EXPLORING THE PERCEPTIONS OF EMISSIONS LIABILITY MANAGEMENT IN CORPORATE CARBON ACCOUNTING

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Exploring the Perceptions of Emissions Liability Management

in Corporate Carbon Accounting

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ABSTRACT

Exploring the Perceptions of Emissions Liability Management

in Corporate Carbon Accounting

Numerous countries, organizations and entities have pledged to reach net zero goals in carbon and other greenhouse gas emissions by the year 2050. Road to achieving this collective goal passes through a reliable accounting method and a robust system that ensures emissions removed from the atmosphere indefinitely. Emissions Liability Management (ELM) framework, which is proposed by Roston et al. (2023) comprises both requirements. Framework is stating that firms should match their emissions with reverse removal assets and only emit carbon if the firm is adding more value than cost of removing carbon matching the duration of emissions. This study explores Emissions Liability Management (ELM) in corporate strategies through qualitative methods. Given the concept has been proposed in the recent years, there are limited or little if any research in literature on the applicability of ELM. To achieve this purpose, in-depth interviews with industry experts and corporate executives based in Türkiye with notable ESG practices was conducted. The methodological approach is based on Best-Worst method and open-ended interview questions. The results emphasize that corporate executives prioritize the advantage coming from cost and risk reduction while considering integration ELM to strategy. The data obtained from the interviews shows that ELM is considered an applicable concept if several variables come together, integrating would presents a confident stance and gives a positive signal to all stakeholders.

ÖZET

Kurumsal Karbon Raporlamasında Emisyon Yükümlülük Yönetimi Çerçevesine Bakış Açısının İncelenmesi

Çok sayıda ülke, kurum ve kuruluş, 2050 yılına kadar karbon ve diğer sera gazı emisyonlarında net sıfır hedefine ulaşmayı taahhüt etti. Bu kolektif hedefe ulaşmanın yolu, güvenilir bir emisyon muhasebe yönteminden ve emisyonların sonsuza kadar atmosferden uzaklaştırılmasını sağlayan sağlam bir sistemden geçiyor. Bahsedilen her iki gerekliliği de kapsayan Roston ve diğerleri (2023) tarafından önerilen Emisyon Yükümlülük Yönetimi (ELM) çerçevesi, firmaların emisyonlarını karbon yakalama varlıklarıyla eşleştirmeleri ve emisyonlarını pozitif yönde tersine çevirebilmek için gerekli olandan daha fazla değer sağlamaları halinde emisyon yapmaları gerektiğini savunmaktadır. Bu tez, kurumsal stratejilerde Emisyon Yükümlülük Yönetimi'ni (ELM) niteliksel yöntemlerle araştırmayı amaçlamaktadır. Son yıllarda çıkan yeni bir konsept olması göz önünde bulundurularak, ELM'in uygulanabilirliği hakkında literatürde yok denecek kadar az çalışma bulunmaktadır. Bu amaca ulaşmak için Türkiye'deki ESG uygulamalarıyla öne çıkan firmalardaki kurumsal yöneticilerle görüşmeler yapıldı. Metodolojik yaklaşım "Best-Worst Method" yöntemine ve açık uçlu görüşme sorularına dayanmaktadır. Sonuçlar, şirket yöneticilerinin ELM'yi stratejiye entegre etmeyi düşünürken maliyet ve risk azaltımı sayesinde elde edilen avantaja öncelik verdiklerini vurgulamaktadır. Bunların yanı sıra, ELM'nin birden fazla değişkenin bir araya gelmesi durumunda uygulanabilir bir kavram olarak değerlendirildiğini, entegrasyonun kendinden emin bir duruş ortaya çıkaracağını ve tüm paydaşlara olumlu bir sinyal vereceğini göstermektedir.

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CHAPTER 1:

INTRODUCTION

The United Nations address climate change as a defining global issue in recent years, which is driven by anthropogenic activities since 1800s and requires collective action (United Nations, 2023b). Carbon dioxide and other greenhouse gas emissions are the main reason for the climate change. The world temperature today is 1.1°C higher with respect to years 1850 to 1900 and promises made in Nationally Determined Contributions to limit the increase in Greenhouse Gas (GHG) levels below 1.5°C in 2030 will high probably be exceeded if serious emission reductions are not achieved (Intergovernmental Panel on Climate Change, 2023). There is an unanimity that decreasing the emissions in current processes will not be sufficient, the goal cannot be reached unless netting is accomplished by negative emission acts (van Vuuren et al., 2018). Besides, switching to zero emission alternatives in all processes is not a plausible expectation.

Netting carbon emissions requires a robust carbon accounting method firstly to realize the duration and the magnitude of emissions. Given the absence of an international obliged standard, numerous methodologies are adopted by entities in terms of carbon accounting. Oladeji et al. (2023) highlighted the problematic 4 aspects of various practices as having complex vast range of emission sources, unavailable and dispersed data, high uncertainty in measurements and limited or duplicative counting systems.

GHG Protocol was aimed to be a risk disclosure tool but with a series of updates and revisions through more than 20 years since its first publication in 2001, it endeavoured to form carbon accounting methodology (Roston, 2021).

Jia et al. (2022) analysed GHG Protocols' metrics to find out they were non-comparable for multiple entities and lacked to provide cause-and-effect decision-making. They further justified counting the measured factors, in other words the unit of energy consumption, which is under the Scope 1. Kaplan and Ramanna (2022) criticized flaws in Scope 3 demonstrating how it is ineffective in correctly calculating known emissions from all direct and indirect suppliers in addition to estimating the emissions when uncharted. As explained further in the literature review section, E-Liability accounting method is proposed to overcome the challenges of Scope 3 emissions. Liabilities are attached to products or services and are passing through the entities of a supply chain from immediate supplier to immediate customer adding each entity's own emissions at each step in the e-ledger.

Roston et al. (2023) took a step further and structured the framework of Emissions Liability Management (ELM) to pave the way to emission reductions. In summary, the framework suggests acting as a trust fund to ensure the emissions are netted against zero for their durations in the atmosphere by a diversified portfolio of nature based and/or technology-based removal assets. Although as wonderful as it sounds as a concept, given it has been proposed in the recent years, there is almost no published research on the perceptions of investors, companies, and other organizations on the applicability of ELM that would lead to unified attempt to use in practice.

This study aims to explore ELM in corporate performance through qualitative methods. By conducting in-depth interviews with industry experts and corporate executives of companies with notable Environmental, Social and Governance (ESG) practices, the study examines how ELM, a rather concept in sustainability research, is perceived by corporate decision makers across various industries in Türkiye. The

methodological approach is based on Best-Worst method and open-ended interview questions. The study contributes to the existing literature by providing insights on how this rather concept is perceived as a practice by corporates.

The remainder of the study is organized as follows. The next section outlays the theoretical background of the research: building foundations for carbon accounting, E-liability accounting method and Emissions Liability Management concept are described. The methods utilized in this study are explained deeply in the METHODOLOGY section. The perceptions of the ELM concept as a strategy in the Turkish context are reported in FINDINGS section. The discussion and conclusion with final remarks are described in DISCUSSION AND CONCLUSION section.

CHAPTER 2:

LITERATURE REVIEW

2.1 International sustainability agreements and policies

Accounting for carbon in practice and carbon accounting research have aroused as a consequence of Kyoto Protocol and European Union Emissions Trading System. The international agreement of Kyoto Protocol was prepared to put a burden on developed countries to decrease and limit GHG emissions to specific pre-defined amounts. Being adopted on December 11,1997 in Kyoto Japan, the agreement has become an international law on February 16, 2005 and had 192 parties involved. The protocol obliged only 37 developed countries to reduce the emissions since it acknowledged those have greater liability on the high levels and greater capabilities to reduce (United Nations Framework Convention on Climate Change, 2019).

Following the completion of the first commitment period, the Doha Amendment was attached to Kyoto Protocol at the 18th session of the parties in 2012 for a second commitment period, which included 2013 to 2020. The extension comprised adding nitrogen trifluoride as a greenhouse gas covered and expedited the one-sided strengthening of commitments by individual parties (Erbach, 2015). The amendment came into force on 31 December, 2020 only after reaching the threshold of 144 parties agreeing the amendment (United Nations Framework Convention on Climate Change, 2020). Doha Amendment did not last long as in Paris, at the Sustainable Development Summit 2015, Paris Agreement, which productively succeeded Kyoto Protocol was signed (Tardi, 2024).

Paris Agreement was reached by the national leaders at the UN Climate Change Conference (COP21) in Paris on December 12, 2015. Paris Agreement differed from Kyoto Protocol as the agreement contained both developed and developing countries to cooperate in reducing the emissions all together. While the bottom-up approach was fulfilled by the participation of some nations by setting national targets voluntarily, the reporting and reviewing system available to all contributors to follow the implementation of the agreement reflected the top-down structure of the Paris Agreement (Ministry of Environment, Urbanization and Climate Change, n.d.). The agreement binding 194 states and European Union, which entered into force on 4 November, 2016, has targeted three long-term objectives:

1. Reducing the impacts of climate change by declining greenhouse gas emissions and holding the global temperature increase below 2°C even put efforts to cap at 1.5°C with respect to pre-industrialization levels

2. Recurrent monitoring and reviewing of the collective progress towards the goals of the agreement

3. Contributing developing countries financially to fight climate change, improve their capabilities in adapting its consequences and bolster their resilience (United Nations, 2015).

