

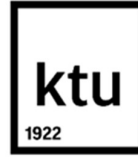
Kaunas University of Technology
School of Economics and Business

Effects of Climate-Related Matters on Financial Statements
Master's Final Degree Project

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Kaunas, 2022



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Accounting and Auditing (6211LX037)

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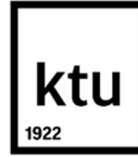
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Study field and area (study field group): Accounting, Business and Public Management.

Keywords: Climate change, Risks and Opportunities, Financial Statements, Sustainability.

Kaunas, 2022. 84 pages.

Summary

Climate change affects almost all economic sectors, just the impact of risks differs by sector, organisation, industry, and geography. One of the ways to mitigate climate change is to innovate and adopt financial instruments. Mandatory climate reporting can trigger an improvement in carbon performance because of legislative and societal pressure. Unfortunately, identifying and quantifying climate risks and opportunities seems to be a challenge for companies. The biggest issue for companies is that they have a lack of knowledge and skills to identify what scenarios could seriously disrupt the company's operations. Furthermore, there is no dedicated accounting standard related to climate-related matters, which leads to inconsistency in reporting. Just half of the reviewed companies included the results of their scenario analysis in their disclosures. In January, 2021, regulators released new reporting standards set by the Task Force on Climate-related Financial Disclosures (TCFD) requiring all commercial companies to develop more effective climate-related financial disclosures. Companies should assess which financial impacts are likely to impact their revenues, expenditures, assets, liabilities, capital and financing. Considering that, the main aim of the research was to develop a methodology to assess climate-related matters' effects on a company's financial statements. The objectives were created to highlight the issues related to climate change and their effects on financial statements, to analyse theoretical solutions to existing climate-related matters disclosure methods in the financial statements, to develop a methodology to identify climate-related matters disclosed in companies' financial statements, and to empirically investigate the effects of climate-related matters on a selected company's financial statements and make recommendations for other companies. Identifying risks and opportunities, stress testing, and scenario analysis are ways for a company to imagine plausible future worlds and plan for resilience. The main findings of the research revealed that accounting for climate-related matters is difficult due to uncertainty in calculation approaches. The biggest challenge is to evaluate "rebound effects" when future climate change might reduce energy usage and hence energy costs. Leading to increases in customers' incomes and hence energy consumption. For this purpose, a collaboration between accounting academics and the natural science sectors can mitigate the drawbacks of matters related to climate change disclosures in financial statements; otherwise, the matching of physical and monetary data should only be treated as an approximation. A deeper examination of the facts, however, reveals that some companies tend to report just because of ecological modernisation, which is nothing more than "greenwashing". Other companies just ignore measurements entirely. The research involved qualitative information to identify specific risk and opportunity areas affecting a company, supported where possible by high-level quantitative assessments to offer insight into how climate-related risks and opportunities may affect a company's existing and future financial statement line items. Future research can contribute to finding more systematic tools, allowing companies of all sizes and in different sectors to adapt data from different scientific research fields and studies.

Neniškienė Jolita. Klimato kaitos įtaka Finansinėms ataskaitoms. Magistro baigiamasis projektas / vadovas / vadovė Doc. Dr. Šviesa Leitonienė; Kauno technologijos universitetas, Ekonomikos ir verslo fakultetas.

Studijų kryptis ir sritis (studijų krypčių grupė): Apskaita, Verslas ir viešoji vadyba.

Reikšminiai žodžiai: Klimato kaita, Rizikos ir galimybės, Finansinės ataskaitos, Tvarumas.

Kaunas, 2022. 84. p.

Santrauka

Klimato kaitos poveikis turi įtakos daugeliui ekonomikos sektorių, tik rizikos dydis skiriasi priklausomai nuo organizacijos, pramonės, geografijos ir sektoriaus. Vienas iš galimų būdų kaip sušvelninti klimato kaitą yra pasitelkiant inovatyvias finansines priemones. Visuomenės spaudimas ir įstatymai reglamentuojantys klimato kaitą, gali prisidėti prie privalomo klimato ataskaitų teikimo ir prie spartesnio išmetamo anglies dioksido sumažinimo. Deja, rizikos ir galimybių nustatymas kylantis dėl klimato kaitos ir jų kiekybinis įvertinimas, vis dar yra iššūkis daugeliui įmonių. Didžiausia įmonių problema yra ta, kad joms trūksta žinių ir įgūdžių nustatyti, kokie scenarijai gali rimtai sutrikdyti įmonės veiklą. Be to, nesant dedikuotų apskaitos standartų klimato kaitai apskaityti, ataskaitų teikimas tampa nenuoseklus. Tyrimai parodė, kad tik pusė iš tirtų įmonių, savo pateiktose ataskaitose įtraukė su klimato kaita susijusių scenarijų analizes. 2021 m. sausio mėn. išleidus naujus ataskaitų teikimo standartus, susijusius su finansinės informacijos atskleidimo darbo grupės (TCFD) rekomendacijomis, visos komercinės įmonės turi pradėti rengti veiksmingesnias klimato kaitos finansines ataskaitas. Jomis siekiama, kad įmonės įvertintų, koks finansinis poveikis gali turėti įtakos jų pajamoms, išlaidoms, turtui, įsipareigojimams, kapitalui ir finansavimui. Atsižvelgiant į tai, pagrindinis tyrimo tikslas buvo sukurti metodiką, leidžiančią įvertinti klimato poveikį įmonės finansinėms ataskaitoms. Tyrimo uždaviniai - atkreipti dėmesį į su klimato kaita susijusias problemas ir jų poveikį finansinėms ataskaitoms, išanalizuoti esamų metodų klimato poveikiui įvertinti finansinėse ataskaitose teorinius sprendimus, sukurti metodiką, leidžiančią nustatyti klimato poveikį įmonių finansinėse ataskaitose, bei atlikti vertinimą kaip klimato kaita veikia pasirinktos įmonės finansines ataskaitas ir pateikti rekomendacijas kitoms įmonėms. Rizikų ir galimybių nustatymas, "stress testing" ir scenarijų analizė yra būdai, kurių pagalba įmonė gali modeliuoti ateitį ir tam pasiruošti. Pagrindinės tyrimo išvados atskleidė, kad apskaita susijusi su klimato kaita yra sudėtinga dėl skaičiavimo metodų neapibrėžtumo. Didžiausias iššūkis yra įvertinti „gražos efektą“, kai dėl klimato kaitos švelninimo sumažėja energijos suvartojimas, o tuo pačiu ir energijos sąnaudos. Vedant prie to, kad didėja vartotojų pajamos, o tuo pačiu ir energijos vartojimas. Šiuo tikslu apskaitos ir gamtos mokslų sektoriai turi dirbti išvien, tam kad sumažintų trūkumus ir prisidėtų prie skaidresnių finansinių ataskaitų teikimo. Kitu atveju, fizinių ir finansinių duomenų įvertinimas, turėtų būti skaičiuojamas tik apytiksliai. Išsamesni tyrimai atskleidė, kad yra įmonių, kurios yra linkusios pateikti duomenis tik dėl ekologiškumo tendencijų, o tai yra ne kas kita, kaip „greenwashing“. Dėl šių priežasčių, kitos įmonės tiesiog visiškai ignoruoja matavimus. Kokybinis tyrimas buvo atliktas, siekiant nustatyti konkrečias rizikų ir galimybių sritis, kurios gali paveikti esamus ir būsimus įmonės finansinių ataskaitų straipsnius. Ateityje atliekami tyrimai gali padėti atrasti konkretesnių įrankių, leidžiančių skirtingo dydžio ir sektorių įmonėms pritaikyti duomenis iš skirtingų mokslinių tyrimų sričių ir studijų.

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Introduction

It is not scientifically possible to assign individual weather events to climate change, but it is already known that global warming will influence extreme weather events. Therefore, climate change is one of the most sensitive issues on the world agenda today. There is plenty of evidence that climate change mainly refers to the increase of human activities on the earth, which is responsible for huge amounts of greenhouse gas emissions (GHG). In fact, the Paris Agreement acknowledges this threat and seeks a global agreement to keep the temperature rise below 2°C this century.

Climate change affects almost all economic sectors, just the impact of risks differs by sector, organisation, industry and geography. The true reality is that some companies, industries and activities will be affected more than others. Climate change can drastically alter a region's economic growth pattern due to temperature changes that increase the likelihood and severity of floods and other extreme events caused by climate change (Alzahrani, Boussabaine, Almarri, 2018). Those changes are the biggest threat to the economy and business activity. This is why companies are motivated to participate in climate change mitigation initiatives (Secinaro, Brescia, Calandra, Saiti, 2020).

The 2°C scenario analysis and targets set by policy initiatives formed the basis for the first mandatory climate disclosure in the world. Recently, the Financial Reporting Council (FRC) has pointed out reporting on climate-related matters as a key matter. But companies are still struggling to meet these needs as the reporting guidelines are still unmeasurable and uncertain as there is a lack of internationally recognised frameworks for companies to decide what information should be reported and how it should be presented. To ensure compliance with the Paris Agreement, many regulators are attempting to fill gaps by developing a set of criteria for determining quality in climate-related financial disclosure and developing reliable and valid instruments for stakeholders to assess the data.

One of the ways to mitigate climate warming is to innovate and adopt financial instruments. Over the last few years, there has been a greater awareness of climate change issues and how they affect financial statements. Now businesses understand how a global crisis could be crucial for the economy and how this might affect businesses around the world. Companies that face climate-related risks and opportunities are making strategic decisions in response as it impacts their financial statements. It could affect the company's assets, liabilities, revenue, operating costs and financing.

Multiple parties will need to work together to achieve a real change, but accountants need to be participants and collaborators who help companies understand and accurately quantify the financial impact of the identified physical and transitional climate risks. And, if companies continue to believe that climate risk has little impact on financial statements today, this may change quickly as a result of regulatory changes, strategic decisions, and shifts in weather patterns.

Studies provide that mandatory climate reporting can trigger an improvement in carbon performance because of legislative (reporting) and societal (disclosing) pressure, but it is still not sufficient to achieve national and international climate goals.

Historically, accountants have struggled to account for and systematically integrate nonfinancial value into financial reports. Relevance of the topic refers to how climate-related matters affect the financial statements and how reliable the information is for the stakeholders.

Research question

How to disclose climate-related matters in the company's financial statements?

Research Aim

To develop a methodology to assess climate-related matters' effects on financial statements.

Research Object

Disclosure of climate-related matters in the company's financial statements.

Research Objectives:

1. Highlight issues related to climate change and their effect on the financial statements.
2. Analyse theoretical solutions to existing climate-related disclosure methods in the financial statements.
3. Develop a methodology to identify climate-related matters disclosed in companies' financial statements.
4. Empirically investigate the effects of climate-related matters on a selected company's financial statements and make recommendations for other companies.

In these master theses, a full analysis of the problem will be conducted. This will address the reasons behind and the effect of climate change-related matters on financial statements.

Theoretical solutions to a chosen problem are presented in the second part of the theses. The answers to the remaining questions regarding climate reporting data consistency and how data inconsistency leads to different results will be presented. Additionally, obstacles to the identification of climate-related risks and opportunities will be assessed in the second part of the research along with the explanation of how to define the same benchmarks of materiality judgments to make the data imputation simpler. These include a discussion of quantifying climate-related risks and the effects of climate-related matters on financial statements. Furthermore, the methodology used in these theses for analysis is presented.

Finally, the analysis of the disclosures of climate-related matters on financial statements is carried out. In this analysis, the importance of accounting standards application, as well as their positive effects on sustainability disclosure, is demonstrated. Pursuing this further, obstacles in climate change reporting are identified and areas that could be developed further to enhance the quality of climate-related matters disclosure on financial statements will be presented. Those are then taken into account before making recommendations for other companies. The analysis is finally concluded with the general findings of these theses to answer the research question.

1. Consideration and Disclosure of Climate-Related Matters on Financial Statements

Without a sound understanding of climate-related risk, there can be no effective action. Disclosure of climate-related matters could be a powerful tool for companies to better understand their climate risks, support their strategy and set out potential areas for future business developments (Climate financial risk forum [CFRF], 2021).

1.1. Overselling Sustainability reporting for the Climate Change Mitigation

Businesses should become a lot more involved in mitigating climate change. The time to be just observers has passed. If companies do not become involved, the risk of having no effective global agreement on climate change is high. As a result, academics, executives, and consultants believed that disclosing sustainability or corporate social responsibility (CSR) reporting was one way to prevent this from happening. "NGO leaders have promoted a theory of how companies can prosper while pursuing a greener and more socially responsible agenda" (Pucker, 2021).

It was expected such outcomes:

1. Companies' performance in terms of social, environmental, and governance (ESG) will improve.
2. Companies with greater sustainability records will get higher equity returns.
3. Investors and other stakeholders will reward businesses that demonstrate superior sustainability performance while putting pressure on those who do not.
4. Methods for measuring social and environmental effects would become more precise and widespread (Pucker, 2021).

Not surprisingly, the literature shows the rapid growth of many companies measuring and reporting their sustainability-related data in the past 25 years. Boards, managers, investors, and other stakeholders increasingly focus on operations and corporate value. The European Union has taken the lead in the disclosure of CSR. The requirement of the 2014 Directive encourages companies to disclose "with respect to environmental matters, social and employee-related matters, respect for human rights, anti-corruption and bribery issues, and board and management diversity" (Dunlap, Grapsas, Vorlat, Loges, 2017).

Secinaro et al. (2020) note in the research that some scientific studies disclose that climate change is one of the factors that adversely affect a company's operations by increasing production costs in the short term and in general impacting companies' financial positions. Other studies argue that carbon emission reduction and proper disclosure in financial statements are positively linked to increased profits and market value of the company.

Speaking about adverse effects, an example could be building assets. The impact of climate change may limit their attractiveness in terms of rentals and value production, as extreme weather events cause damage to structures and pose dangers. As well, climate change plays a huge role in the tourism industry, as climate conditions influence its income. Hence, the understanding of climate change patterns and the effect they have on business assets is crucial, as companies need to design optimal timing policies and strategies to ensure timely management of such emerging risks and avoid their threats and losses to financial statements (Alzahrani et al. 2018).

While plenty of sustainability reporting frameworks are used for investors and other stakeholders, they can, of course, provide the required information related to ESG. However, this sustainability impact does not provide sufficient information about how climate change affects the business and their results, and just a casual observer could believe that this strategy is effective. A deeper examination of the facts, however, reveals that the influence of the measuring and reporting shifts has been overstated. In recent decades, the number of sustainability reports has been increasing. Still, carbon emissions and damage to the environment have continued to rise (Table 1). For example, the air quality damage costs keep increasing (Figure 1).

Table 1. Air quality damage costs from primary fuel use (Capon and Oakley, 2012)

2009 p/kWh. National gas use average. Source IAG.										
	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Gas (p/KWh)	0.04	0.04	0.05	0.06	0.07	0.09	0.11	0.13	0.16	0.2

As seen in Figure 1, corporate reporting on social and environmental performance has not reduced carbon emissions.

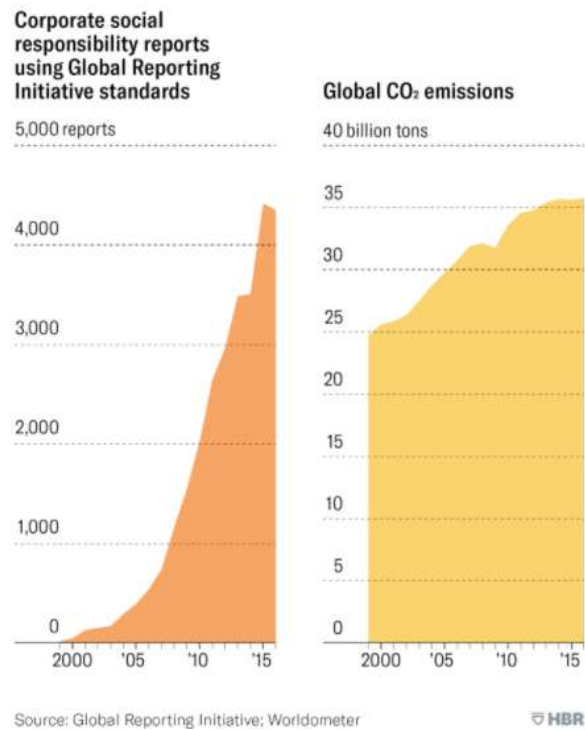


Fig. 1. Growing CO2 levels despite heightened attention (Pucker, 2021)

Evidence shows that because of misleading guidance in CSR reporting and nonstandard measurement systems, the disclosure of socially responsible investment is often just "greenwashing". Worse yet, according to Pucker (2021), "the focus on reporting may actually be an obstacle to progress—consuming bandwidth, exaggerating gains, and distracting from the very real need for changes in mindsets, regulation, and corporate behavior".

Despite the fact that it outlines what companies must reveal in CSR reporting, it is already evident that reporting does not support environmental and social progress and that reporting itself suffers

from some very serious problems. As a climate-change activist, Greta Thunberg noted, "the biggest danger is not inaction. The real danger is when politicians and CEOs are making it look like real action is happening when in fact almost nothing is being done, apart from clever accounting and creative PR" (Independent Global News, 2019).

Global Reporting Initiative (GRI) and the Sustainability Accounting Board (SASB) are working together to standardize ESG reporting standards. Over the last two years, successful projects have been launched to convince worldwide accounting standard-setters that these inadequate practices must be changed. That is why investors have insisted that not only do they want to see International Financial Reporting Standards (IFRS) properly applied, but they also want to know that the assumptions used are in line with a sustainable world as defined by the Paris Agreement (Pitt-Watson, 2021). Going forward, companies may be required under IFRS Standards to evaluate the consequences of climate-related issues while applying the principles to a number of standards.

1.2. The Importance of Climate-Related Financial Disclosures

In 2015, the Financial Stability Board (FSB) created the guidelines led by TCFD to describe climate-related disclosures. The framework introduced a range of recommendations on climate-related financial disclosures, stating that it might help many companies comply with existing disclosure requirements more efficiently. It encourages companies to disclose "climate-related financial information outside financial filings to facilitate the incorporation of such information into financial filings once these issues are determined to be material" (TCFD, 2017). The rapid shift of companies to climate-related matters has become a driving force for innovations to mitigate climate change.

Today, smart companies are relocating their sustainability responsibilities toward the finance function. This change is being made for a variety of reasons. Although reducing and adapting to climate change will require huge investments for the economy through 2030, at the same time, reducing GHG saves money. Companies that reduce their emissions also reduce their energy use, which is a significant company expense. Furthermore, because investors want to make climate-safe investments, they want climate risk to be included in the financial statements (Palmeiro and Gibassier, 2020).

Calculating the financial value of sustainability, such as pricing carbon emissions, does not necessarily help organizations better manage sustainability issues. Nevertheless, most businesses seek to quantify their sustainability impact by introducing an environmental profit and loss statement. Putting a price on social and environmental issues helps companies justify sustainability by demonstrating the costs and benefits of effective management (Palmeiro and Gibassier, 2020).

Preventative environmental initiatives are tangible. However, most businesses do not implement these initiatives into their strategies. Not surprisingly, companies often provide climate-related information in a way that makes it complicated to evaluate their performance or make a comparison to other companies. Existing research have demonstrated the disclosures of climate change's effect on financial performance. Unfortunately, research found that there wasn't enough information between accounting and climate change data to be able to figure out how this relationship worked. It was stated that "overall, by 2020, 72% of European companies will use different climate scenarios as the basis to inform their business strategies" (Secinaro et al. 2020). In addition, in many cases, it is complicated for users to identify and track climate-related matters on financial statements since there are no obligation for auditors to review them.

Disclosures should be collected, documented, and analyzed so that the data reported is verifiable and provided in a qualitative way. More specifically, the disclosed information should present relevant information about the company. Disclosures should be clear, accurate, balanced, and understandable. The data should "be comparable among companies within a sector, industry, or portfolio ". The assumptions should be traceable (TCFD, 2017).

Secinaro et al. (2020) findings state that climate change has been perceived as an adverse factor that affects a company's operations. It increases the company's costs, impacting its financial position in the short term, although proper disclosure of carbon emissions positively impacts the company's profits and market value in the long term.

There is some evidence that CSR requirements have important impacts on companies, but more on their internal operations and reputation than on the external environment itself. Therefore, the impact of carbon reporting seems modest, as some companies tend to report just because of ecological modernisation, which is nothing more than greenwashing (Tang and Demeritt, 2017). As a result, regulators seek to improve climate-related disclosures and expect companies to evaluate their risks related to changing climates to minimize financial shocks. Investors are demanding that companies quantify their exposure to climate-related risk, which they assess as major and important. And corporate executives are beginning to observe an increase in financial losses as a result of climate-related severe weather occurrences. Furthermore, climate change-related expenses are already obvious in business and industry but are being unaccounted for on a balance sheet, leaving companies and investors unprepared and insecure. Instead of financial statements, most climate-related disclosures are provided in annual and corporate governance reports. The financial statement notes should address particular issues and assumptions (AASB_AUASBJointBulletin, 2019).

Going forward, a company may be required to report climate-related information even if it did not recognize any meaningful impairment, losses, or disclose any of these risks in its financial statements, but stakeholders would expect it to. Companies need to explain which sections of their financial statements may be impacted or why their financial statements are not impacted by such risk.

Accounting for climate change should be part of regular financial reporting, with appropriate internal controls for the CFO and audit committee. It means that companies' directors' focus on climate-related issues will require them to be more thorough and promote quantitative financial disclosure of metrics affecting asset impairments, cash flows from operations, net income, access to capital, and so on.

In general, companies must disclose climate-related issues in mainstream corporate reports, as well as the impact on existing financial reporting standards and procedures. The International Accounting Standard Board (IASB) recently underlined how climate risks may be material to assets and liabilities, and so to corporate profits (IFRS, 2019). As O'Dwyer and Unerman (2020) state, there are financial reporting implications that affect financial statements: "asset impairment, goodwill valuation; changes in the useful life of assets; changes in the fair valuation of assets; effects on impairment calculations because of increased costs or reduced demand; changes in provisions for onerous contracts because of increased costs or reduced demand; changes in provisions and contingent liabilities arising from fines and penalties; and changes in expected credit losses for loans and other financial assets". CDSB (2018) seeks to provide information on how IFRS could contribute to reporting on climate-related matters.

1.3. Climate-Related Financial Reporting Considerations

Looking forward, the primary goal for businesses is to connect the climate risk team with the financial accounting team. That would help to assess the materiality of climate risks in the context of financial statement line items, assess the level of detail disclosure and the impact on the financial statement items, and review the assumptions made to evaluate how the risks reflect the company's profile (Deloitte, 2020).

1.3.1. Challenges in Quantifying Climate-Related Risks within an Organisation

Generally speaking, the financial implications of climate-related matters are not always evident and direct, and many companies may find it difficult to disclose them effectively. Key reasons for such uncertainties are the lack of knowledge of climate-related issues within the organisation, which complicates the identification of such risks, focusing on near-term risks and not taking into account risks that may arise later, and challenges in quantifying climate-related risks (TCFD, 2017).

It is critical to evaluate how climate-related matters are going to affect a company's future financial statement line items. Once the company assesses the issues related to such risks and determines the action plan, then it may evaluate the potential financial impact on "revenues, expenditures, assets, liabilities, capital and financing" (TCFD, 2017).

The development of a company's capability and ability to access relevant climate-related scenario analysis seems to be a challenge for the company. Therefore, the climate risk team, with their innovative interdisciplinary academic research, must be connected to the financial team to help companies face this challenge (O'Dwyer and Unerman, 2020).

For example, evaluating the likely incidents and outcomes of material physical risks from climate change within the company will entail complex scientific knowledge as well as an understanding of the impact of climate change on various raw materials and physical infrastructure in various locations (O'Dwyer and Unerman, 2020).

For producers to be able to improve decision-making and estimation of future events related to climate change, there is a need for more integrated, strategic information systems. Such solutions will assist both the climate risk team and the accountants in facilitating evidence-based scenario planning, which is essential for a successful response to a biophysical catastrophe (Tingey-Holyoak and Pisaniello, 2020).

Of course, market-intelligent organisations have created an asset-level database that allows for more extensive scenario analysis due to possible standardisation and accounting rule selection, which is actively maintained, but according to Thomä et al. (2018), this type of data still has its gaps. First of all, there is a lack of transparent formal auditing, which leads to complications in comparing the ownership of a given asset due to a different database that consists of conflicting information. Furthermore, the data sets are not harmonised across different industrial sectors and different business activities, which leads to difficulties in the consolidation of results. In the long run, more systematic tools will be expected to allow companies of all sizes and in different sectors to adapt data from different scientific research fields and studies.

Working between accounting academics and natural scientists will provide exciting opportunities to contribute to transforming business practices and lead toward a zero-carbon economy. Natural science

scholars at a university might have access to insights from environmental science research. In cases where there are gaps in such data, a bigger effort by scientific research might be needed to fill up these gaps (O'Dwyer and Unerman, 2020).

1.3.2. Assessment of the Materiality of Climate-Related Risks

The need to focus on disclosures of material issues in financial statements is critical. There is an overview of current guidelines and regulations on how to assess the materiality of climate-related issues. IFRS (2019) states, that the importance of disclosure is that companies should focus on "climate-related risk in the context of their financial statements rather than solely as a matter of corporate-social-responsibility reporting". One of the problems with financial statements is that they include "too much irrelevant information and not enough relevant information" (IFRS, 2019).

IFRS Standard IAS1 (IFRS, 2019) "emphasizes that an assessment of materiality must be made on the basis of size (quantitative) and nature (qualitative factors), or a combination of both".

Materiality is an important factor in assessing the company's evaluation of the risks and opportunities it faces, and there is no exception for climate-related matters as well. According to the AASB AUASB Joint Bulletin (2019), information is significant if it is missing or misrepresented because it might influence users' decisions based on financial data.

Unfortunately, the concept of materiality has rarely reached a complete agreement. The Task Force acknowledged that "the financial impacts of climate-related issues on organizations are not always clear or direct" (TCFD, 2017). Even though TCFD seeks to simplify the process of materiality judgment, it still covers a mixture of different groups and different time frames (O'Dwyer and Unerman, 2020).

These complications of materiality judgment are provided in 2019 TCFD Status Report. The report states that companies do not identify risks and opportunities in their strategies and risk management disclosures, resulting in them not being able to determine what risks the company views as material. Furthermore, there are uncertainties about which material issues should be disclosed in mainstream reports and which issues should be disclosed in sustainability reports. Research shows "that only 29% of material issues disclosed in sustainability reporting were also disclosed in the risk section of mainstream reports". For all of these reasons, TCFD suggests that sustainability and finance experts collaborate closely. Unfortunately, these two groups of professionals frequently use different concepts of materiality (O'Dwyer and Unerman, 2020).

While climate-related matters are not covered in a clear and detailed manner by IFRS Standards, they clearly state the issues that relate to them. In a publication of IFRS, there are guidelines presented for a better understanding of materiality. The document explores:

- Board guidelines on materiality judgments
- Application of "IFRS Practice Statement 2" for a better understanding of material judgment
- Concerns about financial reporting while using IFRS Standards
- Accounting for climate-related and other developing risks in financial statements
- An explanation of the financial statements' context
- Materiality judgments in terms of investors' requirements (IFRS, 2019).

As provided in IFRS Practice Statement 2 (2021), "materiality judgment is pervasive in the preparation of financial statements and entity makes materiality judgments when making decisions about recognition and measurement as well as presentation and disclosure". Companies should apply IFRS standards in case the data is accessed as "material to the complete set of financial statements". A company also considers, that the primary users will have reasonable knowledge of business and economic activities and will be able to read the financial statements diligently.

IFRS Practice Statement 2, (2021) has four steps for determining what is important when making financial statements:

"STEP 1- identify. Identify information that has the potential to be material.

STEP 2- assess. Assess whether the information identified in Step 1 is, in fact, material.

STEP 3- organise. Organise the information within the draft financial statements in a way that communicates the information clearly and concisely to primary users.

STEP 4- review. Review the draft financial statements to determine whether all material information has been identified and materiality considered from a wide perspective and in aggregate, on the basis of the complete set of financial statements".

