative outlining the impact of specific climate risks and opportunities on the business, aligning with TCFD scenario processes' requirements. For the purpose of EREL, **two climate scenarios are highlighted that could be particularly important for the company**. These two scenarios project vastly different future outcomes that allow the exploration of different types of risks for EREL. The RCP 2.6 scenario represents a best-case scenario with aggressive climate action and minimal physical risks, while the RCP 8.5 scenario represents a worst-case scenario with significant physical and transitional risks. Together, these scenarios provide a comprehensive range of potential futures to inform EREL's risk management and strategic planning.

Scenario 1 – RCP 2.6

One such scenario is the RCP2.6 scenario from the IPCC, which is a scenario leading to a global warming of less than 2 Celsius above pre-industrial levels. As of 2023, global warming is approximately 1.1 degrees Celsius above pre-industrial levels. This scenario means that GHG emissions peak between 2010-2020, which requires an urgent and significant reduction of GHG emissions from companies. This scenario projects more aggressive climate action including increasingly stricter new regulations in the form of stringent building codes and environmental regulations to curb climate change. This scenario mainly entails higher investments to align with such regulations, for example by investing in energy efficiency and renewable energy sources, and increased taxation of emissions and polluting activities. Thanks to the mitigation efforts, the physical impacts of climate change are less severe. For Nordic countries and therefore also for the Stockholm region, the RCP 2.6 scenario could lead to less intense warming, stabilising temperature increases, and reducing the frequency and severity of extreme weather events. This would result in milder winters, less variability in seasonal weather patterns, and a decrease in the likelihood of severe flooding and storms compared to higher emission scenarios. The stabilisation would also mean fewer disruptions to ecosystems and agricultural cycles and a reduced stress on water resources and infrastructure.

Scenario 2 – RCP 8.5

The other scenario is RCP8.5, which assumes much higher levels of GHG concentrations in the atmosphere and a much harsher increase in the effects of climate change and a global warming of 4.3 Celsius compared to pre-industrial levels. This scenario is considered a "business-as-usual", with no additional efforts to mitigate climate change. However, the inadequate response to climate change will entail higher physical risks, such as extreme weather events and chronic changes in weather patterns.

Apart from considering global trends, local institutions also provide valuable insight into how the local climate will change in a specific business location. For this case the website of the Swedish Meteorological and Hydrological Institute provides forecasts on the specifics of the Stockholm climate for the time periods 2011-2040, 2041-2070 and 2071-2100. The service allows the exploration of different climate indicators related to temperature and precipitation patterns.

To underscore the severity of climate impacts for the Stockholm region we picked climate indicators that are relevant for real estate holdings. In the RCP 8.5 scenario, the region will see temperature increases of 1,7 °C by 2040 and 4,9 °C by the end of the century. The number of cooling degree days is expected to triple by 2040. In parallel, the number of heating degree

days is expected to decrease by 11 % by 2040. Cooling degree days are defined as days where the average temperature is over 20 °C and, heating degree days are where the daily average temperature remains under 17 °C (Swedish Meteorological and Hydrological Institute, 2024).

The monthly precipitation is expected to increase by 8 % by 2040 and by 18 % by 2100. Meanwhile days with heavy and extreme precipitation days will increase by 15 % and 35 % respectively by the year 2040, and by 41 % and 85 % by 2100. Heavy precipitation is defined by more than 10 mm of rain in a day and over 20 mm rain in a day is considered to be extreme precipitation (SMHI, 2024).

Therefore, the main consequences for the Stockholm region – where the most important properties of the EREL are located - under the RCP 8.5 scenario include significant flooding due to a substantial increase in heavy and extreme precipitation and intensified urban heat stress as the number of cooling degree days is expected to triple by 2040 due to rising temperatures. Warmer temperatures increase the rate of evaporation and the capacity of the atmosphere to hold moisture, leading to heavier rainfall and, consequently, flooding. Additionally, warmer sea surface temperatures can fuel more intense storms and hurricanes, increasing the risk of storm-related damage. Flooding might be the risk with the strongest impact on EREL because it can cause severe damage to buildings, disrupt utility services, and lead to costly repairs and insurance claims. Flooding can also hinder access to properties, affect tenant satisfaction, and reduce property values. The financial and operational disruptions caused by flooding could significantly impair EREL's business operations and profitability. Additionally, storms pose a significant risk due to their potential to cause direct physical damage to buildings and infrastructure. Floods, often exacerbated by heavy rainfall and storm surges, increase the risk of property damage, disrupt transportation and supply chains, and can lead to long-term economic losses. The combination of increased storm activity and flooding necessitates robust risk management strategies to protect assets and ensure business continuity.

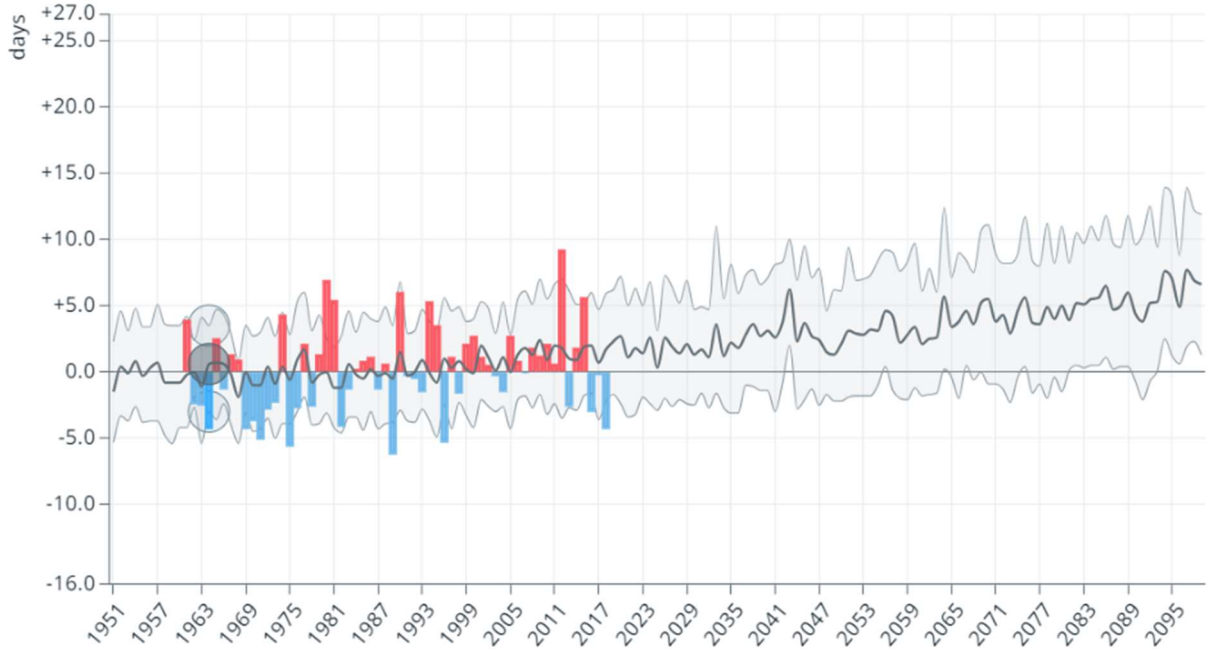


Figure 8.4.1.1 Change in days with heavy precipitation (days) in Stockholm County, RCP8.5 (SMHI,2024)

Other risks associated with the RCP 8.5 scenario include heatwaves and droughts, which can lead to increased cooling costs, stress on water resources, and negatively impact employee health and productivity. Heatwaves can also exacerbate urban heat island effects, making cities like Stockholm hotter than their surrounding areas. Drought conditions can reduce water availability for industrial processes, agriculture, and human consumption, potentially leading to conflicts over water use and increased costs for water-intensive operations.

Additional instructions: Additional and actual information is available on the website of the Swedish Meteorological and Hydrological Institute: https://www.smhi.se/en/climate/future-climate/advanced-climate-change-scenario-service/met/sverige/medeltemperatur/rcp45/2071-2100/year/anom

8.4.2 Solution Task 2

What's the impact on financial performance in scenario RCP 2.6? How does the identified climate-risks "flooding" in scenario RCP 8.5 impact the financial performance of EREL? Use the economic transmission channels to analyse the multifaced ways for each scenario identified.

To understand how climate change impacts the financial performance of a company, the economic transmission channels are an essential tool. Climate-related risks and opportunities are linked to micro and macro level financial impacts by economic transmission channels. The concept was introduced by the Network for Greening the Financial Systems (NGFS). Economic transmission channels describe how climate risks and events influence the well-being of households and businesses (micro level) and the macroeconomy more broadly. Both households and businesses can be affected by property damage caused by extreme weather events, and businesses are further affected by changes in customer demand or legal requirements (and the consequences of not adhering to the changes). Both physical and transitional risks can cause stranding of assets, where businesses are unable to utilise the assets they own, so the value or the useful life of the asset changes. On the wider, macro level climate change can lead to changes in prices, labour market conditions or productivity, just to name a few. These impacts together are called economic transmission channels, as they translate into financial risks for companies. Such financial risks include credit risks, market risks, operational risks, liquidity risks and underwriting risks (see for more details chapter 7.5).

In analysing the economic transmission channels, EREL must consider the multifaceted ways in which climate change can impact its operations. For instance, transition risks, such as the implementation of new environmental regulations, could necessitate substantial investments in property upgrades to meet energy efficiency standards, directly affecting operational costs and capital expenditure. Additionally, physical risks like extreme weather events could lead to property damage, influencing repair costs and potentially altering tenant occupancy rates. Each scenario presents distinct challenges for the company, demanding tailored risk management and adaptation strategies to mitigate the adverse effects on operations and financial performance. EREL's financial performance is affected through various economic transmission channels.

The transmission channels and the impact on financial performance in scenario RCP 2.6

In the RCP 2.6 scenario, the company is likely to encounter more transition risks. Therefore, more heightened market risks as customers opt for more energy-efficient rentals, reputation risks, regulatory challenges from impending legislation such as the CSRD and EU Taxonomy, technical risks requiring investment for property adaptation, declining property values, and difficulties in securing capital would all pose challenges to EREL. To conclude it in a presentation, the following transmission channels are relevant to show the impact on financial performance.

The Power Point-Presentation should include the following key points:

RCP 2.6 Scenario

Microeconomic Impacts:

Regulatory Compliance Costs and Opportunities:

Investment in Sustainable Development: EREL would need to invest in upgrading properties to meet stringent environmental regulations, which could include energy-efficient systems and renewable energy integrations.

Costs of Compliance: These include an increase in expenses, rising costs for energy and building materials, increased maintenance expenses, or also due to the expanded scope of emissions trading and heightened investment costs to fulfil the regulation requirements.

Market Demand Shifts: Changing tenant and buyer preferences towards more sustainable and energy-efficient properties could influence individual property values and rental rates.

Macroeconomic Impacts:

Changes in Land Use Policies and Building Codes: New regulations aimed at mitigating climate impacts can lead to significant shifts in the real estate market, affecting everything from property prices to investment strategies on a large scale.

Legal Risks: Increased litigation risks related to climate impacts and compliance with evolving regulations could affect the broader real estate sector. Energy costs: Fossil energy prices will dramatically increase, influencing macroeconomic outlooks in all sectors.

Economic Growth and Innovation: Green Technology Adoption: The push towards sustainability can drive broader economic growth in green technology sectors, influencing the real estate market indirectly through increased availability and decreased costs of green building materials and systems.

Job Creation in Green Sectors: Expansion in industries related to energy efficiency and renewable energy could enhance overall economic growth, benefiting the real estate sector through increased commercial and residential demand.

Cost of Capital: Potential for lower interest rates on loans for projects deemed environmentally friendly, directly affecting the cost structure of financing new developments or renovations.

Environmental Impacts: In the RCP 2.6 scenario, Sweden, Norway, and Finland could experience less intense warming, stabilising temperature increases and reducing the frequency and severity of extreme weather events. This would result in milder winters, less variability in seasonal weather patterns, and a decrease in the likelihood of severe flooding and storms

compared to higher emission scenarios. The stabilisation would also mean fewer disruptions to ecosystems and agricultural cycles, and a reduced stress on water resources and infrastructure.

The transmission channels and the impact on financial performance in scenario RCP 8.5

Conversely, in the RCP 8.5 scenario, physical risks predominate. These entail extreme weather events like floods and storms, along with chronic changes such as rising sea levels, altered precipitation patterns, significant temperature fluctuations leading to increased energy demands for indoor climate control, and issues related to landslides and erosion. For instance, climate-induced floods and storms may result in physical property damage and operational disruptions, such as the interruption of rental contracts.

The Power Point-Presentation should include the following key points:

RCP 8.5 Scenario

Microeconomic Impacts:

Physical Risk and Damage:

- *Increased Maintenance and Repair Costs*: More frequent and severe weather events lead to higher costs for maintaining and repairing properties, impacting the financial performance of EREL.
- *Insurance Costs:* Rising insurance premiums for properties in high-risk areas affect profitability.

Operational Disruptions:

- *Supply Chain Interruptions:* Localised disruptions in construction material supplies due to severe weather events directly affect project timelines and costs.
- *Utility Disruptions:* Frequent utility outages can lead to increased operational costs and decreased tenant satisfaction, impacting revenue. The utility disruptions lead to the interruption of rental contracts.

Asset and Entity Valuation:

- Properties in vulnerable areas might see a decline in value due to increased risk perception among (potential) investors and buyers, which also impacts the (market) entity value of the company. The financial impact of the shift in market demand under the RCP 8.5 scenario could result in increased capital expenditures on resilient and sustainable construction, potentially higher property values for climate-adapted buildings, and possible depreciation of assets in high-risk areas, all affecting the overall profitability and investment strategies of real estate companies.

Macroeconomic Impacts:

Market Dynamics:

- *Shifts in Property Demand:* As the frequency and severity of climate-related events such as flooding and heatwaves increase under RCP 8.5, consumers will become more aware of the risks associated with living in vulnerable areas. This heightened awareness will drive demand for properties that are located in areas less prone to flooding and other adverse

effects of climate change. Properties that incorporate climate-resilient features, such as elevated structures, water-resistant materials, and efficient cooling systems, will become increasingly attractive. Consumers will be willing to pay a premium for homes that offer greater security against climate-related disruptions. Long-term shifts in desirable locations due to changing flooding risk can alter the broader real estate market, influencing property prices and development strategies.