Implementation of the Paris Agreement can be achieved by both social and economic transformation. The agreement was designed to work in a five-year-cycle, in every five years; countries are obliged to submit their Nationally Determined Contributions (NDCs), in other words their climate action plans (United Nations Climate Change, 2015).

In the first global stocktake of the Paris Agreement, which was held in 2023 in COP28, the governments were called for accelerating the transition from fossil fuels to renewable energy such as solar power and wind (United Nations, 2023a).

On the topic of sustainability in general, on the same year with Paris Agreement, United Nations has adopted the Sustainable Development Goals (SDGs) in 2015 to gather nations under the same cause, which is to terminate poverty, hunger, diseases and discrimination against minorities, and released 17 goals with associated 169 targets to reach the aim to have peace and prosperity all around the world by 2030 (United Nations Development Programme, n.d.). 17 SDGs are given in Figure 1.



Figure 1. 17 Sustainable Development Goals

Source: United Nations Department of Public Information, 2018, p.48

European Union continued to develop agreements and deals on the topic of a sustainable and climate neutral world. European Green Deal (EGD) has come to life for this purpose. EGD aimed to make Europe the first net carbon neutral continent in the world while having a strong economy at the same time and securing that:

1. There will be zero net emissions of GHGs by the year 2050

2. Improving the environmental resources and thus resource usage being parsed from economic growth and

3. Preserving individuals by assuring no one nor a place is left behind (European Commission, 2021).

Fetting (2020) states that the deal was not a law itself and rather than presenting a strategy to cover all the solutions to Europe's environmental problems; European Green Deal offered a set of targets and principles, which are going to be instrumented in the next ten years following its commencement date on January 2020. In addition, he highlighted evaluation of the success of the deal would be associated with the attention given to and implementation of eight elements of Green Deal, which are as follows (European Commission, 2019):

1. Increasing the EU's climate ambition for 2030 and 2050
2. Supplying clean, affordable, secure energy
3. Mobilising industry for a clean and circular economy
4. Building and renovating in an energy and resource efficient way
5. A zero pollution ambition for a toxic-free environment
6. Preserving and restoring ecosystems and biodiversity
7. Farm to Fork: a fair, healthy and environmentally friendly food system
8. Accelerating the shift to sustainable and smart mobility.

2.2 Corporate Social Responsibility and ESG reporting

This collective effort to implement sustainability and achieve net-zero goals has affected the companies and organizations inevitably. As a result, Corporate Social Responsibility has occurred. Corporate Social Responsibility, as a term, refers to firms self-regulating themselves in developing environmentally, philanthropically, ethically, and economically responsible strategies to have positive impact in the society they are built in (Stobierski, 2021).

In the last decades, stakeholders of the corporates have been a catalyser in increasing the importance of sustainability reporting. Competitive advantage of the firms has shifted from cost of performance to sustainability acts in the eyes of the stakeholders. According to Accenture CEO Study, executives were stating that they felt the pressure to set sight on sustainability agenda (United Nations Global Compact, 2019). 68% of CEOs emphasized that customers were the most influential among all stakeholders. Furthermore, governments' potency was leading in having the largest increase in the proportion rising from 31% in 2021 to 52% in 2022 (UNGC, 2019). As a result, communicating sustainability impacts to all stakeholders has gained importance, which led the way to the emergence of Environmental, Social and Governance (ESG) Reporting.

The terms CSR and ESG are highly associated and broadly used interchangeably. However, there is a slight difference where CSR is related more with internal framework in contrast with ESG being an external framework indicating the effect on the world (McGrath & Jonker, 2023). Determinants, characteristics, consequences, and moderators of ESG Reporting has been widely studied in the accounting literature.

Firstly, the ESG reporting of firms reflects their responsible presence to the investors. Thus, they are reducing the risk of possible future penalties or risks taken by not being compliant with the standards. Firms who disclose their CSR information, have a chance to make their long-term strategies aligned with their financial performance, capabilities, and other additional briefing about reputation visible to all stakeholders. Voluntarily disclosed information on ESG, has been found to demonstrate powerful financial performance, lower cost of capital, greater accessibility to treasury in addition to robust positive reputation and satisfied stakeholders for a company (Tsang et al., 2023).

Considering how influential ESG reporting is in firm's value in various ways, communicating the related information in the most effective way emerges as a priority which in turn, created the need for standards on how to report these disclosures. Unlike financial reporting, which has one mandatory standard decided by its own jurisdiction, ESG reporting lacks such kind of a unity. Rather, it is managed individually by several private organizations' standards.

Global Reporting Initiative (GRI) was founded in 1997 with the purpose of creating a comprehensive framework for organizations to announce environmental, social and governance information on the consequences of their activities using a common language (Global Reporting Initiative, n.d.). GRI gives free access to their standards for public good. GRI Standards are encompassed of three sub-standards: Universal Standards which applies to all organizations, Sector Standards which is planned to be developed for 40 sectors to increase the quality of reporting, and Topic Standards to give more insight on specific topics such as taxing, waste, occupational health and safety (globalreporting.org, n.d.).

Climate Disclosure Standards Board (CDSB) was formerly another international consortium of business and environmental non-profit organizations dedicated to enhancing and harmonizing the global mainstream corporate reporting framework which is now consolidated with IFRS foundation (International Financial Reporting Standards, n.d.).

The Carbon Disclosure Project (CDP) was founded to suggest a working mechanism to companies on reporting their GHG emissions and consumed carbon. The construction was mirroring financial reporting by asking sector-related questions to gather information on the emissions (Jebe, 2019). Today, more than 23000 companies have already reported following the guidance of CDP (Carbon Disclosure Project, 2024).

In addition to the institutions mentioned above, International Integrated Reporting Council (IIRC) and Sustainability Accounting Standards Board (SASB) existed for developing frameworks for ESG disclosures. IIRC seek the idea of looking from a broader perspective to create integrated reports reflecting both financial and nonfinancial information on the contrary to CDP and CDSB, who only focused on environmental issues. Similarly, SASB aimed to set sustainability accounting standards to encompass financial value of the entities and ESG information under the financial documentation. ESG Reporting is a multicentre structure, where many standard setters varying on what information in which format is going to be reported exist, and this creates a complicated environment (Sulkowkski & Jebe, 2022).

International Sustainability Standards Board (ISSB)'s foundation was announced on 3 November 2021 by the Trustees of the IFRS Foundation. Moreover, IIRC and SASB have merged to form Value Reporting Foundation (VRF) in 2021. VRF had the intention to work closely with IFRS Foundation to construct a coherent corporate reporting standard while providing the following key resources to investors and businesses: Integrated Thinking Principles, Integrated Reporting Framework, and SASB Standards (Deloitte, 2021). In 2022, one year after the formation of VRF, consolidation of VRF and CDSB under the umbrella of IFRS's new International Sustainability Standards Board (ISSB) took place (International Financial Reporting Standards, 2022).

The ISSB's initial goal was to create globally accepted, comprehensive, and consistent sustainability reporting standards covering environmental, social, and governance issues. Since its inception, the ISSB has swiftly developed and released first two sets of standards IFRS S1 and IFRS S2 in 2023, leveraging its international reach under the IFRS Foundation to set global standards for sustainability reporting (de Villiers et al., 2024). ISSB was demanded to develop these standards especially by G20, the Financial Stability Board and the International Organization of Securities Commissions (IOSCO) reflecting the global interest to understand how sustainability factors were influencing firms' prospects (International Financial Reporting Standards, 2023). As, IFRS S1 and IFRS S2 are complying with the recommendations of Task Force on Climate-related Financial Disclosures (TCFD), the Financial Stability Board (FSB) has asked IFRS to take over the role of monitoring the progress from TCFD as of 2024 (Financial Stability Board, 2023).

On April 21, 2021, the EU Commission declared the endorsement of the Corporate Sustainability Reporting Directive (CSRD), fulfilling a commitment outlined in the European Green Deal to amend formerly existing Non-Financial Reporting Directive (NFRD) and increased the requirements for reporting (KPMG, 2023). CSRD, which came into force in 2023, developed new reporting rules that were in line with European Sustainability Reporting Standards (ESRS) to ensure stakeholders reached the relevant social and environmental information to evaluate the risks and opportunities (European Commission, 2024).

Global Sustainability Standards Board (GSSB), which was established as an independent entity under GRI, aims to provide interoperability between standards set by global, national, and other legislative standard-setters. In addition to giving continued support to the European Financial Reporting Advisory Group (EFRAG) for establishing the European Sustainability Reporting Standards (ESRS). In 2022, GSSB has signed an agreement with ISSB to coordinate their work programs (Global Sustainability Standards Board, 2023). In January 2024, two entities published a joint analysis and mapping source for applying their standards for GHG emissions (International Financial Reporting Standards, 2024)

2.3 Accounting for GHG emissions

Human-kind resourced carbon emissions mainly caused by usage of fossil fuels, cement-making and deforestation, is considered as the root cause for climate change and global warming. According to Bloomberg (n.d.) Carbon Clock, CO2 levels in the atmosphere, which is more than 426 parts per million of the air today, is 52% higher than the levels of the period before industrialization, which was under 300 ppm. As CO2 is the thermostat of the world, we encounter the risk of 2.7°C warming when

compared to pre-industrialization period by the year 2100. In this sense, it is important to track the protocols and application systematics on GHG emissions.