The IFRS Practice Statement 2 (2021) gives an example where a company may be required to disclose information in financial statements even if it has not recognized any meaningful impairment, has not affected the financial statements in any manner, and has not been exposed to any climate-related risks. In fact, if investors have a reasonable expectation that such information would be disclosed, a company is required to so.

In conclusion, the main focus is to underlie these materiality concerns and answer the question of how climate-related financial disclosures could be incorporated into the "mainstream corporate reporting model" (O'Dwyer and Unerman, 2020).

1.3.3. Detailed Disclosure within Financial Statement Line Items

Currently, available literature includes a variety of overviews of existing requirements and recommendations, which might assist investors in assessing the performance of a company and determining the relevance of climate-related risk to their decision-making. The significance is that disclosing climate-related risks is no longer just a question of CSR. Companies may be required to address them within the scope of their financial statements (AASB AUASB Joint Bulletin, 2019).

What companies are still learning is how to quantify, monetary estimate, and communicate the financial implications of climate risks. The risks and opportunities and their financial impact are presented in TCFD recommendations 2017 as without such disclosures, it would be hard to get the required information for decision-making.

Companies are now disclosing some information. However, the possible financial statement line items that might be impacted by climate change include as follows:

- **Asset impairment.** The impact of climate change on cash flow forecasting and the cost of capital will have an impact on the "value in use" and fair value estimates. The movement away from carbon-intensive industries may result in stranded assets.

- **Asset useful life.** Climate change could lead to the decline of residual value and asset useful life. Companies should be aware that assets will continue to operate as usual in the future.
- **Changes in asset fair value due to climate-related and emerging risks.** A company should not assume that they would be able to dispose of the asset after the asset's useful life at the current equivalent market prices.
- **Higher expenditures and lower demand for goods and services, triggering impairment estimations and imposing onerous contract conditions.** Climate change risk and uncertainty must be included in cash flows and discount rates. Existing contracts may become onerous if the expense of fulfilling a contract increases, for example, as the cost of electricity or water increases.
- **Provisions and contingent liabilities that may arise as a result of fines and penalties.** New provisions due to new obligations or existing requirements that are now deemed probable. The timing of the needed financial flows may differ. Disclosure of provisions, contingencies, and onerous contracts is influenced by regulatory measures, especially asset decommissioning obligations. Regulators are taking steps that affect provisions, contingencies, and onerous contracts. For example, asset decommissioning rules have an effect on how these items are recognized, measured, and disclosed. Policy and regulations measures may have an immediate effect- as an exit from the nuclear power. Or it could be a more gradual impact- such as a carbon tax.
- **Changes in expected loans and other financial asset losses.** Climate change may also have an influence on financial assets such as loans receivable or trade receivable. A severe weather event, such as a storm, may have an influence on an individual's ability to repay. That affects the recoverability of mortgages. The value of the collateral may also be impacted (Delloite, 2019).

Accounting standards require the disclosure of key judgments and estimates. The judgments to which climate scenario management can see this as the most likely are used in the preparation of the cash flow forecasts. Moreover, other measurement decisions may be a major source of estimation uncertainty, in which case it may be disclosed most clearly. In addition, there may be significant uncertainty regarding assumptions within the scenario chosen, in particular on individual recognition, measurement, and valuation decisions. Information about these assumptions and the level of sensitivity of these assumptions should be appropriately disclosed (Deloitte, 2021).

Figure 2 shows the main climate-related risks and opportunities that businesses should consider.



Fig. 2. Climate-Related Risk, Opportunities, and Financial Impact (TCFD, 2017)

Transition Risks involve policy and legal, technology, market, and reputation risks, where increased regulation implies changes in business operations, which result in increased expenses, or even more-changes in consumer behavior require long-term changes in business models (TCFD, 2017).

Acute and chronic physical risks include an increase in extreme weather phenomena, which can influence the supply chain and cause disruptions in logistics and the business site network.

It is advised that risk be disclosed for each given timeframe that might have a major financial effect on the business.

Opportunities include aspects such as resource and energy efficiency, products and services, markets, and resilience. Companies may develop and provide solutions to consumers to assist them in reducing their environmental effects, as living, food, and mobility are the key sources of greenhouse gases in private consumption. In this case, companies should consider new business models, climate-responsible products, increased energy efficiency, and other transformations.

Consideration of *AASB/IASB Practice Statement 2 Making Materiality Judgements (APS/PS 2)* is more important for those companies that are directly influenced by climate-related risks. According to TCFD, such sectors include "financial services, energy, transportation, materials, construction, agriculture, food, and forest products" (TCFD, 2017). Climate-related issues, for example, may have an indirect influence on the financial services business "via their client portfolios, such as impaired loans, higher insurance claims, or lower equity holdings" (Li, Michaelides, Rose, Garg, 2019).

There is no dedicated accounting standard related to climate-related matters, and for many companies, there are a lot of uncertainties considering the impact of climate change. There is a challenge for companies to recognise and measure the assets and liabilities in their financial statements as all judgments and assumptions will be based on applying the requirements of existing accounting standards (KPMG, 2021).

The analysis of the first chapter emphasised the importance of combating climate change, despite the challenge of properly disclosing events related to climate change. In response to this matter, the existing methods to disclose climate-related matters in a company's financial statements are going to be studied in the following sections of this research.

Even though the new TCFD recommendations were released in June 2017, to comply with the Paris Agreement, there are still a lot of issues as there are a variety of data sources describing the reporting of financial risks from climate change. It highlights the dramatic gap in the current gathered knowledge on this topic. "Corporate reporting at the physical asset level is often inconsistent in terms of timeliness of disclosure, accounting principles, and coverage in terms of both geography and type of asset and/or reporting entity" (Tingey-Holyoak and Pisaniello, 2020).

For climate scenario alignment analysis, the climate units should be expressed in the metrics for the data to be comparable. Currently, there are limitations and uncertainty around the benchmarks that are being applied in measuring and consolidating the data. According to Ross (2021), the decision is left to the managers on whether and how to present that information in the financial statements. As a consequence, it is still challenging for investors to evaluate the strategies, results, risks, and performance of different companies. Furthermore, because climate reports are not audited, such climate-related information must be presented in such a way that auditors can detect if the financial statements lack key information and are free of substantial misstatements.

Sustainability metrics have not yet been incorporated into the public accounting standards. Despite this absence, mandatory nonfinancial reporting has been increasing. To address these new demands, sustainability accounting reporting initiatives have been spread all over the world to provide companies with standardized reporting metrics. Provided examples by Gibassier, Arjalies, Garnier (2018) include "Global Reporting Initiative 2002-2017, Sustainability Accounting Standards Board (SASB), Climate Disclosure Standards Board, International Integrated Reporting Council (IIRC), Greenhouse Gas Protocol, International Organization for Standardization (ISO) standards on life cycle assessment", material flow cost accounting, water accounting, sustainable brands, Carbon Disclosure Project, social life cycle assessment, the Natural Capital Protocol, and so on. Meanwhile, some public bodies have proposed what should be included in sustainability accounting. Moreover, an increasing number of educators have incorporated sustainability into their accounting curricula.

The major focus and challenge for companies in proper disclosure of climate-related matters in financial statements are having a lack of knowledge and skills to identify which scenarios could seriously disrupt the company's operations. Once the nature of climate-related risks and opportunities is presented in TCFD, both accounting academics and natural science sectors must develop competence in incorporating this risk information into their management processes. Collaboration between two parties can mitigate the drawbacks of matters related to climate change disclosures in financial statements. The research notes how essential it is to link biophysical and accounting data streams into the business as the best estimates of the management are no longer enough for proper disclosure of financial statements. Therefore, these two parties need to work hand in hand to get complex knowledge of CO₂ offsets, information on environmental taxes, or provisions that need to be recorded.

The varied lack of uniformity across sectors, as well as the varied terminology, make it difficult to assess disclosures against TCFD recommendations and compare them to peers. Another problem is

that it is concluded that companies may still struggle to evaluate the risks that would materially impact the company and fully understand and incorporate the probability and impact of climate-related risks and opportunities into their analyses. Just half of the reviewed companies included the results of their scenario analysis in their disclosures, even though companies admitted that they conducted scenario analysis but did not provide results (Chartered Professional Accountants of Canada [CPA], 2021).

Conclusions are drawn from the analysis by experts that shows that companies are increasingly disclosing information on climate-related risks and opportunities in their financial statements, but the major challenges companies face still remain. Unless regulators move forward and verify that the information given by companies is accurate and complete through accounting standards and assurance requirements, the information disclosed by companies will not meet the criteria.

Some studies indicate improvements in climate-related disclosures, but they still lack the scale and quality needed to satisfy investor demand. Previous studies have focused mostly on voluntary reporting. In this thesis, the focus will be directed at the effect of reporting climate change through mandatory regulations and considering the performance at the company's level. The research will highlight that a mandatory climate reporting regime might be a suitable instrument to improve climate reporting data and assess how this information affects financial statements. The rest of this work will work toward the exploration of this research problem. By exploring both formal knowledge based on available literature and practical knowledge gathered from empirical evidence, the aim is to bring new ideas and findings to the academic field.

2. Theoretical Solution to the Effects of Climate-Related-Matters on Financial Statements

As noted, concerns about financial accounting practices relating to climate-related matters are invisible to the general public and most policymakers have a considerable impact on financial statements. This section aims to provide insights on how to address existing climate change issues from a theoretical perspective. Therefore, in this section, a thorough description of the existing theories, methods, and practices regarding climate-related matters' disclosures on financial statements was evaluated. In the beginning, the research directions of existing research were presented. Following this, the existing methods, materials, techniques, and theoretical frameworks used by other researchers were presented. The main purpose of this section is to get a better overview of the current position in the industry, to provide constructive empirical insights into what occurs when international standards are not in place, and to help carry out the research that is needed to answer the research question.

2.1. Research Directions of Climate-Related Matters and its Reporting

Climate change has become a serious problem in the world, and its threats face several risks in many sectors of society. An analysis of studies on possible financial risks arising from climate change scenarios was performed. Understanding how and when certain climate risks, particularly financial risks, may arise is critical to limiting losses (Alzahrani et al. 2018).

Climate accounting, which is defined as the accounting of climate-related impacts underlying financial instruments, has emerged as a major issue for financial institutions, governments, and civil society organizations. Despite a growing body of research on climate accounting, there are not enough applications found that govern accounting frameworks, methods, challenges, and gaps. It's also important to note that existing research focuses on data gaps rather than the accounting principles used in financial reporting (Thoma et al. 2018).

Recent extensive analysis on climate accounting and accountability focus mostly on the term "environmental", "social", and "eco-efficiency", which has many different meanings. It includes information about corporate sustainability measurement, management, and stakeholders' engagement in the climate accounting development process. GRI provides tools to make it easier to collect the data and prepare reports. Subsequently, following internal carbon GHG accounting, was used to assess the liabilities of tradable rights stemming from emissions taxes and trading systems (Gulluscio et al. 2020).

The majority of the analysed articles focused on accounting and external reporting. Articles directly focusing on auditing and governance have not been found. In terms of accounting, the majority of publications concentrated on carbon and GHG accounting. In particular, it was focusing on the concept of climate change accounting, the gaps in measurement and comparison, inconsistency, and deficiency of accounting standards. As for external reporting, the analysed articles focused on stakeholders' pressure on climate reporting, the present status and main characteristics of corporate climate disclosures, the investors, asset owners, and management role in climate change disclosures, relationships and expectations of mandatory and voluntary disclosures, and climate change measurement and comparison methodologies. In terms of research techniques, the majority of these studies have been examined through case studies, surveys, or interviews.

As long as this research is focused on climate-related matters and how they affect financial statements, in the following sections, the existing methods and research directions of climate accounting are going to be explained by referring to existing literature.

It is recommended (TCFD, 2017) that a company's reports on climate-related issues be presented in a more targeted and auditable manner. Rather than producing reports in an inconsistent and incomparable way, they should first develop clear and objective measures for the most relevant and immediate ESG issues. According to Kaplan and Ramanna (2021), reporting GHG would be the ideal point to start. GHG is treated as the most dangerous to the planet, but at the same time, it is the easiest to measure among ESG. Despite that, as research shows, reporting still has some serious errors, as some emissions are reported twice, while others have been ignored by some companies entirely. The solution to overcoming these problems has been presented by Kaplan and Ramanna (2021).

To continue with GHG accounting, Ramirez and Gonzales (2013) have considered the accounting of carbon assets and their treatment in the financial statements. Despite the growth of the carbon markets and the climate change economy, the accounting standards still do not have the necessary consensus. Therefore, in their research, the different positions of applications adopted by regulators and companies have been presented.

Bebbington and Gonzalez (2008) focus on accounting issues, mainly related to the valuation of pollution allowances and their recognition as assets and liabilities arising due to pollution. In addition, a closer investigation has been conducted into the accounting and reporting of risks and uncertainties that arise from climate change. It described the results of a precautionary approach to accounting and reporting for climate-related matters.

Capon and Oakley (2012) in their recent research have emphasised the importance of looking at the present and future risks and opportunities as it is a fundamental strength of the research. It discussed climate-related risks to the Built Environment industry. "Urban heat island, building overheating, flood damage, and water supply and demand" are examples of such concerns. Many potential concerns have been discovered in the Climate Change Risk Assessment (CCRA) methodology, but have not been investigated. It was based on current research outputs and government evaluations, and it contained a list of key assumptions and uncertainties about the assessment (CCRA, 2012). One of them states that climate change risks for any industry can only be completely understood if the sector's adaptation capability is considered. According to Tingey-Holyoak and Pisaniello (2020), many primary producers lack the necessary tools to deal with climate-related risks, so effective collaboration between the financial and natural scientist sectors is critical.

It is very complicated to predict the likelihood of risks related to climate change that will occur in the future and their timescale of occurrence. According to the literature, climate change risks and the inability to predict the future lead to changes in financial statement line items, such as damage to companies' assets, reduction of property, insurance problems, increased liabilities, and many others. Even worse, these severe events can disrupt nearly one-quarter of worldwide supply-chain matters. For instance, floods in Thailand and earthquakes in Japan have a remarkable effect on business profit (Wagner, 2012). Work disruption in the construction sector reduced the profit growth of many companies worldwide. All of the identified financial losses could be measured by evaluating the costs of damage. Climate change's potential financial risks have been analysed by Alzahrani et al. (2018).

The most important factors have been distinguished as restricted access to getting insurance, increased costs of insurance, and inability to pay debts.

In regards to credit status, banks are under rising pressure on how to protect their finances and ensure the services they provide to their clients. Eceiza, Harreis, Hartl, Viscardi (2020) have described the main principles for climate-risk management in the banking sector.

As evidenced in the literature, there is growing concern about chaos in financial reporting. This provides researchable problems on how to incorporate TCFD reporting into mainstream business reports. Integrated reporting is a rapidly growing area of accounting and finance research. Over 400 business and management journals that were indexed by Scopus in 2020 have integrated reporting in their articles. *"Accounting, Auditing, and Accountability Journal"* alone produced two special issues on this subject in four years. For an area that has only been around for 10 years, this is a huge research output (O'Dwyer and Unerman, 2020). Accounting guidelines currently do not allow any exclusions for climate risk, but just a few companies make it clear in their financial statements how they account for such risks.

To effectively integrate climate-related risks and opportunities into corporate-level risk analysis and management procedures, companies and the financial industry must learn how to do TCFD-style climate scenario analysis. O'Dwyer and Unerman (2020) analysed the challenges companies face in this regard. The materiality of the resulting risks is an important consideration in both undertaking and reporting on climate-based scenario analysis and also integrating it into corporate-level risk management processes. The same literature points out that it is hard to apply monetary concerns to issues related to climate change.

The climate change risks and whether it is material from the investor perspective have been introduced by Amel-Zadeh (2021). The conducted survey examined the importance of climate change for investors' decisions and investigated what kind of risks is posed by climate change. The results revealed that even though investors have not considered the importance of climate risks disclosures in the past, the view has been changed and it is believed that climate change is financially material to companies and in particular to "resource-intensive" sectors.

This sort of corporate reporting framework, which focuses on identifying the financial impacts of climate-related risks and dependencies rather than the impacts of a company on climate change, presents several issues. When high-level academic research is used to solve these difficulties, it is more probable that they will be managed more successfully. Despite the opportunity and demand for research in this area, TCFD reporting has yet to be examined in academic accounting or finance literature (O'Dwyer and Unerman, 2020).

Bearing in mind the complexity of reporting, CDSB (2018) presented recommendations on how to adapt existing standards and create new ones. Understanding the standard's role in accounting is important. New things are constantly standardised about what has previously been standardised, yet existing standards and classifications are always being revised; there is a constant tension between continuity and change. Challenges have emerged for climate change issues to enter into the world of financial accounting and fit into the existing standards. There are many different types of global financial accounting, but none of them has been updated to account for things like global warming (Lovell, 2014).

Lovell (2014) in the article investigates the unresolved attempts to implement financial accounting standards for GHG allowances. Theories concerning the role of standards may help to explain the hidden work of standards in society and explain why certain items are difficult to standardise. However, there are significant gaps in understanding how standards fit into larger processes of policy and future innovation. The idea is to investigate the function of standards in the market and to give insights into the relationship between climate change and standards. Thoma et al. (2018) observed the consequences of the complexity of accounting standards. It was suggested that a greater focus must be given to the accounting decisions that underlie climate accounting. Their analysis of fundamental accounting principles revealed that, in many situations, no one principle governs them all. Rather, the most appropriate accounting rule depends on the specific case. Moreover, the accounting rule chosen will have a big influence on the final results. Accounting issues discussed in the article cause considerable discrepancies in the findings, with no or even a negative connection between the two indicators in certain circumstances. Thoma et al. (2018) emphasize the variety of accounting decisions used in the "context of climate accounting for financial portfolios". The problem is that these accounting decisions are made in the absence of a unified basis in an accounting framework appropriate for the issue of climate change.

Table 2 below summarizes the research directions that investigate the level and reliability of climate change-related matters disclosed in companies' financial statements that are popular and relevant to different industries, including the actual methods used by research and the results of those findings.

Table 2. Suggested approaches from the existing literature

Research direction	Reference	Research method	Main aim	Results
Accounting for carbon emission allowances and Greenhouse gas emission (GHG)	Ramirez and Gonzales (2013)	Surveys	To investigate the effect of carbon emission accounting in financial statements. To analyse specific issues in reporting carbon assets.	Different treatment of carbon asset in financial statements; Lobbying; Artificial volatility of results in companies; Double entry.
	Kaplan and Ramanna (2021)	Field study	To present a solution for better measure of environmentally damaging outputs.	Eliminates duplicative counting; Reduces manipulations; Can apply materiality threshold specific to GHG; Reports can be audited.
	Lovell(2014)	Surveys Case study Interviews Analysis of Standards	To classify carbon asset and set accounting rules for emission allowances.	A complex, uncertain and messy process of application of accounting standards.
Accounting and reporting for the risks and uncertainty related for global climate change (GCC);	Bebington and Gonzalez (2008)	Survey Interview	To show the importance of accounting involvement in the communication of risks and uncertainties.	Lack of communication between companys and stakeholders; Information is unreliable and inconsistency.
	Alzahrani, Boussabaine, Almarri (2018)	Surveys	To discover financial risks emerging from climate change related matters.	Increased insurance excess and expenses; Inability to repay debts.
	Tingey-Holyoak and Pisaniello (2020)	Case study	To highlight the importance of accounting-integrated systems to make judgments of uncertainties.	More efficiently collaborations between financial and natural scientist sectors needed.
Materiality judgment	Amel-Zadeh (2021)	Survey	To examine the importance of climate change for investment decisions; To investigate what kind of risks is posed by climate change.	The increased pressure of regulators and increased threats of litigation towards pollution; The resource-intensive sectors are most sensitive to climate risks.

Recommendation and application of Accounting Standards	O'Dwyer and Unerman (2020)	Surveys	To problematise and demonstrate the early stage of development of TCFD.	Needs To develop new practices; Challenges to understand climate-related scenario planning; Climate related materiality determination; Challenges of implementation of TCFD reporting.
	Barth, Chen, Cahan, and Venter (2017)	Systematic and comparative analysis Synthesis of analysis results	The importance of interaction between financial and non-financial information.	Positive association between integrated report quality and company's value.
	CDSB (2018), TCFD (2017), IFRS (2021), KPMG (2021), Deloitte (2021)	Field study	To inform and shape policy developments.	A set of standards haven't been adjusted for a new accounting item as climate change; The areas of potential financial implications is presented.
Tools for measure and manage climate related issues	Capon and Oakley (2012)	Survey Interview Theoretically simulated case studies.	Loss and damage related to climate change attribution issues.	Measures do not simple match to losses and damages, so informed judgments about probable costs should be done.
	Thoma, Dupre, Hayne (2018)	Surveys Interview Secondary statistics data Third-party source	Overview of accounting principles and implications of choosing different rules.	Difficulties to allocate economic activities to financial instruments.
The concept of climate change accounting.	Wagner (2012)	Interview	The expectations of climate policy and relations to companies strategy.	Optimistic case fo climate policy.

This theoretical literature study revealed that the existing articles in the literature related to climate change accounting are not well developed, particularly among practitioners, implying that professional standards for this topic have yet to be determined. By assessing the literature review, it was found that about 30% of the authors of these articles are not typical "accounting scholars" who usually write on climate accounting, but also scholars who in parallel included climate change accounting issues in their research. In fact, this is the way it should be, as climate accounting should be analysed and research done in collaboration among people from different research areas (Thoma et al., 2018).

In conclusion, this part of the research has indicated several areas where climate change accounting and reporting research is needed. To begin, accounting for climate change requires the relatively simple creation and implementation of basic accounting rules to guarantee that accounts reflect an accurate and fair picture of the financial consequences of "pollution allowances". Furthermore, there is a need for companies to cooperate with their stakeholders about the risks associated with Global Climate Change (GCC) and how to clarify uncertainties. This shifts the conversation to non-financial reporting, which has already begun to put a strain on the accounting field (Bebbington and Gonzalez, 2008).

To start analyzing the mentioned problems, first, the main principles will be evaluated to reach theoretical solutions. Understanding the financial impact, as well as other risks and opportunities posed by climate change in general, can simplify the working mechanism of the different methods that will be studied in the following chapters.

2.2. Accounting for Carbon Emission Allowances

This section of theses describes the existing methods, materials, and techniques used for accounting for carbon emission allowances as carbon asset recognition may impact the accounting balances in many different ways.

Lovell (2014) investigates the unsolved issue regarding financial accounting standards for GHG allowances. Because of the constant revision, it is hard to keep track of standards and their classifications. The research has been done in the following aspects: the first is the assessment of relevant literature on standards. In the second part, the theories of markets and government have been assessed. Third, focusing on strategies in regards to understanding and defining standards related to emission allowances. Finally, conducting research on new policies and guidance to understand the current ones.

Theories on the role of standards help to explain why certain things are difficult to standardise. It is still unclear how standards fit into broader policy and technological transformation processes. The idea is to investigate the relationship between standards and climate change. The results of a case study show how climate change is used in practice. Since emission allowances are "incommensurable," accountants have tried to learn more about emission allowances by comparing them to more common accounting items like government grants, taxes, and leases. The findings actually demonstrate how difficult it is for accountants to judge emission allowances (Lovell, 2014).

Another example from the results of Lovell (2014) concerns various methods of accounting for emission allowances. According to the IASB, even when emission allowances are used in different ways, they are still the same item. In other words, accountants should treat them uniformly. The complexity of using emission allowances is at the core of the standardisation effort. The main complication is how to handle numerous uses of emission allowances; people and companies use emission allowances to comply with regulations, offset their emissions voluntarily, trade and profit from them. It is noticed that the purpose and identity of emission allowances are misunderstood in both financial accounting and carbon markets. Because there is not a single international standard dedicated to climate-related issues, companies in different parts of the country and in different industries have made their own rules for how to account for emission allowances.

Ramirez and Gonzales (2013) have considered the accounting of carbon assets and their treatment in the financial statements in a very detailed manner. Despite the growth of the carbon markets and the climate change economy, the accounting standards still do not have the necessary consensus. Therefore, in their research, the different positions of applications adopted by regulators and companies have been presented.

First of all, it was difficult to assess how to treat a carbon asset on a balance sheet. According to accounting nature in a certain environment, a carbon asset could be treated as inventory, or in other cases, as a financial instrument, or even as an intangible asset. After long discussions with regulators, it was decided to treat carbon assets as intangible assets, as such recognition would be the most appropriate approach.

The second issue was the initial recognition and its value. According to the standards, if the assets have been acquired at a fair value, this price will be their initial value. But in fact, most of the companies' emissions rights are received from governments for free or at a very low price, usually lower than their fair value.

The third issue considered is measurement and recognition. The survey results revealed the differences in statements due to the valuation of a carbon asset on a balance sheet. Also, it was mentioned that after recognising the carbon asset, it could be revaluated according to standard IAS 38 as "other comprehensive income". But, when these assets are liquidated, the gains recorded in

equity will become part of the distributable funds, and what would the consequences be if they were utilized to offset emissions? Furthermore, some companies may apply different approaches when carbon units are received for free: they are treated as donations or subsidies, or, according to standard IAS 20, they could be shown as liabilities. And lastly, there is one more option for recognising a carbon asset: as income directly in the result of the year for those freely received carbon assets.

The 2010 financial report uses data from the financial records of major European greenhouse gas emitters to classify, quantify, and report the companies' emissions. The findings revealed that accounting for emission allowances requires the use of more than one standard, which financial accountants must interpret with reasonable care. For example, the International Financial Reporting Interpretations Committee (IFRIC) ruled that free allowances should be "measured initially at their fair value (market price, which is currently around 4 euros per tonne of CO₂ but historically has been as high as 20 euros per tonne) and the difference should be classified as a government grant". In terms of liabilities, emissions should be recognised as "provision" and accounted for following IAS 37 ("Provisions, Contingent Liabilities and Contingent Assets"), and measured at "fair value" (Lovell, 2014). It indicates a lack of clarity in the definitions and principles of IFRS. According to IFRIC-3, certain "gains and losses" should be shown in the income statement while others should be shown in the equity statement, resulting in a mixed presentation model, and some "emission allowances" should be measured at cost while others should be measured at "fair value" (Lovell, 2014).

As a result, it was recognised by standard setters that in many cases, the standard does not prescribe the specific procedure, and companies, as well as auditors, should select the most appropriate ones according to the circumstances.

Taking into account that evidence, such different accounting and reporting lead to lobbying. As a result, while evaluating how characteristics related to climate risk impact financial statements, Ramirez and Gonzales (2013) also analyzed how these practices are being developed. It must be emphasised that it was discovered with the help of PricewaterhouseCooper (PwC) that entrepreneurial activities have resulted in acts that are not entirely compliant with the IFRSs.

To continue with GHG accounting, Kaplan and Ramanna (2021) for emission liability accounting proposed two steps. First of all, the quantity of GHG could be estimated by environmental engineers, as they understand this area the best. Second, using "activity-based costing" (ABC) to allocate overhead and other expenditures to the products and services that were made or provided at a certain time.

Other studies and solutions proposed by Kaplan and Ramanna (2021) include current improvements in emissions measurement by environmental engineers. The system improvement will allow GHG reporting to achieve the relevance and reliability that is now required of corporate financial reports. At the same time, clear and specific guidance for measuring and reporting GHG emissions was provided in their article, as well as conclusions regarding the difficulties of "tracking emissions from suppliers and customers across the value chains, making it virtually impossible for a company to reliably estimate numbers".

As an example, a manufacturer of car doors provided a challenge in which the company must track all GHG emissions from its "upstream suppliers' " processes, including the extraction, transportation, production, and other inputs. The car-door company must additionally estimate the cost of transporting the car door to its client, manufacturing the finished automobile, transporting the car to

a showroom, and servicing the vehicle by the end-use consumer for up to 15 years (Kaplan and Ramanna, 2021).

As a result of uncertain futures, companies are required to think more long-term and include more forward-looking disclosures in their corporate reports. The estimation of all of those emissions, as specified, results in significant measurement error, which leads to bias and manipulation, particularly for businesses with long, complex, and multi-jurisdictional value chains, as well as for governments and other organizations. Therefore, many companies just ignore the measurements entirely.