- *Labor market conditions:* Under the RCP 8.5 scenario, the predicted increase in frequency and severity of climate-related events, such as extreme precipitation and flooding, will likely result in more frequent and extensive damage to infrastructure and buildings. This translates to a higher demand for skilled professionals who can repair and maintain buildings to ensure they are resilient or to restore them to functionality after weather-related damage. The surge in repair and maintenance needs will stretch the capacity of the labour market, potentially leading to a shortage of qualified workers. As damage from climate events becomes more common, the demand for workers skilled in modern, resilient construction techniques and retrofitting buildings to be more climate-resistant will also rise. However, due to a shortage of qualified workers costs for repair and maintenance are therefore expected to increase.
- *Economic Shifts Due to Climate Impacts:* Widespread damage and the need for extensive repairs and rebuilding efforts after severe weather events can strain economic resources and redirect capital from other economic activities, potentially slowing overall economic growth.

Regulatory and Market Responses and Political Risks

- *Ad-hoc regulation:* Driven by the political dimensions of climate related catastrophes, ad-hoc regulations, like a strict carbon curb will drastically impact business models and lead to unforeseen domino effects in various sectors.

8.4.3 Solution Task 3

Which IFRS-line items are affected by the RCP 2.6 and RCP 8.5 scenarios and the identified transmission channels? Try to calculate the impact on Equity and Operating Profit as well as Profit before Tax for the years 2024-2028.

By utilising the economic transmission channels identified in the previous tasks, the scenarios RCP 2.6 and 8.5 will affect the company's income statement and balance sheet, making them differ from the baseline scenario as follows.

Baseline scenario

Given the fictitious nature of the case company, financial forecast assumptions are based on the reported historical and forecast financial data as well as the estimation assumptions made in the financial statements of comparable listed Nordic companies in the real estate industry[10]. Special consideration was given to how they discussed various financial aspects in their respective annual reports for 2023, including profit and general growth, future strategies,

[10] The following four Swedish and one Finnish company were included in the analysis; Atrium Ljungberg AB (556175-7047), Diös Fastigheter AB (556501-1771), Kojamo Oyj (0116336-2), Wallenstam AB (0116336-2), and Wihlborgs Fastigheter AB (556367-0230).

changes in financial and operational costs, as well as the impact of geopolitical and other events such as urbanisation. Their annual reports served as the foundation for our initial assumptions, which were subsequently refined to reflect the specific circumstances of our case company and broader macroeconomic conditions, including the inflation rate. The adjustments made to these assumptions and figures contribute to their current form. These assumptions have been used in guiding the model's forecast for the years 2024 to 2028. As each of these assumptions is delved into, the aim is to provide clarity and transparency, establishing a robust foundation for financial analysis.

The income statement forecast without climate effects for the years 2024 to 2028 is shown in Figure 8.4.3.1. As is shown, the property costs, other income, and central administration and marketing are kept at a constant growth rate, mirroring the average growth of the past six years. For depreciation and impairment, the growth rate is set at 5 %, as otherwise, the line item would be illogically low compared to the other items.

The Gains & Losses from Fair Value Measurement Investment Properties is calculated from the changes in the value of the Investment properties while deducting the investments made to upgrade the buildings. Meanwhile, the share in results of joint ventures was also kept at a constant 10 % to indicate broader growth in the business area and profitability of joint ventures.

Interest income is set to 4 % in the year 2024 to match the current day-to-day interest rate in Sweden (Sveriges Riksbank, 2024). It is estimated to decline in the next years, as based on Sweden’s central bank’s March report, the policy rate can probably be cut in May or June of 2024. The interest expenses are calculated based on the non-current liabilities ranging from 3.48 % in 2024 and steadily decreasing to 1.48 % by 2028. Interest expenses for leasing are assumed to stay at a steady rate of 3.80 %. Dividends are also assumed at a constant 30 % according to comparable companies.

The development of the rental income was forecasted separately, as it is one of the more crucial figures for the valuation. The rental income forecast shown in Figure 8.4.3.2, shows that the development of the income is based on the assumption that the company’s owned square meterage will grow steadily at an annual average rate of 1.65 %. The growth rate for EUR/m² was kept at a constant 5.9 %, based on inflation, increased value due to an overall increase in urbanisation. This calculation resulted in an estimated revenue growth increase from 7.70 % to 8.55 % throughout the forecast period.

Income Statement			Forecast				
in Mio. EUR							
	2023	2024	2025	2026	2027	2028
Rental income	**349,29**	376,19	405,95	438,93	475,52	516,16
Property costs	- **100,62**	- 105,33	- 113,67	- 122,90	- 133,14	- 144,53
Operating surplus	**248,67**	**270,85**	**292,28**	**316,03**	**342,37**	**371,64**
Other income	-	3,76	4,06	4,39	4,76	5,16
Central administration and marketing	- 8,28	- 9,40	- 10,15	- 10,97	- 11,89	- 12,90
EBITDA	**240,39**	**265,21**	**286,20**	**309,45**	**335,24**	**363,89**
Depreciation and impairment	-	- 0,70	- 0,68	- 0,66	- 0,63	- 0,61
Fair Value Gains & Losses of Investment Properties	- 109,08	100,57	104,18	134,91	140,45	146,21
Operating Profit	**131,31**	**365,08**	**389,70**	**443,70**	**475,05**	**509,49**
Interest income	1,71	1,25	2,93	4,38	5,62	6,07
Share in results of joint ventures	3,51	3,86	4,25	4,67	5,14	5,65
Interest expense	- 87,93	- 88,81	- 76,43	- 63,93	- 50,79	- 37,59
Interest exepense leasing	- 0,45	- 0,45	- 0,44	- 0,42	- 0,41	- 0,39
EBT	- **2,16**	**280,92**	**320,01**	**388,40**	**434,62**	**483,23**
Current tax	- 2,88	- 4,09	- 4,66	- 5,65	- 6,32	- 7,03
Deferred tax	2,61	- 53,78	- 61,27	- 74,36	- 83,21	- 92,51
Profit for the year	- **2,43**	**223,05**	**254,08**	**308,39**	**345,09**	**383,68**
Dividends	-	- 66,92	- 76,23	- 92,52	- 103,53	- 115,11
	- **2,43**	**156,14**	**177,86**	**215,87**	**241,56**	**268,58**

Figure 8.4.3.1 Excerpt of the Excel model. Income Statement with forecast figures. Source authors

Forecast for rental income							
Initial assumptions			2024	2025	2026	2027	2028
rental income 2023 SEK	4 043 000 000	Owned square meterage growth rate	*1,70 %*	*1,90 %*	*2,10 %*	*2,30 %*	*2,50 %*
fictional company in m²	2 279 000	Owned square meterage	2 317 743	2 361 780	2 411 377	2 466 839	2 528 510
SEK/m²	1 774	Growth rate for €/m²	*5,90 %*	*5,90 %*	*5,90 %*	*5,90 %*	*5,90 %*
€/m²	159,66	€/m²	169,08	179,06	189,62	200,81	212,66
rental income 2023 EUR	363 870 000	Rental income forecast	391 889 082	422 895 738	457 251 364	495 366 466	537 707 915
growth rate		growth rate	7,70 %	7,91 %	8,12 %	8,34 %	8,55 %

Figure 8.4.3.2 Excerpt of the Excel model. Rental income forecast calculation. Source authors

The Balance Sheet forecast without climate effects for the years 2024 to 2028 is shown in Figure 8.4.3.3. For our case company, the growth rate for the intangible assets - that include the right-of-use assets – is estimated to gradually decrease from 2 % in 2024 to 1.2 % in 2028 reflecting the trend of previous years. The growth rate of investment properties is estimated to increase slightly from 2 % to 2.5 %, as according to Statista (2024) there will be an annual growth rate of 2.58 % from 2024-2028 for the Real Estate market. Investments are needed to fulfil the demand, thus investment properties on the balance sheet are estimated to increase.

The growth rate for property plant and equipment is kept at a constant 2.5 %. Similarly, the Non-current receivables as well as trade and other receivables are kept at constant growth rates at 2.5 % and 3 % respectively. The former includes the hidden line-item derivatives and long-term receivables. Due to the impact of the derivatives, an average of previous years is not a suitable assumption, thus the development is estimated to keep a steady and mild growth. The latter is based on the average of the prior years' figures, calculated using the rental income divided by the trade and other receivables. Changes in prepaid tax expenses and accrued line items are also kept at a constant growth of 6.8 %. Similarly to trade and other receivables, its development is also calculated using prior years' averages, particularly property costs divided by changes in prepaid expenses and accrued income.

Non-current interest-bearing liabilities are assumed to develop from a slight growth of 1 % to a slight decrease of -1 % over the forecast period. The assumption is that there is no aggressive investment strategy for the next few years. Thus, the non-current interest-bearing liabilities will

decrease over time, signalling that our case company is not increasing the amount of loans, but rather focusing on paying them back.

Provisions include mostly the provisions for pension and sales of properties within the group. Over the last years provisions were zero most of the time. Thus, in the forecast, it is estimated to be at a constant 1 % increase. Similarly, the other non-current liabilities are kept at 1 % growth, as they have historically been mostly close to zero. The current tax liabilities and other current liabilities are also assumed to grow at a constant 1 %, with the assumption that the case company will not be paying these in full each year. Trade and other payables are assumed to grow at a steady 6.91 % rate each year reflecting the trend of the past six years.

Balance Sheet		Forecast				
in Mio. EU						
	2023	2024	2025	2026	2027	2028
Non-current assets						
Intangible assets	12,24	11,86	11,47	11,07	10,66	10,25
Investment properties	5 028,48	5 209,05	5 396,43	5 617,87	5 848,31	6 088,10
Property, plant and equipment	1,53	1,49	1,45	1,41	1,38	1,34
Investments in associated companies	9,27	13,13	17,38	22,05	27,19	32,84
Financial assets	18,00	18,00	18,00	18,00	18,00	18,00
Non-current receivables	39,60	40,79	42,01	43,27	44,57	45,91
Total non-current assets	**5 109,12**	**5 294,32**	**5 486,74**	**5 713,68**	**5 950,10**	**6 196,44**
Current assets						
Trade and other receivables	15,63	16,16	16,70	17,26	17,84	18,44
Prepaid expenses and accrued income	7,59	8,11	8,66	9,25	9,87	10,55
Cash and cash equivalents	31,14	83,78	145,99	224,96	303,37	395,56
Total current assets	**54,36**	**108,05**	**171,35**	**251,47**	**331,08**	**424,54**
Total assets	**5 163,48**	**5 402,37**	**5 658,09**	**5 965,14**	**6 281,19**	**6 620,98**
Share capital	17,28	17,28	17,28	17,28	17,28	17,28
Other contributed capital	96,02	96,02	96,02	96,02	96,02	96,02
reserves	26,38	26,38	26,38	26,38	26,38	26,38
Retained earnings	1 875,51	2 031,65	2 209,51	2 425,38	2 666,94	2 935,52
Equity attributable to shareholders of the parent company	**2 015,19**	**2 171,33**	**2 349,19**	**2 565,06**	**2 806,62**	**3 075,20**
Total equity	**2 015,19**	**2 171,33**	**2 349,19**	**2 565,06**	**2 806,62**	**3 075,20**
Liabilities						
Non-current liabilities						
Non-current interest bearing liabilities	2 525,95	2 551,21	2 563,97	2 576,79	2 563,90	2 538,26
Deferred tax liabilities	474,48	528,26	589,53	663,89	747,10	839,61
Provisions	2,34	2,36	2,39	2,41	2,44	2,46
Other non-current liabilities	14,93	15,08	15,23	15,38	15,54	15,69
Total non-current liabilities	**3 017,70**	**3 096,92**	**3 171,11**	**3 258,47**	**3 328,97**	**3 396,03**
Current liabilities						
Current tax liabilities	1,89	1,91	1,93	1,95	1,97	1,99
Trade and other payables	29,96	32,03	34,24	36,61	39,14	41,84
Other current liabilities	98,74	100,18	101,62	103,05	104,49	105,92
Other liabilites						
Total current liabilities	**130,59**	**134,12**	**137,79**	**141,61**	**145,59**	**149,75**
Total liabilities	**3 148,29**	**3 231,03**	**3 308,90**	**3 400,08**	**3 474,56**	**3 545,78**
Total equity and liabilities	**5 163,48**	**5 402,36**	**5 658,09**	**5 965,14**	**6 281,18**	**6 620,98**

Figure 8.4.3.3 Excerpt of the Excel model. Balance sheet with forecast figures. Source authors

Scenario RCP 2.6

RCP 2.6 represents a scenario where aggressive measures are taken to limit global warming to below 2 degrees Celsius above pre-industrial levels. This scenario primarily involves transition risks such as stringent environmental regulations, increased compliance costs, and market shifts towards sustainable practices.

In the case where events progress according to the RCP 2.6 scenario, the Stockholm region experiences moderate climate change effects, but at the expense of making more efforts to curb climate change by reducing carbon emissions. In this case, EREL needs to invest more in future-proofing their building portfolio.

To address the changes expected to stem from this scenario, EREL has decided to start investing heavily in the future-proofing of its buildings. The most impactful element of emission reductions is purchasing renewable green energy to power the buildings.

Based on the assumption we made for the purpose of this case, this results in significantly higher operating costs for the company, namely the following increases in the next 3 years: The company estimates that the upgrades can be carried out in the next three years, and the property costs will decrease after the initial upgrade period. Besides the upgrades the company expects its maintenance costs to increase slightly from the added maintenance needs of the installed solar panels, for example.

Impacts on Financial Statements:

1. **Income Statement:**

   - *Rental income:* After the initial upgrades are done, and the property portfolio is upgraded to fit sustainability standards and requirements, the company will be able to charge higher rents for its properties. This is further supported by the fact that due to the regulations that oblige companies to reduce their emissions, newly upgraded, energy efficient facilities will see increasing demand.

   - *Property costs*: Increased investment in energy efficiency and renewable energy sources will elevate property costs due to the need for upgrades and maintenance. As property costs include energy costs as well, switching to buying renewable electricity from the power company will increase property costs as well, which will not subside until the energy efficiency of the building portfolio is improved.

   - *Operating surplus*: Initially, operating surplus may decrease due to higher property costs, but over time, improved energy efficiency and potential subsidies can offset this.

   - *EBITDA*: Initial reductions due to increased property costs would be possible; however, long-term benefits from energy savings and subsidies are expected. Furthermore, the rapid increase in the Fair Value Measurement Gains makes the EBITDA rise rapidly as well.

   - *Depreciation and impairment:* Slight increase due to new investments in energy-efficient technologies in the headquarters accounted for under Property, Plant and Equipment at cost method and due to investments in software for risk modelling, compliance and databases which are meant to support the climate risk analysis.