GHG Protocol, first released in 2001 and has since been updated several times, has come into discussion in the late 1990s and when World Resources Institute and World Business Council for Sustainable Development have built an NGO partnership and convoked a group of members including environmental groups and industrial companies to start the process of building a standard (Greenhouse Gas Protocol, 2016). According to the GHG protocol, the emissions has been taken into account under 3 scopes: Scope 1, Scope 2 and Scope 3.

- Scope 1: Direct emissions from the company owns and controls that being released as a result of the activities within the company.
- Scope 2: GHG emitted by the consumption purchased energy such as electricity, steam, heat and cooling.
- Scope 3: Indirect emissions which occur in the supply chain of a company encompassing both upstream from its suppliers and downstream by the customers of the entity.

Bernoville (2022) represents 3 scopes of emissions as shown in Figure 2.

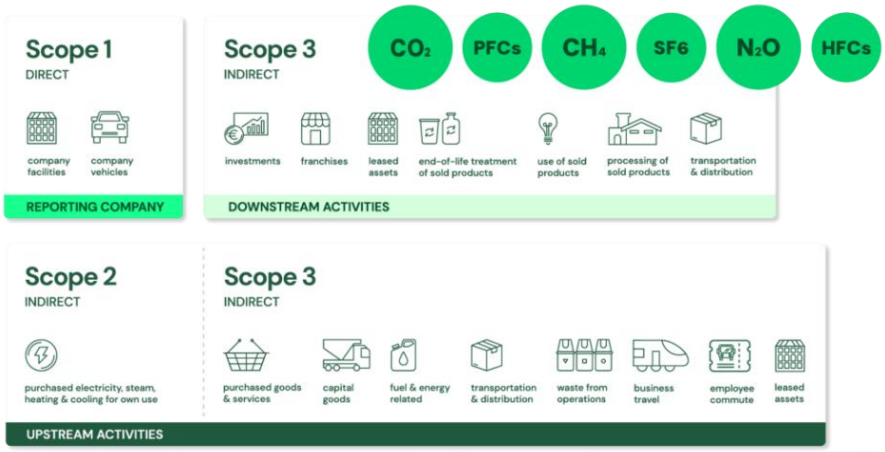

Figure 2. Scope 1, Scope 2, Scope 3 emissions based on GHG Protocol

Source: Bernoville (2022)

Kaplan & Ramanna (2021a) discusses the problems of ESG Reporting, the shortcomings of GHG Protocol and suggested a revolutionary accounting framework for carbon accounting. Kaplan & Ramanna (2021a) argued that it was not possible to consider the components E, S and G of the ESG as a single concept since the measurement of each had its own ways and knots. They further explained the unique features of each:

- Environmental measures were the most acceptable ones as they depended on objective and measurable outcomes reflecting companies' usage of the substances. They emphasized to give the priority to reporting GHG emissions.
- Although some dimensions of the Societal performance were agreed upon public such as preventing slavery, there still were respectable number of topics that had to be interpreted subjectively.

- Governance was by nature a complicated dimension as it dealt with the process instead of the outputs.

They dive in Environmental aspect of ESG deeper in the article and remark that starting with the focus of GHG emissions, developing a way to report GHG emissions, it will ease to develop approaches for the non-GHG emissions in the future. Furthermore, Scope 1 and Scope 2 within GHG Protocol are found easy to calculate and follow. However, when it comes to Scope 3, the company is responsible for the emissions all through their supply chain and they are obliged to track up to all suppliers' upstream emissions and down to all customers' downstream emissions. Reaching all the right data, even estimating creates unreliability problems in reporting Scope 3. In addition, in a long supply chain, a supplier may be providing goods or services to several customers on different levels of the chain which is increasing the error caused by adding the same emissions repeatedly.

Kaplan & Ramanna (2021a) at this point suggested the concept of "E-liability" to correct the GHG Emissions reporting framework by implementing the rules in financial and cost accounting to carbon accounting and by passing emissions through the supply chain from supplier to customer. In this system, every entity in a supply chain would only need to account for their direct Scope 1 emissions, which are the emissions resulted from their own operations, add the emissions they directly take from the supplier which could be through goods or services and transmit to the next entity in the supply chain. For a company only reporting their own emissions and their arm's-length neighbours within the supply chain, the risk of duplicate reporting Scope 3 emissions is eliminated and outsourcing some high emissions activities is no longer a way of reducing firm's emissions as they are going to be reimbursed once the good or service is bought from the outsource. By this method,

upstream and downstream emissions are distinguished from each other. Upstream Scope 3 emissions are accurately reported from the liabilities of supplier, while the downstream emissions could only be estimated according to the usage of the product by customers.

In their article, which is won 2022 McKinsey Prize for "groundbreaking management thinking.", E-liability method was illustrated with a hypothetical car-door manufacturer's booked liabilities in a period. The book has opening liabilities, the liabilities from direct suppliers related to raw materials, electricity etc. are added first, then the emissions created by the manufacturer's processes are added in tones of CO2. The emissions transmitted to customers are extracted and finally, net e-liability is reached at the end of the period (Kaplan & Ramanna, 2021b). A rhetorical E-liability statement given in the article is shown in Figure 3.

E-liability flows	TONS OF CO_2
Opening E-liabilities	**3,600**
Add E-liabilities acquired from suppliers	39,800
Electricity	*5,600*
Sheet steel	*10,600*
Glass	*5,400*
Fabric and plastic	*1,200*
Other supplies/components	*4,800*
Capital equipment	*12,200*
Add E-liabilities directly produced through operations	2,600
Subtract E-liabilities transferred to customers	(32,600)
Closing E-liabilities	**13,400**
Change in E-liabilities during period	9,800

Figure 3. The rhetorical E-liability statement of the car-door manufacturer

Source: Kaplan & Ramanna (2021b)

2.4 Carbon-offset principles

After the accounting method is determined, the question of how to lower GHG emissions arise. Furthermore, to combat climate change, reducing emissions is not enough at this point, the gases should be removed from the atmosphere permanently.

Carbon offset refers to reducing the emissions of CO2 or other GHG gases in a different location than they were emitted in order to counterbalance total emissions in the atmosphere (Tsai, 2020). There are two main types of carbon-offsets in the market: one is compliance under CDM (Clean Development Mechanism of the Kyoto Protocol) where bureaucracy is implemented and governed by CDM Executive Board (and associated UN committees) and the other is voluntary markets (Lovell, 2010) where certificates are issued by several agencies.

The ways of net carbon removals, also known as sequestration, are capturing carbon via biotic or abiotic processes. Biotic processes are based on biologic reactions and the preeminent biotic sequestration is via photosynthesis (Lal, 2003). On the other hand, abiotic processes are based on chemical reactions where carbon is restrained in racks and other geological formations (Halmann & Steinberg, 1998).

There are judgments on how effective these carbon-offset markets are working, though. Verra, an NGO world's leading standards for climate action, has been investigated to find out that more than 90% of the offset credits realized by rainforests were inefficient in fighting carbon emissions (Greenfield, 2023). The scepticism on the accuracy of voluntary carbon-offset market remains and companies are expected to disclose how they put actual carbon removals in practice to clear the air (Temple-West, 2022). By some climate actors, carbon offsets are handled as two different concepts: avoidance and removal offsets. Avoidance offsets aim to minimize the upcoming emissions by switching to clean energy or opting for low-

emission processes. On the contrary, removal offsets require to sequester carbon from the atmosphere which results in direct reduction (Comello et al., 2023).

Kaplan et al. (2023) establish 3 carbon offset principles for legitimate removals. According to this framework first principle stated that only removal-offsets had to be considered in reducing E-liabilities. Highlighting the need in praising the firms for actual sequestration, they suggested that removals shall be the same amount as Scope 1 emissions. Second principle stated that removal offsets could be traded while E-liabilities could not be traded. Offsets shall be considered as any other good or service provided by competent suppliers to deduct from E-liability balances. On the contrary, E-liabilities are not merchandised. They are associated with the entity and only transferred to another E-liability book through selling the goods to customer. Here, the entity's responsibility is to lower the transferred E-liability, they cannot send away all the E-liabilities. Third principle stated that for carbon capture to be perceived as a tradeable removal offset, "timing and magnitude" of the offsets should be "probable and estimable". A convenient example to a probable and estimable offset is when a device that captures carbon into rocks functions correctly and the removal amount potential is known. A complementary sub-principle suggested that a company is allowed to use the removal offset to "net" its E-liability book only when carbon was physically removed from the atmosphere permanently. Fourth principle stated that offset asset shall be decreased or increased regarding the new information on the timing and magnitude of realized removal.