The solution proposed by Kaplan and Ramana (2021) incorporates a core business measuring task—exploring how cost and financial accountants calculate a company's value-added. When a car door manufacturer measures its value-added, it does not estimate all of the prices paid by all companies at all levels of its value chain. Rather, each company just records how much it spends on products and services from its suppliers, as well as how much it earns when it sells items to its consumers. The same idea could be applied to GHG emissions.

Similar to how companies "report on their opening inventory, annual purchases of raw materials, finished goods produced, cost of goods sold, and closing inventories, companies may report on the stocks and flows of their emission liabilities" (Kaplan and Ramanna, 2021). There would be taken into account "net emission liabilities at the beginning of a period, emission liabilities acquired, net emission liabilities produced during the period, emission liabilities disposed of, and net emission liabilities at the end of the period" (Kaplan and Ramanna, 2021).

Such an accounting system has several advantages, including eliminating double-counting, minimizing incentive manipulation, and the ability to apply materiality rules. Several major ESG reporting standards already require corporations to disclose whether environmental issues pose a significant financial risk to the company. As a result, many GHG-intensive activities remain undetected since they have no meaningful influence on a company's financial accounts. Regardless of the financial effect, the emission-liability system may apply a materiality threshold for GHG. Furthermore, a company's end-of-period emission liability balances, like its financial assets and liabilities, can be traced by auditors (Kaplan and Ramanna, 2021).

The findings revealed that accounting for carbon and GHG emissions is difficult due to uncertainty in calculation approaches. While waiting for new emissions-liability guidelines, larger companies may take action by voluntarily adopting this approach and encouraging their entire supply chain to do the same. This might give a competitive advantage by proving to environmentally conscious stakeholders that the company is working to reduce total-value-chain GHG emissions.

The fact that standards are produced by specialists in their fields—whether farmers, plumbers, engineers, or physicians—makes the study of standards complicated. For example, financial accounting standard setters are unfamiliar with the concept of carbon markets. Accountants' strategy of linking "emission allowances" to "fishing quotas or reproduction rights" may seem unusual to non-experts, but it makes sense to accountants. With the IASB's principles, it is a practice-based reaction to the continued uncertainty (Lovell,2014).

2.3. Accounting and Reporting for the Risks and Uncertainty Related to GCC

For climate-change critics, in particular, the risk of being proven incorrect in the coming decades might be expensive. The effects will include disruption of the company's operations, property damage, disruption of supply chains and infrastructure, higher maintenance and material costs, and raised prices. Some businesses and services may benefit from climate change by increasing market share, creating wealth in communities, and getting access to new financing sources (European Commission, 2021).

The sources that trigger the occurrence of risks are directly related to temperature, floods, and extreme events. Alzahrani et al. (2018) concentrate on their research on financial risks that may arise as a result of climate change scenarios. The literature review claims that climate change financial risks would impact buildings and real estate in both direct and indirect ways. Direct risks include damage repair or component replacement costs. Indirect financial risks include occupant and employee productivity issues, as well as insurance problems. Climate change will accelerate economic losses by increasing population migration away from affected regions, driving up living standards' costs and increasing pressure on services and resources. The amount of financial risk is claimed to be dependent on both the factors of location and market condition. These variables impact administrative and operational costs, as well as taxes. An increase in temperature will restrict access and road use due to erosion and landslides, causing further disruptions. As rainfall patterns change, drought and soil moisture get worse, which damages buildings and increases maintenance expenses. Temperature changes are expected to exacerbate the soil moisture issue. This will result in higher financial losses and fewer available lands and places appropriate for development and construction projects, causing a price discrepancy.

The theoretical literature overview performed by Alzahrani et al. (2018) formulated the research methodology. The financial risks that come from climate change scenarios were identified and presented to specialists. The survey findings were statistically ranked and compared. The research uses a questionnaire to assess climate change risks in the sector. A study found that 23 financial risks occurred due to climate change (Figure 3). The research study used descriptive statistics to examine the questionnaire by determining the lowest and highest risk. In general, the research was achieved by considering three steps: (1) investigating the causes of climate change, (2) identifying the potential risks that could directly influence the damage, and (3) systemising risks in a practical way.

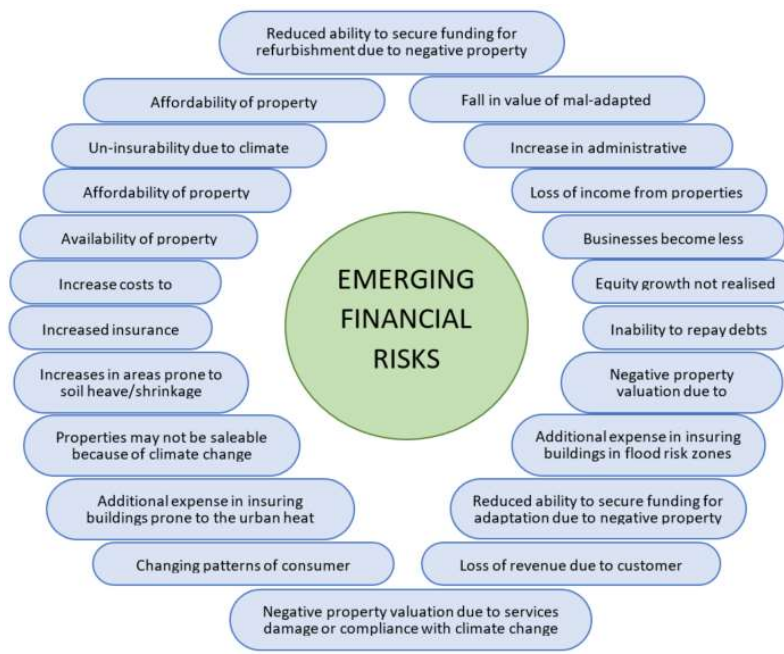


Fig. 3. List of identified emerging financial risks (Alzahrani et al., 2018)

The results have shown that the private sector is more sensitive to costs that may affect its balance sheet. The most likely risks to occur due to climate risks have been identified as: "increased insurance excess", "additional expense in insuring buildings in flood risk zones", "increased costs to purchase" and "increase in administrative expenses". Climate change has influenced the way businesses operate. This knowledge is important for developing policies, processes, and procedures to deal with and manage these new risks (Alzahrani et al. 2018).

Roberts (2008) identified the whole chain of impacted regions in the construction industry due to climate change. Climate change will require a new building design. Warmer temperatures, more intense and rainy weather, and higher subsidence risk are just a few. Flood risk regions will increase, requiring both initial protection and fast recovery measures. In such flood zones, property insurance may be costly or impossible to get. Depending on the risk of flooding, the value of mortgages in the high-risk zone might increase eight times by the mid-2050s, making the mortgage business suffer a potential loss (Capon and Oakley, 2012).

Consequently, in a low-or zero-carbon society, new buildings must use fewer fossil fuels. Passive measures such as improved airtightness and thermal mass will be required in homes, offices, schools, and other buildings to optimize energy efficiency. A larger amount of solar energy and other renewable sources of energy will be required as well. Innovative buildings will use a bunch of alternative technologies to minimize energy consumption and the energy required to build them, including the embodied energy in the materials they contain.

Aside from the industries described in this section, which will be mostly impacted by climatic events, many other sectors, such as tourism, industry, forestry, and so on, are also in danger. It is clear that climate change affects everyone and that there is no time to delay. An understanding of the implications of climate change is a requirement before taking these steps.

Bebbington and Gonzalez (2008) wanted to emphasize the importance of "non-financial information" along with "financial information" in presenting appropriate results regarding climate change accounting. According to Governor Carney, mentioned in CDSB (2018), "a mix of forward-looking and sufficiently granular, qualitative and quantitative information is needed to offer real insight into how climate-related risks and opportunities may impact a company's existing and future business lines". In connection with this, Bebbington and Gonzalez (2008) distinguished two different risks that companies are expected to encounter: regulatory and competitive risks. As it is known, regulatory risks depend on issued policies and their applications. A competitive risk occurs when "carbon-intensive goods and services may become obsolete in a carbon-constrained future compared to low-emission products and technology".

Research states that even if a reporting mechanism is produced quickly, the information is still unreliable as it lacks comparability and conciseness. Further, development will be needed to assess the reliability of carbon exposures and their management disclosures and to test hypotheses that companies suffer from climate change risk and carbon trading schemes.

When TCFD refers to "forward-looking" information to be presented in a company's disclosure, they do not provide the requirements on a time horizon, recognising its "context-specific", "sectoral", and "entity-specific nature". TCFD states that identifying vulnerabilities in companies coming from climate-related transitional and physical risks would be a first step in identifying climate resilience within the company, its strategy, risk management, and metrics related to disclosures (CDSB, 2018).

In addition to accounting and reporting for the uncertainty related to climate change, precautionary accounting and reporting for climate change are discussed. This research direction is distinguished by two consequences of such a precautionary approach that is relevant for accountants (Bebbington and Gonzalez, 2008). First, any account of climate change uncertainty should be participatory, including stakeholders and their various preferences according to the different levels of risk. Second, possible obstacles to standardising carbon accounting are highlighted when technical facts and social issues are incomparable. A paradoxical situation, but the evidence indicates that policymakers prioritize GHG emissions. The explanation is that sustainable development is difficult to access and, thus, it is difficult to define what sustainable development involves. Research has developed two approaches to cope with the uncertainty of climate change.

To begin with, it should be used as a research engagement strategy to explore how carbon accounting and accountability develop. Secondly, due to the scientific and technical inconsistency of climate change measures and under-specifications of GHG emissions, accounting research should proceed with "normative-oriented research" and participation in the process of designing "carbon accounts" (Bebbington and Gonzalez, 2008).

In this uncertain environment, the banking industry has to work on two aspects: to manage its finances and, at the same time, ensure financing for the "green agenda" (Figure 4) (Eceiza et al. 2020).

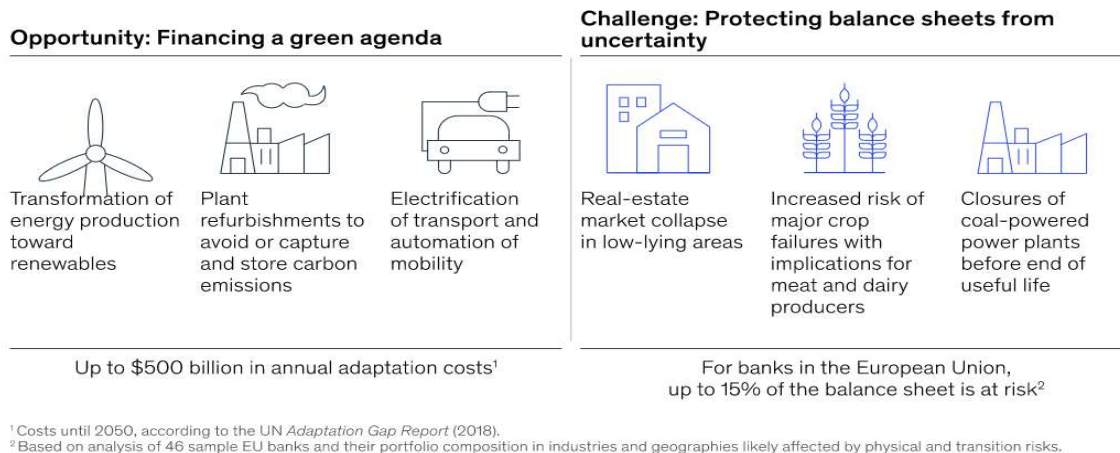


Fig. 4. Opportunities and challenges for banking industry (Eceiza et al. 2020)

Companies will be more exposed to value loss as physical and transition risks arise, potentially affecting their credit ratings. Loss of coastal property, land redundancy, and forced site adaptation or closure are all possible outcomes of risky scenarios. For banks, this means more stranded assets, uncertain terminal values, and perhaps a loss of reputation if they are not considered to efficiently serve their clients. Because of this, banks need to act quickly and effectively to adapt to climate risks by figuring out how climate factors work. One of the tools, besides formulating the strategy and aligning risk processes, is called "stress testing". Along with "scenario analysis", it will be a very helpful tool for banks to access their resilience. To do so, banks must first identify potential risks as well as a primary risk driver by industry. And afterward, banks have to quantify the effect of those risks on a portfolio level. To achieve these goals, banks need to invest in new technologies, data, and, of course, talents who will be able to develop strategies in line with their activities in a different location and different industry (Eceiza et al. 2020).

O'Dwyer and Unerman (2020) have been focusing on problematizing TCFD reporting in its early stages. The authors emphasised the key challenges that preparers and users of TCFD have experienced. The paper explains the importance of collaborations between financial and natural scientist sectors to help to improve the effectiveness of climate-based scenario planning.

Other scientific literature indicates how primary producers and their accountants need more accounting-integrated farm data and systems to make judgments, assumptions, and estimations regarding the potential effects of continuing climate risks on their companies. Primary producers are the most vulnerable to future climate-related uncertainties and risks. Climate change is having an impact on global agricultural markets, making short-term forecasting very difficult. Farmers and their accountants must prepare for and evaluate the probable impact of continuing climate risks on their natural and financial capital, which requires the use of "accounting-integrated biophysical" and socioeconomic data streams (Tingey-Holyoak and Pisaniello, 2020).

In a comparable situation, a review of the authors' current project on integrating accounting and agricultural data for water-related risks caused by global warming and other obstacles is presented. Using the most common accounting software, it has proven difficult to relate agricultural accounting models and scenarios to physical units. The case study methodology was used on a potato farm in the South Australia to address the accounting and biophysical data gaps. A series of 2018–2020 site inspections, meetings, interviews, and equipment installations allowed the potato producer to actively

contribute to the system's shape, nature, and logic. Data from the farm accounting system was analyzed for operational, tactical, and strategic planning and regulating costs involved in crop production. A case study on this farm illustrates the creation of an accounting-embedded tool that may help farmers make irrigation decisions. A software tool, Waterlink, was created to be able to link primary data to a consolidated database for calculation and comparison purposes. The financial effect was calculated using water, power, and other related expenditures. This data may be used as a basic cost tracker, but it can also be used to guide possible strategies in climate and other disasters. Unfortunately, many small producers lack access to such tools, data, and understanding of the basic assumptions and estimations. Consequently, the accounting field needs to link up and provide the on-farm data needed for climate risk scenarios and sensitivity analysis (Tingey-Holyoak and Pisaniello, 2020).

A review and an analogous case comparison indicated the importance of agricultural data being more quickly and effectively linked with accounting data for accurate scenario planning for climate risks. In such circumstances, the "best estimate of directors is no longer sufficient". It means advanced, strategic information systems are required for companies to strengthen their "decision-making capacity, scenario-planning ability, and potential information disclosure". Such tools will help accountants, in particular, and companies, in general, to maximize their chances to gain a competitive advantage and increase profit growth (Tingey-Holyoak and Pisaniello, 2020).

To conclude this chapter, it should be emphasised, that it might be challenging to decide how climate-related issues, as well as non-climate ones, may evolve in the future. The industry must have consistent meteorological data as well as defined techniques for performance prediction. Tools must be adequate and take into consideration future climatic conditions in order to be designed to move beyond compliance (Roberts, 2008).

2.4. Materiality Judgements of Climate-Related and Emerging Risks

Investors are increasingly considering material climate risks and opportunities as significant drivers of a company's ability to generate value over time. Therefore, there is a clear need for consistent, comparable, and material climate-related issuer disclosure. A growing number of investors recognise the importance of the portfolios in which they invest, and the same information is requested from companies to make better risk assessments.

In the survey conducted by Amel-Zadeh (2021), the focus was to identify whether investors believe climate change is considered important to their portfolios and how companies' management evaluates climate change as a material risk. Furthermore, the investigation was conducted in more detail regarding what kind of risk companies expect climate change to pose.

First of all, the survey results were filtered by companies' size and sector to understand whether the difference between these factors influences the survey results. Survey results revealed that large heterogeneity exists across sectors and that climate risks are mainly financially material to companies in "resource-intensive" sectors, which are likely most impacted by the effects of climate change and future regulatory changes. Companies in the energy sector are ranked first, with 68% of investors responding that they believe the impact of climate change to be material for companies in this sector. This is followed by companies in basic materials (62%), utilities (60%), transportation (56%), and industrials (56%). The result revealed that the two biggest risks companies are exposed to are regulatory and litigation risks and the risk of operational reliability and continuity of business. The

other potential risks have been identified as customer demand, the risk of stranded assets, and employee safety. As a barrier to the use of climate change information, investors state difficulties in identifying and quantifying climate risks. The findings further suggest that not many companies, in sectors for which investors believe climate risks to be material, actually disclose information on climate change, citing challenges with the identification and quantification of these risks. Overall, the results suggest that climate risks were not considered important in the past, but investors, management, and company owners' views about such risks have changed significantly, and they will be even more important in the future.

Empirical evidence suggests that voluntary disclosures are misleading as they are prepared strategically. In most cases, companies provide environmental information because of good performance on environmental metrics or because of public pressure (Amel-Zadeh, 2021). Other companies tend to be more transparent, but because of unclear standards, face the problem of revealing "too much irrelevant information and not enough relevant information in financial statements" (IFRS, 2021). Because of this, the AASB and AUASB issued a Practice statement and provided examples of how climate-related risks can affect financial statements and what standards should be applied in preparing financial statements and auditing. The AASB's and IASB's provide one of the best guidelines for determining materiality judgments. Materiality must always be considered when making disclosures in financial statements.

According to the definition provided in AASB 101/IAS (2019), "information is material if omitting it or misstating it could influence decisions that users make based on financial information about a specific reporting entity". The definition further states that an assessment is performed based on "size (quantitative variables) and nature (qualitative elements), or a mix of both". However, quantifying and disclosing the financial impacts of climate risks is still a relatively new concept for companies. In addition, it is not quite clear what exactly is relevant to be disclosed in the financial statements (Deloitte, 2021). When determining materiality, external qualitative elements such as the industry in which the company operates and investor expectations should be taken into account (IFRS, 2019).

Ground and Kang (2021) emphasized that, as evidenced by disclosure standards such as TCFD in relation to ESG, requires a detailed explanation when disclosing plans or particular actions to reduce certain risks and whether they might be "non-quantifiable" at the moment but are nonetheless material. Furthermore, since the definition of materiality asks what a reasonable investor considers to be relevant and important, it must reflect the expectations of the market that influence and form such an understanding.

In addition, materiality judgments may result in the disclosure of data that is not required by accounting standards. This may include disclosing "assumptions made about climate change in the assessment of an impairment loss for an individual asset, even if such disclosure is not required under AASB 136/IAS 36 because no impairment has been recognized (especially if including an assumption would result in an impairment) or the impairment recognition was unaffected by a climate risk assumption" (IFRS, 2021). Similarly, companies may "disclose significant estimates or judgments made about climate-related risks even if there is no current financial impact or significant risk of materially adjusting the carrying amounts of assets and liabilities in the next financial year and thus no disclosure required under" AASB_AUASBJointBulletin (2019).

The TCFD distinguishes between the financial and non-financial sectors as well as how these sectors must consider climate-related risk in their "impairment assessments" and how it affects decisions made about the recognition or measurement of items in financial statements. In APS/PS 2, an example is provided in which the company operates in an industry that is exposed to debt coming from a country whose national economy is now facing serious financial problems. Because other international banks are exposed to such debt, there is a logical assumption that the reporting bank will be exposed to such risk as well. Even though only a small amount of the debt is held by the reporting bank, this suggests that these external qualitative elements should also be considered when assessing whether disclosure of the reporting bank's lack of exposure to this risk is material. Even if the company did not recognize any major "impairment" write-downs or other effects in the financial statements, given these external circumstances, companies in the same industry must still identify material disclosures that are likely to occur.

According to Ground and Kang (2021), "it is expected that public bodies should be required to make climate and other ESG-related disclosure that is principles-based and driven by financial materiality, and based on existing standards that have already seen wide adoption, such as SASB and TCFD". Literature says that companies commonly disclose their reporting related to climate change risks, but they conclude that none of the reviews determine whether those risks would materially impact the company.

2.5. The Global ESG Disclosure Framework

Over the last decade, mandatory non-financial reporting has been increasing. To address these new demands, sustainability accounting reporting initiatives have been spread all over the world to provide companies with standardized reporting metrics and how to systematically integrate non-financial value into financial reports. Companies are being encouraged to disclose climate-related matters according to issued guidelines and standards.

Recently, the Value Reporting Foundation (VRF)—including various sustainability and accounting boards and councils—has officially merged with the IFRS Foundation, creating one single global ESG disclosure framework. The framework and standards correspond to TCFD. The question remains how much overlap will be left between existing ESG disclosure guidelines and how the GRI will fit into this initiative (Figure 5) (Carter and Filosa, 2021).

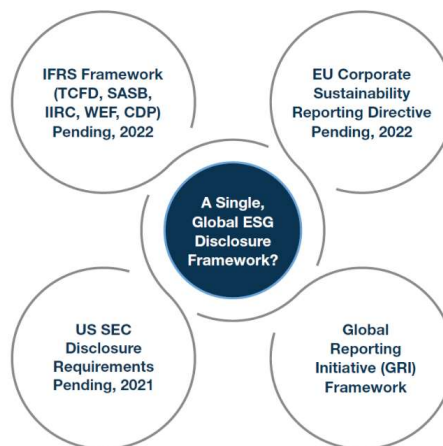


Fig. 5. Single global ESG disclosure framework (Carter and Filosa, 2021)

In April 2021, a new, updated Corporate Sustainability Reporting Directive (CSRD) has been established which includes amended requirements of the Non-Financial Reporting Directive (NFRD). It means that companies have to disclose very detailed information about non-financial risks and opportunities within their operations. The impact of those risks is required to be included in annual, sustainability, and integrated reports and should reflect companies' performance and development regarding non-financial issues (European Commission (2019)).

The IIRC Framework identifies two goals for integrating reporting: (1) to improve the quality of information regarding financial capital and its allocation, and (2) to support decision-making and actions to create a company's value. As a result, integrated reporting, compared to accounting standards or other regulations, has the "dual objective of providing information for external and internal decision-makers". The disclosure reflects two perspectives: (1) climate change impact on the company "transition risks" and "physical risks" and (2) the negative impact on the climate due to the company's activities (Figure 6). In addition, the disclosure must be made in compliance with the materiality methodology (European Commission, 2019).

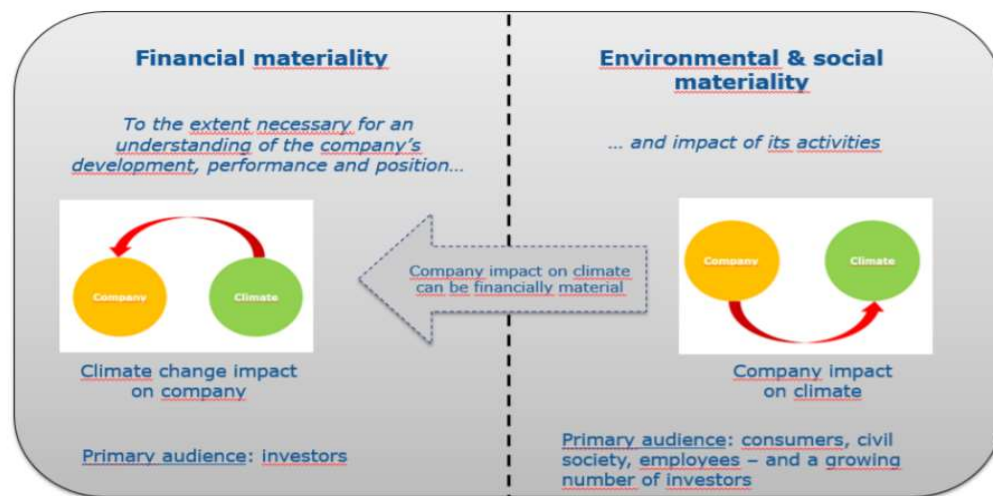


Fig. 6. Double materiality perspective (European Commission, 2019)

Barth, Cahan, Chen, Venter (2017) empirically evaluated the extent to which and how integrated reporting achieves this dual objective. The evidence shows that interaction between "financial and non-financial information" has a positive effect on a company's value. Barth et al. (2017) confirm that integrated reporting improves the quality of data available to investors for their decision-making and reduces the bid-ask spread.

According to Barth et al. (2017), despite the differences between IFRS and integrated reporting, using both improves accounting quality and overall disclosure quality. While IFRS is based on principles, the IIRC's Framework defines how to account for and report specific transactions. IFRS only applies to financial data, while integrated reporting combines financial and non-financial data to create value. IFRS defines financial reporting content but does not define how it is delivered to investors. In addition, integrated reporting requires dialogue with investors and stakeholders (Barth et al. 2017). As written by CDSB (2018), it is not clear how climate change information should be integrated into existing mainstream internal procedures and reporting methods. This makes such integration complicated.

The focus of this section is based on CDSB (2018) investigations on standards to explore new policy challenges such as climate change, helping to adapt current standards and create new ones. Understanding the importance of standards in accounting is essential. But why the standards? As Lovell (2014) comments, "For issues such as climate change, relatively new on the scene, a focus on standards is particularly pertinent because new climate change policies, carbon commodities and ways of measuring greenhouse gas emissions must all somehow fit with standards that already exist".

In reality, however, the IASB's method of categorizing and standardizing carbon accounting in IFRIC-3 was found to be unworkable by the companies who would be required to do the accounting. The review performed of the international regulations on climate change mitigation suggests that international policy and international obligations on climate are the key instruments for achieving one of the most crucial objectives of the disputed matter, namely to reduce and control climate change. However, the main question concerning reliable climate reporting is whether international and regional agreements, regulations, and obligations existing in international law are nowadays sufficient instruments to meet and reverse climate-related problems.

The importance of standards has been highlighted here, particularly the need to unify practices and activities across the sector and to evaluate how climate change creates new issues and concerns that challenge existing standards. Instead of doing a deep analysis, CDSB (2021) focuses on the principles of financial accounting standards that are in line with the recommendations of TCFD. The IASB standards that are relevant to companies evaluating how to implement the TCFD recommendations are the focus of the article. In particular, it is focusing on the "accounting aspects of standards and guidance rather than strategic and narrative aspects" (CDSB, 2018). In the absence of international norms, organizations have obtained legitimacy for their accounting systems in other ways.

Considering that the recommendations of the TCFD are required to extract quantitative information from "mainstream financial filings and that the financial impacts of climate change should be categorised based on income statement and balance sheet elements, it seems relevant to explore the role of financial accounting standards in climate-related financial disclosures" (CDSB, 2018).

CDSB and AASB_AUASBJointBulletin highlight a specific set of standards and supports the integration of climate-related matters into financial statements, however, it is not clear how it is conforming with existing reporting practice. Therefore, the next sections will highlight some guidelines and common practices for adapting accounting standards into mainstream reporting.

2.6. Accounting Standards in Climate-Related Financial Reporting

If business continues on its current path, the level of dangerous climate change will rise in the near future. These changes have been turned into a set of guidelines and policies that have been put together by different groups of authorities.

Some elements of financial accounting standards require a focus on known liabilities related to past events or obligations. However, new and revised financial accounting rules specify how to deal with future risks, notably for accounting reasons and related disclosures. The CDSB (2018) opens a discussion on whether any of the standards' or other materials' principles or practices apply to climate-related risk disclosures.

The new approach should evaluate whether recognising an asset or liability gives useful information to users of financial statements about changes in revenue, expenses, or equity. This new criterion should reduce the possibility of excluding information regarding carbon-related assets from disclosures merely because they did not fulfill the "old" recognized standards.

Before going deeper into the specific standards, it is important to understand what "recognition" means in an accounting concept. The recognition criteria, especially those relating to judgments about probable or expected economic benefits, have raised concerns about whether some assets—including what the TCFD refers to as "carbon-related assets"—should be recognized for financial accounting purposes. "Recognition" is an accounting concept that determines if and how an item (such as income, liability, or asset) should be included in the financial statements. The phrase "carbon-related asset" refers to assets with direct or indirect GHG emissions. It has been suggested that the potential financial consequences of climate-related risk might include asset impairments (CDSB, 2018).

It is under discussion whether oil, gas, and mineral reserves should be impaired in financial accounts since they do not fulfill standards for future economic benefits. So, considering that the energy industry is one of the most vulnerable to climate change, it is worth investigating if the TCFD's proposed asset impairment application covers all assets, including "non-exploitable fossil fuel reserves", or only recognized assets (CDSB, 2018). However, if the information is relevant and the company's financial position changes, the IASB allows disclosure in the notes of financial statements. These notes would be a possible area where a company's scenario analysis findings may be disclosed.