   - *Fair Value Gains & Losses of Investment Properties:* Potentially high gains after the company has finished the upgrades necessary to align properties with sustainability standards and building codes. These initial investments will show

up as fair value gains as the upgrades are completed gradually towards the end of the forecasting period. Due to the pioneering position, the demand from customers will increase, contributing to the raise in fair value.

– *Interest expense:* As the upgrades of portfolio buildings are financed by external financing, the interest expenses undergo an initial increase, however, as the interest rate for the majority of the non-current liabilities is decreasing the interest expense in general is expected to decrease as well.

– *Operating Profit:* In the initial year the operating profit will be lower, because of the elevated costs and the staggered fashion of the appearance of the fair value gains on the upgraded investment property.

Income Statement		Forecast				
in Mio. EUR						
	2023	2024	2025	2026	2027	2028
Rental income	349.29	376.19	405.95	438.93	484.30	540.22
Property costs	- 100.62	- 127.90	- 135.99	- 144.85	- 142.87	- 159.36
Operating surplus	248.67	248.28	269.96	294.08	341.43	380.86
Other income	-	3.76	4.06	4.39	4.84	5.40
Central administration and marketing	- 8.28	- 9.40	- 10.15	- 10.97	- 12.11	- 13.51
EBITDA	240.39	242.64	263.87	287.50	334.16	372.75
Depreciation and impairment	-	- 0.80	- 0.79	- 0.75	- 0.72	- 0.69
Gains & Losses from Fair Value Measurement Investment Properties	- 109.08	201.14	269.23	319.66	409.06	446.37
EBIT	131.31	442.98	532.31	606.41	742.50	818.43
Interest income	1.71	1.25	8.90	5.24	2.58	0.29
Share in results of joint ventures	3.51	3.86	4.25	4.67	5.14	5.65
Interest expense	- 87.93	- 108.78	- 95.27	- 83.64	- 76.62	- 61.94
Interest expense leasing	- 0.45	- 0.45	- 0.43	- 0.42	- 0.40	- 0.38
EBT	- 2.16	338.86	449.76	532.27	673.20	762.06
Current tax	- 2.88	- 4.93	- 6.54	- 7.74	- 9.79	- 11.09
Deferred tax	2.61	- 64.88	- 86.11	- 101.90	- 128.89	- 145.90
Profit for the year	- 2.43	269.06	357.11	422.63	534.52	605.08
Dividends	-	- 80.72	- 107.13	- 126.79	- 160.36	- 181.52
	- 2.43	188.34	249.98	295.84	374.17	423.55

Figure 8.4.3.4 Excerpt of the Excel model. Income statement in RCP 2.6 scenario. Source: authors

2. Balance Sheet:

– *Intangible assets:* Increase due to investments in compliance and risk modelling software and additional databases that support the risk analysis.

– *Investment properties:* Higher initial costs for upgrades but the potential for increased property values over time. The increase is more pronounced after the projects are finished in 2027 when there is a stark uptick in investment property values. The upgrades in energy efficiency and compliance with sustainability regulations raise the valuation of investment properties.

– *Non-current interest-bearing liabilities:* Increased due to financing of new investments; however, long-term benefits include potential lower interest rates for green projects.

Balance Sheet		Forecast				
in Mio. EUR						
	2023	2024	2025	2026	2027	2028
Non-current assets						
Intangible assets	12.24	11.81	11.37	10.92	10.47	10.01
Investment properties	5,028.48	5,384.62	5,812.05	6,293.24	6,867.29	7,407.25
Property, plant and equipment	1.53	1.77	2.05	1.99	1.92	1.86
Investments in associated companies	9.27	13.13	17.38	22.05	27.19	32.84
Financial assets	18.00	18.00	18.00	18.00	18.00	18.00
Non-current receivables	39.60	40.79	42.01	43.27	44.57	45.91
Total non-current assets	5,109.12	**5,470.12**	**5,902.86**	**6,389.47**	**6,969.44**	**7,515.88**
Current assets						
Trade and other receivables	15.63	16.16	16.70	17.26	17.84	18.44
Prepaid expenses and accrued income	7.59	8.11	8.66	9.25	9.87	10.55
Cash and cash equivalents	31.14	254.39	174.77	103.08	14.70	12.09
Total current assets	54.36	**278.66**	**200.12**	**129.59**	**42.41**	**41.07**
Total assets	5,163.48	**5,748.78**	**6,102.98**	**6,519.06**	**7,011.85**	**7,556.95**
Share capital	17.28	17.28	17.28	17.28	17.28	17.28
Other contributed capital	96.02	96.02	96.02	96.02	96.02	96.02
reserves	26.38	26.38	26.38	26.38	26.38	26.38
Retained earnings	1,875.51	2,063.85	2,313.83	2,609.66	2,983.83	3,407.38
Equity attributable to shareholders of the parent company	2,015.19	**2,203.53**	**2,453.51**	**2,749.34**	**3,123.51**	**3,547.06**
Total equity	2,015.19	**2,203.53**	**2,453.51**	**2,749.34**	**3,123.51**	**3,547.06**
Liabilities						
Non-current liabilities						
Non-current interest bearing liabilities	2,525.95	2,854.32	2,868.60	2,882.94	2,868.52	2,839.84
Deferred tax liabilities	474.48	539.36	625.46	727.37	856.25	1,002.15
Provisions	2.34	2.36	2.39	2.41	2.44	2.46
Other non-current liabilities	14.93	15.08	15.23	15.38	15.54	15.69
Total non-current liabilities	3,017.70	**3,411.12**	**3,511.68**	**3,628.10**	**3,742.75**	**3,860.14**
Current liabilities						
Current tax liabilities	1.89	1.91	1.93	1.95	1.97	1.99
Trade and other payables	29.96	32.03	34.24	36.61	39.14	41.84
Other current liabilities	98.74	100.18	101.61	103.04	104.47	105.89
Other liabilites						
Total current liabilities	130.59	**134.12**	**137.78**	**141.60**	**145.58**	**149.72**
Total liabilities	3,148.29	**3,545.24**	**3,649.46**	**3,769.70**	**3,888.32**	**4,009.86**
Total equity and liabilities	5,163.48	**5,748.77**	**6,102.96**	**6,519.04**	**7,011.83**	**7,556.93**
Σ	0.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Figure 8.4.3.5 Excerpt of the Excel model. Balance sheet in RCP 2.6 scenario. Source: authors

Scenario RCP 8.5

RCP 8.5 depicts a high-emission scenario with severe physical risks, including frequent and intense flooding, storms, and rising sea levels.

As in this scenario the most severe climate impacts unfold in the long-term, in the short-term modelling, the company is only expected to experience mild effects of climate change, such as minor damages from torrential rains, and hotter summers. These are expected to increase property costs through heightened cooling costs reflected in the energy need and possible repairs from water damage.

The long-term effects can be better captured by adjusting the growth rate in the DCF model, which the paper will elaborate on later in the chapter.

This scenario focuses on the immediate and long-term physical impacts on the company's properties.

Impacts on Financial Statements:

1. **Income Statement:**

   - *Rental income:* Potential slight decrease due to property damage and lower occupancy rates in flood-prone areas. Customer demand decreases for non-sustainable properties and properties in more risk-prone areas.
   - *Property costs:* In the short term, the property costs, which include maintenance, repair and energy costs for heating and cooling are expected to be relatively minor, as floods and increasingly hot summers are part of present realities. A more significant increase due to frequent repairs, maintenance, and insurance costs will be incurred in the long run. Insurance costs will also increase as insurers start expecting more property damage.
   - *Operating surplus:* Slower growth than in the RCP 2.6 scenario in the short term and potential loss of rental income in the long run combined with an increase in property costs.
   - *EBITDA:* Reduction compared to the base scenario due to increased operational costs and decreased rental income.
   - *Fair Value Gains & Losses of Investment Properties:* A slow loss of value due to the lingering effects of climate change. The fair value measurement might become more volatile in the long term, as climate change effects become more pronounced.
   - *Operating Profit:* Considerably lower than in the RCP 2.6 scenario due to combined effects of increased costs and reduced income.

Income Statement		Forecast				
in Mio. EUR						
	2023	2024	2025	2026	2027	2028
Rental income	349.29	375.14	403.69	435.28	470.26	509.04
Property costs	- 100.62	- 108.04	- 116.67	- 126.23	- 136.84	- 148.64
Operating surplus	248.67	**267.10**	**287.03**	**309.05**	**333.41**	**360.40**
Other income	-	3.75	4.04	4.35	4.70	5.09
Central administration and marketing	- 8.28	- 9.38	- 10.09	- 10.88	- 11.76	- 12.73
EBITDA	240.39	**261.47**	**280.97**	**302.52**	**326.36**	**352.77**
Depreciation and impairment	-	- 0.70	- 0.68	- 0.66	- 0.63	- 0.61
Gains & Losses from Fair Value Measurement Investment Properties	- 109.08	95.54	98.88	129.27	128.84	133.88
EBIT	131.31	**356.31**	**379.17**	**431.13**	**454.57**	**486.03**
Interest income	1.71	1.25	2.88	4.26	5.43	5.84
Share in results of joint ventures	3.51	3.86	4.25	4.67	5.14	5.65
Interest expense	- 87.93	- 88.81	- 76.43	- 63.93	- 50.79	- 37.59
Interest expense leasing	- 0.45	- 0.45	- 0.44	- 0.42	- 0.41	- 0.39
EBT	- 4,982.85	**272.16**	**309.43**	**375.71**	**413.94**	**459.54**
Current tax	- 2.88	- 3.96	- 4.50	- 5.47	- 6.02	- 6.69
Deferred tax	2.61	- 52.10	- 59.24	- 71.93	- 79.25	- 87.98
Profit for the year	- 4,983.12	**216.09**	**245.69**	**298.31**	**328.67**	**364.88**
Dividends	-	- 64.83	- 73.71	- 89.49	- 98.60	- 109.46
	- 4,983.12	**151.26**	**171.98**	**208.82**	**230.07**	**255.41**

Figure 8.4.3.6 Excerpt of the Excel model. Income statement in RCP 8.5 scenario. Source: authors

2. **Balance Sheet:**

   - *Investment properties:* Slow and constant depreciation due to physical damage and decreased market value.
   - *Non-current liabilities:* Increase in provisions for repairs and maintenance; potential increase in insurance liabilities.
   - *Current liabilities:* Increased due to frequent and unexpected costs related to weather events.

Balance Sheet		Forecast				
in Mio. EUR						
	2023	2024	2025	2026	2027	2028
Non-current assets						
Intangible assets	12.24	11.86	11.47	11.07	10.66	10.25
Investment properties	5,028.48	5,204.02	5,386.10	5,601.89	5,820.72	6,048.19
Property, plant and equipment	1.53	1.49	1.45	1.41	1.38	1.34
Investments in associated companies	9.27	13.13	17.38	22.05	27.19	32.84
Financial assets	18.00	18.00	18.00	18.00	18.00	18.00
Non-current receivables	39.60	40.79	42.01	43.27	44.57	45.91
Total non-current assets	5,109.12	**5,289.29**	**5,476.41**	**5,697.70**	**5,922.52**	**6,156.53**
Current assets						
Trade and other receivables	15.63	16.16	16.70	17.26	17.84	18.44
Prepaid expenses and accrued income	7.59	8.11	8.66	9.25	9.87	10.55
Cash and cash equivalents	31.14	82.37	142.10	217.35	292.04	378.98
Total current assets	54.36	**106.64**	**167.46**	**243.86**	**319.75**	**407.96**
Total assets	5,163.48	**5,395.93**	**5,643.87**	**5,941.55**	**6,242.27**	**6,564.49**
Share capital	17.28	17.28	17.28	17.28	17.28	17.28
Other contributed capital	96.02	96.02	96.02	96.02	96.02	96.02
reserves	26.38	26.38	26.38	26.38	26.38	26.38
Retained earnings	1,875.51	2,026.77	2,198.75	2,407.57	2,637.64	2,893.06
Equity attributable to shareholders of the parent company	2,015.19	**2,166.45**	**2,338.43**	**2,547.25**	**2,777.32**	**3,032.74**
Total equity	2,015.19	**2,166.45**	**2,338.43**	**2,547.25**	**2,777.32**	**3,032.74**
Liabilities						
Non-current liabilities						
Non-current interest bearing liabilities	2,525.95	2,551.21	2,563.97	2,576.79	2,563.90	2,538.26
Deferred tax liabilities	474.48	526.58	585.82	657.76	737.00	824.98
Provisions	2.34	2.36	2.39	2.41	2.44	2.46
Other non-current liabilities	14.93	15.10	15.26	15.43	15.60	15.77
Total non-current liabilities	3,017.70	**3,095.25**	**3,167.44**	**3,252.38**	**3,318.94**	**3,381.48**
Current liabilities						
Current tax liabilities	1.89	1.91	1.93	1.95	1.97	1.99
Trade and other payables	29.96	32.03	34.24	36.61	39.14	41.84
Other current liabilities	98.74	100.28	101.82	103.36	104.90	106.44
Other liabilites						
Total current liabilities	130.59	**134.22**	**137.99**	**141.91**	**146.00**	**150.27**
Total liabilities	3,148.29	**3,229.47**	**3,305.43**	**3,394.29**	**3,464.95**	**3,531.75**
Total equity and liabilities	5,163.48	**5,395.92**	**5,643.86**	**5,941.55**	**6,242.27**	**6,564.49**
Σ	0.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Figure 8.4.3.7 Excerpt of the Excel model. Balance sheet in RCP 8.5 scenario. Source: authors

8.4.4 Solution Task 4

Illustrate the differences in enterprise valuation for the company EREL using a five-year cash-flow projection based on IFRS line items and DCF calculations that include climate-related risk impacts. Please compute the WACC and select the Beta using the respective sheets. Complete the DCF models for each of the three scenarios: without climate impact, RCP 2.6 and RCP 8.5. Determine the different growth rates for each scenario required for the multi-stage DCF calculation.

To facilitate the valuation calculation, in addition to compiling financial forecast assumptions for the DCF model, it is necessary to determine WACC and Beta. Climate risks naturally impact WACC and Beta, as the risks affect financing rates. Regarding the WACC and the Beta used in the Excel model, both parameters were calculated to reflect our case scenario company's risk profile and market conditions.

First, the beta was estimated. The Beta used was 1.20. As can be seen in Figure 8.4.4.1 The Beta calculation is based on the FTSE EPRA Nareit Global Real Estate Index Series (Investing.com, 2024). This gives a good representation of the real estate industry and its trends globally, as it tracks companies listed on stock exchanges that earn income from owning, trading, and developing real estate assets. It was calculated by calculating the percentage changes per each measurement date over the years 2021-2023, and then taking the slope of these figures.