2.5 Emissions Liability Management (ELM)

When the CO2 enters the atmosphere, it abides for a long time namely between 300 and 1000 years. In other words, carbon outlives the human's lives who emitted them (Buis, 2019). Whether it stays within a firm's carbon ledger or transferred to customers by selling the goods and services, the party holding those e-liabilities is responsible offset the carbon that will affect multiple life cycles of firms and humans. Roston et al. (2022) suggested Emissions Liability Management (ELM) framework, which would encourage firms to put capital in reducing current and future emissions, create demand for more high-quality offsets and pave the way to technological advancement in current sequestration methodologies. ELM acts like an insurance company, estimating the future liabilities of a company and assures that the company devotes capital and create cashflows to extinguish those liabilities in the course of time. ELM requires the firms to capture emitted amount of carbon to be removed permanently. The entity may use a varied portfolio of removal technologies that procures different durations of removals and risks attached to them. For the sake of their working paper, they optimistically assume the life of emitted carbon in the atmosphere as 500 years within the NASA range. To illustrate how ELM works, forestation is presumed to capture carbon for 50 years and a company shall hold a portfolio of offsets for covering several transaction cycles until 500 years of permanent removal is achieved. Inherently, there are impairment or accretion risks attached to nature-based solutions that results in creating ambiguity in the future permanence of the offset. There are no penalties for companies if the offset is reversed after they retire the certificate. ELM compels companies to follow their entire e-liability flow instead of the e-liabilities in the current period.

Obligating firms to match their liabilities with the same duration offset assets, would create a demand and price increase in the biotic removal assets. Early birds on adapting these assets would lower their cost. Moreover, since there are risks associated with biotic removal assets (e.g. diseases and fires in the forests), the ELM trust behaves those assets as technology-based removal assets plus the risks regarding pricing issues. Thus, even though the sequestration method direct-air-capture-to-rock is expensive today, the price would potentially fall to one fifth in 10 years. The authors believe that ELM is a reliable step into realizing net zero claims. Under ELM framework, companies with high e-liability stocks will be perceived as high leveraged firms because of their requirement for allocating financials to removal assets. Firms would willingly to adapt ELM to signal good financial performance to their stakeholders. In the end, the willingness in switching to low or zero emissions processes in the supply chains is inevitable (Roston et al., 2023).

CHAPTER 3:

METHODOLOGY

3.1 Research objectives

The aim of this study is to explore the perceptions on Emissions Liability Management (ELM) in corporate performance and decision-making processes. To achieve this, in-depth interviews are conducted with industry experts, and corporate executives. The purpose of gaining detailed insights into decision makers' impressions towards this new concept, a qualitative rather than a quantitative approach is used. There are four main objectives of this research:

1. Understanding ELM Integration: Investigate how companies may integrate ELM factors into their corporate strategies and decision-making processes.
2. Perception Analysis: Explore the perceptions of stakeholders towards ELM factors.
3. Impact on Corporate Strategies: Examine how ELM considerations may shape corporate strategies and influence outcomes.
4. Sectoral and Regional Insights: Provide insights into the differences in ELM integration and impact across various industries and geographic regions.

3.2 Research methodology

The decision-making process about integrating ELM concept in an organization could be considered as Multi-Criteria Decision-Making problem. Decision-makers and experts related to the topic are going to consider several decision criteria, evaluating the pros and cons before making changes in the carbon accounting strategy and adopting a new method.

This study firstly utilizes the Best-Worst Method (BWM) approach to gain a deeper understanding and investigate the importance of each criterion in the process of adapting ELM concept. In addition to BWM Method, semi-structured in-depth interview questions are utilized to explore perceptions deeper. In this section, BWM Method and interview questions are described.

3.2.1 Best-Worst Method (BWM)

The Multiple-criteria decision-making (MCDM) technique "Best-Worst Method" is applied in this study to calculate the weights of each criterion and sub-criteria to be used in making the decision to adapt ELM as a corporate strategy. BWM, which was proposed by Rezaei (2015), uses pairwise comparisons to show the relative preference of one criterion over the other. Firstly, the best (most important) and the worst (least important) criteria are selected by the decision maker and then, the best criterion is compared to the other criteria and the other criteria is compared to the worst criteria using a nine-point Likert scale. The method has a five-step procedure to set the weights of the criterion. In addition, a consistency ratio is calculated to check the reliability of the findings. A linear BWM Solver is used in this study to calculate the weights of each criterion.

BWM has been used widely since it overcomes the disadvantages of other MCDM methods such as Analytic Hierarchy Process (AHP) by requiring fewer questions and providing consistency (Ren et al., 2017). There are several examples of utilizing the BWM method for sustainability of the supply chains (Ahmadi et al., 2017), evaluating the R&D performance of firms (Salimi & Rezaei, 2018), Ranking model of total quality management enablers in healthcare establishments (Talib et al., 2019) and in Sustainability Reporting decision making (Gutiérrez et al., 2021).

Rezaei (2015) defines the steps of the method as follows:

Step 1. Deciding the criteria and sub-criteria if available which are going to be considered by the decision makers to solve the problem. In this study, the decision criteria (costs and benefits) for sustainability reporting decisions making compiled by Gutiérrez et al. (2021) is adopted.

Step 2. The best criterion, the worst criterion and sub-criteria respectively are classified by the respondent. Comparison is not performed at this step.

Step 3. The relative importance of the best criterion over other criteria is identified using a nine-point scale. Pairwise comparison is realized by using the numbers given in Table 1. The result is Best-to-Others vector as given in Equation (1):

$$A_B = (a_{B1}, a_{B2}, \dots, a_{Bn}) \quad (1)$$

Where a_{Bn} indicates the importance of the best criteria "B" with respect to criterion "n".

Step 4. The relative importance of all the other criteria over the worst criterion is identified using a nine-point scale in the same way as the previous step. The result is Others-to-Worst vector as given in Equation (2):

$$A_w = (a_{1w}, a_{2w}, \dots, a_{nw})T \quad (2)$$

Where a_{nw} indicates the importance of the other criteria "n" with respect to the worst criterion "w".

Table 1. Numbers and Relative Importance

Number	Relative importance
1	Equally important
2	Weakly important
3	Moderately important
4	Moderately plus important
5	Strongly important
6	Strongly plus important
7	Very strongly important
8	Very, very strongly important
9	Extremely important

Source: Ahmad et al. (2020)

Step 5. Optimal weights $(w_1^*, w_1^*, \dots, w_n^*)$ are calculated. In order to reach the optimal weights, a solution, where the maximum absolute differences are obtained, is calculated as given in Equation (3):

$$\left\{\left|\frac{w_B}{wj} - a_{bj}\right|, \left|\frac{w_j}{w_w} - a_{jw}\right|\right\} \text{ for all j, it is minimized,} \quad (3)$$

which is subject to

$$\sum_j wj = 1$$

$$wj \geq 0 \quad \text{for all j.}$$

Equation (3) is converted into a linear optimization problem as in Equation (4) (Rezaei, 2016):

$$\min \xi^L \quad (4)$$

$$\text{Subject to } \left| w_B - a_{bj} w_j \right| \leq \xi^L, for\ all\ j$$

$$\left| w_j - a_{jw} w_w \right| \leq \xi^L, for\ all\ j$$

$$\sum_j wj = 1$$

$$wj \geq 0 \quad \text{for all j.}$$

Solving the linear problem in Equation (4) with unique solution, optimal weights of "n" criteria $(w_1^*, w_1^*, \ldots, w_n^*)$ and consistency ratio ξ^* are obtained.

Step 6. Calculating the consistency ratio and criteria optimal weights. In order to check the reliability of the results, consistency ratio is calculated using consistency index according to Table 2. For greater values of ξ^*, the consistency ratio is increased, which implies less reliable comparisons. The degree of consistency is high when the consistency ratio value is close to zero,

$$Consistency\ ratio = \frac{\xi^*}{Consistency\ index} \tag{5}$$

Table 2. Consistency Index Table

a_{bw}	1	2	3	4	5	6	7	8	9
Consistency index (max ξ^*)	0.00	0.44	1.00	1.63	2.30	3.00	3.73	4.47	5.23

Source: Rezaei (2015)

In their study, Gutiérrez et al. (2021) explored the importance of criteria in choosing a sustainability reporting standard. The ability of 6 criteria and 21 sub-criteria to be used as decision-making criteria in sustainability strategy was agreed on

with a panel of experts following the extensive literature research. Their criteria were adopted for this research since it was considered well-suited for application for making strategical decisions under the topic of sustainability, as it has garnered consensus among experts in the field. The criteria are given in Table 3.

Table 3. Decision Criteria and Sub-Criteria Used in BWM Method

C1	Economic Cost	SC11	Cost of implementing the strategy (e.g. cost of certification or cost of employee training)
		SC12	Cost of reporting the information
		SC13	Cost of new information and control needs (e.g. strong information management systems)
C2	Cost and Risk Reduction	SC21	Firm efficiency
		SC22	Ability to attract capital and cost of financing
		SC23	Fiscal advantages and costs of complying with present and future regulations
		SC24	Risk prevention and/ or mitigation (e.g. consumer avoidance and NGO boycotts)
C3	Internal Organizational Benefits	SC31	Implementation of the sustainability strategy in the firm
		SC32	Continuous improvement and coordination in the organization
		SC33	Allocation of resources
C4	Competitive Advantage	SC41	Stakeholder-oriented competitive strategy
		SC42	Long-term vision (strategy) of the firm
		SC43	Differentiation from other competitors
		SC44	Access to new markets and market share
C5	Reputation and Legitimacy	SC51	Corporate image
		SC52	Reputation over time
		SC53	Legitimacy to stakeholders
C6	Synergistic Value Creation	SC61	Relations with employees
		SC62	Relations with customers and suppliers
		SC63	Relations with financial institutions
		SC64	Relations with regulators and public administrations

Source: Adaptation from Gutiérrez et al. (2021)'s criteria

3.2.2 In-depth interviews

The objective of this study is to gain a deep understanding of managerial perceptions to integrating ELM concept and carbon removal technologies to corporate strategies. In addition to evaluating the criteria for decision making, qualitative research method in-depth interviews are employed. In-depth interviews with senior managers and vice presidents of strategic departments, who are involved in managing sustainability topics, are carried out to do further investigation. In-depth interviews are performed with five participants from two different companies, which are known to be pioneers in sustainability topic. Oral answers are received from each respondent, and the answers are analysed by considering interpretive paradigm.