The CDSB (2018) and AASB_AUASBJointBulletin (2019) investigated the TCFD recommendations through the lens of several IFRS standards. Table 3 sets out the most relevant IFRS accounting standards arising from climate-related matters.

Table 3. IFRS accounting standards arising from climate-related matters

IFRS Standards
“AASB 101/IAS 1 Presentation of Financial Statements
IAS 36, Impairment of Assets
IAS 37, Provisions, Contingent Liabilities and Contingent Assets
AASB 116/IAS 16 Property, Plant and Equipment and
AASB 138/IAS 38 Intangible Assets
AASB/IFRS 13 Fair Value Measurement
IFRS 7 Financial Instruments: Disclosures
IFRS 9 Financial Instruments
IFRS 15 Revenue from Contracts with Customers
IFRS 17 – Insurance Contracts”

Companies must evaluate the degree of information required for reliable disclosures and estimate the effect on financial statement line items. Climate scenario analysis, assessment of risk and opportunities, stress testing, and sensitivity analysis may all be used to examine the business implications of physical and transitional risks and opportunities (Deloitte, 2020).

There is evidence that practitioner accountants who prepare company accounts on a daily basis are expecting authority and reassurance from sources other than the IASB on their choice of climate change accounting treatment and disclosure. Due to the lack of international standards, the role of auditors has also been significant in offering advice and instruction, as one interviewee states that most companies would have met with their auditors and said, "Hey, we have this new commodity, how the heck do we account for this?" (Lovell, 2014).

According to Deloitte's (2021) findings, currently, companies are demonstrating some level of disclosure related to climate change mostly in areas such as (Table 4):

Table 4. Disclosure in financial statements

Changes in useful life of assets
The "useful life" of an asset indicates the period the company expects to use that asset. Because of climate-related consumer or investor pressures, a business may make a strategic choice to retire or shut down an asset before the end of its economic life (KPMG, 2021).
<i>Disclosures</i> Key climate-related assumptions are used to estimate useful lives. Any sources of estimation uncertainty that are caused by climate-related concerns should be considered.
Asset impairment
Changes in climate legislation or market demand for certain products may indicate impairment for some companies, which may also affect the discount rate. Alternatively, an asset's "useful life" may be reduced, affecting the expected cash flow period (KPMG, 2021). Companies need to impair the asset when the value of the asset exceeds the "recoverable amount", which is higher than the sale price or the present value of the expected cash flow. This is important for climate disclosure because the value of assets, especially "carbon-related assets", may be overstated in business accounts if the valuation does not take climate change into account. Under IAS 36, management must review "whether there is any indication that an asset may be impaired" at the end of each reporting period (AASB_AUASB JointBulletin, 2019).
<i>Disclosures</i> Cash flow judgment is used in calculating recoverable amounts. Estimation of any uncertainties caused by climate change. Potential changes in the recoverable amount result from the impairment (KPMG, 2021).
Fair value measurement
The AASB/IFRS 13 standard requires the disclosure of essential assumptions used when assets are recognized at fair value. Physical climatic events (droughts, floods, storms, and heat) may severely impact certain assets valued at fair value. A market's willingness to pay for an asset based on climate-related risk uncertainty will likely be influenced by these climate factors.
<i>Disclosures</i> The consequences of severe weather events and the effect on fair value, including how it was evaluated, have to be presented (KPMG, 2021).
Changes in expected loans and other financial asset losses
IFRS 9 applies more "forward-looking information to recognise expected credit losses" (CDSB, 2021). This involves determining the effect of climate change on the customer's capacity to service and repay debts and the value of the

collateral (KPMG, 2021). “If there has been a big increase in credit risk after the financial asset was first recognized, impairment is measured as lifetime expected credit loss (ECLs)”. ECLs must be measured using knowledge regarding historical events and present situations, as well as estimates of future economic conditions (KPMG, 2021).

Climate change is a significant business risk for an insurance company. Material risk treatment strategies involve the establishment of underwriting and investing policies, monitoring systems, and stress and scenario analysis. The integration of climatic temperature modeling scenarios into another insurance company allows for an assessment of potential premium impacts over time (Deloitte, 2021).

Disclosures

The assessment of credit risk-taking must take into account the impacts of those counterparties in climate-exposed sectors.

Identification of loss amounts due to climate risk factors.

The main areas of ECL are affected by uncertainty (KPMG, 2021).

Going concern

The going concern assessment refers to the ability determined by the amount of cash the company expects to generate in the future. Asset impairment, mentioned above, should be taken into account. Furthermore, such a risk influences its ability to get funding to continue performing its obligations. Companies must assess the future cost of borrowing money as well as potential barriers to obtaining finance associated with financial institutions' climate risk management plans, whether disclosed or reasonably expected (KPMG, 2021).

Disclosures

A material impact due to climate change could influence the ability to continue as a Companies need to impair the asset when the value of the asset exceeds the "recoverable amount", which is higher than the sale price or the present value of the expected cash flow "going concern".

Estimation and judgment of assessment of going concern (KPMG, 2021).

Provision and contingent liabilities

IAS 37 refers to "provisions and contingent liabilities/assets" and defines an "event as being probable if it is more likely than not to occur" (AASB_AUASBJointBulletin, 2019). Provisions are calculated using the best estimations. Obligations relating to new laws or regulations are recognized only when the legislation is virtually certain to be established as drafted.

Climate risks may influence already planned site repair and restoration activities. Similarly, new laws or regulations may increase decommissioning costs. Technological improvements and developments may impact the estimated provisions recognized when expected that they will occur. Insurers may need to increase claims provisions for more urgent climate-related events including storms, fires, and floods. Companies must assess whether climate-related litigation or fines should be recognized. If it is assumed that no provision is necessary, a company should consider whether any disclosures about "contingent liabilities" need to be made. Climate-related risks may increase the costs of fulfilling contractual commitments when such commitments exceed the economic benefits received and may result in onerous contracts that must be provided for (KPMG, 2021). In very general words, IFRS 15 states, that when it comes to long-term contracts, a positive outcome should be spread out over periods, and when it comes to “an onerous contract, a negative result should be provided immediately” (CDSB , 2018).

Disclosures

Estimation and judgment of assessment of provisions and contingent liabilities (KPMG, 2021).

Presentation of Financial Statement

IAS 1 requires disclosure of any important "climate-related judgments and assumptions made affecting the recognition and measurement of assets and liabilities that would be relevant to a user's understanding as well as the causes of estimate uncertainty"(KPMG, 2021).

While the level of climate-related estimates and judgments disclosed varies per business, they must be relevant and detailed, including the specification of what factors have been examined. Once identifying a unique climate risk that a company faces, the company has to assess the materiality of those risks in financial statements.

2.7. Climate-Related Matters Attribution Issue to Financial Instruments

Loss and damage were identified as different concepts from adaptation in 2008 when the AOSIS suggested a "Multi-Window Mechanism" to account the unique idea of loss and damage coming from climate change effects. The attribution issue was shown to be the most significant barrier to addressing loss and damage. Many researchers have proposed methodologies. However, no globally agreed-upon system has been developed as of yet. Furthermore, the extent of loss and damage caused by climate change to livelihoods varied significantly between developing and developed countries.

Difficulties raised by Thoma et al. (2018) in the literature include distinguishing between "avoidable and unavoidable loss and damage", as well as monetary and non-monetary loss and damage. The "attribution problem" was shown to be one of the most significant limits related to climate matters. Therefore, such an issue must be understood and treated effectively. Improved attribution methods should be carefully researched and evaluated, and their use in extreme weather should be studied.

Moreover, the majority of the reporting guidelines are oriented toward dataset selection rather than fundamental accounting procedures. Thoma et al. (2018) seek to fill this gap by demonstrating the challenge of accounting for climate-change-related data. The research was done by analyzing accounting principles using a combination of empirical and theoretical sources. In addition, if applicable, the article enriches the market overview with recent developments.

As part of an EU-funded research project on 2 C scenario analysis, Thoma et al. (2018) interviewed over 100 institutional investors on their climate accounting methodologies and performed direct portfolio analysis with over 200 institutional investors. Unfortunately, due to data confidentiality, not all participants provided relevant information. Hence, the study does not provide quantitative conclusions about particular accounting preferences or choices. These interviews are not clear enough to draw independent conclusions or create quantitative data (Thoma et al. 2018).

Another source is a technical application, which is used to demonstrate the consequences of using different accounting rules and different approaches. The information presented is based on Bloomberg financial data and annual report carbon footprint statistics, as well as third-party data sources where applicable. In the research done by Thoma et al. (2018), it was provided challenges that companies face in connecting the values to actual economic activities. The research approach was into classifying accounting units into three categories: "carbon footprinting, green/brown metrics, and climate scores". The indicators have been specified on an example for all three indicators using a chosen company as the case study. The issue seems to be that all of these data are given at the group level and are not connected to the actual economic activities of the selected company. In this regard, a few findings may be important. First, qualitative indicators are inappropriate if climate accounting is used as a step or input into financial risk or value models. Second, economic activity should be connected to quantitative measures. Without this connection, the unit cannot be allocated to one of the three key financial inputs: the item's "price", the "cost of the good", or the "volume sold". After determining the accounting unit, the next significant accounting issue is determining how to allocate

a company's economic activity to financial instruments. This accounting concept is the most difficult to absorb since it lacks clear guidelines in most accounting systems (Thoma et al. 2018).

R. Capon and G. Oakley (2012) in their study used quantitative estimates for all metrics that were measured. Where quantitative risk data is not available, the CCRA team has had to rely on expert judgment to produce suggestive estimates. The research aim was to quantify the productivity loss caused by increased office temperatures as a result of climate change by measuring "the unit costs of lost time (productivity per hour, derived from output per hour)". It was demonstrated how loss and damage related to climate change issues demand various approaches. The study would record both the hours when the threshold temperature is exceeded and the level of temperatures over the threshold since temperature affects productivity. Overheating of buildings has been extended to evaluate overheating's impact on workplace productivity. The combination of overheating and warmer temperatures has been shown to increase absenteeism and reduce productivity. This takes a lot of data and disaggregated climate data. However, these measurements do not simply match productivity losses, which would allow for valuation. In the absence of this data, the study made informed judgments about the probable costs. But interpreting these changes requires caution.

Ground stability and subsidence were also highlighted as substantial economic risks. It is hard to forecast how climate change will affect this risk, but subsidence claims are likely to increase in the future. Climate change is expected to increase the risk of floods from tidal, fluvial, and surface water sources. Property insurance may become more expensive or difficult to obtain as the probability of flooding increases. There, the value of mortgages that might be at risk because they could not obtain flood insurance was then estimated (R. Capon and G. Oakley, 2012).

The guidance also suggests considering "rebound effects". In this instance, the fact that future climate change might reduce energy usage and hence energy costs, thus increasing consumers' disposable income and so leading to increased energy consumption. It was not possible to evaluate these "rebound effects" in the study provided by Capon and Oakley (2012), but it is highlighted that they are potentially considerable and should be a focus of future research. While researchers make every effort to apply the greatest monetary value to the data available, data shortages have dictated estimates using alternative prices. To sum up, the calculation of climate-related effects on financial statements should only be treated approximately.

Since the global financial crisis, authorities throughout the world have put greater effort into financial sector taxes to generate revenue and improve social welfare. At the same time, a variety of environmental policy initiatives, such as carbon pricing and fuel taxes, a reduced VAT rate on transportation tickets, and emissions trading schemes, have been introduced to address the issue of global warming (Dupre et al. 2021). The measurement and reporting are required for both emissions-reducing regulations and the transparency of the company's ethical responsibility towards societal expectations.

In conclusion, the selection of measurements and methods for the evaluation of financial statements' line items affected by climate change is one of the main focuses of the research. AASB 101 Financial statement presentation requires "disclosure of future assumptions and sources of substantial estimating uncertainty that have a significant risk of resulting in a material adjustment to the carrying amounts of assets and liabilities"(KPMG, 2021).

2.8. The Complexity of Reporting Climate-Related Matters in Financial Statements

In November 2019, the IASB, whose mission is to develop accounting standards for global financial markets, published "IFRS Standards and Climate-Related Disclosures". According to TCFD, disclosures related to climate change should be specified, gathered, documented, and assessed in such a manner that the information presented is reliable and of high quality. But, in reality, what does this mean? To begin with, all disclosures should be reviewed by a company's CFO, audit committee, or both. It should include climate-related risks, indicators, and objectives. Companies should also perform scenario analysis to address the future risks of their business models. According to IASB standards, management should consider whether climate-related risks will influence the amounts and disclosures presented in financial statements and whether this information is essential to investors' decision-making (Li et al. 2019).

Some ESG reporters intend to go further than disclosure and assess the financial value of components for inclusion in the company's income statement. They think that such a statement would provide a more complete estimate of a company's true profits. However, calculating the value of many ESG components—for example, the effect of a company's "labor practices", "workforce diversity", and "governance"—is significantly more difficult than estimating the "accruals based on future cash flows that underlie basic financial reporting" (Kaplan and Ramanna, 2021). It could be compared with some CEO's and accountants' attempts to include "human resources on a company's balance sheet" to declare that "employees are our most valuable asset". Those ambitions failed because it is quite irrelevant to measure employees' value (for example, how much money was spent on recruiting and training employees in the past). Furthermore, finding a method to estimate the value of ESG's elements would be significantly more difficult, if not impossible. By presenting various nonfinancial performances as a single concept, some ESG promoters may have prevented critical thinking about how to properly analyze and disclose each ESG component (Kaplan and Ramanna, 2021).

According to Kaplan and Ramanna (2021), "the focus should be on what companies can and must do well now: improve the measurement and reporting of GHG emissions in an integrated, comprehensive, and auditable way. And at the same time, the lessons learned can serve as a basis for measuring and tracking other environmental and social outcomes arising from business operations".

Among many large asset managers and financial institutions, the implementation of disclosures has begun. Companies have started to cover "scenario analysis" for analyzing climate-related risks as well as how climate change and related extreme weather events represent tangible risks to investment portfolios. Even though many companies have already begun responding to the requirement for climate-related risk disclosure, the comparison remains difficult due to differences in language and terminology used between industries and organizations. So, just a very few companies measure or predict climate risks in a proper way (Li et al. 2019).

Eventually, TCFD will assist in more quantitative disclosures, especially metric disclosures, on the financial effect of climate-related risks on a company. As it is known, climate change may cause asset impairments and new liabilities may be required to account for regulatory fines and penalties resulting from stricter regulatory requirements. Furthermore, the consequences of climate-related risks and opportunities may have an influence on cash flows from operations, net income, and access to financing. As a result, financial leaders should be engaged in the organization's assessment of climate-related risks and opportunities, as well as attempts to manage the risks and maximize the benefits.

Finally, the assumptions underlying the cash flow calculations used to evaluate "assets (e.g., goodwill, intangibles, and fixed assets) impairments" must be explored in depth (TCFD, 2017).

In general, TCFD sends a message that disclosure related to climate events should use existing financial standards. It also acknowledges that this is a challenge for the companies, as climate reporting has previously been reported outside of mainstream reporting. As an example, in an interview, an accountant from a large European energy company describes his company's gradual reduction of GHG disclosure: "At first we wanted to be very transparent, we wanted to disclose everything, yes? ... But because we started to have a lot of problems with our auditors we decreased the disclosure ... we haven't changed the accounting scheme, which could have a material impact on numbers, but we changed the disclosure ... we decreased the disclosure very, very much and now it is, you know, it's good" (Lovell, 2014).

Reflecting on those issues, the joint project between IASB-FASB has been identified to accelerate the process of IASB standards development. Considering standards in financial accounting is a good place to start. This leads to another significant finding, that calculating methods do not have to be exact, but rather trackable by market players and integrated into the system.

The scientific literature discussed in this section provided the research problem for this thesis. However, the empirical analysis of companies' climate-related matters disclosure is necessary to reveal specific opportunities gained by companies in determining and reporting on expected material climate-related risk and make recommendations for other companies in different industry sectors in the region.

The examined reporting lacks consistency and, in many cases, gives an impression of nothing more than just "greenwashing" or "overselling". Reflecting on those issues, one unified reporting conceptual methodology was created (Figure 7):

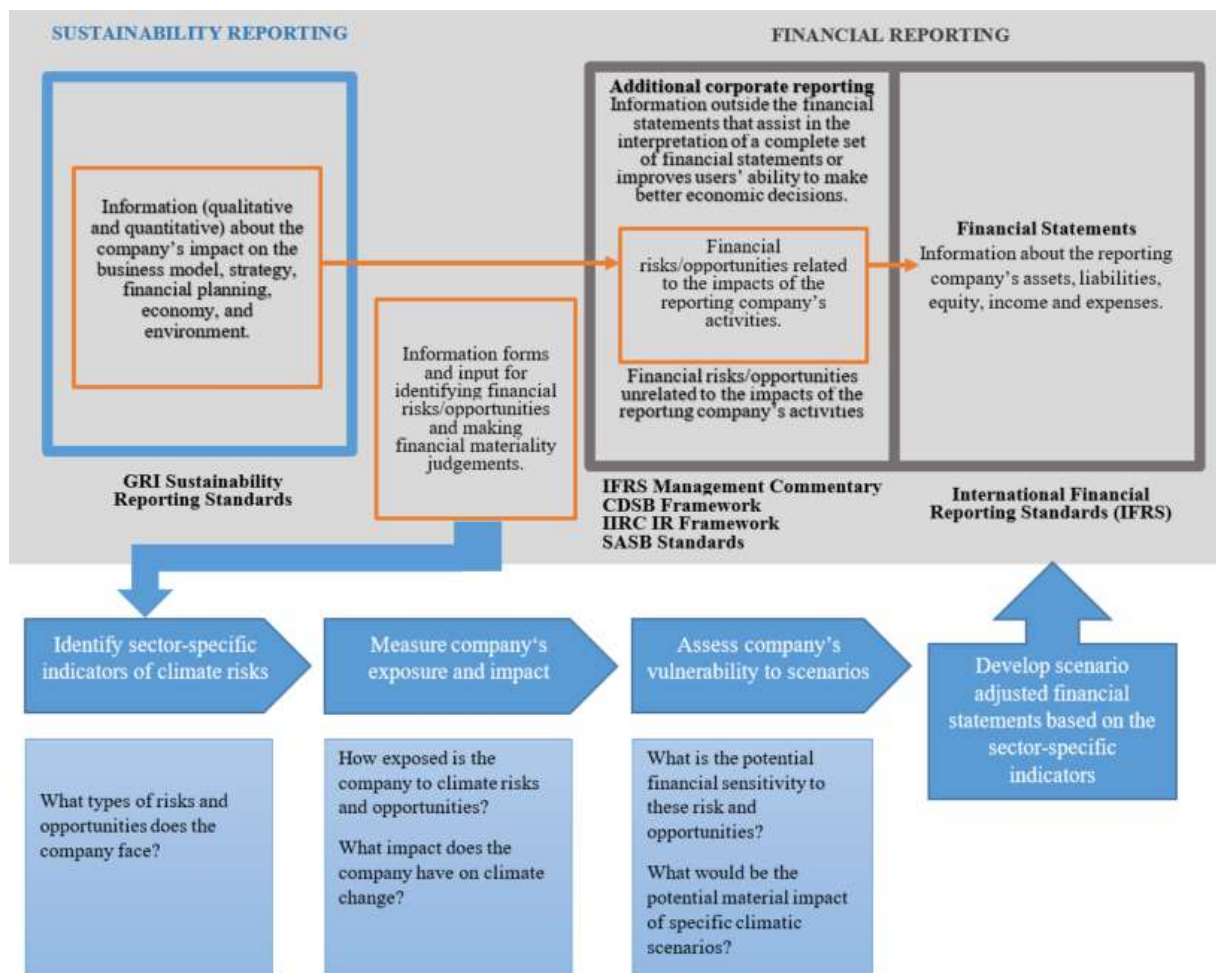


Fig. 7. Reporting methodology of climate-related matters to financial statements

From the overview of theoretical solutions, it could be concluded that climate accounting and practice can only be understood through exploring sustainability standards in conjunction with accounting standards. The assessment should begin by providing more entity-specific qualitative and quantitative information on the company's impact on the business model, strategy, financial planning, economy, and environment. As relevant to the company, identify financial risks and opportunities along with materiality judgment. Finally, after assessing the company's vulnerability to various climate scenarios, the adjusted financial statements are developed.

3. Effects of Climate-Related Matters on Financial Statements' Evaluation Methodology

The goal of this research is to develop a methodology to assess climate-related matters' effects on companies' financial statements. In doing so, the research focuses on the research question: how to disclose climate-related matters in a company's financial statements? In addressing this question, the research seeks to identify methodological developments to evaluate climate change effects on companies' results.

The research of the existing literature did not provide a globally-agreed methodology how to assess the effect of climate change on financial statements. Therefore, a conceptual methodology of analysis was developed, including a few steps:

Step 1. A case study to answer a research question and to achieve research objectives was applied to empirically investigate the effects of climate-related matters on financial statements. The company's background is presented to illustrate the core activities, sector, key financial data, and geographies where the company operates.

Step 2. Disclosure of the company's key performance indicators related to climate-related matters and their relevance to the company's business model, strategy, and financial planning. Using the company's emissions measurement, the progress toward EU targets was presented. To calculate an impact assessment's base, each assumption related to the company's footprint and handprint was specified in quantitative terms. The analysis was done by analysing the company's sustainability report.

Step 3. Identification of sector-specific indicators of climate risks. Those risks have been identified using correlational analysis, secondary statistical data, and a list of potential risks and opportunities identified in its activities. Such detection could be found by searching for systematic patterns and replicating them in different sectors. Whether a company is or may be affected financially by climate-related issues usually depends on the company's exposure to existing external and internal data and the nature of its business. Using a qualitative assessment, the goal of this step was to identify:

- Key climate-related external environmental trends;

For each scenario, the potential climate effect on returns across asset classes was presented, and the assumption of the company's resilience to business model and strategy was identified.

- Climate-related influencing sensitivity factors within the sector;

Such an analysis reveals trends in possible climate-related risk variables towards each other through time under four alternative scenarios. The primary goal for businesses is to understand their portfolio exposures to the asset classes and industry sectors most sensitive to technological (T), resource availability (R), physical damage impact (I), and policy (P)-(TRIP) factors, as well as those with the greatest potential climate impact on returns (Mercer, 2015).

Step 4. Assessment of perspectives on climate-related business activities. Identifying risks and opportunities related to climate change requires an understanding of the climate change risks and opportunities to which the company may be exposed and an understanding of the environment in which it operates. This information has been identified from the following sources (Table 5) (Chartered Professional Accountants Canada [CPA], 2021):

Table 5. Sources of company information

Subject Company Annual and Sustainability Reporting
<u>Risks and Opportunities identified from a review of annual and sustainability reporting:</u>
Some companies include statistics on sustainability or climate change in their annual or sustainability reports. Examining this reporting and comments provides data that may be used to detect risks and opportunities.
SASB Materiality Map
<u>Risks and Opportunities identified from the SASB Materiality Map:</u>
The SASB Materiality Map highlights sustainability issues that may impact an industry/financial sector's position or operational performance. Although these issues are broader than just climate change, the SASB Materiality Map may help inform the risk and opportunity identification through listing issues that affect companies within the subject company's industry.

- Company's materiality analysis for key environmental themes;

In classical financial reporting, material issues are those that have a major influence on a company's operational performance and have a substantial influence on how that company impacts the environment and society from a sustainability aspect (Bloomberg Impact Report, 2020). Provided materiality assessment, depicted in the environmental materiality matrix, includes both of these perspectives.

- Climate change risks and opportunities that the company may encounter;

A risk rating matrix has been constructed, using accessible data and best judgment to determine significant implications for evaluation purposes. Criteria, such as the likelihood of occurrence and the potential financial effect of each risk and opportunity should be assessed (i.e., materiality).

- Using a risk rating matrix, the risks and opportunities that are most significant to the company;

To select the most important risks and opportunities for the company, a test using a risk rating matrix the following methodology was conducted:

- Climate-related risks include simulating the financial effect of the risk (i.e. reduced revenue or increased costs) within the selected period and its expected influence on the company's results.
- Climate-related opportunities include the possible financial gains (i.e., increased operating profit or revenue) within the selected period that the opportunity is considered.
- Likelihood: the intensity and effect of that occurrence in terms of risks and opportunities (SSE PLC Sustainability Report, 2021).

Step 5. Conducting sensitivity analyses around major climatic indicators. This step would be a starting point for scenario analysis. Future outcomes deriving from climate change scenarios were identified by applying the following approach:

- Stress testing. This evaluation may include a review of qualitative and quantitative data supported by the company's annual report, including key exposure data and the company's carbon strategy. The assessment of climate change that has already occurred could be a very useful tool for future projections and assessment of the sensitivity of climate variations.

- Scenario analysis. The analysis was done through content analysis and conducting secondary statistical data. Determining the best paths forward in a range of different future climate scenarios is the best tool for assessing the potential effects of climate change. This procedure should be part of every company's scenario analysis process.

The scenarios have been considered:

Low-carbon future (1.5°C). Such scenario shows a narrow but achievable pathway to achieve net-zero CO₂ emissions by 2050 (NZE). With quick technological and policy improvements, it would restrict temperature rise to less than 1.5°C. The core elements include a tendency toward greater use of large-scale renewables, a movement toward electrification, and public pressure against the use of gas (IEA, 2021).

Extreme global warming (4°C). Stated policies (STEPS) scenario is more conservative. It assumes little or no coordinated mitigation effort and that climate change continues to be its primary focus. It is not expected that governments will achieve all their objectives. So, by 2030, the physical implications of climate change will be more obvious due to slower and less thorough changes. In the fight against climate change, a lack of coordinated policy and regulation leads to higher overall costs and less visibility across the network. Inequality of access where certain decarbonisation activities have the potential to leave some sectors of society behind. The development scenario adjusted financial statements and assessed the effect of climate-related matters on the company's assets, liabilities, equity, income, and expenses (IEA, 2021).

Step 6. Obstacles in climate change reporting were identified and areas that could be developed further to enhance the quality of climate-related disclosure on financial statements were presented. Those are then taken into account before making recommendations for other companies. The analysis was finally concluded with the general findings of these theses.

The study is based on a deductive methodology, as certain issues were specified at the beginning, and current methodologies and theories were researched in relation to those issues, and from those results, a conceptual reporting methodology was created to assess whether the existing framework applies to practice or not.