FTSE EPRA/NAREIT Developed Europe						
	USD	USD/EUR	EUR			Beta
29-12-2023	1 869,99	0,9061	1 694,40	-0,98 %		1,200
28-12-2023	1 893,24	0,9038	1 711,11	0,25 %		1,200
27-12-2023	1 895,79	0,9003	1 706,78	0,78 %		
22-12-2023	1 865,21	0,9080	1 693,61	0,88 %		
21-12-2023	1 848,62	0,9082	1 678,92	-1,22 %		
20-12-2023	1 860,14	0,9137	1 699,61	1,39 %		
19-12-2023	1 841,37	0,9104	1 676,38	0,60 %		
18-12-2023	1 820,17	0,9155	1 666,37	-0,41 %		
15-12-2023	1 822,83	0,9179	1 673,18	-0,59 %		
14-12-2023	1 850,44	0,9096	1 683,16	6,24 %		
13-12-2023	1 723,54	0,9192	1 584,28	-0,05 %		
12-12-2023	1 711,33	0,9262	1 585,03	-0,95 %		
11-12-2023	1 722,56	0,9290	1 600,26	0,59 %		

Figure 8.4.4.1 Excerpt of the Excel model. Selected Beta. Source authors

Then the WACC is estimated. As presented in chapter 6.2., the WACC formula is:

$$WACC = \left(\frac{}{E}V \times Re\right) + \left(\frac{}{D}V \times Rd \times (1 - TaxRate)\right)$$

Where:

- (WACC) is the weighted average cost of capital
- (E) is the market value of equity
- (V) is the total market value of equity and debt
- (Re) is the cost of equity

- (D) is the market value of interest-carrying debt
- (Rd) is the cost of debt

The walkthrough of the WACC calculation is shown in figure 8.4.4.2. Essentially the beta 1.20 is multiplied by the Swedish market risk premium of 4.60 % (Damodaran, 2024). To obtain the cost of equity, the risk-free interest rate of 2.43 % based on Swedish 10-year government bonds is added to this result (Wall Street Journal, 2024). The figure is then multiplied by the equity portion calculated as the market value of equity divided by the market value of debt and equity, which gives the weighted cost of capital.

Simultaneously, the debt capital costs before taxes are calculated using the 2023 financial figures, as interest expense divided by non-current interest-bearing liabilities and other non-current liabilities. This is then multiplied by the tax shield, which is the actual tax rate of Sweden, to get the debt capital costs after taxes. This is then further multiplied by the debt portion, calculated in a similar manner to the equity portion, but for debt, to get the weighted cost of debt. When the weighted cost of capital and debt are added together, the result is the WACC.

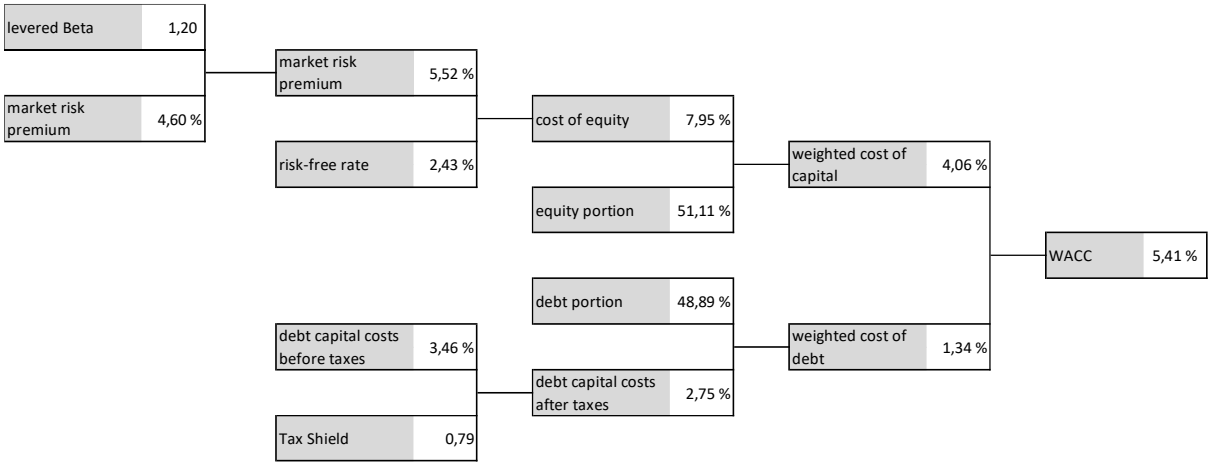


Figure 8.4.4.2 Excerpt of the Excel model. WACC calculation. Source authors

The initial DCF model presented in Figure 8.4.4.3 portrays the valuation of the company before factoring in the climate-related impacts outlined in Chapter 8.4.3. It evaluates the shareholder value of the case company over a five-year forecast period from 2024 to 2028. Key financial parameters are considered in the calculation of free cash flow. Additionally, the analysis incorporates a terminal value, representing the company's estimated future value at the end of the forecast period. A description of the calculation of the DCF model can be found in more detail in Chapter 6.2. The terminal value used in this case was determined using a two-stage growth rate, as shown in Figure 8.4.4.4.

A two-stage – or in general a multi-stage - growth model can be implemented when it can be assumed that a company's growth trajectory is expected to fluctuate in the future. The stage 1 growth rate encompasses the first ten years of growth. After that, the “terminal value” (TV) growth rate is applied. The two-stage approach is particularly apt for this case, given the potential for increased investments in the coming years to ensure compliance with both regulations as well as general climate risk mitigation and adaptation activities. In terms of climate risk impacts, and even in general in the current socio-political climate, there is a reason to believe that the growth rate will not stay constant, even during the forecasted period of 5

years. Regulatory changes, physical and transition risks as well as overall market sentiment all play a significant role. By considering these factors, the DCF model can be made to reflect the climate risk impacts' effect on the case company's growth rate in the future. This involves adjusting growth projections based on expected changes in regulations, market dynamics, and operational challenges arising from climate-related risks.

In the case of the baseline scenario as can be seen in Figure 8.4.4.4., the stage 1 growth rate is estimated to experience a slight growth of 1.25 %. In the longer term, the growth rate is estimated to not exceed 1 % implying a static state.

Shareholder Value Calucation							Forecast					
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	TV
Growth rate		*11,10 %*	*-16,26 %*	*43,80 %*	*-38,12 %*							
EBIT	286,92	318,78	266,94	383,85	237,51	131,31	365,08	389,70	443,70	475,05	509,49	509,49
- taxes on EBIT	- 59,11	- 65,67	- 54,99	- 79,07	- 48,93	- 47,77	- 75,21	- 80,28	- 91,40	- 97,86	- 104,96	
NOPLAT	227,81	253,11	211,95	304,78	188,58	83,54	289,87	309,42	352,30	377,19	404,54	509,49
+ depreciation	0,09	1,08	0,81	0,81	1,53	-	0,70	0,68	0,66	0,63	0,61	
-/+ Gains & Losses from Fair Value Measurement Investment Properties						- 109,08	- 100,57	- 104,18	- 134,91	- 140,45	- 146,21	- 146,21
- investments	- 193,59	- 410,31	- 140,67	- 148,86	- 356,58	-	- 80,28	- 83,45	- 86,75	- 90,18	- 93,75	- 93,75
+/- change in working capital	112,00	- 37,00	68,00	- 78,00	111,00	-	50,15	59,63	76,29	75,63	89,30	
Free CF	146,31	- 193,12	140,09	78,73	- 55,47	- 25,54	159,88	182,10	207,59	222,83	254,48	269,53
Growth rate in terminal value												
Terminal Value												
DCF	**146,31**	**- 193,12**	**132,91**	**70,86**	**- 47,36**	**- 25,54**	**159,88**	**172,76**	**186,84**	**190,28**	**206,16**	**4 960,36**

Figure 8.4.4.3 Excerpt of the Excel model. DCF model before climate impact. Source authors

Multi-stage DCF model without Climate impact			
		PV from 2024 -2028	**915,92**
two-stages			
	Stage 1	**TV**	
CF	269,53	283,26	
discount rate	5,41 %	5,41 %	
annuity growth rate	1,25 %	1,00 %	
number of periods in annuity	5	5	
			Enterprise Value
	957,25	**4 003,11**	**4 960,36**

Figure 8.4.4.4 Excerpt of the Excel model. Two-stage growth rate for the DCF model without climate impact. Source authors

In terms of the two climate scenarios that represent distinct trajectories of future climate conditions, both have been integrated into the DCF model. This integration allows us to simulate the diverse outcomes and climate impacts anticipated in each scenario. By incorporating these climate scenarios into our analysis, we aim to capture the potential range of risks and opportunities that may arise due to varying degrees of climate change.

To ensure a comprehensive evaluation, each climate scenario has been implemented separately within the DCF model. This separation enables us to isolate and assess the specific implications of each scenario on the company's financial performance and valuation. By analysing the outcomes of each scenario individually, we gain insights into the differential effects of climate change on the company's future cash flows and overall enterprise value.

Similarly to the initial DCF model developed for the baseline scenario, the terminal value used in each climate scenario was calculated separately. This involved employing a two-stage model

that accounts for the unique growth dynamics expected under each climate scenario. By calculating the terminal value separately for each scenario, we can discern how climate-related factors may influence the company's long-term growth prospects and, consequently, its valuation.

Integrating these climate scenarios into the DCF model allows us to adopt a forward-looking perspective and assess the company's resilience and adaptability in the face of climate-related challenges. By exploring multiple scenarios, we can better understand the potential range of outcomes and make more informed decisions to mitigate and adapt to risks and capitalise on opportunities in a changing climate landscape.

In Scenario RCP 2.6 as can be seen from Figure 8.4.4.5, the impact of the mitigatory and adaptive actions against physical climate risks in the case company's operations is evident. This is mirrored across various line items in the DCF calculation. The range of choices against physical and transition climate risks directly affects the company's assets, operations, and financial performance.

The company's free cash flow experiences an observable decline compared to the baseline scenario. This decline can be attributed to several factors, including increased maintenance and repair costs associated with climate-related damage to infrastructure as well as costs linked to mitigatory and adaptive actions against said risks. As a result, the company's ability to generate surplus cash flow for reinvestment or distribution to shareholders is affected under Scenario RCP 2.6. On the other hand, due to the mitigatory and adaptive actions, the long-term value of EREL is estimated to see a drastic increase from the baseline scenario due to the growth rate changing, as is shown in Figure 8.4.4.6.

Initially, the growth rate is estimated to face a slight decrease to 0.75 % due to higher CapEx. The revenues are estimated to dip, while the costs are estimated to increase. These are both repercussions from the mitigatory and adaptive actions undertaken, which require investments. This in turn drives the prices up, which the customers are estimated to not yet be prepared or interested in paying for. Hence the lower growth rate. However, after the stage 1 period, the growth rate is estimated to increase to 2.5 % surpassing the original growth rates. This is due to the operations and assets having adapted to climate change. This has caused EREL's operations to increase in resiliency towards climate-related risks and the company brand becomes more attractive to customers. Thus, the company's value increases in the long-term.

Scenario RCP 2.6						
Shareholder Value Calucation						
	2024	**2025**	**2026**	**2027**	**2028**	**TV**
EBIT	442,98	532,31	606,41	742,50	818,43	818,43
- taxes on EBIT	- 91,25	- 109,66	- 124,92	- 152,96	- 168,60	
NOPLAT	351,73	422,66	481,49	589,55	649,84	818,43
+ depreciation	0,80	0,79	0,75	0,72	0,69	
-/+ gains & Losses from Fair Value Measurement Investment Properties	- 201,14	- 269,23	- 319,66	- 409,06	- 446,37	- 446,37
- investments	- 155,60	- 158,82	- 161,77	- 165,19	- 93,76	- 93,76
+/- change in working capital	220,77	- 82,20	- 74,35	- 91,15	- 5,49	
Free CF	216,56	- 86,81	- 73,54	- 75,14	104,90	278,30
Growth rate in terminal value						
Terminal Value						
DCF	**216,56**	**- 82,36**	**- 66,19**	**- 64,16**	**84,98**	**7 123,16**

Figure 8.4.4.5 Excerpt of the Excel model. DCF model with climate impact of Scenario RCP 2.6. Source authors

Multi-stage DCF model with Climate impact - Scenario RCP 2.6			
		PV from 2024 -2028	**88,83**
two-stages			
	Stage 1	**TV**	
CF	278,30	286,74	
discount rate	5,41 %	5,41 %	
annuity growth rate	0,75 %	2,50 %	
number of periods in annuity	5	5	
			Enterprise Value
	979,06	**6 144,11**	**7 123,16**

Figure 8.4.4.6 Excerpt of the Excel model. Two-stage growth rate for the DCF model for climate impact of Scenario RCP 2.6. Source authors

In the DCF calculation Scenario RCP 8.5, the analysis reveals that in the short term, there is no significant disparity between the RCP 8.5 scenario compared to the baseline scenario, as seen in Figure 8.4.4.7. Unlike the forward-looking approach adopted in the RCP 2.6 scenario, the dynamics at play in Scenario RCP 8.5 are characterised by a more moderate influence of climate risk impacts on the case company's financial performance on the forecast level. The difference in the free cash flow manifests in the long run due to the implications of the changing growth rate, as opposed to a prominent short-term impact.

One of the distinguishing factors in Scenario RCP 8.5 is the company's approach to climate risk management, which involves a lesser emphasis on mitigatory, and adaptive actions compared to Scenario RCP 2.6. The short-term impact on the financial forecasts is not as prominent, as the company would not have to carry the costs of the mitigatory and adaptive investments, which is one of the underlying causes for the increased costs in the RCP 2.6 scenario. Consequently, while climate risks still exert a negative influence on the company's financial outlook, the magnitude of this impact is relatively subdued compared to the more proactive stance adopted in Scenario RCP 2.6.

In Scenario RCP 8.5, the primary driver behind the adverse impact on enterprise value is attributed to the underlying two-stage growth rate utilised in the DCF model, as is portrayed in Figure 8.4.4.8. The initial growth rate is estimated to match that of the baseline scenario's 1.25%, as not much is estimated to change. The climate risks' contribution to the overall decline in enterprise value manifests in the longer run, with the growth rate declining to 0.20 %. Due to the lack of mitigatory and adaptive actions, the enterprise value falls below the baseline value.