In-depth interviewing method is favoured for this newly proposed concept, since it lessens the drawbacks of recording weak opinions by giving the opportunity to clarify participants' understanding by providing them additional information about the topics under investigation. While preparing the questions, perception analysing studies in carbon accounting literature are reviewed in this study. Interview questions are partly developed by adapting the questions of Jones et al. (2017), which examined the lay perceptions of carbon dioxide utilisation technologies and partly developed to investigate whether arguments of the ELM concept reciprocated in the views of decision makers. Ethics Committee Approval obtained for this study is given in APPENDIX A. The interview guide, which is given in APPENDIX B, consists of the questions about information and the experiences of the participant, ELM concept perceptions, and conclusion questions.

3.3 Data collection and interviewing process

The sample consists of five participants from two companies, which are known as being pioneer in applying sustainability actions within their strategy in Türkiye. One, which creates software and services for energy management, was selected as the top rank World's Most Sustainable Companies 2024 by TIME and Statista (TIME, 2024) and the other one at the top levels in Banking sector is known for sustainability finance. For the confidentiality reasons, the names of the companies are not disclosed in this study. The participants are either strategic decision-making senior managers, who are related to sustainability topics, or directly the people within the sustainability teams managing the process in and outside of the company with stakeholders. The reason for selecting these specific respondents is providing different views for aligning the concept with the company strategy, sales strategy, and stakeholder strategy and cover the topic in an extensive way as there are no evidence from Turkey. The interviews took place in a quiet setting lasting approximately 60 minutes. Two respondents are contacted through online meetings, where three of the respondents are interviewed face-to-face in their workplaces. Prior to interview, oral and written presentations are done to explain the purpose of the study, the consent form aligned with ethical committee is signed and participants are guaranteed that their personal information will be kept confidential. The interviewees are communicated about the ELM concept in advance of their interview days by providing them the original article and a summary of the suggestions of the concept, which is previously prepared by the interviewer. Before starting the interviews, the summary is provided to reduce the prospect of recording little knowledge on the specific topic.

The in-depth interviews consist of two parts: scaling the criteria for BWM and answering the open-ended questions. All interviews are recorded under the consent of the respondents and transcripts of the voice recordings are used to prevent missing vital points. Findings of the perspectives are presented after analysing the interviews.

CHAPTER 4:

FINDINGS

A qualitative research method is used in this study by conducting in-depth interviews. The analysis of the data is presented under the following headings: (i) Explanation of the participants, (ii) ELM Concept, (iii) Applicability of ELM Concept, (iv) Perceived Benefits and Risks of integrating ELM to Strategy, (v) Designing Zero Emission Processes, (vi) ELM Portfolio, (vii) Price Discovery, (viii) Integrating ELM Strategy and Stakeholders, (ix) Perceptions on voluntary early actors of ELM. Following the findings of the perspectives through in-depth interviews, the results of the BWM method is presented in this chapter.

4.1 Interview participation

There are four males and one female participants with long years of experience in their industry and engaged in the sustainability business within their firms. Among all participants, two people are vice presidents, one person is leading marketing and digital services department, one person is leading the consulting activity, and one person is sustainability manager. Demographic characteristics of the participants are given in Table 4.

Table 4. Demographic Characteristics of Participants

Participant	Gender	Participant's Title	Sectoral Experience	Years of Service at the Current Company
E-1	Male	CFO & Strategy Vice President	17	13
E-2	Male	Marketing & Digital Services Manager	12	12
E-3	Female	Consulting Activity Manager	11	5
E-4	Male	Country Sales Vice President	16	13
E-5	Male	Sustainability Manager	7	2

4.2 Emissions Liability Management (ELM)

In this section, participants' perceptions of ELM strategy are presented. Firstly, the general view about the concept is investigated. Before the interviewing process, suggestions and arguments of the concept are presented and an article is provided to the respondents. Then, the benefits and risks attached to implementing ELM strategy, and its effects on carbon removal technologies, stakeholder perceptions, price discovery and voluntary acting are questioned.

4.2.1 ELM concept

Out of all participants, only one participant states that he has heard "Emissions Liability Management" as a concept before being contacted for this study. However, all the respondents are aware of the carbon removal technologies, carbon offset methods, carbon emission management and carbon border adjustment mechanism.

After being provided with the detailed information of the concept, ELM is perceived as a solution to take a step to decarbonizing collectively by the respondents. Participants are confident that collaborative action is needed and new methods like ELM, which shapes an outline, shall be tried to achieve the net-zero goal:

> …I believe that the world is currently at a critical turning point, standing on the edge of a precipice. At this edge, I am convinced that such theories and methods must be tested without hesitation. Whether it be these or other methods, they must be implemented because there is no turning back now. Given this point of no return, we need to consider our carbon footprint and accelerate global decarbonization strategies. This issue is not solely the responsibility of companies, individuals, governments, or NGOs alone. I believe a collective consciousness and collective wisdom must be brought to bear. In this context, academics should present these methods, collaborate with the private sector, the government, and the individuals, and truly evaluate the benefits if there are any tangible results. Therefore, I think the adoption of such approaches must increase… (E-1)

One participant, who also believes in a collective awareness, emphasizes that the parts, who are responsible for the high carbon emissions, shall be kept more responsible for reversing the effects and ELM concept may act as a catalyser:

> …Ultimately, as human beings, we live on the same planet. Whatever one of us does inevitably affects the others. Therefore, we share a common problem, but we observe that the sources causing the problem are not contributing to the solution. As a result, we see that the motivations to take responsibility are not developed inherently. I believe that tools like the emission liability management we are discussing today can serve as motivators for taking on this responsibility. On a broader scale, I consider it crucial to regain the awareness that our planet is not an inheritance from our grandparents but rather a trust we hold for our grandchildren… I am personally glad that we are discussing one of the ways to solve this problem, as it gives me hope for our future… (E-4)

4.2.2 Applicability of the ELM concept

When asked for the applicability of the ELM concept in real life, all respondents believe that it is inevitable to follow a concept's guideline to reach the net-zero reality that entities promised for 2050 and the suggestions of ELM are found reasonable to act. However, one participant highlights several variables shall be complied with at the same time to realize ELM giving the example of legal obligations:

> …Some things need to happen at the right time. Take electric vehicles, for example—they've been around for a long time. If we look back to the 1930s and 1940s, there were already electric vehicles… But certain factors for ELM need to come together as in electric vehicles example. What are these? Firstly, legal obligations haven't yet started—in fact, even the requirement for disclosure in Turkey won't begin until 2026. The Paris Agreement requires Türkiye to reduce emissions by 55% by 2035, but companies are still not fully aware of how close this deadline is... (E-2)

One participant believes, although it is a well-intentioned purpose for the world, investing in a new carbon strategy shall be supported by money income to the entity to be considered. They complement the variables affecting applicability of the concept by adding (i) profitability of the company, (ii) penalties to be faced when being non-compliant, (iii) the green image to influence stakeholders and (iv) the need to propagate the mindset of halting and reversing the carbon emissions are crucial for human lives:

> …I don't believe that any company would invest solely for the sake of protecting the environment; there must be a reason to do so. In the context of a capitalist system driven by the pursuit of profit, the motivation should be to eliminate risks. What are these risks? Potential fines, the profits to be gained from such investments, the improvement in company image, and how that image can be monetized. Without the threat of penalties for not investing, controlling, or eliminating emissions, I don't think this shift will happen naturally. Therefore, presenting this issue within a structured framework, as a tool that all stakeholders agree upon, could be a solution… However, what did we observe during the Russia crisis? The very countries in Europe that claimed to be 'green, environmentally friendly, and leaders in sustainability' turned to coal plants when they faced the threat of energy shortages for heating, cooling, and electricity; they also reactivated nuclear plants that were on the verge of being shut down. This shows that survival

takes precedence over global issues. For this reason, convincing people that this is genuinely a solution for survival should be one of the key success criteria... (E-4)

All the respondents agree that when it is discovered that short-term solutions are not sufficient to fight carbon net zero, long-term solutions, which is proposed in ELM trust fund, are going to become more crucial. One participant emphasizes the importance of pilot trials of this new concept to see the real consequences:

> …In order to truly experience the concept, it needs to be tested in certain limited areas or pilot regions to see if any results can be obtained . . . To see whether it can be implemented, we first need to act. Without taking that initial step, I don't think deciding the applicability of the concept is very feasible… (E-1).