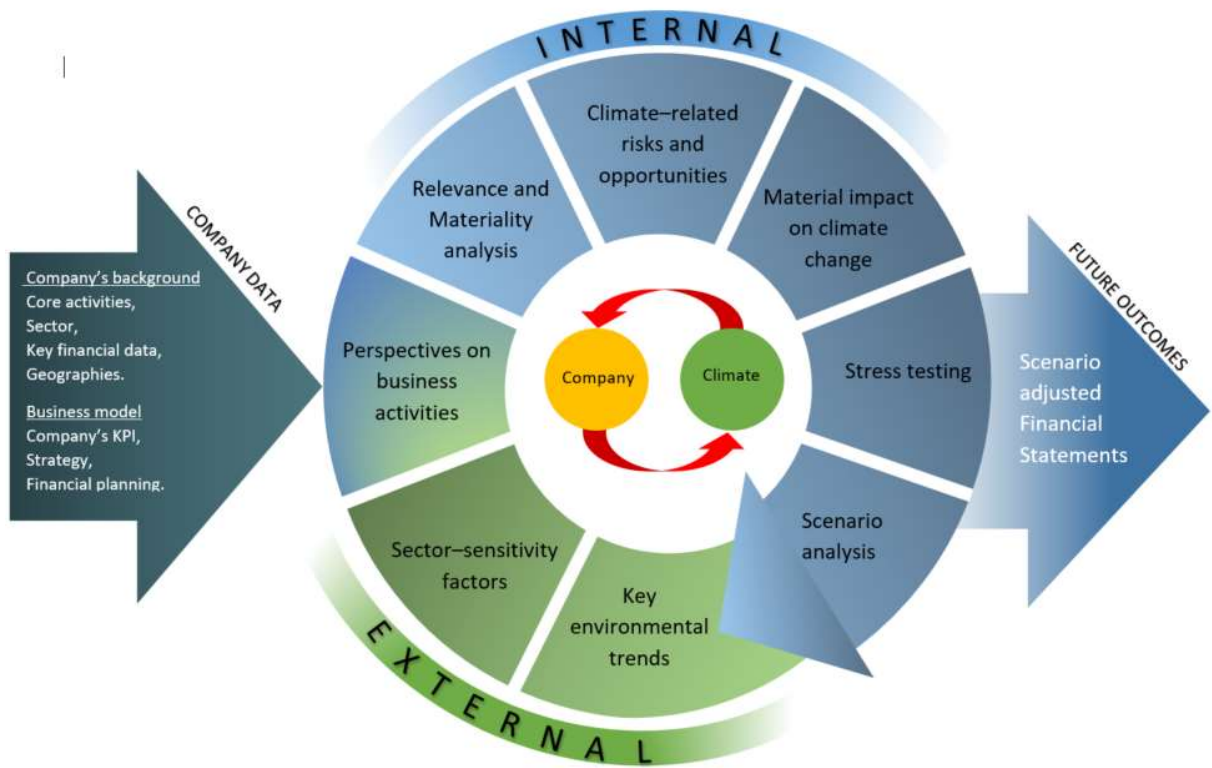


Fig. 8. Effects of climate-related matters on financial statements' evaluation methodology

The effects related to climate-matters may be considered to fall into two categories: effects of climate-related matters on the company and the company's effect on the climate. The information referred to the effects of climate-related matters on the company expected to be disclosed if it is required to understand the company's growth, performance, and position. Typically, investors' focus is concentrated on the latter approach. The information referred to a company's effect on the climate is required to understand the company's impact on the external environment. This approach is of most interest to society, employees, and the entire supply chain. It has been observed that these perspectives tend to overlap going forward. As markets and public policy adapt to climate change, a company's positive or negative environmental impact will increasingly translate into financial risks or opportunities.

4. Research Findings of Effects of Climate-Related Matters on Financial Statements

Considering that 2020/21 was the last year of voluntary disclosure, the priority was to develop the improved requirements for identifying a company's climate-related risks and opportunities. To do so, using internal and external data, a broad analysis was undertaken to assess relevance, materiality, and financial consequences affecting the company's performance.

The EU has set a target of being net-zero by 2050. In this context, companies need to think about how their business models, strategy, and financial planning will be affected by this, information on the company's impact on the environment, their principal risks, and other changes governments may wish to enact, and then report on the effects (Financial Reporting Council [FRC], 2019).

The case study that follows will assist in highlighting the important principles in the framework.

CASE STUDY

CAVERION: Company background (Caverion Investor Presentation, 2021)

Core activities

Caverion supports performance and human well-being by making built environments smart and sustainable.

The company's building performance offering consists of:

- Efficiency business (3/4 of revenue)
- Solution business (1/4 of revenue)

Sector

Infrastructure.

Caverion found almost 30 EU taxonomy operations in seven economic areas. The most significant are identified as: Construction & Real Estate, Energy, and Renewables, providing for around 87 % of overall EU taxonomy qualified revenue for Caverion.

Expenditures

Major capital expenditure :

- Non-current assets gross capital expenditures were EUR 26.0 million in 2021, or 1.2 % of revenue.
- IT investments totaled EUR 8.0 million. IT and mobile technologies have been improved to increase internal operations and efficiency. Another EUR 18.0 million was spent on acquisitions.
- In 2021, Caverion spent almost EUR 4.9 million on research and development related to products and services, or 0.2 % of revenues. Under the Scope 3 category of purchased goods and services, materials related to electricity and HVAC account for the largest portion of the company's material use.

Major operational expenditures :

- Materials and supplies EUR 523.9 million
- External services EUR 398.4 million
- Employee benefit expenses EUR 889.9 million
- Other operating expenses EUR 216.3 million

Revenue

Caverion's revenue in 2021 was nearly EUR 2.1 billion. Services business units comprises the biggest part of total revenue at 66%. Revenue from contracts with customers was 34%. Revenue from contracts with customers – 34%. Organic revenue growth > 2% in 2021.

Geographies

Europe

4.1. Caverion Business Model and Strategy

Buildings and infrastructural projects use the most natural resources. Everyday building and infrastructure usage may contribute to direct and indirect GHG emissions, global and local resource scarcity, water stress, and poor human health implications. Client and regulatory demands for a more sustainable built environment are driving the development of markets to decrease building and infrastructure lifecycle effects. As a consequence, numerous businesses throughout the value chain are benefiting—from suppliers to engineering and construction companies that can offer sustainable project design, consulting, and construction services. These services could help a business gain a competitive advantage and make more money as more people want cost-effective, environmentally friendly projects and new policies come into place (SASB, 2022).

The Engineering & Construction Services industry works with customers who are affected by and contribute to climate change. Many infrastructure projects, including renewable energy initiatives, strive to minimize GHG emissions. As a result of changing climate rules, such initiatives in the sector may lose a significant part of their revenues and earnings from customers in carbon-intensive industries. Project delays, cancellations, and reduced long-term revenue development possibilities are all potential downside risks. Companies that concentrate on GHG reduction infrastructure projects may gain competitive advantages as these markets expand. Climate change impacts business in many ways, but investors may benefit from understanding the risks and opportunities embedded in a company's backlog and future prospects (SASB, 2022).

In 2021, Caverion worked on its new strategy. A market being full of opportunities, Caverion's new long-term vision is focused on fundamental future capabilities. Enabling performance and wellbeing in smart and sustainable built environments is a core objective of Caverion. Climate change continues to be the world's largest concern. CO₂ emissions arise mostly in urban areas, making solutions urgently needed. Therefore, Caverion's energy-efficient and sustainable solutions are helping to create a carbon-neutral society and will be improved to meet consumer needs going forward. People, customer experience, sustainability, and digitalisation are the company's key strategic areas. Caverion anticipates increased market demand for its products and expertise as well as changes in trends and policies (Caverion Annual Review, 2021).

Caverion anticipates future development in smart and sustainable technologies. A smart city strategy, digitalisation has been pushing the Caverion sector for years. As a result of this, Caverion has become the first choice for customers looking to digitalise built environments using smart solutions. Investing in smart technology and digital solutions, growing a sustainable business, and launching a purpose-driven brand were some of the main strategic plans that the company had in place (Caverion Annual Review, 2021).

The EU's stimulus programs emphasize green growth and digitization. For this purpose, Caverion anticipates that national and EU programs will raise demand in 2022, providing more opportunities for smart solutions (Figure 9).

Caverion's Building Performance offering

By making built environments smart and sustainable, we enable performance and people's well-being

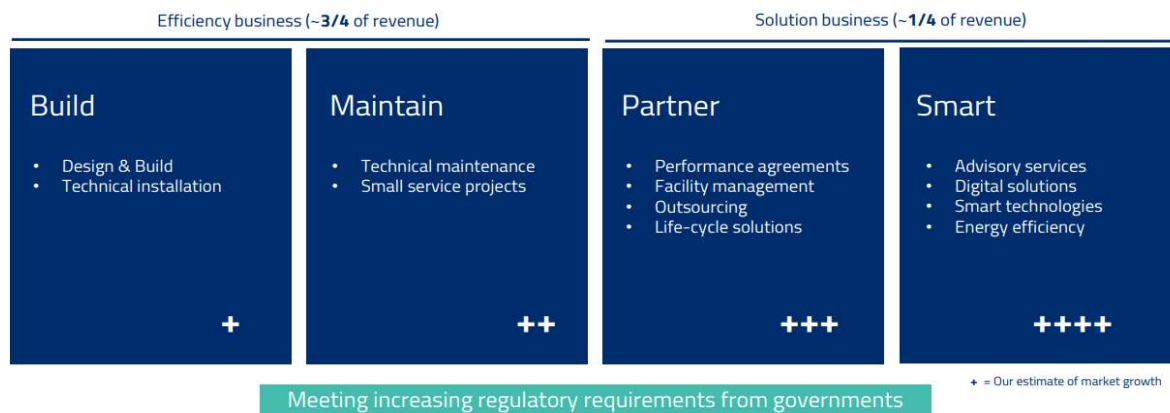


Fig. 9. Caverion estimate of market growth (Investor presentation, 2021)

4.1.1. Driving Climate Actions

Caverion started his Fit for Growth journey in 2018. Pursuing this further, Caverion will proceed on a path toward long-term growth (Caverion Annual Review, 2021).

A net zero-focus strategy

EU-driven policies and national legislation raising energy efficiency and carbon-neutrality standards foster growing environmental awareness. Caverion has established high sustainability goals. The company already provides a handprint twice the size of its footprint (Scope 1-2). The objective is to have a handprint 10 times larger than the footprint by 2030. The climate objectives will be met through expanding the use of renewable energy in the built environment and managing service and supply networks sustainably.

Commitment to climate resolutions

Caverion signed the UN Global Compact and the Sustainable Development Goals in early 2021 and recently joined the Science Based Targets project in early 2022, to further commit to fighting climate change through its solutions and services. Through those promises, Caverion pledges to integrate the program and its values into its strategy, as well as share them with its stakeholders. Caverion published its EU taxonomy eligibility criteria for 2021 in 2022 for the first time. The purpose of the EU taxonomy is to unify reporting according to TCFD recommendations.

Climate adaptation and resilience

Services promoting sustainability, such as enhanced energy efficiency and interior climate control, are in high demand. Caverion places special emphasis on sustainability in both smart technology and digital solutions. For example, the transition from toxic F-gases to CO₂-based refrigeration is increasing the demand for renovations and modernisations. Caverion is at the forefront of providing sustainable cooling alternatives and refrigeration automation technology.

4.1.2. KPIs and Targets 2021

Companies should report key performance indicators (KPI) relevant to their specific industry. According to the NFRD and TCFD standards, companies should think about applying indicators showing existing climate-related disclosures, such as those linked to results or key risks (European Commission, 2019).

In 2021, in light of the Paris Agreement, Caverion set itself a clear and simple target to halve its carbon intensity (Table 6).

Table 6. Caverion key performance indicators 2021(Caverion sustainability report, 2021)

KPI	2021	Target 2025	Target 2030
Reduced footprint: tCO2 emissions from the fleet of service vehicles (Scope 1)*.	15.0	Decreasing	Decreasing
The material Scope 1-3* emission categories are defined. The carbon footprint has been defined and and measured.	80%	100%	100%
Carbon handprint/footprint(Scope 1-2)*	>2x	5x	10x
Define the carbon handprint for the Caverion offering. The carbon handprint impact is measured for customers and society.	20%	100%	100%

**Scope 1:* Direct GHG emissions that occur from the company's direct use of fuel.

Scope 2: Indirect GHG emissions associated with the company's consumption.

Scope 3: All other company's indirect GHG emissions.

Caverion's footprint and carbon emissions are low since the company focuses on installation and services rather than product manufacture. In Caverion's activities, CO2 emissions from service vehicles exceeded energy consumption emissions in 2021 (Figure 10). Caverion is increasing the number of remote services, reducing the number of routes, and using biofuels and electric cars to cut down on emissions.

Scope 1				
CO2 emissions from direct energy sources, tonnes	2019	2020	2021	
CO2 emissions, petrol	1,595	1,121	1,119	
CO2 emissions, diesel	21,028	17,461	19,335	
CO2 emissions bio diesel*			4	
CO2 emissions, light fuel oil	2	9	16	
CO2 emissions, natural gas	631	236	813	
CO2 emissions, LPG	28	39	10	
Total direct CO2 emissions	23,285	18,866	25,055	

Scope 2				
CO2 emissions from indirect energy sources, tonnes (market-based)	2019	2020	2021	
CO2 emissions, electricity	4,628	2,218	3,930	
CO2 emissions, district heating	1,523	1,585	1,627	
CO2 emissions district cooling*			12	
CO2 emissions, geothermal	10	6	10	
Total indirect CO2 emissions	6,162	3,809	3,701 **	

Direct and indirect CO2 emissions, total	2019	2020	2021
	29,447	22,675	28,765

Scope 3 ***				
CO2 emissions, tonnes	2019	2020	2021	
Business travel, air travel CO2 emissions	1,778	28.8	26.8	

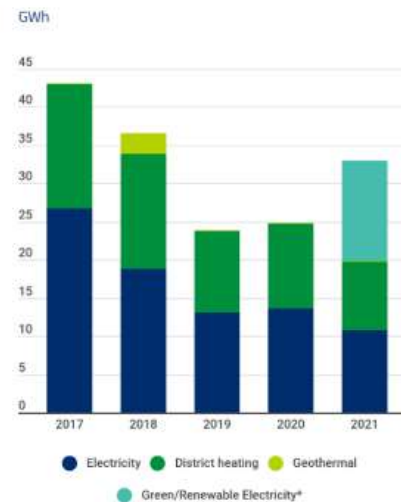
Intensity ratios				
Direct and indirect CO2 emissions/revenue (mEUR)	2019	2020	2021	
	16.5	10.5	13.4	

* New measurement 2021

** Total Scope 2 CO2 emissions from indirect energy sources, tonnes (location-based: 1,888 tCO2)

*** More detailed Scope 3 emissions measurements will be calculated in 2022, linked to our SBT work. Business travel is a small percentage of the total Scope 3 emissions.

Indirect energy consumption



Scope 1 & 2 CO2 emissions

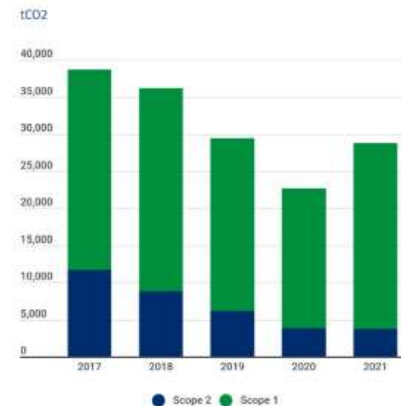


Fig. 10. Emissions measurement (Caverion Sustainability Report, 2021)

The majority of Scope-2 emissions come from leasing office buildings. Caverion is dedicated to increasing renewable energy usage in its facilities as well as performing daily energy-saving initiatives. Some of the company's divisions have already committed to using 100 % renewable energy by 2022 (Caverion Annual Review, 2021).

Caverion completed its first full analysis and assessment of Scope-3 emissions in 2021. Caverion evaluated all Scope-3 emission categories and found that purchased goods and services and product usage were the major contributors to the greenhouse. According to Caverion, Scope 3 accounts for almost 90% of its carbon emissions. Annual CO2 reductions through Energy Performance Contracting (EPC), energy management, and electric vehicle (EV) charging stations currently exceed Caverion's Scope-1–2 footprints. Caverion is well-positioned for sustainable development and to meet the ambitious 5X objective by 2025 as it grows its carbon emission estimates and sales with a positive handprint effect (Caverion Annual Review, 2021).

Caverion's progress towards CO2 emission reduction is presented in Table 7.

Table 7. Caverion progress towards science-based targets

	2019 baseline	2021	Reduction from baseline (2019 - 2021)	Reduction target in 2025/2030
Scope 1	23.285	25.055*	8 %	Decreasing
Scope 2	6.162	3.701*	-40 %	x 5/x10
Scope 1+2	29.447	28.765	-2 %	x 5/x10
Scope 3	16.5	13.4	-19 %	-20 %

*New measurement in 2021

The measurement indicates that CO2 emissions from its own service fleet have not exceeded the target yet and have remained about the same. Scope 2-3 is progressing toward set targets.

4.2. Assessing Financial Impacts of Climate-Related Risks and Opportunities.

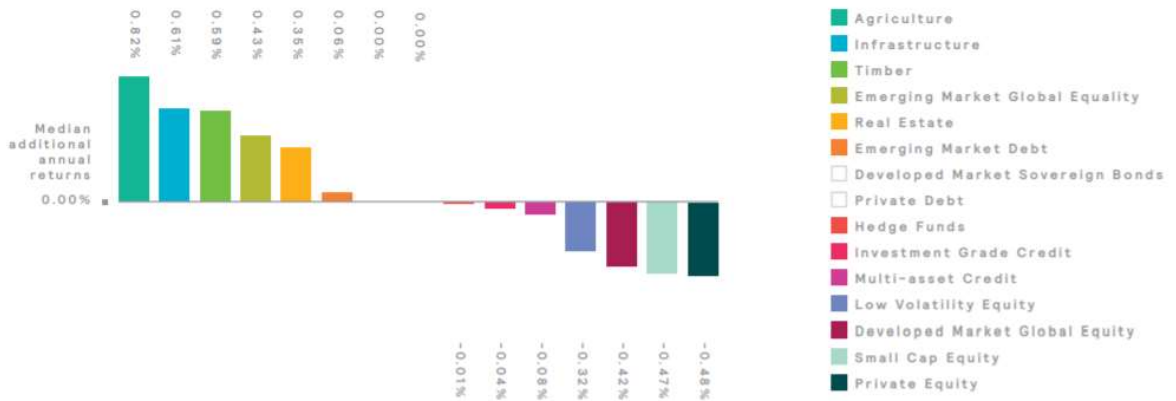
To guide companies to understand which financial impacts are likely to be the most relevant to them, TCFD provides a high-level overview of four areas where companies may be affected: "revenues, expenditures, assets and liabilities, and capital and financing". The financial impact of climate change on a company depends on its exposure to particular risks and opportunities, its plans to manage and control those risks and opportunities, and the influence on the company's income statement, cash flow statement, and balance sheet (TCFD, 2017).

4.2.1. Scenario Pathways and Sector Resilience to Climate Change

Companies should evaluate how climate-related risks and opportunities vary over time, as well as their possible implications while preparing for the impacts of climate change. Companies that do not correctly assess their business model and strategy in the context of climate change may negatively influence the environment as well as their company, including their profit and loss statement, financing, future regulatory burden, and "license to operate". In contrast, identifying new climate-related possibilities may help a company's business strategy and profitability prospects (European Commission, 2019).

The systematic pattern of potential climate impact on a specific sector could be detected by using Mercer's Implications for Strategic Asset Allocation (SAA) approach. It defines four climate scenarios and four climate risk factors and incorporates them into the modeling process with more typical market assumptions, scenarios, and risk factors (Mercer, 2015).

Figures 11–14 show the possible effects of climate change on returns across asset classes for each scenario (Mercer, 2015).



Source: Mercer

*Transformation scenario-strong climate action.

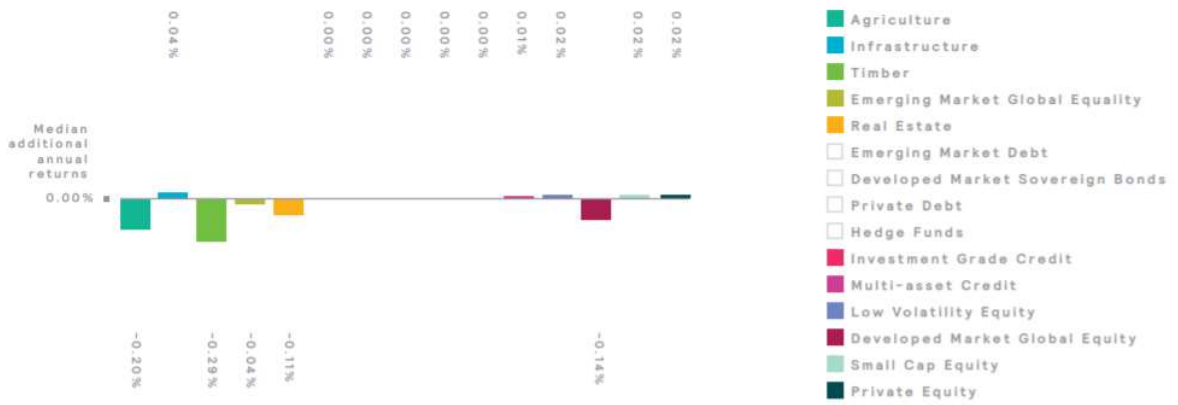
Fig.11. Asset classes under transformation scenario (Mediam annual return impact over 35 years) (Mercer, 2015)



Source: Mercer

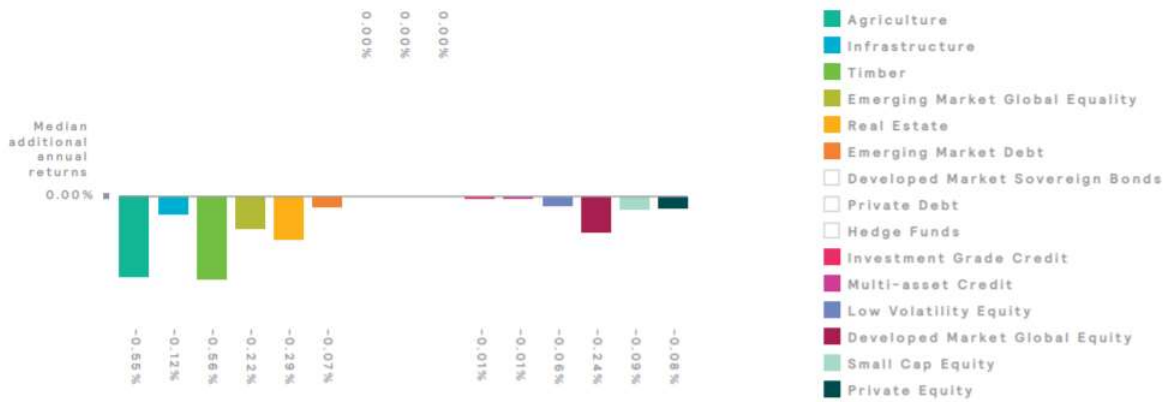
*Coordination scenario-some climate action.

Fig.12. Asset classes under coordination scenario (Mediam annual return impact over 35 years) (Mercer, 2015)



Source: Mercer

Fig.13. Asset classes under fragmentation (Lower damages) scenario (Median annual return impact over 35 years) (Mercer, 2015)



Source: Mercer

*Fragmentation scenario-limited climate actions.

Fig.14. Asset classes under fragmentation (Higher damages) scenario (Median annual return impact over 35 years) (Mercer, 2015)

As demonstrated above, it is expected that the Infrastructure and Real Estate sectors Caverion belongs to will have an increase in expected returns under transformation and coordination future scenarios and a slight decrease under fragmentation future scenarios. Taking into consideration different climate-related scenarios over different time horizons, it could be stated that Caverion’s business model and strategy are resilient to climate change. Furthermore, multiple opportunities for competitive advantage and revenue growth could be created.

Figures 15-18 depict the climate change risk factor pathways for each of the climate change scenarios. For example, if Policy is predicted to cost EUR 5 in year-35 of the model, and Resource Availability is expected to cost EUR 1, in the same year, the ratio of their respective applications in that year should be 5:1 (Mercer, 2015).

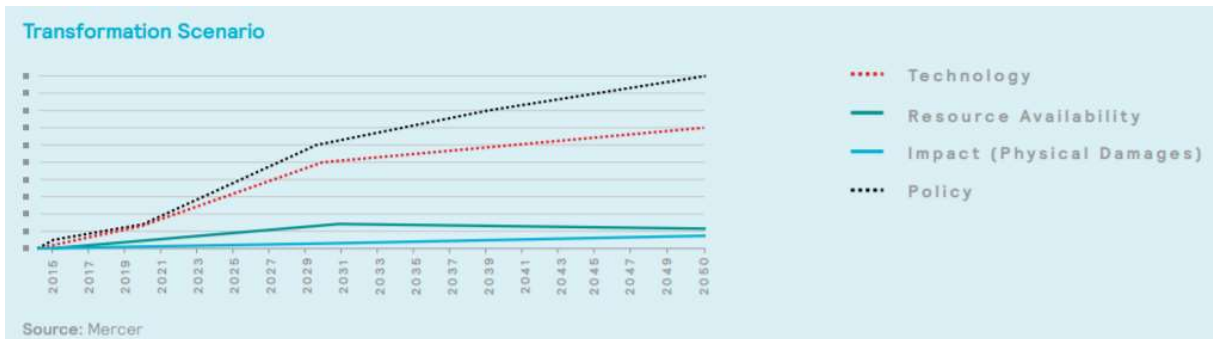


Fig.15. Transformation scenario-pathway of climate change risk factors to 2050 (Mercer, 2015)

We can see that the dominant climate change risk factor is Policy under the transformation scenario. This factor is well correlated with technological investment flows and is likely linked with policy interventions.

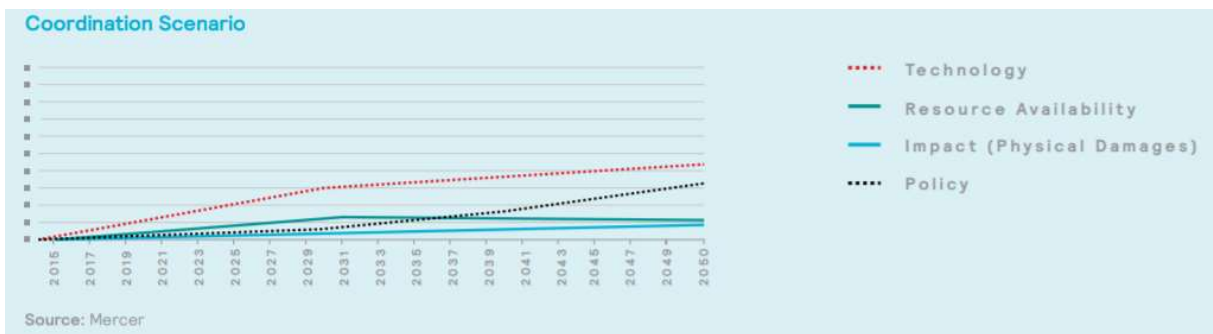


Fig.16. Coordination scenario-pathway of climate change risk factors to 2050 (Mercer, 2015)

Policy action is limited in the coordination scenario. Despite the absence of regulatory involvement, technological innovation draws investment flows. As a result, the Technology risk factor is the most important climate risk element in the coordination scenario.

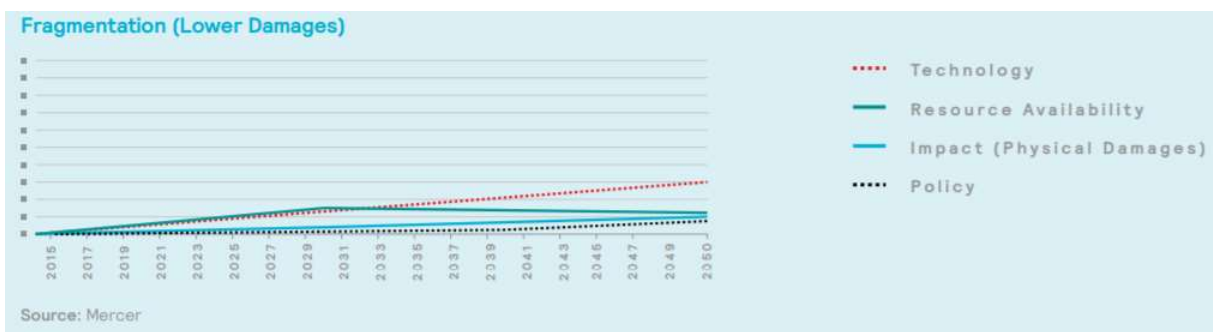


Fig.17. Fragmentation (Lower damages) -pathway of climate change risk factors to 2050 (Mercer, 2015)

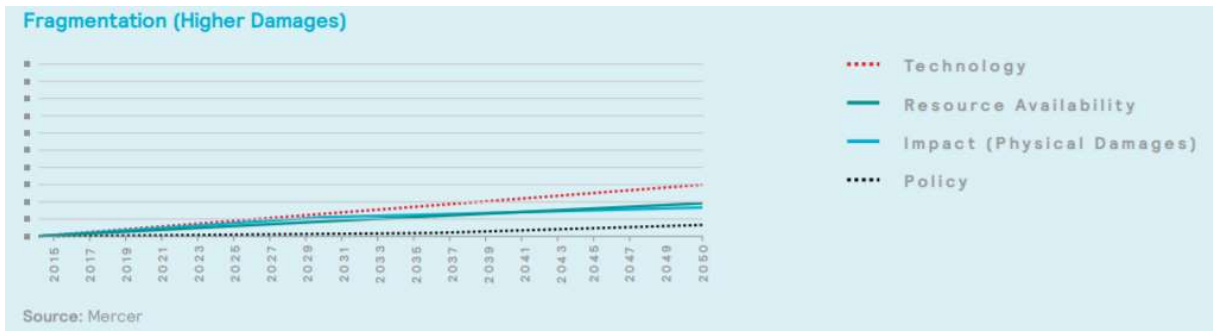


Fig.18. Fragmentation (Higher damages) -pathway of climate change risk factors to 2050 (Mercer, 2015)

The Technology and Policy pathways are the same under both fragmentation scenarios. The distinction between these two scenarios is in Resource availability (the influence of changing long-term weather patterns on resources like water) and physical damage (the impact of catastrophes such as flooding caused by sea-level rises) (Mercer, 2015).