Scenario RCP 8.5						
Shareholder Value Calucation						
	2024	**2025**	**2026**	**2027**	**2028**	**TV**
EBIT	356,31	379,17	431,13	454,57	486,03	486,03
- taxes on EBIT	- 73,40	- 78,11	- 88,81	- 93,64	- 100,12	
NOPLAT	282,91	301,06	342,32	360,93	385,91	486,03
+ depreciation	0,70	0,68	0,66	0,63	0,61	
-/+ gains & Losses from Fair Value Measurement Investment Properties	- 95,54	- 98,88	- 129,27	- 128,84	- 133,88	- 133,88
- investments	- 80,28	- 83,45	- 86,75	- 90,18	- 93,75	- 93,75
+/- change in working capital	48,65	57,05	72,47	71,80	83,94	
Free CF	156,43	176,46	199,43	214,34	242,84	258,40
Growth rate in terminal value						
Terminal Value						
DCF	**156,43**	**167,41**	**179,50**	**183,03**	**196,72**	**4 165,76**

Figure 8.4.4.7 Excerpt of the Excel model. DCF model with climate impact of Scenario RCP 8.5. Source authors

Multi-stage DCF model with Climate impact - Scenario RCP 8.5			
		PV from 2024 -2028	**883,09**
two-stages			
	Stage 1	**TV**	
CF	258,40	271,57	
discount rate	5,41 %	5,41 %	
annuity growth rate	1,25 %	0,20 %	
number of periods in annuity	5	5	
			Enterprise Value
	917,73	**3 248,04**	**4 165,76**

Figure 8.4.4.8 Excerpt of the Excel model. Two-stage growth rate for the DCF model for climate impact of Scenario RCP 8.5. Source authors

Table 8.4.4.1 provides a comprehensive overview of the enterprise values derived from the different scenarios — namely, the baseline without climate impact, Scenario RCP 2.6, and Scenario RCP 8.5 — utilising DCF model. The disparities in enterprise value across the scenarios stem from a multitude of factors that shape the financial outlook and risk profile of the company.

Initially, the financial assumptions underpinning the DCF model remain consistent across all scenarios. However, the introduction of climate impact considerations, as described in Chapters 8.4.1, 8.4.2 and 8.4.3, introduces the grounds for a divergent trajectory for each scenario. These climate-related factors encompass a spectrum of influences, including physical climate risks, mitigation and adaptation efforts, regulatory dynamics, and market sentiments, all of which exert varying degrees of influence on the company's valuation.

The baseline DCF valuation yields an enterprise value reflecting a scenario where climate risk impacts and mitigation, as well as adaptation strategies, are not explicitly factored into the analysis. This baseline assumes that the company continues its operations without significant changes or disruptions due to climate-related factors. It does not account for potential increases in operating costs, changes in regulatory requirements, or impacts from extreme weather events that could affect revenues and expenses.

Scenario RCP 2.6 places greater emphasis on addressing physical climate impacts and implementing corresponding mitigation and adaptation measures, resulting in the highest

enterprise value. This scenario involves significant efforts to reduce greenhouse gas emissions and adapt to physical climate impacts. As a result, it places greater emphasis on addressing physical climate impacts and implementing corresponding mitigation and adaptation measures. These efforts include investing in resilient infrastructure, adopting energy-efficient technologies, and complying with stringent environmental regulations. Under RCP 2.6, the enterprise value is higher than the baseline because proactive climate risk mitigation and adaptation leads to a more stable financial outlook. Reduced climate-related disruptions and early adoption of sustainable practices increase the company's attractiveness and can lower its cost of capital. Additionally, enhanced reputation and regulatory compliance open new market opportunities and improve competitive position.

In contrast, in Scenario RCP 8.5, the enterprise value is shaped by a different set of dynamics, primarily driven by changes in the growth rate rather than extensive mitigatory and adaptive actions. With a reduced focus on climate risk mitigation and adaptation efforts, the impact on enterprise value in Scenario RCP 8.5 is primarily attributed to adjustments in the growth trajectory of the company. This underscores the importance of considering not only the direct impacts of climate risks but also the broader implications for strategic decision-making, growth prospects, and long-term sustainability.

DCF Model Enterprise values comparison

	Without climate impact	*Scenario 1 (RCP 2.6)*	*Scenario 2 (RCP 8.5)*
Enterprise value	4 960.36	7 123.16	4 165.76

Table 8.4.4.1 DCF Model Enterprise values comparison. Source authors

8.4.5 Solution Task 5

Implement a Monte Carlo Simulation on the annuity growth rates in Stage 1 and the Terminal Value process for each of the three scenarios: without climate impact, RCP 2.6 and RCP 8.5. Use the different growth rates from Task 4 for the multistage DCF calculation as basis. Elaborate proposals for distribution assumptions for the growth rate variables and outline how you can determine distribution parameters. Apply Lumivero @Risk functionalities in Microsoft Excel to set up the simulation. Compute statistics and create charts of the resulting distributions for the enterprise values, as well as the distribution parameters of the growth rate. How can this information contribute to an advanced decision-making process?

The point estimates for enterprise values as indicated in section 8.4.4. significantly depend on the choice of the annuity growth rate in stage 1 as well as in the Terminal value process. Although data based and supported by expert knowledge, growth rates crucially rely on idiosyncratic as well as economy-wide risks. In order to reflect the effects of potential deviations from the assumed growth rates, we suggest applying Monte Carlo simulations to produce distributions for enterprise value results in the different scenarios. With this, we could demonstrate how and to what extent climate risks impact enterprise values given uncertainties in the economic and business environment. Following this approach, calculating the enterprise value results can be operationalised rather than simply described.

After the selection of an IPCC RCP scenario, the input needed from the business is first the qualitative narrative, regarding the impact of certain climate risks (and opportunities) on the business. This is in line with demands by the TCFD scenario processes.

Using our comprehensive list of economic transmission channels from above, a range of potentially impacted IFRS line items or key parameters such as WACC assumptions could be identified. For each of the chosen variables, three-point expert estimations can serve as parameters for triangular distributions which then serve as the basis for Monte Carlo simulations. In order to illustrate the proposed methodology, we focus on the annuity growth rate as a key parameter in the DCF model for deriving enterprise values.

Starting with growth rate estimates as outlined in section 8.4.4., we use an average of expert estimations considering business and economic risks to the annuity growth rate. Our observations show an average of approximately 0,7 times the baseline annuity growth rate as a kind of worst case, while 1,3 times the growth rate as expected maximum, given different scenarios of the economic and business environment. Hence, we apply these factors to the annuity growth rates applied in section 8.4.4 and define triangular distributions for the parameter annuity growth rate in stage 1 as well as in the Terminal Value process.

As we intend to keep tool complexity limited, and in order to offer an Excel-based platform for analysis, we apply the Lumivero "@Risk" suite for our simulations.

As a first step, we define the triangular distribution parameters for our target variables, as can be seen in the following screenshot:

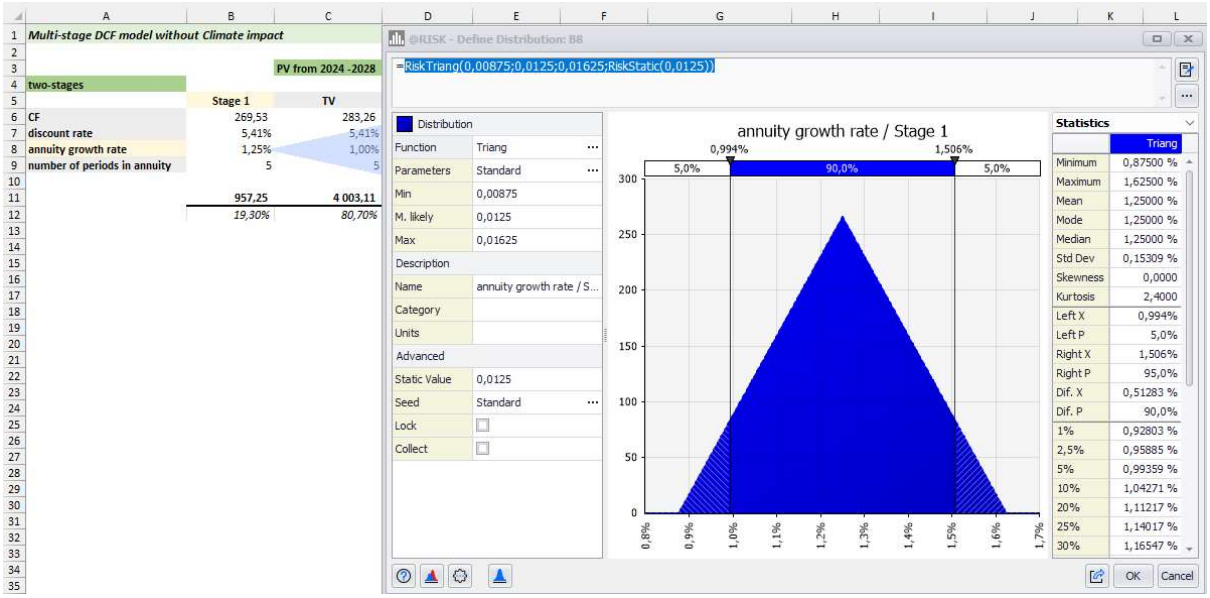


Figure 8.4.5.1 Excerpt of the Excel model. Specification of distribution for growth rate variables in the DCF model without climate impact. Source authors

As an example:

Baseline annuity growth rate for Stage 1 (first 5 years) is 1,25 % in the baseline scenario. Applying the 0,7 and 1,3 factors, respectively, we get 0,875 % as lower limit, and 1,625 % as upper limit for the triangular distribution, reflecting a three-point estimate for the growth rate.

We repeat this for Stage 1 and TV values, for all 3 scenarios (DCF without climate impact, Scenario RCP 2.6, Scenario RCP 8.5).

In the second step, we define the variable to simulate based on Monte Carlo variations of the annual growth parameters, which is the Enterprise value. This is shown in the following illustration:

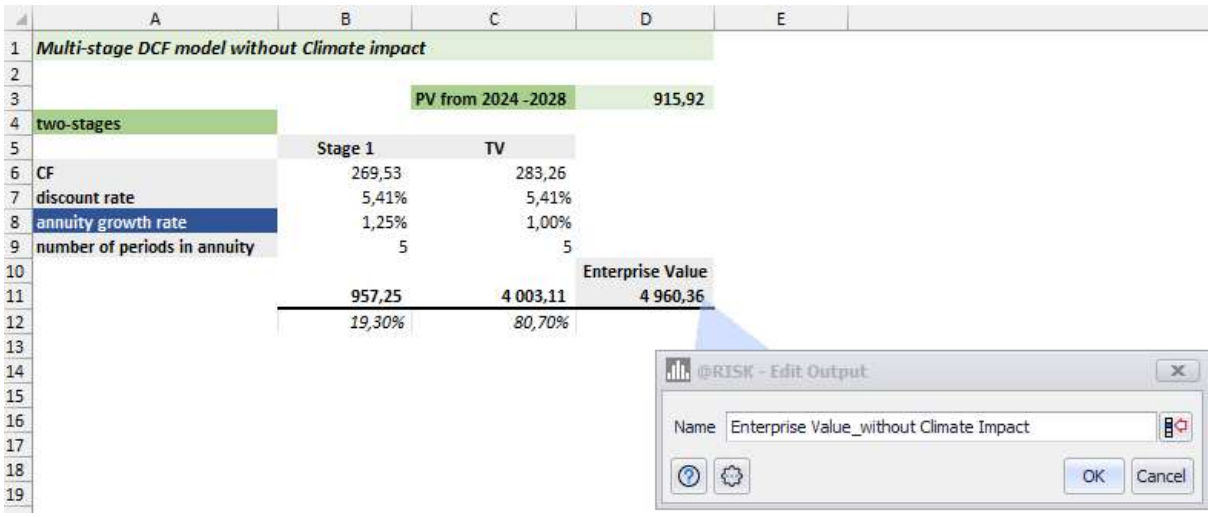


Figure 8.4.5.2 Excerpt of the Excel model. Specification of output variable for the Monte Carlo simulation in the DCF model without climate impact. Source authors

After specifying the distribution of the relevant parameters, as well as the target variable, the methodology of the simulation can be set up.

For illustrative purposes, the number of simulations is set to 10.000, as convergence shall be sufficiently high. We determine this value in the Simulation settings:

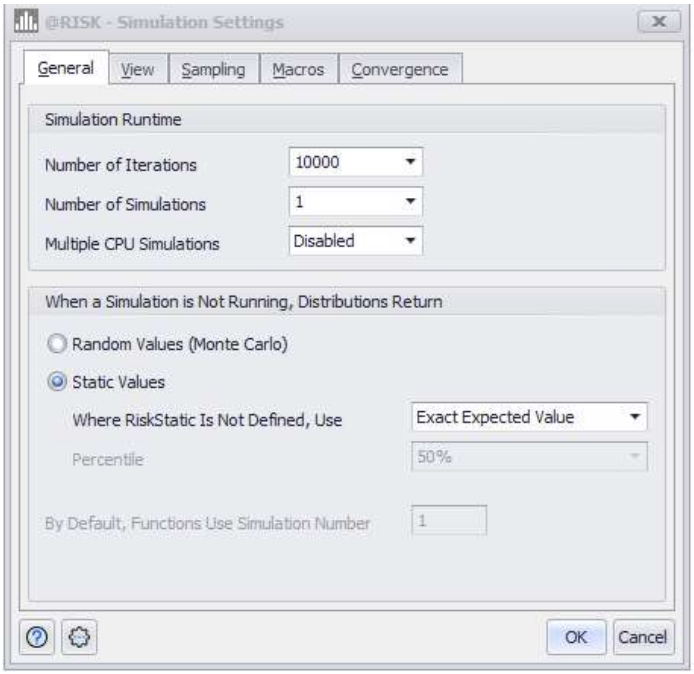


Figure 8.4.5.3 Excerpt of the Excel model. Specification of general simulation settings and number of simulations for the Monte Carlo simulation in the DCF model. Source authors

@Risk offers a wide range of specification options for the Monte Carlo simulation. The following screenshot illustrates the relevant options:

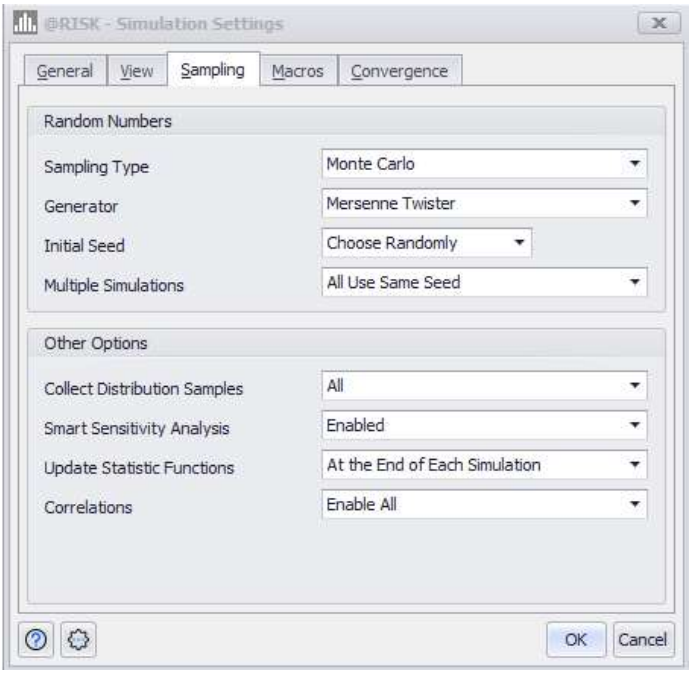


Figure 8.4.5.4 Excerpt of the Excel model. Specification of sampling type and random number generator for the Monte Carlo simulation in the DCF model. Source authors

After defining the simulation settings, the simulation can be easily started.