4.2.3 Perceived benefits of integrating the ELM to strategy

One of the main benefits of integrating ELM strategy within the firm is perceived as giving positive signals to the stakeholders. Participants agree that being considered as carbon responsible by the stakeholders in and out of the company is beneficial in many aspects. Participants believe that applying ELM concept within the strategy signals that the company knows what they are doing and can compensate the harm and risks they cause in the long term. For the stakeholders within the company, the benefits are perceived circular. Employee awareness can play a role, as they may demand more sustainable practices. For example, new talents interested in sustainability are likely to prefer working for companies with a meaningful purpose. This desire to work for companies with a truly meaningful mission can also encourage companies to invest in these areas. For stakeholders outside the company, one respondent explains the investor expectations:

> …Financial institutions are expected by external stakeholders or investors to manage the very things they finance that contribute to emissions. Managing these effectively means progressing towards net zero. Even if they don't achieve net zero, they are expected to move in that direction by external stakeholders. . . Therefore, being able to do this, and demonstrating that they can (achieve net-zero), is a crucial

benefit . . . There are many benefits, both for the bank's reputation and for attracting new investors. Economically, it also helps create new business opportunities… (E-5)

The benefits of integrating ELM are not only considered being related to an entity itself but also to other components of its supply chain. When the company has the power to disseminate ELM strategy to upstream and downstream supply chain components, overall goal of net-zero will likely to be achieved collectively. The benefit for the supply chain is explained by one respondent:

…Ultimately, we produce materials in different parts of the world and then transport them to various locations to provide solutions to the end customers. In a global climate crisis, if there are storms, fires, or rising sea levels, ships may become inoperable. This could lead to disruptions in the supply chain or a situation, where potential customers are displaced due to the climate crisis, or where solutions can no longer be implemented in certain areas. This might lead to a period, where a company cannot find customers for its solutions. Thus, the system is self-sustaining. We apply solutions to whom? To our customers. The customer must survive to still have the potential to acquire these solutions. Therefore, this will benefit the company's survival as well. I believe it should cover the entire supply chain . . . For example, Marks & Spencer, a well-known textile company, includes criteria in their supplier selection for their contractors or suppliers in Bursa that require better energy management and more environmentally friendly solutions. The reason is not that they favour the company or want it to be more profitable, but to ensure that their suppliers can manage risks effectively so they can continue to provide services. One of the benefits of this approach is that it supports not just the company alone but also the entire network of stakeholders, contributing to the continuity of business and life by ensuring everyone moves forward together… (E-4)

One participant touches another point and emphasizes one of the benefits of the concept as being based on certain metrics and calculations of carbon emissions. With the help of the accounting method and risk calculations suggested by the writers, emissions become trackable. Being trackable improves capabilities to measure and control emissions. Another participant agrees to this and adds that the most important current problem of companies is setting, tracking, and reporting accurate goals. If corporate companies can manage this correctly, the real benefit will come from the subsequent stage—the implementation phase.

On the other hand, ELM is perceived as being able to provide a framework if nothing else a roadmap by providing a long-term plan in an environment lacking certain borders:

> …Decarbonization and sustainability is not a short journey. It's not like traveling from Istanbul to Kocaeli; it's more akin to traveling from Istanbul to Berlin—a very long journey. Throughout this journey, you need to take actions every day. The work done under the ELM model involves long-term efforts that will stay with you and support you along the way... (E-2)

4.2.4 Perceived risks of integrating the ELM to strategy

The main risks are perceived as initial costs of implementing the strategy and the budgets for carbon removal technologies. All participants agree that even though there may be initial cost disadvantages with these kinds of strategies, once they become established and grounded, they offer the chance to achieve entirely different outcomes. Therefore, there will not be any losers in this process in the long term. However, there are some remarkable other risks. Rejecting to work with or finance customers or other stakeholders requiring non-renewable energy sources is one of them. One participant highlights this aspect from both relationships with customers and competitive advantage perspective:

> …Costs may not be immediately amortized; unfortunately, you need to bear this burden. Additionally, you need to move away from coal, for example, by deciding not to finance coal projects. This can create a temporary competitive disadvantage, especially since other institutions in Türkiye might still be financing coal. If your customer asks for financing and you have to say no because of your 2050 targets, you might face issues in your customer relationships. You are bearing that risk and disadvantage in the short term, but I believe that, in the long run, these goals will bring benefits... (E-5)

ELM suggests that the risks of reversing in the carbon capture capabilities of portfolio is calculated. However, these risks are attached to today's circumstances. Another risk of applying the strategy today is the uncertainty of the climate in the

upcoming years. If the divergence from initial carbon capture plan is extreme, the cost risks may not be mitigated even in the long term:

> …For example, carbon capture and afforestation are two separate projects, but there's a risk with afforestation. We're operating under the assumption that the climate will remain as it is today. However, will it really be the same 10 or 15 years from now? With rising temperatures, storms, floods, and extreme droughts during the summer, will this project turn out as we envision it, or will it be futile? Are we doing the wrong thing? Would it be more beneficial to take that investment and, instead, improve the processes in our own facilities, even if it's more costly?.. (E-2)

It is stated in all participants' interviews that collective action and consciousness is one of the building blocks of net zero goal. One respondent believes that the concept shall be supported with regulations and highlights the most crucial risk is inability to act together:

> …For example, Schneider Electric continues to invest in this area, but if this doesn't differentiate them in the market, if it doesn't bring any benefits within a reward or penalty system, or if competitors don't suffer from not doing the same, then, in the end, it just means extra costs for the company. This would reduce profitability and potentially cause the company to fall behind in competition. That's why I believe that without proper regulation or a collective, widespread adaptation to these issues, individual initiatives are unlikely to be sustainable or highly effective in the long run… (E-4)

In addition, they draw attention to the importance of preventing greenwashing activities by the utilization of the ELM strategy:

> …In the financial sector, banks report to CDP, but their main objective in doing so is not necessarily to be greener, but to meet the criteria for accessing more favourable financing. However, the low-cost loans they obtain from institutions like the World Bank, or the European Development Bank are not offered at a lower rate when they provide these funds to projects in the market. Instead, they use these thematic loans as a tool to maximize profits. This approach undermines the trust and confidence of those observing the situation from the outside. If not implemented correctly, I believe it could also harm overall awareness of the issue… (E-4)

4.2.5 Designing zero emission processes

Writers of ELM suggests that the framework would drive the companies to adjust their processes in the first place and switch to lower carbon emissions alternatives instead of emitting and buying carbon offsets later. One participant explains whether it is applicable to design low emission processes:

> …Today, these technologies exist and is feasible. Therefore, with today's technology, the answer to the question is yes. However, given the technology of the past and the expectations of humanity at that time, along with the absence of climate-related challenges, it was not very feasible then… In summary, designing systems that emit less, defining and codifying these through regulations, and starting from today by banning traditional or polluting systems will be a significant step towards the solution. It is very inefficient to continue damaging something while simultaneously trying to fix it—it's like trying to brake a vehicle without first taking your foot off the gas. If we first take our foot off the pedal and then apply the brake, we can be certain that we will stop more quickly… (E-4)

The participants agree that ELM would motivate firms to altering to lower carbon emitting processes when costs allow. It is believed that while carbon removal technologies' costs are high, companies would choose to use green energy sources to decrease the amount of emissions to be offset:

> …We offset Scope 1 and 2 emissions already, but we have not yet taken any action for Scope 3. Our carbon emissions are approximately around 19,000 tons. The annual carbon cost can reach 20 to 30 dollars as you can imagine. When you multiply it, as you can see, it results in a significant budget. Given the high budget, it naturally becomes noteworthy, and the idea develops as follows: instead of allocating such a large amount of money here—let's say, for financing a reforestation project—I would rather invest it in an internal energy efficiency project. We are exploring various methods to manage this. The first ideas that come to mind are energy efficiency initiatives and investment in a Solar Power Plant... (E-5)

However, two of the participants highlight the risks in some energy intensive sectors, where setting direct emissions to zero is impossible. In those cases, portfolio of carbon removal technologies is acknowledged as the only solution to net zero:

> …Sectors such as metal mining, petroleum and natural gas, and iron and steel are highly energy intensive. No matter how much effort you put into these areas, you can only reduce your carbon emissions to a certain extent. Therefore, it becomes necessary to cover this in some way… There are green energy companies, with wind farms installed across the country. Since they purchase energy from these sources,

their energy appears to be zero-carbon. Companies that do not have this option will have to purchase green energy at a much higher cost. Therefore, yes, if I can improve my process, I should proactively avoid emitting carbon into the atmosphere and not rely on reforestation projects—or consider tree planting as a hobby. However, there are also sectors where emissions can only be reduced to a certain point. In iron and steel, for instance, where iron is melted in a furnace, it is a highly energy-intensive process, making this approach impractical. There will be limitations, and it will need to be managed accordingly… (E-2)

4.2.6 ELM portfolio

The idea of creating a portfolio derived from different carbon removal technologies to offset, for example, 500 years of carbon, as suggested in the article, is not considered fully feasible because it spans such a long period and conflicts with the prevailing "let sleeping dogs lie" mindset. However, on the other hand, there is a high degree of confidence that a hybrid portfolio of removal technologies and energy sources would distribute the risks, provide customers and end-users with a gradual transition, and thereby make this concept more feasible over time:

…I believe that the solution lies in hybrid approaches…This will require engineering, mathematics, and robust calculations. However, there has not yet been a cumulative development of know-how on this subject globally. Perhaps there is a need for such know-how to emerge. While the biggest criticism of renewable energy has been its lack of continuity, engineers worldwide are now beginning to build expertise specifically in hybrid solutions. In smaller regions—New Zealand, if I recall correctly—they have realized that continuous energy production can be achieved by utilizing wind, solar, and water resources within the same area. We might see similar implementations through pilot projects here as well. I believe that sharing risks across a portfolio will be beneficial… (E-1)

One participant states the importance of gradual transition within the portfolio especially while providing consultancy to end-users:

…This is the approach we follow in all our consulting solutions. We create a ranking from the easiest to implement to the most difficult. Our ranking criteria can vary—it might be based on cost, or on projects that will prevent higher emissions . . . We categorize these as Scenario 1, 2, 3, and so on. In Scenario 1, we consider impact, carbon footprint, and lower costs. In Scenario 2, there's a more balanced approach, while in Scenario 3, projects with higher carbon footprints and higher costs come into play. Therefore, the client's priorities are crucial. But from a consultant's perspective, I believe that presenting the project sequentially and with

prioritization, rather than presenting the entire project all at once, will be much more beneficial in terms of feasibility and acceptance… (E-3)

4.2.7 Price discovery

Majority of the participants think about the price discovery of the carbon removal technologies that economies of scale rules would apply to today's expensive removal technologies:

> …This is entirely about 'economies of scale.'. . . A great example of this is solar energy. When solar technology first emerged in renewable energy, the investment cost of solar was much higher compared to fossil fuels—there was a significant gap . . . Currently, when you want to make an investment to generate energy from scratch, the most expensive energy source is fossil fuels. The investment cost for a facility to produce energy from natural gas or oil has become much higher than that of wind and solar. This is entirely due to 'economies of scale.' The Chinese entered this market, and with increased competition, they created economies of scale. The same applies here. When you achieve a benefit and make paybacks more advantageous, why not?.. (E-1)

In addition, it is noteworthy that the respondents state the perception of what is cheap and what is expensive is subjective in this topic. With subjective it is meant the perception of something being expensive or cheap is rooted in the benefits it provides. The answer lies in understanding on which risks will be mitigated, which taxes will be avoided, or how much incentive will be received if a company was to invest in the technology. Even if dollar per ton value doesn't decrease significantly, mitigating the costs caused by facing taxes and penalties makes the removal technology perceived cheaper.

4.2.8 Integrating ELM strategy and stakeholders

All participants state that early adaptation and integration ELM to the company gives positive signals to stakeholders. One participant considers stakeholder impact from two different perspectives:

> …Therefore, I will approach the topic from two perspectives: first, implementing this method within our own operations will undoubtedly positively impact our market image; and second, presenting it to our clients as a recommendation from a company they already work with—using a method familiar to them—will also create a positive impression… Beyond that, let me say this: When you stand in front of a client, especially with the consultant hat on, they expect you to be up-to-date with the latest technologies. They want to know if there's a new method related to this, if a new regulation has been published, or if you're well-versed in public sector matters…. Therefore, being aware of these things and being able to say, 'Look, there's a method like this,' enhances our brand value in the eyes of the client. It directly impacts our commercial activities. (E-3)

In addition to positive signals to external stakeholders, positive impact on internal stakeholders is also considered by the respondents. Providing a "meaningful purpose" to employees is a beneficial aspect of integrating ELM where losing the interest of the young new talents is a risk for the company. One participant states:

> …We're talking about a theme where employees work for a sustainable company, constantly monitor the sustainability index, and even have a portion of their annual bonuses tied to this issue. What does this achieve? It raises awareness and encourages everyone to focus on this matter, allocate resources, invest, and ensure it's implemented with the right governance model. For instance, in the quarterly presentations by top management, there's always a dedicated page for this topic. On that page, the company's chosen target criteria from the United Nations' sustainability goals are tracked through measurable KPIs (Key Performance Indicators). This helps to engage the employees… (E-4)

The financial resources, investors, are also a significant part of the stakeholder ecosystem. From the investor point of view, sustainability studies are rated in a positive way. So, it is believed that integrating ELM would take investors' attention. One participant explained that it had been observed there was a take-off in stock prices after the company started to invest in sustainability strategies:

> "…We see that the company's stock prices have increased rapidly since it started investing in sustainability, digitalization, and electrification… Why does an

investor invest in a company? An investor invests in a company because it manages its future risks. No investor invests in today; they invest in the future. So, the fact that the company's stock value is rising shows that the main driving force behind this is that the company is effectively identifying and acting on future risks..." (E-4)

One participant highlights that as banks serve as financial advisors to their clients, they also position themselves similarly when it comes to sustainability. Since they engage with customers while integrating sustainability strategies, adopting ELM is perceived as a great opportunity to develop a plan and mobilize customers who are the non-negligible components of the system to reach final goals. If the firm can convey ELM message to the customer, excite them, and motivate them to take action, they are not just sending a positive signal; but they are also taking significant steps closer to the real goal.

4.2.9 Perceptions on voluntary early actors of ELM

All participants unanimously concur that integrating the ELM strategy into the company’s framework ahead of any mandatory requirements offers a profound advantage. While the novelty of the approach and its inherent uncertainties present certain challenges, it is widely believed that early adoption will position the organization as a more resilient and forward-thinking entity, ensuring a well-established system is in place before the window of opportunity closes. High investment costs of ELM strategy caused by the need for carbon removal technologies, renewable energy, and low-emission process adjustments, may possibly cause disadvantage in a price-competitive market. However, it is certain that at a point in time, all the companies should comply with net-zero processes. When the time comes, the firms with already established systems become superior. One participant mentions about a well-known tissue brand in Türkiye to show the superiority of a company to be tied closely to its product (strategy in this case):

…In marketing, there’s a concept known as a generic brand, and Selpak serves as an excellent example of this. We often refer to tissues or napkins simply as 'Selpak,' which speaks to the brand's dominance. As long as Selpak avoids significant damage to its image, it enjoys a substantial competitive edge. The same principle applies here. When companies implement a practice related to this area and it later becomes regulated, those companies will hold a competitive advantage. They’ll become key influencers of the regulation from the outset. Companies that have already adopted this practice can approach regulators or policymakers and advocate, 'Look, this has these benefits, and other companies should do the same,' effectively engaging in lobbying. Unfortunately, lobbying sometimes carries negative connotations in our context, but in this case, it is far from undesirable. By lobbying, these companies start the game, so to speak, with a 3-0 lead and have the opportunity to influence lawmakers—this represents a significant advantage.... (E-1)

4.3 Results of BWM

The optimal weights of main and sub-criteria to be considered while integrating ELM strategy are calculated in this study by using BWM. After implementing BWM as discussed in “methodology” section, criteria are ranked following their optimal weights in such a fashion that the most weighted enabler is ranked first, and the other enablers are ranked in descending order according to their declining weights. Moreover, sub-criteria are also ranked in the same manner.

Main criteria to be considered while making the decision are categorized into six groups as given in Table 3: Economic Cost (C1), Cost and Risk Reduction (C2), Internal Organizational Benefits (C3), Competitive Advantage (C4), Reputation and Legitimacy (C5), Synergistic Value Creation (C6). The best and the worst criteria are identified by taking the responses of five managers participated in this study and results are given in Table 5.

Table 5. "Best" and "Worst" Main Criteria Identified Based on the Responses of the Participants.

Main Criteria	Identified as “best” by expert No.	Identified as “worst” by expert No.
Economic Cost	2	
Cost and Risk Reduction	3, 4, 5	
Internal Organizational Benefits		1, 2, 3, 4
Competitive Advantage	1	
Reputation and Legitimacy		5
Synergistic Value Creation		

The calculated weights of each criteria and sub-criteria based on the responses are given in APPENDIX C. The criteria are first evaluated among themselves without sub-criteria to determine their weights. During the evaluation process, each respondent’s assessments are first analysed individually. Then, the average of the assessment results from the five managers is taken to reach the final criteria weights. Throughout the study, aggregation by geometric mean and aggregation by experience are preferred while calculating the final values of the criteria. The reason for choosing the geometric mean is to eliminate the problem of sensitivity to outliers that is associated with the arithmetic mean. After finding the geometric means, a normalization process is applied to reach the total value of 1 with the weights of the criteria. The reason for choosing aggregation by experience is to check the influence of years of experience on the results. The weights of the main criteria derived by geometric mean is given in Table 6. The weights of the main criteria derived by experience is given in Table 7.