The findings reveal that Policy is clearly linked to Technology. The two factors are correlated, but effective new technology may become less dependent on policy settings in the future. Under all four climate change scenarios, the technology component is important. However, the technology development pathway remains very unclear, and this factor is one of the most difficult to evaluate because of its complexity with mitigation and adaptation initiatives, as well as uncertainty surrounding research and development successes or failures (Mercer, 2015). Moreover, TCFD (2017) implies that increased technology costs in research and development are critical for materials and building group organizations. This industry is often capital-intensive, requiring large expenditures on equipment and facilities, limiting its ability to adjust to climate change risks.

Climate-related influencing sensitivity factors' analysis shows, that the energy business is predicted to be the most vulnerable to the effects of climate change, as well as the most differentiated (Mercer, 2015). As the biggest part of Caverion's activities are assigned to the energy sector, providing products and services related to renewables, it was highlighted the following sensitivities to climate risk factors (Table 8):

Table 8. Energy sensitivity to climate risk factors (Mercer, 2015)

<p>Technology:</p> <ul style="list-style-type: none"> • Renewables are already a reality in certain markets and are likely to become more common in the near future. • The speed of the price reduction for solar panels has exceeded expectations. Solar's reliability and low risk make it a good alternative for debt financing. • Wind technology is developing, although at a slower rate than solar technology. The wind has the benefit of being less expensive. 	<p>Resource availability:</p> <ul style="list-style-type: none"> • Wind and solar have limited sensitivity to resource availability risk.
<p>Impact:</p> <ul style="list-style-type: none"> • Extreme weather events pose a risk of causing operational interruptions. 	<p>Policy:</p> <ul style="list-style-type: none"> • Solar and wind energy have grown significantly in recent years due to government regulations.

The results provide insights into the potential impacts of different climate scenarios. It is expected that European companies will be less vulnerable to climate change policy shocks given the existing policies and commitments in place.

4.2.2. Perspectives on Climate-Related Business Activities

Developing a complete picture of a company's climate risks and opportunities requires strong organizational coordination. When assessing the effect of climate change on financial statements, the company should consider all the risks and opportunities it faces. This information has been identified from the company's annual and sustainability reporting along with the SASB Materiality Map.

Caverion is sensitive to a series of risks, including political, technical, operational, market, customer, financial, and others. Caverion's usual operational risks come from its services and projects. Some of these are tender risks (e.g., calculation and pricing). They also include "contractual terms and conditions, partnering, subcontractors, supply chain, material procurement, and pricing, long-term service commitments, guaranteed service levels, skilled employees, and project management" (Caverion Sustainability Report, 2020).

Climate change mitigation, energy efficiency, and circular economy promotion are widely demanded. Caverion's ability to design, produce, operate, and maintain solutions that meet this need is essential to reaching the company's targets. In 2020, Caverion started to define the net impact of all its operations. A multi-dimensional approach to preparing EU Taxonomy calculations includes the division-level or business unit breakdown of green revenue. Taxonomy activities can be identified for each profit center, project, customer, or service contract. They can also be identified for a customer based on service and project master data. For the first time in 2022, this will be a useful tool to be able to do more accurate sustainability reporting (Caverion EU Taxonomy and Calculation Principles, 2021).

Battling climate change, Caverion can do a lot for buildings, industries, and infrastructure. The company provides smart technical solutions, services and high-quality advice throughout the lifetime of buildings, infrastructure, industrial sites, and processes. It's unique because it covers the whole life cycle (Table 9):

Table 9. Company's activities (Caverion Annual Review, 2021)

Activity	Company products, technologies and services
Construction & real estate	
Installation, maintenance and repair of energy-efficiency equipment	Installations, maintenance and repair of HVAC equipments and LED lighting, life cycle projects and maintenance contracts
Installation, maintenance and repair of EV charging stations	Installations, maintenance and repair of EV charging stations
Installation, maintenance and repair of devices for measuring, regulating and controlling energy performance of buildings	Installations, maintenance and repair of building automation systems, refrigeration automation and remote monitoring services
Installation, maintenance and repair of renewable energy technologies	Installations, maintenance and repair of renewable energy technologies, including pumped hydropower stations and solar panels
Energy	
Electricity generation using solar photovoltaic technology	Installation and maintenance related to solar power plants
Electricity generation from hydropower	Preventive maintenance related to facilities and equipment for hydropower generation
Electricity generation from renewable non-fossil gaseous and liquid fuels	Installations and operation of thermal power stations
Transmissions and distribution of electricity	Installations and maintenance related to transmission and distribution lines and substations
District heating/cooling distribution	Installations and maintenance of district heating and cooling networks and facilities
Installation and operation of electric heat pumps	Installation and maintenance of electric heat pumps
Cogeneration of heat/cooling and power from solar energy	Installation and maintenance of connections from solar power generation to energy networks
Production of heat/cooling from bioenergy	Installation and operation of pellet boilers and other bioenergy generation facilities
Production of heat/cooling using waste heat	Installation and maintenance of heat recovery systems for pulp mills and heat exchangers for buildings
Information & communication	
Data-driven solutions for carbon emissions reductions	Development of SaaS software and systems related to carbon emission reductions
Professional, scientific and technical activities	
Professional services related to the energy performance of buildings	Advisory services related to energy efficiency, SRI services, EPC/ESCO contracts
Transport	
Infrastructure for rail transport	Installations and maintenance related to infrastructure for railways and subways
Infrastructure enabling low-carbon road transport and public transport	Installations and maintenance related to road traffic telematics and public EV charging stations
Infrastructure enabling low-carbon water transport	Installations and maintenance related to airport infrastructure
Manufacturing	
Manufacture of energy-efficiency equipment for buildings	Manufacturing of cooling equipment and building automation systems
Water supply, sewerage, waste management	
Construction, extension, operation and renewal of water collections, treatment and supply systems	Installation and maintenance of water treatment systems
Construction, extension, operation and renewal of waste water collection and treatment	Renewal of wastewater collection/sewage and treatment systems
Collection and transport of non-hazardous waste in source segregated fractions	Installations and maintenance of pneumatic waste collection systems

The company's design and building knowledge are useful for new building projects, and it may operate as a partner for procurement, design, construction activities, and engineering of building technology systems, assuring energy efficiency at every level. In the near future, new construction is likely to decline, while modernisation in bigger cities is expected to increase (Caverion Annual Review, 2021).

For existing buildings, Caverion offers experience in building energy efficiency, which reduces CO₂ emissions. The company replaces old lighting with energy-efficient solutions, installs air-source heat pumps, and enhances the management capabilities of building systems connected to energy efficiency. Heat recovery systems and ventilation systems may be implemented as well (Caverion Annual Review, 2021).

Demand for greater energy efficiency and advanced technologies may boost this industry's profits. The result suggests that the value of a typical building-materials company in the civilised world grows by 35% in the executive scenario and by 80% in the expert scenario. In the absence of stricter

regulatory measures, values might decrease by 10% to 20% due to expected short-term cost pressures (Brinkman, Hoffman, Oppenheim, 2008).

For EV charging stations, the company can provide installation and maintenance, which requires extensive technical expertise and certified experience. Caverion can help with the entire process and enable mobility with low emissions.

Caverion's goal is to minimize GHG by using logistical innovations and modern vehicles. A growing number of gas, hybrid, and electric vehicles are already in use. Caverion pays close attention to new technology and is willing to make more eco-friendly cars available for more people to use in the future (Caverion Annual Review, 2021).

Caverion's own activities are not very energy-demanding, so the risks associated with rising energy consumption are minimal. Waste and chemicals generated by Caverion's activities are recycled and disposed of in accordance with the law (Caverion Annual Review, 2021).

For power plants and industries, Caverion can offer efficient shutdown services, reducing expected maintenance downtime and extending the life of the equipment. Digital remote monitoring and Caverion SmartView can reduce costs while improving end-user satisfaction and reducing the properties' carbon footprint. Demand will be driven by increasing energy efficiency, a better indoor climate, and stricter environmental policies in the next few years (Caverion Annual Review, 2021).

4.2.3. Determining Relevance and Materiality

A significance test was performed to evaluate the financial impact and likelihood of occurrence of each risk and opportunity. For each risk and opportunity, the Caverion environmental materiality matrix ranks them according to their potential financial impact. This identifies the relevance of each material risk or opportunity (SSE PLC Sustainability Report, 2021).

In the first stage, Caverion performed a materiality analysis for important environmental topics (Figure 19). Caverion, with a focus on lifecycle management and smart and sustainable solutions and services, assists customers in achieving significant energy savings and therefore mitigating climate change. Those themes are considered the most important to Caverion. A sustainable supply chain is deemed essential to the company as well.

Caverion's own operations are considered low material to the company. They include the fuel consumption of the car fleet, which has the most significant environmental footprint. If Caverion uses a lot of energy to run its own businesses, this will have a small effect on the company's results. Because the circular economy is growing worldwide, waste management and effective material usage are important in Caverion's day-to-day activities, although they are considered one of the least material for the company.

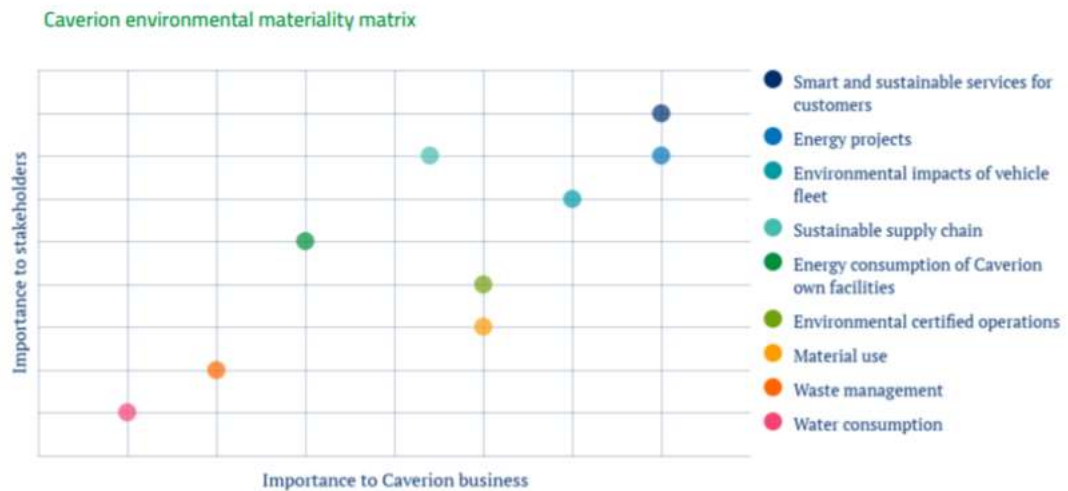


Fig. 19. Caverion environmental materiality matrix (Caverion Sustainability Report, 2021)

The next step is to filter the identified climate change risks and opportunities that Caverion may face. The risk rating matrix (Table 10) helps to rank each risk and opportunity based on how likely it is to happen and how much money it could cost.

Table 10. Risk rating matrix

Rating	● Low	● Moderate	● High
Likelihood	Physical: Low-less than 1 in 10 years of events. Transition: Low-a very unlikely occurrence.	Physical: Medium- 1 in 5 years of events. Transition: Medium- possible occurrence.	Physical: High-1 in 3 years of events. Transition: High-an extremely likely occurrence.
Materiality	● Waste management ● Water consumption	● Energy consumption of Caverion own facilities ● Environmental certified operations ● Material use	● Smart and sustainable services for customers ● Energy projects ● Environmental impacts of vehicle fleet ● Sustainable supply chain

4.2.4. Emerging financial risks and opportunities

Caverion poses physical and transitional climate-related risks. Caverion's transformation to a low-carbon economy requires investment in renewable and low-carbon energy sources. The output of the climate-related risk and opportunity assessment process is summarised in (Appendix 1).

Out of all the risks and opportunities that were assessed, there are eight aggregated, which are believed to be the most relevant for Caverion:

Risk 1. Enhanced emissions-reporting obligations (Scope 1 and 2)

Risk 2. Extreme weather events damage network assets

Risk 3. Costs to transition to lower-emissions technology

Risk 4. Increased costs of materials and supplies

Opportunity 1. Decarbonisation of transport drives investment in EV charging infrastructure

Opportunity 2. Energy-efficient solutions to a Smart Building

Opportunity 3. Green growth and digitalisation, automatisisation packages

Opportunity 4. Increase in demand for energy through renewable sources (solar, hydropower, thermal power stations) (Scope 2)

Risks and opportunities have been presented in more detail in (Appendix 2). No doubt, other risks may arise in the future.

After identifying the risks and opportunities linked with climate change and severe weather events, managers and analysts must analyze the financial implications of those risks and opportunities. A report from the World Economic Forum says that failing to adapt to climate change is one of the top five global risks in 2022 (World Economic Forum [WEF], 2016).

4.3. Future Outcomes and Scenarios

Using the initial screening assessments, the next step is to focus on stress testing and scenario analysis. The following technique uses universal economic frameworks to estimate probable future outcomes under various climatic scenarios (for example, governments are taking steps to prevent global average temperatures from increasing by more than 2°C above pre-industrial levels) (World resource institute [WRI], 2012).

While extracting risk data may be time-consuming, numerous institutions, including expert groups like the Carbon Tracker Initiative, financial analysts, and other commercial tool providers, give fundamental data for scenarios. Tools for doing such evaluations are just now becoming accessible, and they are normally only available via commercial suppliers. In reality, it takes a lot of research to make practical tools that can be used for stress tests and scenario analysis (WRI, 2012).

This chapter discusses the process by which management can evaluate the potential financial impact. This assessment may include an analysis of qualitative and quantitative data provided by a company in its annual report. It reflects the company's important exposure figures and the company's carbon strategy.

4.3.1. Stress Testing

Companies struggle with recognizing and measuring assets and liabilities in their financial statements since all judgments and assumptions are dependent on current accounting rules. The historical data, based on the previous results, could be one of the tools to predict the future.

Climatic stress testing involves the collection of two types of data: standard financial data and climate data. Traditional financial data is required to perform historical stress testing and portfolio evaluations. Climate data is often derived from scenarios and provides high-level information on physical risks and transition paths. Climate stress testing provides an overview of a company's overall climate risk. This means that the test results include both quantitative climate loss estimations and qualitative climate risk management strategies.

To evaluate a company's portfolio, traditional financial data has been assessed through historical financial development (Appendix 3).

Instead of doing extensive simulations or projections on the long-term future of services and products, quantitative evaluations were developed (Figures 20–21) to determine higher-level materiality and define a scale of substantial financial effect.

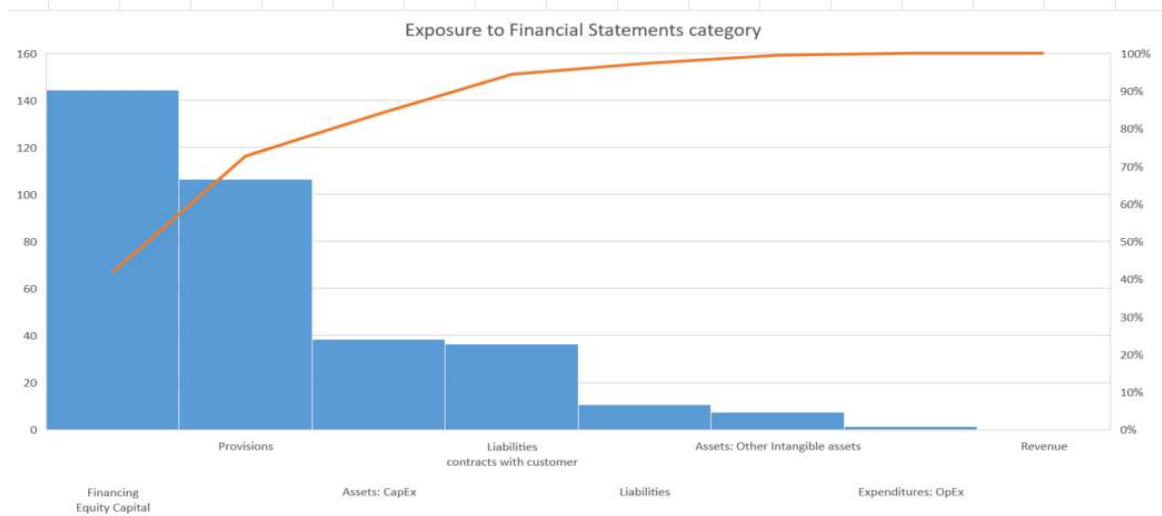


Fig. 20. Caverion's exposure to financial statements category

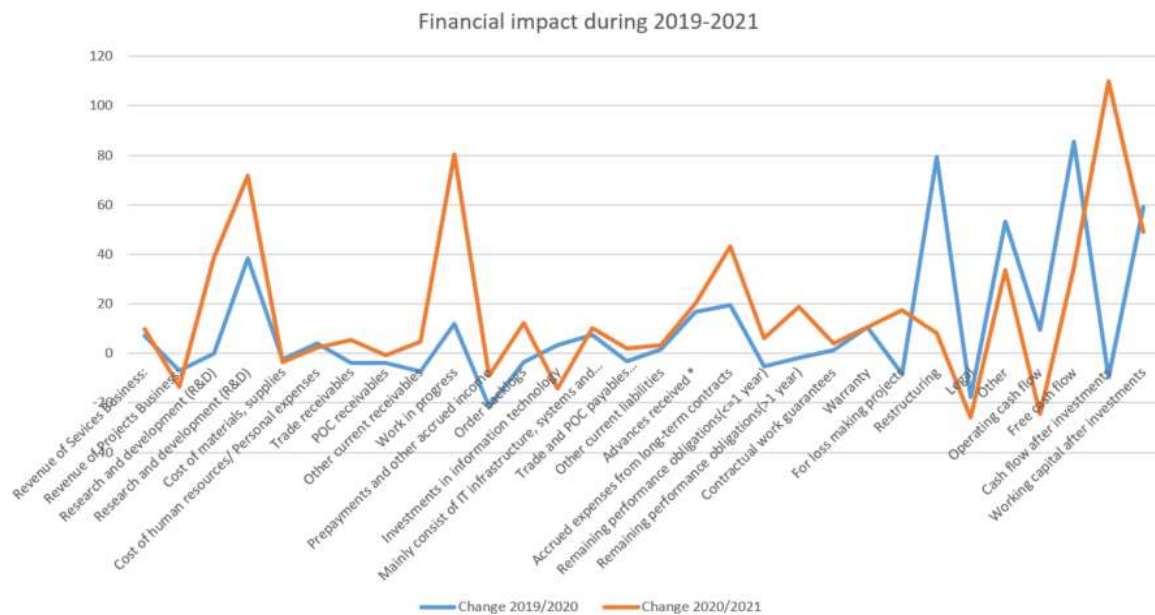


Fig. 21. Financial impact during 2020-2021

Revenue growth has been the most essential financial aim in the Fit for Growth approach, and it is predicted to grow by more than 4%. Despite a total revenue decrease during 2021, the revenue of the services business continuously grew over the period. This provides a basis for successful growth in 2022. A decrease in project revenue could be the result of delayed projects, an increase in the number of potentially onerous contracts, and the company's continued selective approach, which includes supply chain partners, customer relationships, the availability of skilled employees, and the management team to coordinate a sustainable business. In the future, services, which make up two-thirds of the company's total revenue, are expected to keep growing at a profitably high rate (Caverion Annual Review, 2021).

Caverion's expenditure related to research and development activities had a significant increase during the period. Product and service development activities were for EUR 4.9 (3.6) million in recent years. A total of EUR 2.5 (1.8) million was recorded as an expenditure in the income statement, with EUR 2.4 (1.8) million capitalised. Caverion is expanding its ESG goods and services to meet rising demand. Investment in ESG data and tools has increased, resulting in faster employee growth in R&D, BI, and Editorial and Research (Caverion Annual Review, 2021).

In 2021, rising material costs adversely affected the building technology industry. Some regions have experienced supply shortages and delays. Despite that, the cost of materials and supplies in Caverion decreased during the period. The company has taken proactive steps to improve the supply chain and regulate prices. Inflationary pressure is likely to be less severe in 2022 than in 2021, but higher material costs and prolonged delivery delays may still impact Caverion's company. Concerns include raw material price increases and decreases in employee availability. Materials required for electrical and HVAC constitute the majority of Caverion's resource usage under Scope 3. Increasing expenses include material and energy costs, which might negatively impact the company's operations (Caverion Annual Review, 2021).

The tangible assets category was mostly affected by the work in progress line item, which kept increasing dramatically during the period. Receivables are written off when it is likely that no payment will be received. Because of the nature of its business, Caverion is involved in conflicts and legal actions regarding various projects. In many cases, just a small proportion of the receivable has been recorded as revenue. Caverion's recovery of receivables might lead to disagreements and legal action. Due to unpaid receivables and long-term client commitments, Caverion faces operational credit risk. The rise in work in progress could also have been caused by a company's growth, which led to more backlogs (Caverion Annual Review, 2021).

Since 2020, there have been regular investments in information technologies and just in 2021, they decreased by 18%, which indicates that Caverion historically continued to focus on unified IT infrastructure. In 2021, several IT systems were renewed. Internal IT systems and mobile technologies have been improved to increase internal procedures and efficiency. Thus, the company's technology and digital solutions are meeting rising market demands (Caverion Annual Review, 2021).

In the liabilities category, the biggest increase is noted in contracts with customers. Accrued expenses from long-term contracts have kept increasing during the period and in 2021 reached 24%. This financial statement line item indicates an increased number of orders, which means growth for the

company. From Caverion's practice, amounts included in contract obligations at the beginning of the year are recognized as revenue throughout the year (Caverion Annual Review, 2021).

Caverion's business often provides financial guarantees to its stakeholders. In particular, for the security of advance payments, the performance of contract obligations, and the warranty defects that may arise. The biggest increase in contingent liabilities is noted in contractual obligations over 1 year. Many contracts incorporate various construction systems that the customer has bought from Caverion. Liabilities of contractual work guarantees remained stable, despite the fact that it is not clear if the company will have continued access to sufficient guarantees from financial institutions at competitive terms or at all. The lack of such guarantees might have a negative impact on Caverion's business and financial status (Caverion Annual Review, 2021).

As stated above, Caverion's business is involved in disputes and legal proceedings. Claims, conflicts, and legal actions, in many cases, are unpredictable. However, the decreasing figures in legal provisions lead to the assumption that environmental legislation has no impact on businesses.

Figure 19 shows the company's significant exposure to the provision category. The most sensitive line item is for loss-making projects, which in 2021 increased by 26%. Group policy allows for onerous contracts when the cost of meeting commitments outweighs the expected benefits.

Despite the decrease in operating cash flow, Caverion continues to prioritise cash flow generation. Decreasing operating cash flow was impacted by a change in working capital due to higher receivables. Cash flow after investments increased by 120%, as there were improvements in some divisions of the industry compared to the previous year (Caverion Annual Review, 2021). In general, climate uncertainties might impact Caverion's cash flow projections and growth rates in several ways:

- Because of its impact on global emissions, it is subject to government regulation or consumer pressure to limit its sale;
- In the construction industry, there is a growing demand for "Green Star" certified buildings. This is one example of how customer preferences are likely to change.
- Heat waves and other weather events are expected to increase maintenance costs (KPMG, 2021).

The results showed that Energy, Infrastructure, Construction & Real Estate sectors are more sensitive to costs that may affect their balance sheets (Figure 20). In order to increase revenue, Caverion should be focusing on capital expenditure rather than operating expenditure, as operating expenditures do not have a big influence on the results. The most sensitive financial statement line items were identified as: research and development (R&D), investments in information technology, work in progress, accrued expenses from long-term contracts, remaining performance obligations (> 1 year), provisions for loss-making projects, and operating cash flow. This shows Caverion's commitment to making a difference in sustainability together with its customers, which is at the core of the company's growth strategy. The company should continue to focus on the cost of materials and supplies, knowing that suppliers play a significant role in the company's supply chain. Most of Caverion's technical systems and solutions are built and deployed using components obtained from suppliers.

To get more precise calculations, in 2022, Caverion will start to report for the first time its EU taxonomy eligibility levels for 2021. The calculation will be done by identifying the individual taxonomy activities based on profit center, project, service contract, or customer and by identifying

mass taxonomy activities based on service and project master data. This way, double accounting will be eliminated. Meanwhile, based on the existing external and internal data and according to the importance of the nature of business, identified risks and opportunities were ranked as follows (Figure 22):

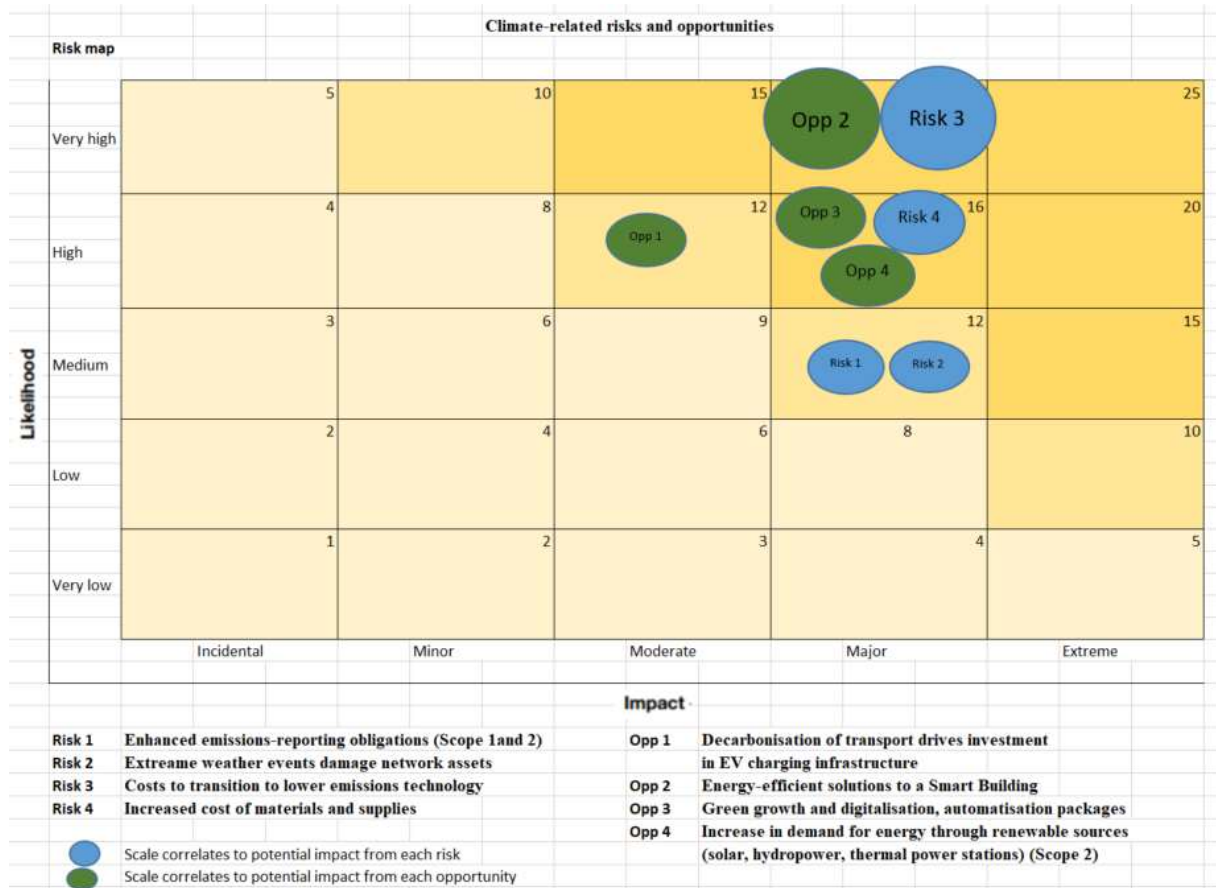


Fig. 22. Likelihood of the impact

The findings may be used to improve risk management procedures and create new strategies to benefit from climate opportunities. Existing stress testing models can be a good place to start when thinking about the relationship between financial risks and losses.