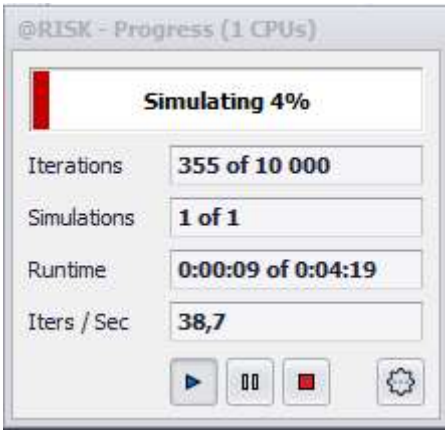


Figure 8.4.5.5 Excerpt of the Excel model. Progress window during the Monte Carlo simulation process. Source authors

Simulation results are illustrated in a distribution chart, and quantitative results are given:

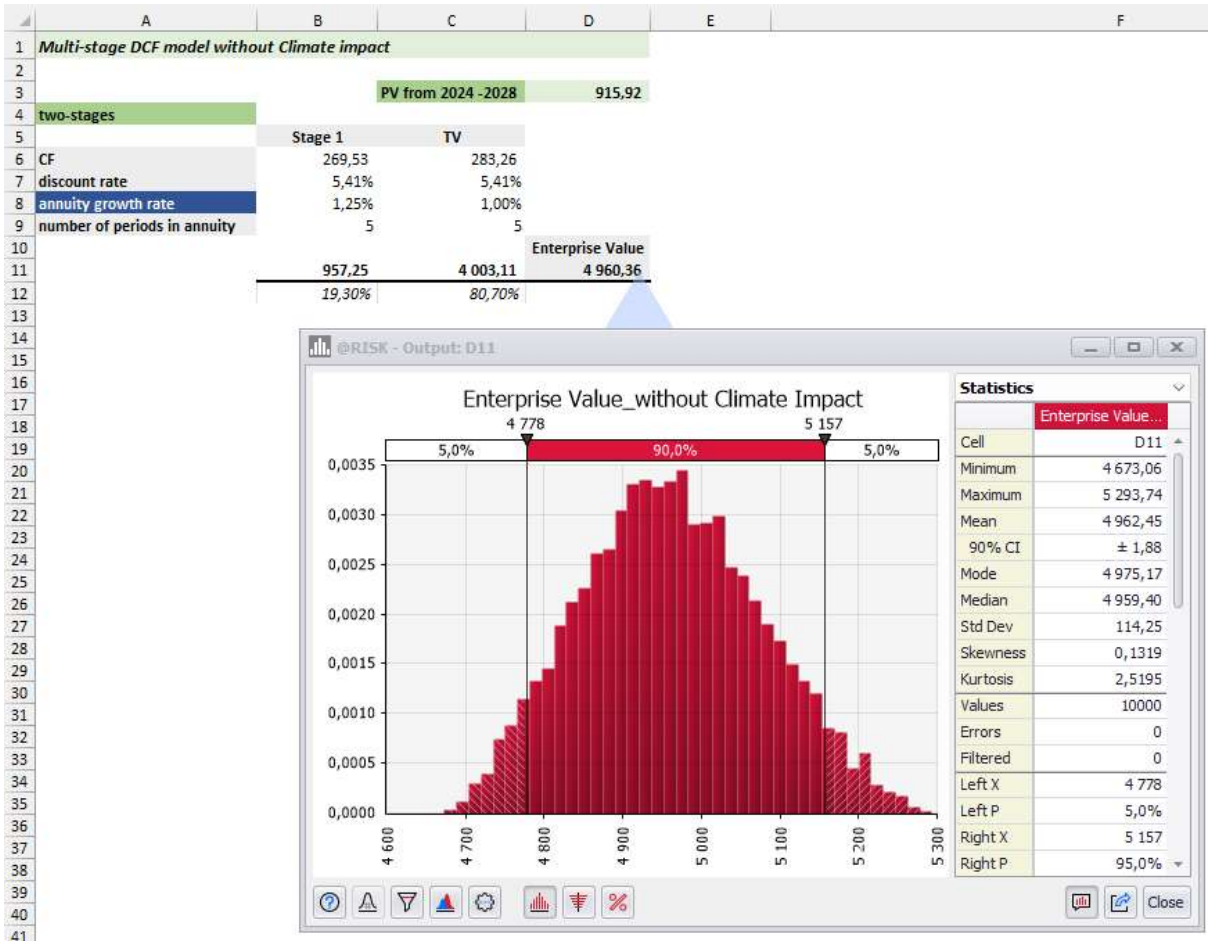


Figure 8.4.5.6 Excerpt of the Excel model. Output window of the Monte Carlo simulation in the DCF model without climate. Source authors

We obtain simulation results for all three scenarios.

@Risk output dashboard offers a condensed illustration of Enterprise Value distribution in all scenarios, combined with information about the relevance of the two annuity growth factors for the final result. The following illustration gives an example of the output:

Scenario 1: Enterprise Value without Climate Impact

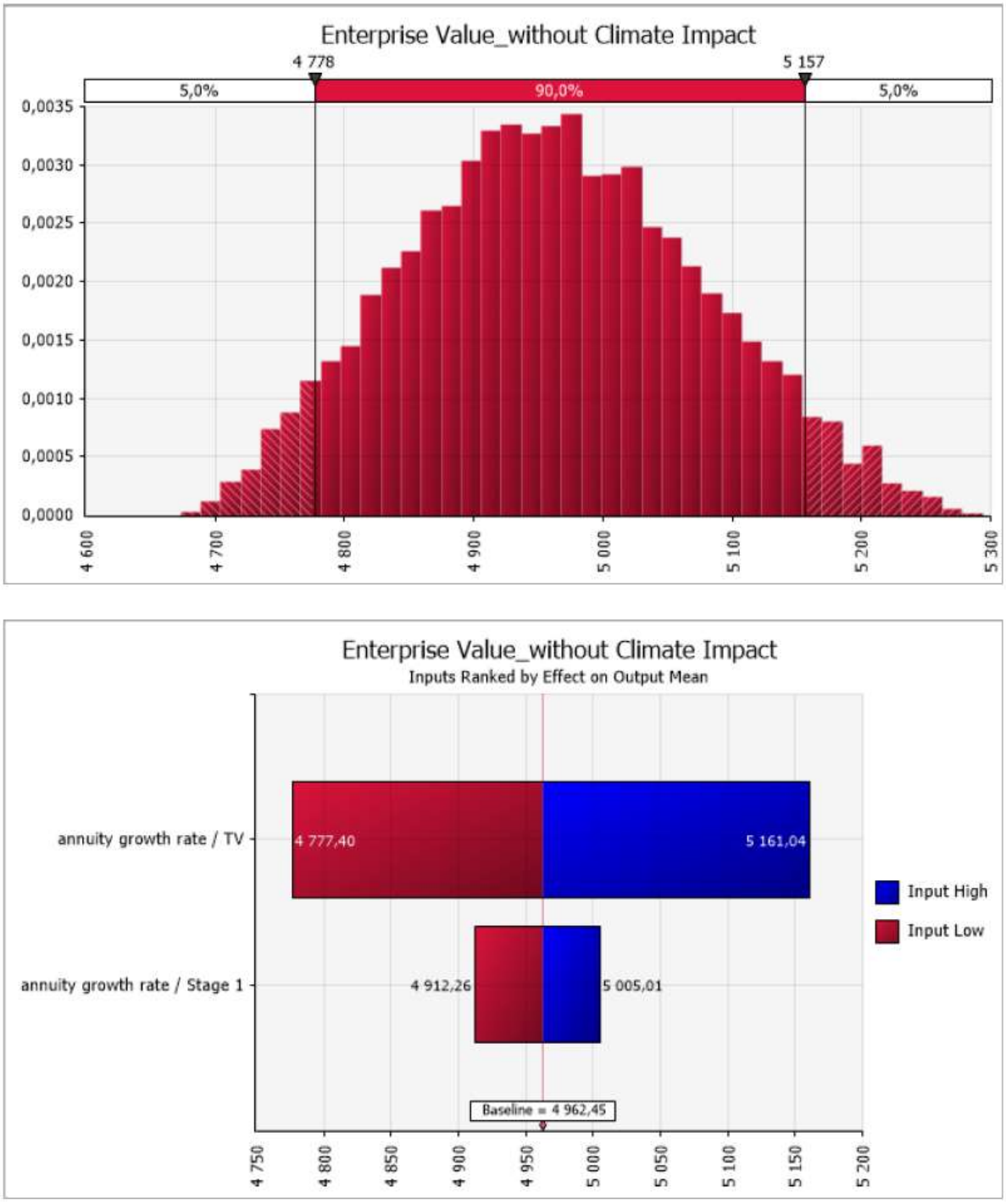


Figure 8.4.5.7 Output file of @Risk Monte Carlo simulation: Simulation results for the DCF model without climate. Source authors

Scenario 2: Enterprise Value under Climate Scenario RCP 2.6

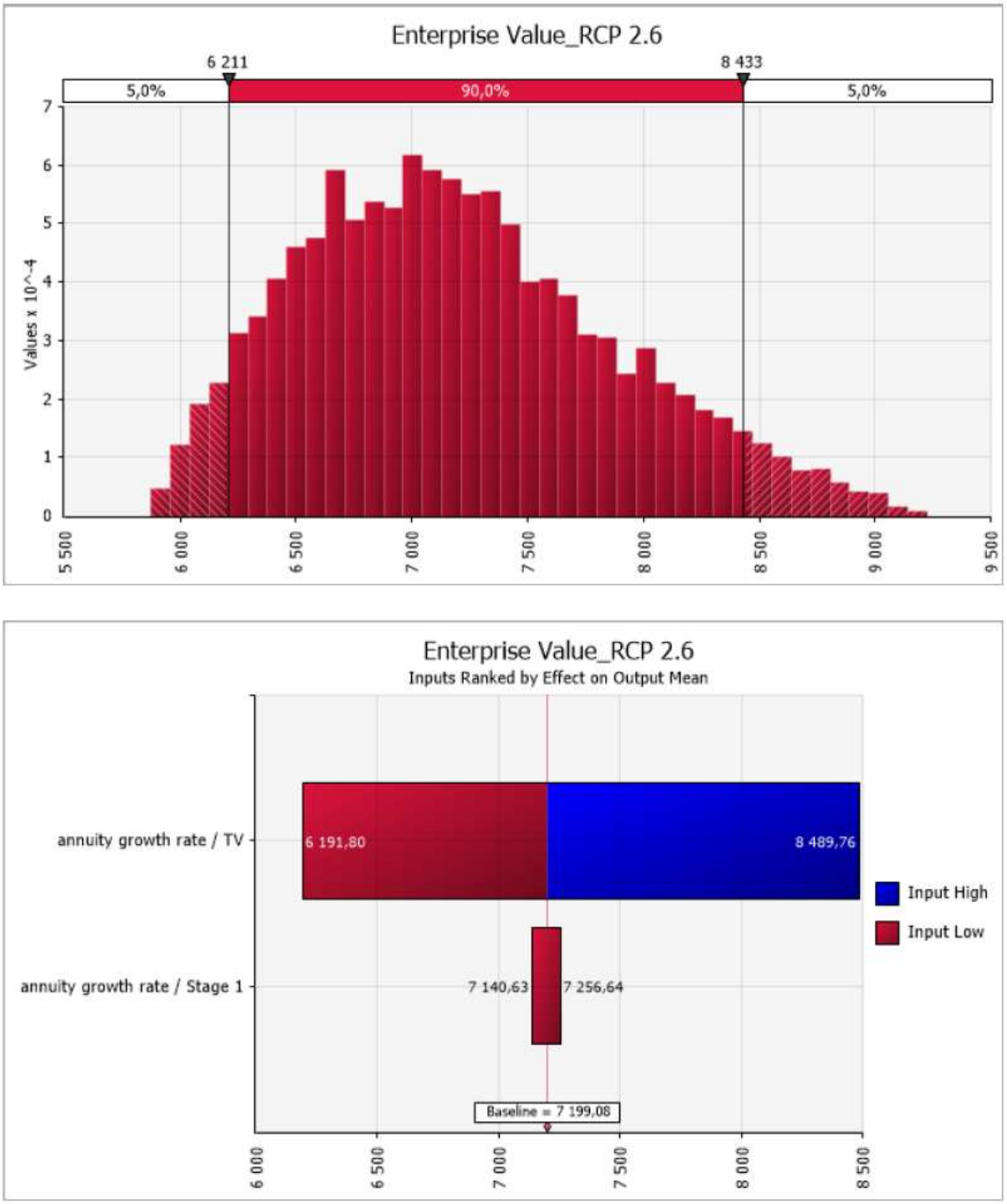


Figure 8.4.5.8 Output file of @Risk Monte Carlo simulation: Simulation results for the DCF model for Climate scenario RCP 2.6. Source authors