4.3.2. Scenario Analysis

Unlike the existing climate-related reporting requirements, the TCFD report requires strategic disclosures that outline the effects of several climate scenarios on the company's business, strategy, and financial planning (CDSB, 2017).

The literature on a company's impact on climate change may be divided into three categories: physical risks, transition to a lower carbon emission, and creating scenarios for economic stress testing. Integrated Assessment Models (IAMs) build on theoretically optimum paths. "What-if" inquiries generally only reveal how the theoretical path changes. Users often want to see how policy, society, and technology might change the direction of emissions. It is difficult to quantify changes in customer preferences, investment decisions, and expectations, as well as limits on technology implementation, so it requires lots of knowledge and expertise, including business intuition.

To better understand the impact of climate change on Caverion's company, an analysis of the effects of 1.5°C and 4°C global warming scenarios was undertaken. The 1.5°C and 4°C scenarios assume that average global temperatures will have risen by 1.5°C and 4°C, respectively, by the year 2100. The company's influence in 2030 and 2050, assuming the same business operations as now, has been examined.

Every company should evaluate the timeline for analyzing sensitivity and the impact of any significant indications on the company's results. Since Caverion does not have such a process implemented yet, key indicators from IEA (2021), IRENA (2022), and predictions from similar sector companies will be taken. It examined a few climate trends and a few societal trends that may affect Caverion's material issues in the future. These insights could be used to look at the effects of the most important climate-related risks and opportunities that a company faces.

The World Energy Transition Outlook 2022 establishes KPIs for a 1.5°C scenario pathway, which includes investment and consumption in the energy transition (Appendix 4). Data presents key indicators relevant to Caverion's business (International Renewable Energy Agency [IRENA], 2022).

Renewable energy has the potential to decarbonize 90% of the electricity industry by 2050. Direct applications of renewables provide alternatives for decarbonizing transportation, buildings, and industries. The proportion of direct renewables in end-use sectors must increase from 12% in 2019 to 19% by 2030. District heating is a great way to use renewable energy in the market, but more investment is needed (IRENA, 2022).

Energy intensity will have to improve. By 2030, the proportion of improvement in energy intensity must be increased to 3.1% per year, which is twice as much as it currently is. Special consideration must be given to building decarbonisation, which will require significant expenditures on energy-efficient renovation and electrification. All new construction must be energy-saving, and renovation speeds should increase drastically. Energy consumption for space heating falls by nearly half in the 1.5°C scenario, mainly due to better efficiency and extensive use of electric heat sources such as heat pumps. Due to a combination of efficiency improvements, the reduction of energy usage in the construction sector will reach 99 EJ by 2030, compared with the 121 EJ reported in 2019 (IRENA, 2022).

Electrification has the capability to increase energy efficiency. Under the 1.5°C Scenario, direct power consumption in end-use sectors will increase to around 31 000 TWh by 2030, up from 22 850 TWh in 2019. Energy-saving initiatives will be crucial. In the 1.5°C scenario, transportation electrification will be intensified, with a significant deployment of smart charging stations for electric vehicles (EVs) in the next decades. To speed deployment, enabling policies must be enacted (IRENA, 2022).

Clean hydrogen and biofuels will play key roles in balancing renewable electricity supply and demand, and in the building sector, they will play a complementary role to electrification, greening the existing gas grid through biomethane or hydrogen. Clean hydrogen roadmaps and plans, new or updated infrastructure, and project developments must all be accelerated before 2030. The 1.5°C scenarios will need significant resources (IRENA, 2022).

As indicated, huge investment increases are required to achieve net-zero carbon. According to Wind Energy Technologies Office (WETO), investments in the energy transition would total USD 47 trillion between 2021 and 2030 and USD 35 trillion between 2030 and 2050, respectively, six and four times the historical average. USD 35 trillion will be needed under the conservative scenario between 2021 and 2030. In comparison to the conservative scenario, a 1.5°C climate pathway represents a more than 70% increase in investments to accelerate the energy transition until 2030 (IRENA, 2022).

Climate-related risks may increase the cost of fulfilling contractual commitments, increase provisions, and result in remaining performance obligations. Caverion's operations will be significantly impacted by policy changes influencing carbon prices and changing market trends. To better understand the impact of climate change on financial statements, a 1.5°C and a 4°C scenario were assessed in the 2030s and 2050s.

The WEM's international prices for fossil fuels show what prices are needed to get enough investment in supply to meet predicted demand (Table 11).

Table 11. Fossil fuel prices by scenario in European Union (IEA, 2021)

Fossil fuel prices	2020	Net Zero Emissions by 2050 (1.5 °C)		Stated policies	
		2030	2050	2030	2050
Natural gas (USD/Mbtu)	4.2	3.9	3.6	7.7	8.3
Steam coal (USD/tonne)	50	52	44	67	63
IEA crude oil (USD/barrel)	42	36	24	77	88

Under a conservative scenario, demand is still high, resulting in prices continuing to rise. Thus, material and supply prices will increase as well. Some experts think this is a sign that the world is about to start a new supercycle, which is when prices for energy and other goods rise for a long time because of strong demand and limited supply (IEA, 2021).

Regulating carbon prices is a very successful decarbonisation strategy. By raising carbon price ratings, governments may significantly cut emissions and move toward a greener development path. Prices in the EU have risen since 2018 and now exceed EUR 30 per tonne of CO2. CO2 price assumptions are an important input into WEM because the pricing of CO2 emissions influences energy demand by changing the relative costs of using different fuels. More than resource availability, consumer choice will drive the energy mix. Global energy consumption is rising, driven by rising living standards in developing countries. The structure of energy demand is projected to vary over time, with a decreasing role for fossil fuels and an increasing one for renewable energy.

Decarbonisation strategy should encourage customers to become environmentally friendly and make final energy prices "cost-reflective ". Including taxes, offsets, capital costs, and other surcharges the government provides, the final energy bill in the future is predicted as follows (Figure 23):

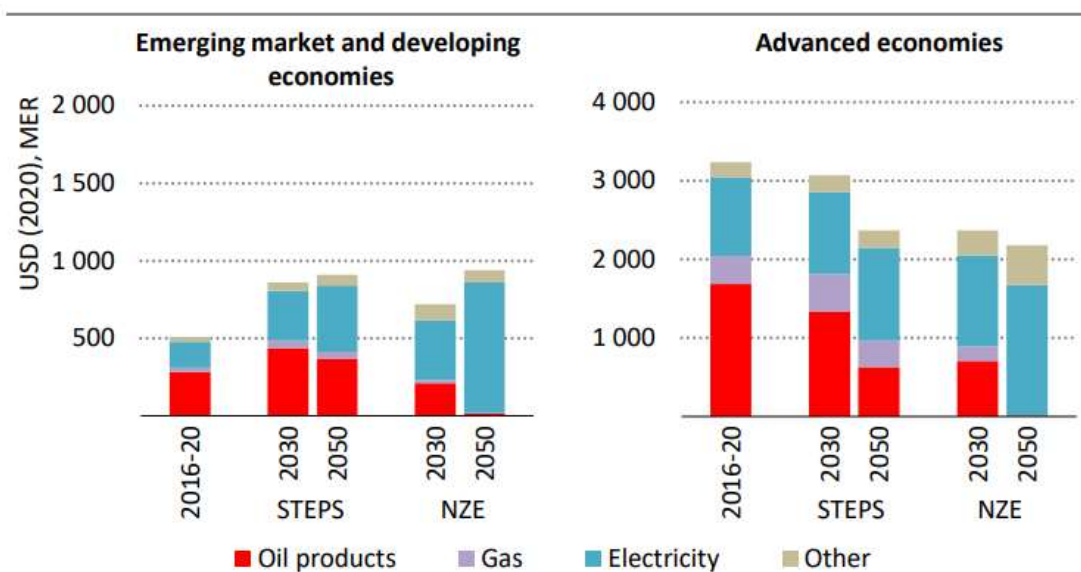


Fig. 23. Average energy bills by fuel in NZE and STEPS scenarios (IEA, 2021)

Solutions related to "energy efficiency improvements, electrification, and switching to low-carbon sources could all help to make energy more affordable" (IEA, 2021). As shown in the chart, energy bills in advanced economies are expected to decline continuously in the future. Several emerging economies anticipate implementing CO₂ emission-reduction plans. All regional markets have access to offsets, which is likely to result in price convergence. Table 12 shows how carbon prices impact electricity, industry and energy prices.

Table 12. CO₂ prices for electricity, industry and energy production in European Union (IEA, 2021)

CO ₂ prices	2020	Net Zero Emissions by 2050 (1.5 °C)		Stated policies	
		2030	2050	2030	2050
CO ₂ prices for electricity, industry and energy production (USD (2020) per tonne of CO ₂)	140	130	250	65	90

The IRENA policy recognizes that aggressive mitigation goals imply higher carbon costs, but policy diversity offers lower fossil fuel pricing. Policies encourage the development and usage of alternative fuels, such as hydrogen, biogas, and biomethane. Moreover, carbon pricing can raise substantial revenues. Under a conservative scenario, carbon prices do not increase since no significant effort is made to mitigate global warming (IEA, 2021).

Another point should be made that Caverion's exposure to transition risks is a result of not just their own activities, but also those of their whole supply chain. Even if a company's activities are not carbon-intensive, the broad impacts of climate change may raise the cost of supplies or reduce its consumer base, reducing profitability.

Overall, the progressive depletion of resources requires the development of more challenging and complicated reservoirs. Over time, this tends to raise the cost of creating new solutions. But new, more efficient manufacturing technologies and techniques are expected to be used more and more in the future.

In Table 13, all costs represent fully installed and delivered technologies and include engineering, procurement, and construction costs to install the module (IEA, 2021).

Table 13. Fully installed and delivered technology costs (IEA, 2021)

Technology costs	2020	Net Zero Emissions by 2050 (1.5 °C)		Stated policies	
		2030	2050	2030	2050
Buildings (USD/kW)					
Air source heat pumps	610	520	370	570	490
Industry (USD/tpa)					
Primary steel production (Conventional)	640	650	680	650	660
Primary steel production (Innovative)	n.a	980	900	1400	1050
Vehicles (USD/vehicle)					
Hybrid cars	15710	13490	12090	14290	13110
Innovative	21760	14520	12590	15370	13210
Batteries and hydrogen					
Hydrogen electrolyzers (USD/kW)	1480	460	360	850	630
Utility-scale stationary batteries(USD/kW)	310	155	110	180	130
Fuel cells (USD/kW)	110	43	28	58	39

These reduced prices show that prices for fully installed technologies in the energy sector will become lower over time. Technology innovation helps reduce prices, improve stability, and make renewables more accessible (IEA, 2021). Reduced prices could also bring more opportunities to Caverion as volume may increase. Revenue growth in a company’s financial targets is expected to be more than 4% over the cycle. In 2021, 33% of Caverion’s revenue was considered eligible under EU Taxonomy.

Targets translated into policies and measures are presented in (Appendix 5). The measurements do not simply match the productivity gain or losses, which would allow for a precise valuation. For such an analysis, high-quality data on company-level emissions intensity is required. Companies are getting better at reporting greenhouse gas emissions, but they still lack reported and estimated emissions intensity data. The data used in this research was sourced from both internal and external sources, including the International Energy Agency. In the absence of particular data for the case study, the research made informed judgments about the probable costs and revenues for a timeline of 2021–2030, taking into account 1.5°C and 4°C climate scenarios (Table 14).

Table 14. Scenario adjusted Financial Statements, EUR million

Effect on Statement of financial position	2021	Change	1.5 °C Timeline 2021-2030	Change	4 °C Timeline 2021-2030
Initial total non-current assets	595.6				
<i>Items affected by climate- related matters</i>					
Investments in information technologies	8.0 EUR million	6x	48 EUR million	4x	32 EUR million
Total non-current assets after adjustment	595.6		643.6 EUR million		627.6 EUR million

Effect on Income statement, EUR million	2021	Change	1.5 °C Timeline 2021-2030	Change	4 °C Timeline 2021-2030
Initial Revenue	2139.5				
<i>Items affected by climate-related matters</i>					
EV charging infrastructure revenue		1.33 %	28.46	0.97%	20.75
Total Revenue after adjustment	2139.5		2167.96		2160.25
Initial Costs	(2025.7)				
<i>Items affected by climate-related matters</i>					
Materials and supplies costs	-523.9	-6%	31.43	67%	-351.01
Travel expenses (Scope 1)	-33.6	-6%	2.02	67%	-22.51
Office premises expenses (Scope 2)	-9.7	-25%	2.43	-7%	0.68
Total Costs after adjustment	(2025.7)		(1989.82)		(2398.54)
EBITDA	113.8		178.14		(238.28)
Depreciation, amortisation and impairment	-70.3		-70.3*		-70.3*
Operating profit	43.5		107.84		(308.59)

*Not assessed

Analysis shows that, without actions, both scenarios present risks to Caverion. However, many of these changes represent material opportunities as well. The scenario analysis shows the likely events that could take place if each scenario plays out and how Caverion could respond to these scenarios.

The financial impact from 2021–2030 is more optimistic in the 1.5°C scenario and more pessimistic in the conservative scenario. The biggest investments in technologies are predicted in the 1.5°C scenario, keeping in mind that investment in technologies from 2030 to 2050 is expected to decrease by 25%. Investments in information technologies continue to be focused on building a harmonised IT infrastructure and common platforms. Internal processes and efficiency at Caverion are further developed with new IT systems and mobile tools that make them even better.

According to the research, prices are lower when customers are engaged, energy efficiency is promoted and negative emissions are compensated for. The 1.5°C scenario has the lowest total cost, mostly due to considerable improvements in transportation and home heating, such as customers preferring electric vehicles and negative carbon emissions from the electricity sector. This leads to a rapid reduction in cost.

These scenarios are not forecasts or predictions of the future. They are techniques for a company to prepare for resilience. These factors may be combined to predict income statement and balance sheet changes. Table 14 illustrates hypothetical impacts on both revenue and costs that ultimately result in a positive operating profit under the 1.5 °C scenario and a negative one under the 4 °C scenario.

This section finds that under some scenarios, the best way to manage the company's risk associated with climate change is to increase exposure to those factors that have a higher sensitivity to climate change.

4.4. Recommendations and Research Perspectives

Cost estimates for two scenarios are difficult to estimate, yet this project is very valuable for many stakeholders. Reporting of climate-related matters is new for many companies, requiring new skills, data, methodologies, and time to build a reliable basis for assessment of the effects on a company's financial statements. It is recommended that in conducting climate-related information for the first time, companies should focus on what they can and must do well in the meantime. It is recommended to keep climate scenarios simple at first so that lessons learned and gained knowledge and experience can be used to improve reporting quality over time.

The literature on standards is a good starting point for thinking about financial accounting, a field known for its rules, measurements, and classification. This leads to another significant finding: that calculating methods do not have to be exact, but rather trackable by market players and integrated into the system.

To begin with, all disclosures should be reviewed by a company's CFO, audit committee, or both. It should include climate-related risks, indicators, and objectives. Companies should also perform scenario analysis to address the future risks of their business models. If regulators do not move forward and make sure that the information companies give is accurate and complete through accounting standards and assurance requirements, the information companies give will not meet the criteria.

One problem is that companies may still be struggling to evaluate the risks that would materially impact the company and fully understand and incorporate the probability and impact of climate-related risks and opportunities into their analyses. For this purpose, a collaboration between accounting academics and the natural science sectors can mitigate the drawbacks of matters related to climate change disclosures in financial statements. Meanwhile, some public bodies have proposed what should be included in sustainability accounting. Moreover, an increasing number of educators have incorporated sustainability into their accounting curricula.

In terms of the scenarios, a broader set of standardized scenarios is needed. Despite the progress made, there are still areas that could be developed further to enhance macrofinancial risk analysis. The guidance also suggests considering rebound effects. In this instance, the fact that future climate change might reduce energy usage and hence energy costs means consumers' disposable income might increase, leading to increased energy consumption. It was not possible to evaluate these rebound effects in existing studies, but it is highlighted that they are potentially considerable and should be the focus of future research.

Only a small number of the evaluations of climate change implications covered in this research provide quantitative estimates of a company's costs, benefits, and uncertainty features. Studies that are related to uncertainties are rather correlational, and therefore a direct cause-and-effect relationship cannot be accessed. To mitigate the level of uncertainties, larger statistical sample sizes and data collection from larger regions and over longer periods of time should be gathered. Future

research can contribute to finding more systematic tools, allowing companies of all sizes and in different sectors to adapt data from different scientific research fields and studies.

Additionally, EU Taxonomy could be applied in new ways. Besides its primary goal of classifying environmentally sustainable activities, it could be a very useful tool in measuring the climate effect on each financial statement's line item. Using Caverions' example, individual identification based on profit center, project, service contract, or customer could be done. Otherwise, identifying risks and opportunities, assessing stress, and sensitivity testing are nothing more than a way for a company to imagine plausible future worlds and plan for resilience. Despite the fact that researchers do everything they can to apply the greatest monetary value to the data they have, the matching of physical and monetary data should only be seen as an approximation.

Conclusions

This work is being pursued to perform scientific research on how climate-related matters affect the financial statements. Recent increasing awareness of climate damage shows how a global crisis could be crucial for the economy and how this might affect businesses around the world. Once the company assesses the issues related to climate-related matters and determines the action plan for those issues, then it can evaluate the actual and potential financial impact on revenues, expenditures, assets, liabilities, capital and financing.

1. Throughout the problem analysis, the importance of combating climate change was emphasised, particularly given that current requirements, guidelines, and measures are ineffective and fall far short of the intensity required. Empirical evidence suggests that voluntary disclosures are misleading as they are prepared strategically. To fulfill the regulations, the companies should have prioritised climate risk in their reporting. However, it was not clear how to identify climate-related risks, especially future uncertainties and the allocation of financial value to environmental issues. Difficulties in the application of existing accounting standards and materiality judgments lead to inconsistency across companies' reporting and a lack of transparency in formal auditing.
2. In the theoretical part, the selection of measurements and methods for the evaluation of the financial statement's line items impacted by climate change is one of the main focus. However, the majority of research are oriented toward dataset selection rather than fundamental accounting procedures, emphasising the inconsistency in asset or liability recognition criteria, loss and damage attribution problems, and irrelevant financial materiality assessment. In addition, the literature emphasised the importance for companies of having consistent meteorological data as well as a defined technique for future performance prediction. Tools must be adequate and take into consideration future climatic conditions in order to design climate scenarios and evaluate the effects on financial statements. In light of the current position in the industry, empirical insights indicate what happened in the absence of inconsistent international standards, which led companies to obtain legitimacy for their accounting systems in other ways.
3. Later, a conceptual methodology was proposed which explains that climate accounting and practice can only be understood through exploring sustainability standards in conjunction with accounting standards. Based on the defined steps of the conceptual methodology and the application of a case study of Caverion, the findings were drawn, which were as follows:
 - a) In order to identify the vulnerabilities to which Caverion is exposed, different climate-related scenarios over different time horizons were considered. The content analysis shows that the two biggest risks companies are exposed to are Policy (P) and Technology (T) which are clearly connected to each other. The results revealed that Caverion's business model and strategy are resilient to climate change. Furthermore, multiple opportunities for competitive advantages and revenue growth could be created.
 - b) Out of a long list of climate-related risks and opportunities emerging within the sector, key climate-related risks and opportunities Caverion faces were identified. Reviewing the external environment, sensitivity factors within the sector, company's business perspectives, and environmental materiality matrix, there were four risks and four opportunities distinguished, which it is believed are significant and have been presented in more detail.

c) There is no dedicated accounting standard related to climate-related matters, and for many companies, there are a lot of unknowns and uncertainties considering the impact of climate change. There is a challenge for Caverion to recognise and measure the assets and liabilities in its financial statements as all judgments and assumptions will be based on applying the requirements of existing accounting standards. Regardless of this challenge, the potential financial impact of the risks was mostly assessed in contingent assets and liabilities, provisions on receivables, loss of incentive revenues, increased capital investments, legal and maintenance costs, production costs, and costs to adopt and deploy new practices and processes. In other words, downside risks may manifest through project delays, cancellations, and diminished long-term revenue growth opportunities. The potential financial impact of the opportunities mostly arises from additional revenue and the opportunity for additional growth, thus saving costs.

d) Stress testing and scenario analyses were performed to assess the company's resilience to climate change. The most sensitive financial statement line items were identified as: research and development (R&D), investments in information technology, work in progress, accrued expenses from long-term contracts, remaining performance obligations (> 1 year), cost of materials and supplies, provisions for loss-making projects and operating cash flow. In fact, tools to perform such evaluations are only emerging now and are generally only available through commercial providers. In creating a 1.5°C and 4°C scenario analysis, two pathways were taken and considered as broad types of risks and opportunities using the TCFD risk framework. Based on Caverion's nature, there were identified specific risk and opportunity areas that could impact the company in 2030, each of which was assessed qualitatively, supported where possible with high-level quantitative assessments. The assessments were based on financial scenarios and did not represent financial forecasts.

e) The analysis suggests that regulatory intervention or shifting socio-economic trends such as carbon pricing restrictions might have a substantial influence on the Caverion value chain. The study results give preliminary high-level insights into these prospective business and financial impacts.

- The results have shown that Energy, Infrastructure, Construction & Real Estate sectors are more sensitive to costs that may affect their balance sheets. Caverion should be focusing on capital expenditure rather than operating expenditure, as operating expenditures do not have a big influence on the results, except for the cost of materials and supplies. This element plays a significant role in the company's supply chain.

- Strong demand and some constraints on supply lead to high prices for carbon and energy, and hence there are increases in the cost of materials and reduced flexibility of operations. So far, the company has coped well with the increase in material prices, but focusing on material prices requires caution. Caverion's operations are not carbon-intensive, but the effects of climate change mean that a move to a low-carbon economy could make its supplies more expensive and its customer base shrink, consequently affecting its profitability.

- A trend toward more large-scale renewables would be a positive development for Caverion, supported by a significant increase in investment in technologies and expenditures on R&D. But without investment ahead of need, the company would face a backlog. The demand for electricity-efficiency increases, which would trigger electricity network upgrades and investment as well. As a result, Caverion needs to spend money on technologies that allow them to work together with

financial and natural scientists to make decisions and assumptions that estimate how climate risks will affect their business.

4. The results of the research suggest that, if nothing is done, both scenarios pose a risk to Caverion. The financial impact from 2021 to 2030 is more optimistic in the 1.5°C scenarios than in the conservative scenario, which confirms the theory that disclosure of climate-related matters in financial statements increases the company's costs in the short term, although proper disclosure of carbon emissions positively impacts the company's profits in the long term. According to the analysis, prices are lower when society is involved, energy efficiency is maintained and negative emissions are compensated. Even though this is not the total cost of 1.5°C, it is clear from the analysis that scenarios that meet Net Zero by 2050 do not cost more than other scenarios where Net Zero is not met by 2050. The results suggest that while transition risks can be avoided through inaction, higher CO₂ emissions, physical damage, and other risks come at significant economic costs. Moreover, a low-carbon future scenario represents material opportunities. However, the scenario avoids the severe negative implications of a higher temperature increase in 2030 and beyond because consistent data related to a company's whole portfolio is difficult to collect. As more consistent data becomes accessible, this will improve the ability to accurately measure the effect of climate-related matters on financial statements.
5. The findings revealed that accounting for climate-related matters is difficult due to uncertainty in calculation approaches. Even though guidance suggests considering a rebound effect, unfortunately, due to a lack of available data, it was necessary to offer an estimate using alternative prices and treat calculations as an approximation. This is one of the reasons why so many companies just ignore the measurements entirely. In the long run, future tools will allow businesses of all sizes and in different industries to adapt data from different scientific research fields.

The results can be used to enhance risk management practices and to develop new business strategies to capitalize on climate opportunities. However, because it simplifies the modeling of climate-related disclosures on financial statements, this is a good place to start. Addressing this is a priority for future work.

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










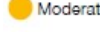


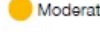





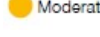





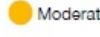


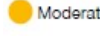

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Appendices

Appendix 1. Climate-related risks and opportunities within the sector.

Table 1. Climate-related risks within the sector

Type	Risk	Likelihood	Materiality	Rating	Impact on FS
Policy	Closure of traditional power plants due to policy shifts. The government's responsibility is to ensure stable electricity. Example: Restrictions on traditional energy sources or higher carbon fees.	 Low	 Moderate	 Moderate	Reduced revenue/Reduced costs
Policy	Increasing carbon emission reduction pressure may disrupt processes.	 Low	 High	 Moderate	Increased costs
Policy	Monetary losses, backlogs, increases in onerous contracts as a result of legal proceedings related to climate mitigation.	 High	 High	 High	Reduced revenue due to recognition assessment
Policy	Enhanced emissions-reporting obligations (Scope 1 and 2). Changes in policy cause write-offs, asset impairment, and early retirement.	 High	 High	 High	Increased costs.
Policy	Business viability due to energy policy disputes and agreements regarding the integration of solar energy into existing energy infrastructure (SASB, 2022).	 Moderate	 Moderate	 Moderate	Reduced revenue
Policy	Cancellations of hydrocarbon-related projects and non-energy projects connected to climate change mitigation.	 Moderate	 Moderate	 Moderate	Reduced revenue/Reduced costs
Technology	Costs to transition to lower-emissions technology. Expenditures on innovative and emerging technologies.	 High	 High	 High	Increased costs
Markets	Increased costs of materials and supplies. Manufacture of energy-efficiency equipment for building	 High	 Moderate	 High	Increased costs
Market	Reduction in demand for energy through the transmission network (Chartered Professional Accountants of Canada[CPA], 2021).	 Moderate	 Low	 Low	Reduced revenue/reduced cost
Market	Increased supply uncertainty due to changing lifestyle habits (e.g. EV, air conditioning, etc.)	 Low	 Moderate	 Low	Reduced revenue
Physical risks. Chronic	Rising temperatures. Temperatures are expected to rise, potentially affecting buildings, infrastructure, and industrial processes.	 Moderate	 Moderate	 Moderate	Increased capital costs, Reduced revenues

Physical risk. Acute	Un-insurability or increased insurance costs due to climate change.	Moderate	Moderate	Moderate	Increased costs
Physical risks. Acute	Extreme weather events damage network assets. Storms, tornadoes, tropical cyclones, severe heat/cold, floods, and other extreme weather occurrences are predicted to increase due to climate change.	Moderate	High	High	Reduced revenue/ Increased costs
Physical risk. Acute	Droughts and warmer temperatures raise the chances of wildfires, which may damage infrastructure and disrupt activity.	Low	Moderate	Moderate	Increased maintenance costs, reduced revenue
Physical risk. Acute	Flooding and rainy seasons might become more severe, causing structural damage to buildings.	Low	Moderate	Moderate	Increased maintenance costs, reduced revenue

Table 2. Climate-related opportunities within the sector

Type	Opportunities	Likelihood	Materiality	Rating	Impact on FS
Resource efficiency	Increased service efficiency through improved technologies.	Moderate	Moderate	Moderate	Increased operating profit, Increased revenue, Reduced costs
Products and services	The development of new renewable energy power stations. A rise in demand for installation and maintenance related to solar power plants.	High	High	High	Increased revenue
Products and services	Componys' position as a performance leader in the industry. Increasing opportunity to expand into new geographic and unregulated economies.	Moderate	Moderate	Moderate	Increased revenue
Products and services	Decarbonisation of transport drives investment in electric vehicles charging infrastructure	High	High	High	Increased revenue
Products and services	Energy-efficient solutions to a Smart Building	High	High	High	Increased revenue
Products and services	Green growth and digitalisation, automatisisation packages	High	High	High	Increased revenue
Markets	Emergence of off-grid living. Professional services related to the energy performance of buildings.	Moderate	Moderate	Moderate	Increased revenue

	Creating additional income streams via revenue diversification.				
Markets	Increase in demand for energy through renewable sources. Large-scale renewable energy will remain the cheapest source. Population growth and changing lifestyles are predicted to boost energy demand (e.g. Electric vehicles, air conditioning, etc.) Future heating demand will decrease while cooling demand will increase.	● High	● High	● High	Increased revenue
Market	Government subsidies for solar energy.	● Moderate	● Moderate	● Moderate	Increased revenue

Appendix 2. Most relevant Caverion’s risks and opportunities. Data in brackets relates to the prior year's period.

RISKS

Table 1. Risk 1. Enhanced emissions-reporting obligations (Scope 1 and 2)

Transition risk factor that impact Caverion’s services:	Potential financial impact of the transition risk of climate change to Caverion’s business:
<p>Policy and Legal risk: More aggressive climate change policies enhance emissions-reporting obligations.</p>	<p>Potential financial impact: Costs of reducing fleet emissions, contingent assets, liabilities, receivables provision, and write-offs.</p>
<p>The Scientific Based Target (SBT) is based on the most recent climate science data and scientific consensus. What emission reductions are required to keep global warming to 1.5 °C? The UN climate agreement set a target of a 50% decrease in global carbon emissions by 2030, with a net zero by 2050. This goal was agreed upon by the European Council in December 2019 (Council of the European Union, 2020). The Climate Monitoring Mechanism requests all EU countries to keep track of their emissions and report them under Scopes 1 and 2. In 2021, the rate of decarbonising the energy sector was expected to rise 27% from the year before (Bloomberg).</p>	<p>In order to reduce service fleet emissions, Caverion implements more environmentally friendly vehicle fleet behavior. In 2021, Caverion had 4.300 vehicles. However, the service fleet's CO2 emissions remained at about 15,000 tCO2. The fleet uses 95% diesel. Caverion’s order backlog in 2021 increased by 15.8% to EUR 1,863.8 million compared with the previous year (EUR 1,609.1 million). Backlogs may be referred to as long-term contracts due to climate mitigation with ongoing performance obligations or revenue backlogs. Other current liabilities increased to EUR 278.3 (273.0) million in 2021, while trade and POC** payables increased to EUR 197.7 (188.0) (Caverion Annual Review, 2021). Caverion has written down several projects in recent years. Caverion disclosed a German high-risk project completion delay till the end of 2021. It's likely that new risks may arise in this or future projects. There is a challenge for a company to recognise and measure the impact of climate change. Therefore, judgments and assumptions have been used to evaluate the potential financial impact of reasons for a delayed project.</p>
<p>Reporting obligation</p>	<p>Applying “<i>IAS 37 – Provisions, contingent liabilities and contingent assets</i>”, current obligations can be regarded as there is sufficiently evident to give rise to the obligation and to disclose the potential loss of revenues, stocks, or contracts” (CDSB, 2018). Furthermore, the “<i>IFRS 15- Revenue from Contracts with Customers</i>” standard states that a positive outcome should be spread out over time, and a negative outcome should be provided immediately (CDSB, 2018). Caverion write-offs or reserves on receivables when no payment is anticipated. To value trade receivables, Caverion uses a policy that includes estimations and critical judgment.</p>

*The **percentage-of-completion method** (PoC) is a typical revenue recognition approach for long-term contracts.

Table 2. Risk 2. Extreme weather events damage network assets

Physical risk factors that impact Caverion’s distribution networks:	Potential financial impact of the physical risk of climate change to Caverion’s business:
<p>The Acute Physical Risk: Storms, floods, and heat waves may damage network assets due to the</p>	<p>Potential financial impact: Write-offs, provisions, loss of incentive revenue, increased insurance, legal and maintenance costs.</p>

increased intensity of severe weather events.	<p>Caverion is involved in a few legal procedures due to delayed delivery or defects in the projects. It might affect the company’s collection of receivables. Current trade and POC receivables grew to EUR 33.8 (30.2) million and other receivables grew to EUR 541.9 (506.5). Aside from the impact of climate change, it's hard to anticipate how claims, disputes, and legal actions will end. The accounting standards require that write-offs and provisions be recorded appropriately.</p> <p>Caverion's business often provides financial guarantees to its stakeholders. In particular, for the security of advance payments received, the performance of contracts obligations and warranty defects. Many contracts incorporate various construction systems that the customer has bought from Caverion. The lack of such guarantees might have a negative impact on Caverion's business and financial status. The number of contractual work guarantees increased to 467.9 (454.9) million in one year. Caverion intends to have few guaranteed facilities to mitigate this risk (Caverion Annual Review, 2021).</p>
Reporting obligation	<p>According to KPMG (2021), “<i>IFRS 15- Revenue from Contracts with Customers</i>, climate-related risks may increase the cost of meeting contractual obligations and could give rise to onerous contracts that may need to be provided for”. Climate-related matters may raise the cost of supply chains and transportation. In that case, climate-related judgments and assumptions have to be made in determining the estimate of provisions (KPMG, 2021).</p> <p>Damaged network assets have an influence on long-term contracts’ revenue recognition. According to <i>IFRS 15</i>, proportional revenue recognition applies to long-term contracts that may be reasonably estimated. Exceeding income is noted in advances received. Invoicing less than the revenue recognized relates to accrued income. Costs over the completion stage are capitalised as work in progress and expenses from long-term contracts incurred before completion relate to accrued expenses (KPMG, 2021).</p> <p>“<i>IFRS 17-Insurance Contracts</i> deals with the measurement of future cash flows associated with long-term insurance contracts” (KPMG, 2021). Due to rising acute events, insurers may increase claims provisions (KPMG, 2021).</p>

Table 3. Risk 3. The costs of the transition to lower-emissions technology

Transition risk factor that impact Caverion’s Renewable business:	Potential financial impact of the transition risk of climate change to Caverion’s business:
<p>Technology risk: Expenditures on innovative and emerging technologies.</p>	<p>Potential financial impact: Increased capital investments, costs to adopt/deploy new practices and processes.</p>
<p>Technical advances may impact the effort required to restore places and may impact the estimated provisions if there is enough data to verify their occurrence.</p>	<p>Increasingly, Caverion has invested in digital solutions such as Caverion “SmartView, Remote Services, and IoT solutions”. Caverion has also engaged in developing expertise in “Smart Technologies such as Building Automation, Refrigeration, and Security”, as well as carbon emission reduction technologies. In order to serve customers throughout the</p>

<p>It's all about new technology and better efficiency. Speed, scale, and success in reducing the world's carbon and energy intensity are the key factors for successful companies (Mercer, 2015).</p>	<p>lifetime of their built environments, Caverion provides monthly maintenance services. More than 14,000 highly trained and motivated workers deliver this (Caverion Annual Review, 2021).</p> <p>Caverion was historically focused on unified IT infrastructure. In 2021, IT investments totaled EUR 8.0 (9.7) million. Internal IT systems and mobile technologies have been improved to increase internal procedures and efficiency. Thus, the company's technology and digital solutions are meeting rising market demands. Investment in organic growth, including digitalisation and offering development, is the most important area of Caverion's capital allocation. The company's R&D expenditures climbed to roughly EUR 4.9 (3.6) million, or 0.2 (0.2)% of revenue (Caverion Annual Review, 2021).</p>
<p>Reporting obligation</p>	<p>Reporting includes committed and proposed capital expenditures related to climate-related risk implications (AASB_AUASBJointBulletin, 2019). When making a business less carbon-intensive, expenses might impact a company's cash flow by increasing maintenance costs or capital expenditures (KPMG, 2021).</p>

Table 4. Risk 4. Increased costs of materials and supplies

<p>Transition risk factor that impact Caverion's Renewable business:</p>	<p>Potential financial impact of the transition risk of climate change to Caverion's business:</p>
<p>Market risk: Manufacture of energy-efficiency equipments. Delivering sustainable service.</p>	<p>Potential financial impact: Increased production costs, increased provisions and liabilities.</p>
<p>In 2021, the market was hit by rising material prices as well as shortages and delays in the delivery of some supplies by region. Price changes for energy and water, and new requirements for waste treatment have raised manufacturing costs (Caverion Annual Review, 2021).</p>	<p>Even though the costs related to materials and supplies slightly decreased to EUR 523.9 (529.0) million, purchased goods and services related to electricity and HVAC makeup the largest portions of Caverion's material use.</p> <p>In 2021, rising material costs adversely affected the project business. Some regions have experienced supply shortages and delays. Inflationary pressure is likely to be less severe in 2022 than in 2021, but higher material costs and prolonged delivery delays may still impact Caverion's company. Concerns include raw material price increases and decreases in employees' availability. The cost of raw materials and consumables rose to EUR 13.7 (13.3) million.</p> <p>Caverion ensures that new and existing suppliers provide sustainable services. The supply chain includes several components, materials, and services, and the selective point of view of these partners has already reduced the number of Caverion's suppliers in 2021 (Caverion Annual Review, 2021).</p>
<p>Reporting obligation</p>	<p>Due to climate risks and carbon intensity, rising material, supplier, transport, and construction prices could impact the company's revenue growth. Caverion's long-term contracts are influenced by market pressure to be environmentally friendly. Recognition of onerous contracts has to be disclosed under <i>IFRS15-"Revenue from Contracts with Customers"</i>. Judgments and estimates related to climate-related matters need to be disclosed as provisions and contingent liabilities. (KPMG, 2021).</p>

OPPORTUNITIES:

Table 5. Opp. 1. Decarbonisation of transport drives investment in EV charging infrastructure

Opportunity described for Caverion's electric service:	Potential financial impact of the climate-related opportunity to Caverion's business:
<p>Products and Services: The decarbonisation of transport presents opportunities for Caverion's EV charging infrastructure.</p>	<p>Potential financial impact: Additional revenue, saving costs, opportunity for additional growth.</p>
<p>Electric vehicles (EV) are a key element in a sustainable world. By 2050, 100% of the world's road fleet will be powered by electricity or hydrogen. To meet the Net Zero Scenario, roughly 60% of new automobile sales must have zero emissions by 2030. The electrified transport sector grew the fastest in 2021 (BloombergNEF, 2021).</p> <p>Global EV infrastructure spending increased by 77% to \$273 billion. EV investment could beat renewable energy investment this year (BloombergNEF, 2021).</p> <p>Although electric vehicles represent less than 5% of the market today, they are projected to make up 32 % of sales by 2030 (Walton, Alberts, Hamilton , 2020).</p>	<p>In the last 50 years, CO2 emissions have increased dramatically. Caverion believes it can make a significant contribution to combating the climate crisis and is building up its services accordingly. In Norway, around 75 companies' diesel vehicles will be replaced by EVs by 2021. In the near future, Norway alone will need to replace 200 vehicles each year. Caverion is a leading EV charging infrastructure installer in Sweden and Norway. Companies such as Swedish Toyota, Lexus, IONITY, and Virta choose Caverion for their services (Caverion Annual Review, 2021).</p> <p>In regards to Caverion's own footprint, EV charging stations and other energy efficiency solutions already provide savings of more than double.</p>

Table 6. Opp. 2 Energy-efficient solutions to a Smart Building

Opportunity described for Caverion's industrial solutions and advisory services:	Potential financial impact of the climate-related opportunity to Caverion's business:
<p>Products and Services: Development of smart building infrastructure to support the delivery of an accelerated net zero transition provides opportunities for Caverion.</p>	<p>Potential financial impact: Increased social behavior and increased demand for "Green Star" rated buildings impact revenue growth and enhance opportunities for additional growth.</p>
<p>The UN estimates that industrial sites, transport, and buildings contribute to over 70% of global CO2 emissions. Starting in 2021, the Energy Performance of Buildings Directive (EPBD) expects a rapid emissions reduction in the building sector. The suggested EPBD revision will go even further, aiming to establish a new Minimum Energy Performance Standard for both existing and new buildings. This is in line with the EU's "Fit for 55" climate package, and it represents the Renovation Wave strategy. As a part of this plan, there will be at least a 50% rate of renovation</p>	<p>One of the main parts of Caverion's handprint is accumulated from smart building automation, smart heating and cooling, sustainable refrigeration, and industrial solutions. Efficiency can be monitored by a program that monitors, for example, waste heat, combustion purity, and electricity consumption. With Caverion SmartView, facility managers can quickly control room temperatures or bad ventilation, which optimises energy consumption and positively affects costs. The results of efficiency improvements are reflected both in environmental performance and in economic savings. The winning "Quality Innovation Award 2020" technology saves roughly 2% of power in the process sector. One big pulp mill saves enough energy to power nearly 300 homes for a year. Caverion sees a considerable financial opportunity from this climate-related</p>

by 2030 and at least 200% more energy-efficient buildings by 2030. Old buildings are not likely to fulfill the requirements of the EU Energy Performance of Buildings Directive.	opportunity currently and in the near future (Caverion Annual Review, 2021).
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Table 7. Opp. 3. Green growth and digitalisation, automatisisation packages

Opportunity described for Caverion's Renewables:	Potential financial impact of the climate-related opportunity to Caverion's business:
<p>Products and Services: Digitalisation and automatisisation will revolutionise the industry and provide an opportunity to increase the output and earnings of Caverion.</p>	<p>Potential financial impact: Additional revenue, saving costs, opportunity for additional growth.</p>
<p>The EU's stimulus programs emphasize green growth and digitization. The regulators' focus is to increase energy efficiency and carbon intensity. Statistics show that 20% of emissions can be reduced by digitalisation (Caverion annual report, 2021).</p>	<p>Since the previous Capital Markets Day (CMD), there have been changes in EU legislation related to sustainability and carbon neutrality. Caverion has been selected as the most sustainable building technology service company in Northern Europe in a recent Corporate Knights 2019 study. Therefore, digitalisation and sustainability have been considered the key themes driving Caverion's growth.</p> <p>Digitization and sustainability developments are predicted to continuously drive demand for Caverion's products. Due to rising energy efficiency standards, digitisation, automation and urbanisation, a demand for Caverion's services and solutions is predicted to grow in the next few years. Company increased interest in Smart Technologies and creating digital solutions. Moving from dangerous F-gases to CO2-based refrigeration, for example, requires significant renovations and modernizations. Automation helps to optimise the efficiency of the plants, pumping stations. It helps to observe energy savings from the heating of wells at the pumping stations (Caverion Annual Review, 2021).</p>

Table 8. Opp. 4. Increase in demand for energy through renewable sources (solar, hydropower, thermal power stations) (Scope 2)

Opportunity described for Caverion's Renewable energy projects:	Potential financial impact of the climate-related opportunity to Caverion's business:
<p>Products and Services: As the electrical system becomes net-zero carbon, flexible low-carbon solar, hydro, and thermal generating may produce more energy.</p>	<p>Potential financial impact: Additional revenue, opportunity for additional growth.</p>
<p>The EU's goal to become climate-neutral by 2050 is an ambitious goal that requires drastic changes in energy production, consumption habits, and energy efficiency initiatives. Renewable energy grids continue to be the most cost-effective method of energy production. There is an evident increase in the volumes of renewable power stations.</p>	<p>The EU taxonomy raises the expectations for a positive carbon handprint. Therefore, the consumption of purchased electricity, steam, heat, and cooling increases the demand for renewable sources. It's hoped that by 2050, Caverion's renewable energy production will make up 80% of the company's total electricity production, up from the current level of 38%. Demand response will play a big part in this goal.</p> <p>Since renewable energy cannot be produced on demand, a demand-side response is needed for the balancing act. Caverion provides services for balancing supply and demand in solar and wind electricity grids (Caverion Annual Review, 2021).</p>

Leading to increased demand for installation and maintenance related to reducing carbon emissions (e.g., solar power plants), which leads companies to potential new revenues.

The renewable energy sector became the largest in 2021, and it generated \$366 billion (up 6.5%) from 2020 (BloombergNEF).

By 2030, the EU-27 must have at least 32% renewable energy in their final energy consumption (EU, 2018c).

The renewables sector's returns will rise from 5.3% p.a. to 10.4% (Mercer, 2015).

Appendix 3. Historical company's financial development, EUR million

Category	Definition	2019	2020	2021	Change 2019/2020	Change 2020/2021
Revenue	Revenue of Services Business:	1,274.9	1,364.9	1,402.4	7.1%	2.7%
	Revenue of Projects business:	848.3	790.0	737.1	-6.9%	-6.7%
	Total Revenue:	2,123.2	2,154.9	2,139.5	1.5%	-0.7%
Expenditures: OpEx		1.8	1.8	2.5	0%	39%
Assets: CapEx	Research and development (R&D)	1.3	1.8	2.4	38%	33%
OpEx+CapEx		3.1	3.6	4.9	16%	36%
Expenditures: OpEx	Cost of materials, supplies	542.2	529.0	523.9	-2%	-1%
Expenditures: OpEx	Cost of human resources/ Personal expenses	868.9	902.6	889.9	4%	-1%
Assets: Tangible	Trade receivables	329.6	316.5	346.0	-4%	9%
	POC receivables	197.6	190.0	195.6	-4%	3%
	Other current receivables	32.6	30.2	33.8	-7%	12%
	Work in progress	1.7	1.9	3.2	12%	68%
	Prepayments and other accrued income	23.2	18.2	20.5	-22%	13%
Assets: Intangible	Order backlogs	1,670.5	1,609.1	1,863.8	-4%	16%
Assets: Intangible	Investments in information technology	9.4	9.7	8.0	3%	-18%
Assets: Other Intangible assets	Mainly consist of IT infrastructure, systems and solutions (Historical cost)	114.8	123.3	126.8	7%	3%
Liabilities Current liabilities	Trade and POC payables	194.1	188.0	197.7	-3%	5%
	Other current liabilities	269.2	273.3	278.3	2%	2%
Liabilities contracts with customer	Advances received	216.2	252.2	261.3	17%	4%
	Accrued expenses from long-term contracts	20.4	24.4	30.2	20%	24%
Liabilities Contingent liabilities	Remaining performance obligations (<=1 year)	889.4	842.1	937.5	-5%	11%
	Remaining performance obligations (>1 year)	781.1	767.0	926.3	-2%	21%
Liabilities Contingent liabilities	Contractual work guarantees	444.9	454.9	467.9	1%	3%
Liabilities Provisions	Warranty	21.9	24.2	24.2	11%	0%
	For loss making projects	8.5	7.8	9.8	-8%	26%

	Restructuring	2.9	5.2	1.5	79%	-71%
	Legal	4.5	3.7	3.4	-18%	-8%
	Other	4.7	7.2	5.8	53%	-19%
	Total	42.6	48.0	44.6	13%	-7%
Financing	Operating cash flow	143.7	157.6	103.8	10%	-34%
Equity Capital	Free cash flow	74.0	137.3	67.2	86%	-51%
	Cash flow after investments	64.5	58.2	127.8	-10%	120%
	Working capital after investments	(100.9)	(160.4)	(144.7)	59%	-10%

Appendix 4. KPI for investment needs, consumptions in energy transition (IRENA, 2022)

Key indicators	Historical 2019	2021-2030	2031-2050
Renewables direct uses and district heat			
Biomass (EJ)-Industry	9.2	25	36
Biomass (EJ)-Buildings	28.4	8.3	9.5
Solar thermal consumption (TWhth)-industry	4	890	1291
Solar thermal collector area (million m2)-industry	5	1272	1844
Solar thermal and geothermal consumption (EJ) -heating in buildings	2.1	2.3	6.2
Investment (USD billion/yr) in renewable	33	284	115
Energy conservation and efficiency			
Total final energy consumption (EJ/yr)	393	373	348
Buildings-total final energy consumption (EJ/yr)	121	99	105
Buildings renovation rate (% of stock per year)	1	2	3
Investment (USD billion/yr) in energy efficiency	249	2285	1106
Energy conservation and efficiency		9.1 Gt CO2/yr	Efficiency 25 %
Electrification of end uses			
Electricity consumption (direct)(TWh/Yr)	22848	31070	49275
Heat pumps(million)-Industry	<1	35	80
Heat pumps (million)-Buildings	53	142	290
Electric car stock (million)	18	381	1780
Investment (USD billion/yr) in electrification in end-use sectors-total	14	240	229
Investment (USD billion/yr) in charging infrastructure for EV	2	86	153
Investment (USD billion/yr) in heat pumps	12 USD	154	77
Production of clean hydrogen and derivatives			
Clean hydrogen production (Ej/yr)	>0	19	74
Clean hydrogen consumption (EJ)-Industry	>0	16	38
Clean hydrogen consumption (EJ) -Buildings	>0	2	3.2
Investment (USD billion/yr) in hydrogen and its derivatives	0	133	176

Appendix 5. Vulnerability to scenarios and potential financial effects on Financial Statements

Table 1. Potential financial implications for climate-related risks

	Low-carbon future 1.5 C	Extreme global warming 4 C
Risk	Key assumptions. Timeline 2021-2030	Key assumptions. Timeline 2021-2030
Impact quantification	Technology spending occurs earlier than expected. Predicted a 6x increase.	Predicted a 4x increase. The decrease in technology costs is due to the avoided costs of using renewable energy sources.
Technology costs	<p>Higher technology costs are expected in order to achieve the 1.5°C scenario goals. In 2021, Caverion will keep working on becoming a top service provider and an early adopter of digital and smart technologies.</p> <p>Energy efficiency requirements will continue to increase in the building sector, requiring more investments in heat pumps and renewable and solar solutions.</p> <p>The investment in charging infrastructure for EVs would reach USD 86 billion per year in upcoming years, or 2% of overall expenditure.</p>	In the next decade, renewable technology is unlikely to progress much, and renewable energy costs are unlikely to continue to fall at the same rate as they did over the previous ten years. It is possible that the savings from adopting renewable energy could decrease or that they will take longer to materialise.
Impact quantification	A 6% reduction in fuel prices (Scope 1) and a 25 % reduction in energy bills (Scope 2).	Significant 67% rise in fuel prices (Scope 1) and decrease in energy prices by 7% (Scope 2).
Policy and legal restrictions	<p>To keep global warming to 1.5°C, all governments must adapt their emissions policies.</p> <p>Due to the decreased energy demand in the 1.5°C scenario, less fossil fuel is needed to generate it. Caverion's 100% clean electricity strategy for 2025 reduces current regulatory risk. Caverion is enhancing remote services, lowering pick-ups, and using biofuels and electric cars.</p> <p>By regulating carbon prices, governments successfully cut emissions and move toward a greener development path. In order to implement CO2 emission-reduction plans, some governments offset and convergence emission prices. In this scenario, it reaches 130 USD per tonne of CO2. Even though the 1.5°C scenarios aggressively achieve mitigation goals, policy diversity offers lower fossil fuel pricing. Final energy bills are determined by policies which include taxes and government subsidies (IEA, 2021).</p>	<p>Under conservative scenarios, fossil fuel prices increase in Europe. Demand is still high, resulting in prices continuing to rise.</p> <p>Carbon prices do not increase because no further meaningful action is taken to limit global warming (IEA, 2021).</p> <p>Government offsets for the energy bills are twice as small as they would be in a low-carbon environment (i.e., 65 USD per tonne of CO2) (IEA, 2021).</p>
Impact quantification	Costs are reduced by 6%.	Costs are increased by more than double, i.e., 67%.

<p>Prices of materials and supplies</p>	<p>It is quantified how fuel prices could impact material and supply costs.</p> <p>The natural gas price in 2020 was 4.2 USD/Mbtu. It is predicted a slight reduce in 2030 and 2050 (3.9 USD/Mbtu and 3.6 USD/Mbtu respectively).</p> <p>The steam coal price in 2020 was 50. It is predicted an increase in 2030 and 2050 (52 USD/Mbtu and 44 USD/Mbtu respectively).</p> <p>Production of clean hydrogen increases dramatically- 19Ej/yr in 2030 and 74 Ej/yr in 2050.</p>	<p>In conservative scenarios, the demand is still high, which leads to higher prices, therefore material and supply prices will increase as well. Certain supply restrictions result in high prices for energy and other commodities.</p> <p>The natural gas price in 2020 was 4.2 USD/Mbtu. It is predicted to see a significant increase in 2030 and 2050 (7.7 USD/Mbtu and 8.3 USD/Mbtu respectively).</p> <p>The steam coal price in 2020 was 50. It is predicted to increase in 2030 and 2050 (67 USD/Mbtu and 63 USD/Mbtu respectively).</p>
<p>Impact quantification</p>	<p>It is hard to estimate the costs without knowing the scale of the damage.</p>	<p>It is hard to estimate the costs without knowing the scale of the damage.</p>
<p>Extreme weather events damage network assets</p>	<p>A 1.5°C scenario may not have as many physical threats as other scenarios, but this could have a big impact on the damage to network assets, because these risks can not always be foreseen.</p>	<p>There is an increased chance of fines impacting the whole supply chain, which leads to contingent assets, liabilities and provisions on receivables. A reactive scenario leads to fines and distribution of banking, asset management and insurance markets. Extreme weather events could affect Caverion's core customer base.</p> <p>Companies may face productivity or working day losses. It might need to invest more in being able to deal with weather events than it would in a low-carbon environment.</p>

Table 2. Potential financial implications for climate-related opportunities

	<p>Low-carbon future 1.5 C</p>	<p>Extreme global warming 4 C</p>
<p>Opportunity</p>	<p>Key assumptions. Timeline 2021-2030</p>	<p>Key assumptions. Timeline 2021-2030</p>
<p>Impact quantification</p>	<p>1.33% increase in revenue.</p>	<p>0.97 % increase in revenue.</p>
<p>Energy-efficient solutions to Smart Building</p>	<p>Caverion expects organic revenue growth of more than 4%. In 2021, 33 % of Caverion's revenue was considered eligible under EU Taxonomy.</p> <p>It is expected to see a rapid efficiency in increased renovation rates in the building sector. Building-total energy consumption is decreasing. It was 121 EJ/yr in 2019 and is expected to be 99 EJ/yr in 2030 and</p>	<p>In a conservative scenario, it is expected to result in a decrease in building technology costs. For example, air-source heat pumps (including installation, delivery, engineering, procurement, and construction costs) in 2020 cost 610 USD/kW, but in 2030 the costs are planned to be reduced to 570 USD/kW.</p>

	<p>105 EJ/yr in 2050. The decrease is due to an increase in the renovation rate and a significant increase in investments in energy efficiency. It is predicted that energy conservation and efficiency in 2030 will be 9.1 Gt CO₂/yr and that it will save up to 25% of energy by 2050. Such indicators let to presume increased revenue for a company.</p>	
<p>Green growth and digitalisation, automatisisation packages</p>	<p>Digitalisation and automation should reduce carbon emissions. Caverion consumers benefit from digitalisation, technology and a wide local service network. Digitalisation has been main a part of the company's solution development for years and will continue to be so. It has affected Caverion's profit in various ways.</p>	<p>Without well-managed policies, decarbonisation operations could leave certain sections of society behind: for instance, heat pumps and energy efficiency improvements are too expensive for many people.</p>
<p>Increase in demand for energy through renewable sources (solar, hydropower, thermal power stations) (Scope 2)</p>	<p>The rapid growth of greener development paths will increase customer demand for solutions to be included in these markets. The reduction in the cost of solar PV has been remarkable, with technological advancements bringing construction prices down by an average of 80 % between 2010 and 2019 (IRENA, 2020). The absence of grid connections and supporting infrastructure, uncertain offshore conditions, technology performance, land availability, indeveloped supply chains, unfavourable policy frameworks, high capital costs and shortages of skilled labour are major difficulties (IRENA, 2019a). However, direct renewables must increase from 12% in 2019 to 19% by 2030.</p>	<p>Renewables' costs may stay the same, but climate change could make nonrenewable resources more expensive, which could save a company money in the long run.</p>
<p>Decarbonisation of transport drives investment in EV charging infrastructure</p>	<p>By 2030, EVs should dominate the market and contribute 8.3% of worldwide sales in 2021 (EV-Volumes, 2022). The price of EVs will decrease in the upcoming decades, so the number of EVs will increase from 30,000 in 2020 to over 5 million in 2050. Studies forecast that EVs will contribute up to 86 billion USD per year by 2030. This share will rise rapidly in the coming years. However, EV development relies on infrastructural development in the following decade (Irena, 2022).</p>	<p>Vehicle costs are going down in both scenarios, which means there are more chances for Caverion to support EV infrastructure.</p>