Scenario 3: Enterprise Value under Climate Scenario RCP 8.5

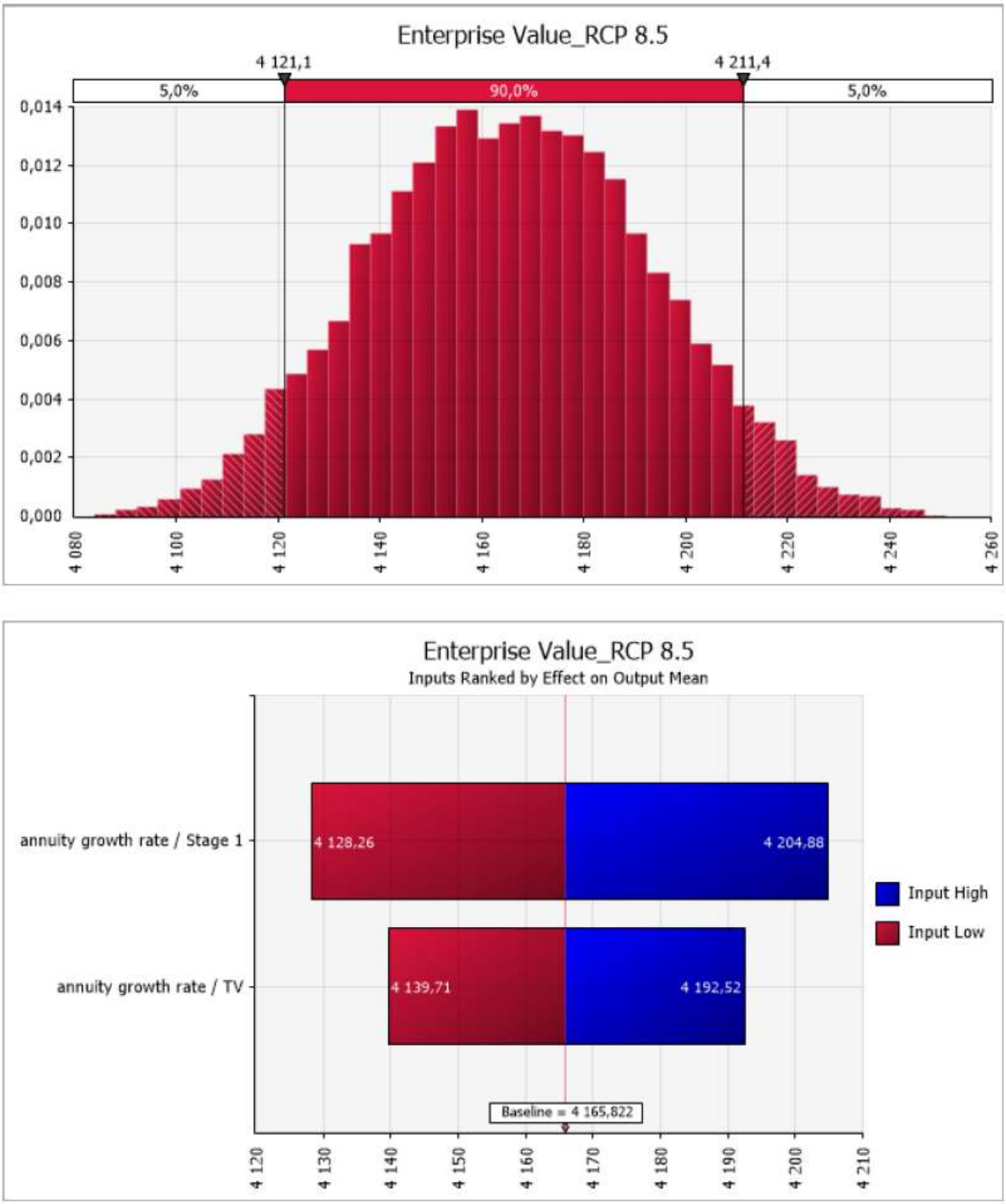


Figure 8.4.5.9 Output file of @Risk Monte Carlo simulation: Simulation results for the DCF model for Climate scenario RCP 8.5. Source authors

Additional to the output file information above, exact simulation data can be deducted from the @Risk model. For each of the simulated annuity growth rates, distribution information can be exported in order to ensure traceability of the results:

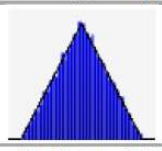
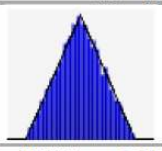
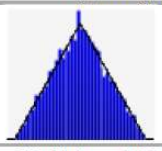
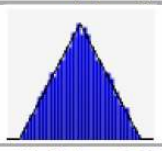
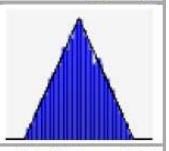
Detailed Statistics						
Input	annuity growth rate / Stage 1	annuity growth rate / TV	annuity growth rate / Stage 1	annuity growth rate / TV	annuity growth rate / Stage 1	annuity growth rate / TV
Function	RiskTriang (0,00875;0,0125 ;0,01625;RiskSta tic(0,0125))	RiskTriang (0,007;0,01;0,01 3;RiskStatic (0,01))	RiskTriang (0,00525;0,0075; 0,00975;RiskStati c(0,0075))	RiskTriang (0,0175;0,025;0, 0325;RiskStatic (0,025))	RiskTriang (0,00875;0,0125; 0,01625;RiskStati c(0,0125))	RiskTriang (0,0014;0,002;0, 0026;RiskStatic (0,002))
Graphs						
Cell	'Multistage DCF model'!B8	'Multistage DCF model'!C8	'Multistage DCF model'!H8	'Multistage DCF model'!I8	'Multistage DCF model'!O8	'Multistage DCF model'!P8
Statistic						
Minimum	0,88178 %	0,70045 %	0,52886 %	1,7540 %	0,88054 %	0,14018 %
Maximum	1,62354 %	1,29338 %	0,97233 %	3,2404 %	1,62453 %	0,25980 %
Mean	1,25217 %	0,99843 %	0,74827 %	2,5029 %	1,25064 %	0,19975 %
Mode	1,31503 %	0,97391 %	0,76313 %	2,5730 %	1,24217 %	0,20004 %
Std. Deviation	0,15218 %	0,12215 %	0,09145 %	0,3060 %	0,15456 %	0,02458 %
Variance	2,316E-006	1,492E-006	8,363E-007	9,366E-006	2,389E-006	6,043E-008
Skewness	-0,0061	0,0130	0,0178	-0,0018	-0,0039	-0,0033
Kurtosis	2,4205	2,4259	2,4255	2,3718	2,3681	2,3821

Figure 8.4.5.10 Excerpt of @Risk statistics output file: Detailed statistics of simulation results for annuity growth rates in the respective scenarios.. Source authors

The model's core output is the statitics on the location parameters of the resulting distributions for the enterprise values in the selected scenarios, which can be found in the following:

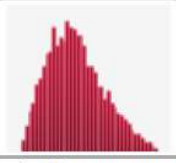
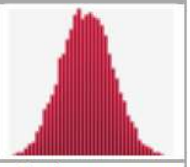
Detailed Statistics			
Output	Enterprise Value_without...	Enterprise Value_RCP 2.6	Enterprise Value_RCP 8.5
Function	RiskOutput ("Enterprise Value_without Climate Impact")	RiskOutput ("Enterprise Value_RCP 2.6")	RiskOutput ("Enterprise Value_RCP 8.5")
Graphs			
Cell	'Multistage DCF model'!D11	'Multistage DCF model'!J11	'Multistage DCF model'!Q11
Statistic			
Minimum	4 673,06	5 872,62	4 083,92
Maximum	5 293,74	9 226,19	4 251,00
Mean	4 962,45	7 199,08	4 165,82
Mode	4 975,17	6 710,10	4 166,12
Std. Deviation	114,25	671,62	27,18
Variance	13 053	451 072	738,8
Skewness	0,1319	0,4452	0,0416
Kurtosis	2,5195	2,6461	2,6529

Figure 8.4.5.11 Excerpt of @Risk statistics output file: Detailed statistics of simulation results for enterprise values in all three scenarios. Source authors

Additionally, quantile information can be deducted from the model:

Detailed Statistics			
Output	Enterprise Value_without...	Enterprise Value_RCP 2.6	Enterprise Value_RCP 8.5
Percentiles			
1%	4 728,18	6 011,78	4 105,73
2,5%	4 751,31	6 100,35	4 113,99
5%	4 777,80	6 210,72	4 121,10
10%	4 813,50	6 363,77	4 130,45
20%	4 860,63	6 591,78	4 142,02
25%	4 879,94	6 687,76	4 146,63
50%	4 959,40	7 132,50	4 165,83
75%	5 041,31	7 635,03	4 184,70
80%	5 063,17	7 779,36	4 189,30
90%	5 118,01	8 154,82	4 201,23
95%	5 156,79	8 433,29	4 211,39
97,5%	5 190,93	8 657,47	4 218,65
99%	5 220,15	8 868,92	4 227,38

Figure 8.4.5.12 Excerpt of @Risk statistics output file: Detailed statistics of quantiles for enterprise values in all three scenarios. Source authors

In order to elaborate results, the following table summarises key findings of the different simulations:

DCF Model Enterprise value simulation results: comparison

	Without climate impact	*Scenario 1 (RCP 2.6)*	*Scenario 2 (RCP 8.5)*
Mean	4 962.45	7 199.08	4 165.82
Std. Deviation	114.25	671,62	27,18
Skewness	0.1319	0,4452	0,0416
5% Quantile	4 777.80	6 210.72	4 121.10
95% Quantile	5 118.01	8 433.29	4 211.39
Dist. Mean – 5% Q.	-184,65	-988,37	-44,72
Dist. Mean – 95% Q.	155,56	1 234,30	45,57

Table 8.4.5.1 DCF Model Enterprise values comparison. Source authors

As can be seen in the table, in the scenario without climate impact, the distance of the mean (4 962.45) from the 5 % quantile is higher compared to the 95 % quantile, implying a risk of higher negative deviations. The standard deviation is 114,25, which we will use for comparison of the other scenarios.

As outlined in section 8.4.4, Scenario RCP 2.6 has a stronger focus on addressing physical climate impacts and the implementation of mitigation and adaptation activities, which, as a consequence, lead to the highest enterprise values. This is mainly due to the more stable financial outlook, leading to an increase in the company's attractiveness for investors, and therefore reducing financing costs.

Looking at the results of the Monte Carlo simulation, it can be deducted that the uncertainty considering the final enterprise values is higher, compared to the baseline scenario without climate impact. Standard deviation of the results is 671,62 (vs. 114,25). Nevertheless, the shape of the resulting distribution (Skewness 0,4452) points to the strong upside potential in

enterprise values. While the baseline without climate impact shows a downside risk in the distribution, scenario results for RCP 2.6 point to a significant upside potential: the distance of the mean (7 199.08) from the 5 % quantile is lower compared to the 95 % quantile, implying a risk of higher positive deviations.

This reflects that, due to the extensive mitigatory and adaptive actions, the more moderate influence of climate risk impacts on the financial performance, opportunities are created for growth potentials on the forecast level.

Those potentials are not visible in scenario RCP 8.5, which is primarily driven by changes in the growth rate, less benefiting from adaption measures. On the one hand, this is reflected in the lower mean for the enterprise value (4 165,82). Standard deviation is lower (27,18), and deviations of lower (5 %) and upper (95 %) quantiles are fairly balanced, leading to being stuck at lower values, without massive downside risk, but also lacking upward potential.

This underlines the necessity of not only focusing on direct climate risk impacts, but also assess implications and potentials from incorporating a clear view on strategic decision making in order to ensure long term and sustainable growth prospects.

The simulation results also show the importance of not only assessing climate scenario impacts based on one-point estimates, but to come up with a structural approach which incorporates deriving data based as well as expert estimated parameter value assumptions for the distribution of the key simulation variables for distribution estimates and long-term sustainability.

The key strength of the Monte Carlo approach is to enrich the basis for decision-making with an assessable risk structure of enterprise values, supporting the setting up of a sustainable risk management and mitigation strategy.

While the basic methodological idea is demonstrated based on variations of the annuity growth rate, an analogous approach can be easily followed when expanding the simulation model to variations of the WACC.

The strength of applying the triangular distribution is the compatibility with empirical data bases on the one hand, as well as assessing more qualitatively driven information based on expert estimates, leading to comprehensive and insightful entity value projections.

Summing up, this method offers a robust framework for integrating climate risk into financial forecasting, as shown in Figure 8.4.5.13 below:

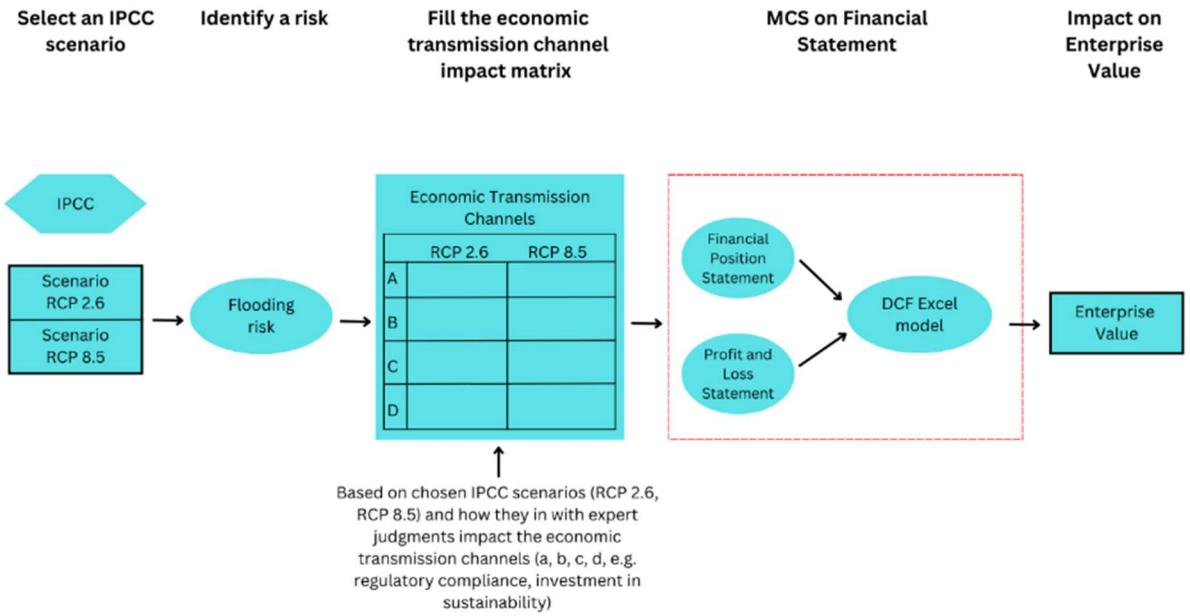


Figure 8.4.5.13 A framework for integrating climate risk into financial forecasting and enterprise valuation Source authors.

8.5 Case Study Take-Aways

Climate risk and opportunity simulations and stress tests are instrumental in assessing the resilience and adaptability of organisations in the context of environmental change. As suggested by the Task Force on Climate-related Financial Disclosures and taken up by the IFRS S2 and supported by science-based scenario data for example from the IPCC or NGFS, these analyses offer insight into how different climate-related parameters, both physical and transition risks (such as CO2 and energy prices), could impact asset and enterprise value. In this chapter, we show how climate-related risks may impact the IFRS financial figures and the factors in the DCF valuation method based on economic transmission channels. In addition, we propose a framework for integrating climate risk into financial forecasting and enterprise valuation

The contributions of this chapter revolve around financial implications of climate as well as the economic transmission channels risks to non-financial companies, and the framework for integrating climate risk into financial forecasting and enterprise valuation. This framework is usable for moving from climate scenario data via the economic transmission channels to actual impact on financial statements and enterprise value. A resulting Excel tool, which is currently under construction, based on the framework might have numerous application areas, some of which (certainly not exhaustive) are listed in the following paragraphs.

1. Banks: Stress tests can identify asset-class vulnerabilities tied to climate-related events, enabling prudent capital allocation and risk mitigation strategies. Regulatory bodies are increasingly incorporating climate stress tests in the financial sector's prudential oversight and disclosure requirements.

2. Assets: For asset managers and institutional investors, these simulations can inform strategic allocation by pinpointing assets that are particularly sensitive to climate-related risks (for example, real estate) or conversely, ones that could benefit from a transition to a lower-carbon economy.

3. Cash-Generating Units (CGUs): For businesses, evaluating CGUs under various climate scenarios aids in more accurate impairment testing. This is particularly critical for industries such as energy, agriculture, and real estate where asset utility along the value chains may be substantially impacted by environmental conditions.

4. Enterprise Valuations: Climate variables need to be integrated into cash flow projections and discount rates as well as terminal (de)growth rates. By doing so, investors can better estimate the future value of their investments.

5. Going Concern Judgements: The viability of a business as a going concern can be more precisely evaluated by considering its ability to withstand both physical and transitory climate risks. This impacts not only management’s internal assessment but also audit opinions and investor perception, also during restructuring and M&A activities.

These simulations and stress tests thereby serve multiple stakeholders: they guide internal management decisions, inform investors, and facilitate regulatory oversight. The complexity and interdependencies of climate risks make these tools not only advisable but increasingly essential for robust financial reporting and strategic planning.

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8.7 Appendix I: Summary of the Effect of Climate Scenarios

Scenario 1:	Aggressive Climate Action (RCP 2.6)
Timeline:	2025-2035
Narrative:	In this enhanced RCP 2.6 scenario, global efforts to curb emissions are more aggressive. Sweden experiences milder climate impacts with minimal flooding risks.
Economic Transmission Channels:	1. Regulatory Compliance: Stricter building codes and environmental regulations. 2. Investment in Sustainability: Need for green retrofitting and sustainable property development. 3. Market Demand: Increased demand for sustainable properties.
IFRS Impact:	**Balance Sheet:** 1. Investment Property: Increased fair value from climate compliance investments. 2. Property, Plant and Equipment: Slower decline due to extended useful lives of the properties. 3. Loans and Borrowing: Might increase to finance the sustainable practices and property upgrades **Statement of Comprehensive Income:** 4. Revenue Recognition: Boosted by higher rental earnings from sustainable properties. 5. Gains from Fair Value Accounting of Investment Properties: Increase and reflects the increase in fair value of investment properties 6. Expense Recognition: a. Depreciation Expense for Property, Plant and Equipment: Positively influenced by lower depreciation charges. b. Other Operating Expense Recognition: Increase in the short-term but will fall in the long-term due to sustainable practices and property upgrades. c. Financial Expenses: May decrease or increase based on sustainable finance and external financing.
Severity Assessment:	Low to Moderate with upwards opportunity potential. Costs are associated with compliance and green investments, but long-term benefits include higher property values and demand.

Table 8.7.1 Summary of Scenario 1: Aggressive Climate Action (RCP 2.6), risk narratives, and IFRS impact. Source authors

Scenario 2:	Limited Climate Action (RCP 8.5)
Timeline:	2025-2035
Narrative:	The world fails to adequately address climate change, following the RCP 8.5 trajectory. Sweden faces severe and frequent flooding, significantly impacting real estate operations.
Economic Transmission Channels:	1. Severe property Damage: Regular flooding leads to substantial property damage and loss. 2. Operational Disruption: Frequent floods disrupt rental operations and tenant businesses. 3. Market Devaluation: Property values decline due to increased risk and operational difficulties.
IFRS Impact:	**Balance Sheet:** 1. Investment Property: Assuming fair value accounting under IAS 40, the fair values decrease and therefore the carrying amount of the investment properties will decrease due to climate risks. 2. Property, Plant and Equipment: Decline due to impairment and higher depreciation charge. **Statement of Comprehensive Income:** 1. Revenue Recognition: Decrease due to lower occupancy rates and operational disruptions. 2. Expense Recognition: a. Loss of Fair Value Accounting: Decrease in Fair Value which leads to fair value losses in specific periods b. Other Operating Expenses: Increased repair and maintenance and insurance costs as well as higher insurance premiums c. Depreciation and Impairment of properties according to IAS 16: Significant impairments due to continual flooding risks and reduced useful life. d. Loss on Fair Value of Investment Properties: Using the fair value method under IAS 40 for investment properties will lead to a decrease of fair values, which is shown in a separate line item in operating profit. Borrowing costs: Arising from higher interest expenses
Severity Assessment:	High. The company faces substantial financial stress due to continuous property damage, operational disruptions, and market devaluation.

Table 8.7.2 Summary of Scenario 2: Limited Climate Action (RCP 8.5), risk narratives, and IFRS impact. Source authors

8.8 Appendix II: Information from SMHI.

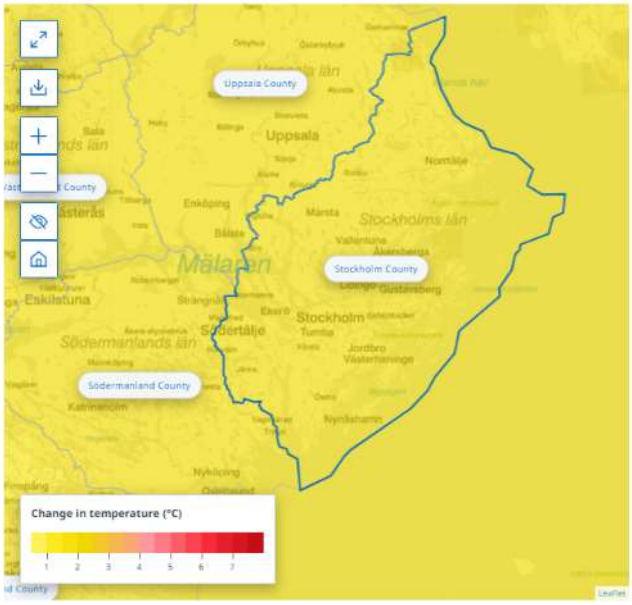

Figure 8.8.1 Change in temperature in Stockholm County in the period 2011-2040 under the RCP 8.5 scenario

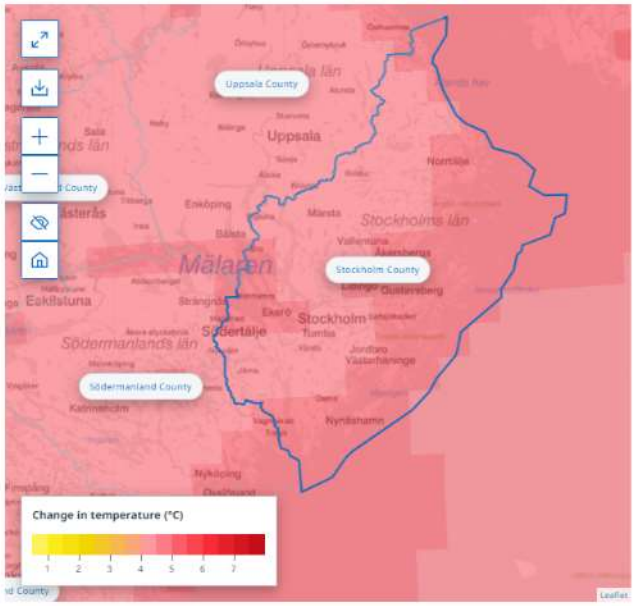

Figure 8.8.2 Change in temperature in Stockholm County in the period 2071-2100 under the RCP 8.5 scenario

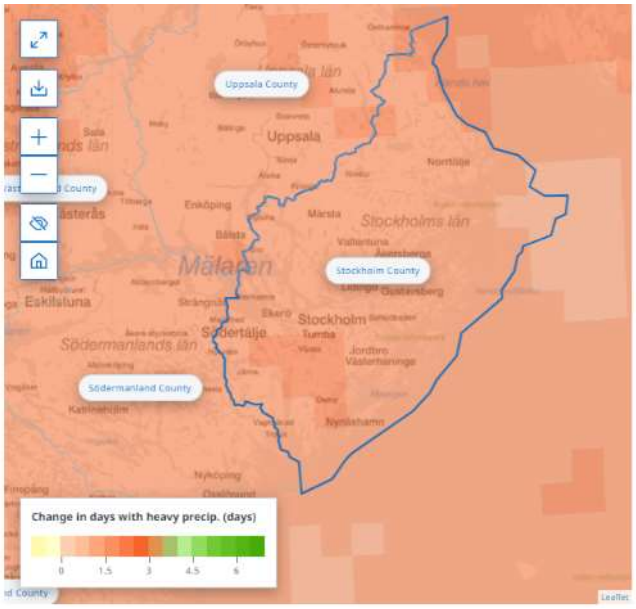

Figure 8.8.3 Change in days with heavy precipitation in the Stockholm County in the period 2011-2040 under the RCP 8.5 scenario

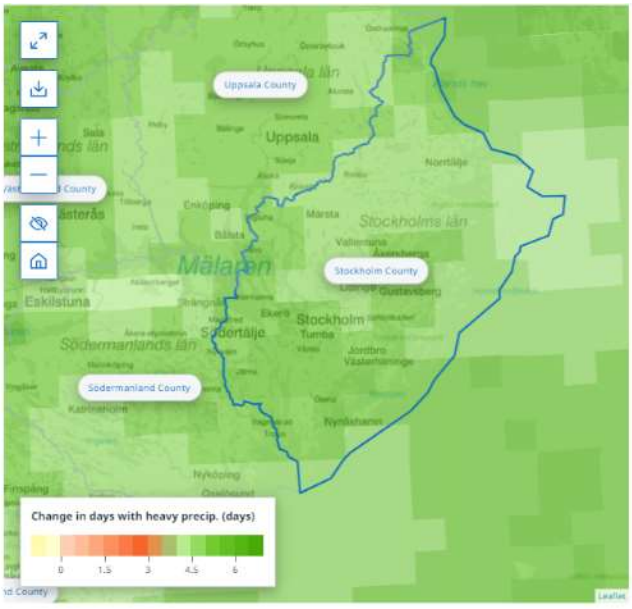

Figure 8.8.4 Change in days with heavy precipitation in the Stockholm County in the period 2071-2100 under the RCP 8.5 scenario

9 Report Summary and Main Take Aways

This comprehensive report, sponsored by NASDAQ Nordic foundation and the Hanken School of Economics, Helsinki, Finland with support from colleagues from the University of Applied Sciences Upper Austria elucidates the intricate connections between financial reporting, sustainability, and climate risks under the evolving ESRS/ IFRS S standards that both follow the TCFD structure and guidance. Through a detailed exploration, it offers practical guidance for Nordic companies in enhancing their sustainability reporting and strategic planning efforts.

Three primary takeaways emerge from the study:

1. **Intersection of IFRS Line Items and Economic Transmission Channels**: The report delves into how climate risks impact various IFRS line items, such as asset valuations, liabilities, revenues, and expenses. These impacts are channelled through physical risks like extreme weather events, and transitional risks, such as regulatory changes. Understanding these channels is crucial for accurate financial reporting and compliance with ESRS/ IFRS S2. For this a due diligence process and an interdisciplinary team structure between financial reporting and sustainability groups is very important, but would require a deeper understanding of the respective processes and logics that may not be easily achieved.

2. **Nuanced Approaches of Nordic Companies**: Analysing sustainability reports and conducting interviews with Nordic companies reveal varying levels of integration of sustainability frameworks into strategic operations and business models (as demanded by ESRS (for example in ESRS 2, SBM-3 or ESRS E1) and IFRS S2. While some companies demonstrate a high degree of alignment, others show only partial integration, highlighting the need for more comprehensive and comparable sustainability practices. The link between the financial reporting and sustainability reporting needs to be strengthened to provide consistent information to investors and stakeholders in general. The found variation suggests significant opportunities for improvement in climate scenario planning and disclosure practices as will be necessary due to regulatory and market pressures.

3. **Significance of Growth Rate Assumptions in Long-Term Planning**: A key insight is the critical role of growth rate assumptions over extended planning horizons when assessing the long-term impact of climate risks. Traditional five-year planning frameworks may not adequately capture the extended nature of these risks. This is especially relevant as both, IFRS S2 and ESRS demand to examine the impact of these risks over a short, medium- and long-term horizon. Emphasising sustainable growth rates provides a more accurate reflection of a company's resilience and adaptability, underscoring the importance of strategic long-term planning over rigid short-term approaches. To understand the growth rates under the impact of climate risks, the IPCC climate scenarios (as well as NGFS scenarios) provide crucial guidance, especially the IPCC/ RCP 2.6 is highly relevant as the regulators demand an analysis using a scenario that achieves the Paris climate goals of limiting global warming to 1.5 (2.0) degrees compared to pre-industrial times.

The report further underscores the necessity for companies to adopt robust quantitative methodologies, such as Monte Carlo simulations and DCF analysis over time, to assess climate risks effectively. These tools aid in understanding the impact of climate-related parameters on

financial metrics and enterprise value. The case study on the fictive real estate company EREL illustrates early practical applications, demonstrating how climate risks influence cash flow planning, discount rates, and terminal value growth factors.

Ultimately, this research contributes to a deeper understanding of how climate risks can/ and need ESRS and IFRS S2 requirements. It highlights the need for improved transparency and comparability in sustainability reporting to establish the link between financial and sustainability reporting, providing valuable insights for internal management, investors, and regulators. By fostering long-term resilience and strategic adaptability based on actual quantitative simulations and evaluations, companies can better navigate the challenges posed by climate change and contribute to sustainable growth.

We thank the NASAQ Nordic Foundation for their kind support for this research programme.

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