Table 6. Weights of the Criteria Calculated Based on Aggregation by Geometric Mean

Criteria and Sub-criteria	E-1	E-2	E-3	E-4	E-5	Aggregated Weights	Normalized Agg. Weights
C1	0.12979	0.38479	0.20475	0.12	0.14618	0.17814	0.19651
C2	0.12979	0.22819	0.32493	0.4	0.38538	0.27180	0.29984
C3	0.03708	0.04474	0.02671	0.04	0.14618	0.04816	0.05313
C4	0.42645	0.15213	0.1365	0.24	0.06645	0.16982	0.18734
C5	0.17305	0.11409	0.20475	0.12	0.10963	0.13969	0.15410
C6	0.10383	0.07606	0.10237	0.08	0.14618	0.09888	0.10908

Table 7. Weights of the Criteria Calculated Based on Aggregation by Experience

Criteria	E-1	E-2	E-3	E-4	E-5	Aggregation by Experience
C1	0.12979	0.38479	0.20475	0.12	0.14618	0.19078
C2	0.12979	0.22819	0.32493	0.4	0.38538	0.27963
C3	0.03708	0.04474	0.02671	0.04	0.14618	0.04959
C4	0.42645	0.15213	0.1365	0.24	0.06645	0.23622
C5	0.17305	0.11409	0.20475	0.12	0.10963	0.14683
C6	0.10383	0.07606	0.10237	0.08	0.14618	0.09694

In the second part of the analysis, the sub-criteria are evaluated among their main criteria to determine their local weights. Then, the aggregation according to geometric mean and experience of the assessment results from the five managers is taken to reach the final local criteria weights. In addition, global weights of each sub-criteria are derived. Global weights are calculated by multiplying the main criteria local weight with the local weight of each sub-criterion. The results are given in APPENDIX D.

When geometric mean is used to aggregate the weights, it can be noticed from Table C1 that among the six main criteria "Cost and Risk Reduction (C2)" is the most significant one with a weight of (0.29984), trailed by "Economic Cost (C1)" (weight 0.19651) and "Competitive Advantage (C4)" (weight 0.18734). The finding suggests that concept makers of ELM shall emphasize more on the "cost and risk reduction" aspects and "competitive advantages" that it will bring to companies in the market to expand the concept in Türkiye. "Internal Organizational Benefits (C3)" criterion has the least importance for making the decision to integrate ELM strategy for the respondents under consideration. Within the category "Cost and Risk Reduction" the sub-criterion "Firm Efficiency (SC21)" is the most compelling criterion, and it is followed by "Ability to attract capital and cost of financing (SC22)". According to the global weights, "Cost of implementing the strategy (SC11)", "Firm Efficiency (SC21) and "Ability to attract capital and cost of financing (SC22)" are the highest ranked ones with weights of 0.11249, 0.10900 and 0,09591, respectively, where "Allocation of resources (SC33)" and "Continuous improvement and coordination in the organization (SC32)" are the latest on the ranking with 0.01616 and 0.01754. The consistency ratio values have been found acceptable in all cases, showing the level of reliability of the findings.

When experience is used for aggregating weights, the most important criteria is “Cost and Risk Reduction (C2)” (weight 0,27963) reiterating the results calculated by geometric means. On the other hand, the second most important criterion becomes Competitive Advantage (C4)” (weight 0,23622) for this aggregation, which is followed by “Economic Cost (C1)” (weight 0,19078). The least important criterion is once again “Internal Organizational Benefits (C3)” (weight 0,04959) for making the decision to integrate ELM strategy providing the same results as geometric mean. Although there is a slight discrepancy, the sub-criterion “Differentiation from other competitors (SC43)” (0,09691) surpasses “Cost of implementing the strategy (SC11)” (0,09515) diverging from the results of geometric mean.

However, “Firm Efficiency (SC21) and “Ability to attract capital and cost of financing (SC22)” are still on the top of the criteria following the first two. In this case, the least important sub-criteria have been calculated as “Relations with financial institutions (SC63)”, “Relations with regulators and public administrations (SC64)” and “Continuous improvement and coordination in the organization (SC32)”.

CHAPTER 5:

DISCUSSION AND CONCLUSION

5.1 Discussion

Considering that ELM is still a new concept, and its implementation is voluntary, it is crucial to recognize the criteria that decision-makers prioritize to transition it from being a mere research topic to a practical application. Through delivering the right message by taking these criteria into account and creating success stories that align with them, a meaningful sense of feasibility of the concept can be achieved.

The first part of BWM analysis calculated by the geometric mean shows that "Cost and risk reduction" is the most highly considered criteria while adapting the ELM strategy according to the decision makers of firms known for sustainability actions in Türkiye. "Economic cost" and "Competitive advantage" follows this criterion; however, there is a significant gap between the weights as being 0.29, 0.19 and 0.18 respectively. The highest ranked sub-criteria of each main criterion are "firm efficiency", "cost of implementing the strategy", and "differentiation from other competitors".

The second part of BWM analysis calculated by experience addresses "Competitive advantage" as the top criterion. "Cost and risk reduction" ranks as the second most important criterion in the decision-making process. It is worthwhile to note that respondents consider "Competitive advantage" as a broader criterion that encompasses other criteria related to cost and efficiency during the in-depth interviews.

Reduction in costs and accessibility to capital are believed to be foundation of having an advantage against competitors. Thus, the results from both aggregation

techniques are in line with each other. Putting aside the fact that ELM is considered an innovative strategy with a high likelihood of success if tried in the eyes of the decision makers, its positive impact on company profitability must be demonstrated. It is not surprising that the cost of implementing the strategy, which is directly proportional to profitability, is the top sub-criterion.

As mentioned in the open-ended questions section, differentiation from competitors is also one of the most significant sources of motivation. The benefit of differentiation from competitors through voluntary adaptation is a point that should be emphasized to promote the spread of the concept. It is observed that "internal organizational benefits" and "synergistic value creation" are the least significant aspects to be considered in the current situation of Türkiye.

The results appear to be opposite of Rodríguez-Gutiérrez et al. (2021)'s study, where the most important was found to be "Reputation and Legitimacy (C5)" and least importance was given to "Economic Cost (C1)". Although the research topic is not the same since this study explores ELM and other study explores Sustainability Reporting, nevertheless, both are related to strategical decision-making in sustainability subject and expected to indicate convenient weights. The divergence in the findings may be interpreted in several ways. Firstly, reputation and legitimacy expectations engender a profitable position to the company. It would not be an irrelevant approach to portray the benefits of reputation and legitimacy as attracting stakeholders and finances in turn. Under this consideration, both research results may be accepted as putting emphasis on the efficiency of the company. Secondly, the samples of the studies are distinguished from each other. This research is conducted amongst the managers in two large enterprises from two different industries, whereas

the other study focused on SMEs (Small and Medium Enterprises). In a sector or segment specific research, the outcomes could be more approximate.

In addition to the evaluation of criteria for BWM method, the participants are asked in the open-ended question session, if they wanted to add other criteria to be considered in their decision-making processes which is absent on the list. While finding the 6 criteria and 21 sub-criteria overarching, two respondents emphasize the consideration of the ability of the strategy to adopt to innovation. In a fast-paced environment, it is most probably that new technologies for removals, energy sources or process optimization by means of emissions will be on table. If a firm were to adapt ELM, decision makers would like to see the competency to keep up with the most up-to-date technologies. Another participant suggests to add "attracting new talents as a great place work" as a sub-criterion.

After ranking and determining the most crucial criteria to spread ELM as a corporate strategy, the perceptions are investigated deeply. Managers think the outline shaped by ELM is a convenient step to achieving net-zero goals if the collaborative consciousness is obtained. By "internalizing the externality" aspect of ELM, the entities who caused most of the emissions today will be kept more responsible in this collaborative action. Applicability of the concept on a broader scale is tied to being complied with a few requirements: legal obligations, profitability of the company, penalties to be faced when being non-compliant, the green image in the eyes of the stakeholders and placing the mindset of how crucial emissions are.

The afore mentioned circumstances reinforce the results from BWM method stating cost and risk reduction is the top rank measure. Respondents state that one of the key advantages of implementing the ELM strategy in a company is that it sends

positive signals to stakeholders. If a company gives the impression of knowing what they are doing and can compensate the harm and risks they cause in the long term, it could attract both external stakeholders and employees.

It is believed ELM concept could be spread by one entity to its other supply chains components. This aligns with the concept of E-liability accounting. After all, carbon emissions are transferred from supplier to customer throughout the supply chain. In this system, the influence of a company implementing ELM on others is undeniable and moves us collectively closer to net zero.

The main risks perceived are the initial costs for implementing the strategy and allocating the budgets for carbon removal technologies as they are costly. Another highlighted risk is the resistance to work with non-committed stakeholders to adjust the processes in an environment that is price-focused and not bound by strict lines and rules on carbon emissions and net zero. Potentially, it could cause a disadvantage in competition. As the writers of the ELM suggested (Roston et al. 2023), it is believed that ELM would drive firms to redesign their processes with lower carbon emission alternatives when possible. When it is not possible i.e. in metal and mining sectors, it is approved that a portfolio of removal technologies is much needed.

As the permanent carbon removal technologies, which are expensive today, become wide-spread, participants contribute to the suggestion of ELM authors and state that economies of scale would apply, and the prices of the technologies would drop both materially and nonmaterially. What is meant with nonmaterially here is, as the risks of not applying removal technologies are well defined and understood in time, the sense of expense would change. Participants agree that early adoption of the ELM strategy, despite its high costs and uncertainties, offers a strong advantage by

positioning companies as resilient and prepared for future net-zero requirements. They are aware that, sooner or later, this issue will be subject to regulations, and everyone will be required to achieve carbon neutrality in some way. When compliance becomes mandatory, firms with established systems will gain a competitive edge.

5.2 Conclusion

California has become the first US State taking legislative action and mandating all companies, whether they are public or private, whose revenues exceed $1 billion, to disclose climate emissions and climate-related financial risks with Climate Corporate Data Accountability Act. The act is going into force in 2026. Under this obligation, companies shall perfectly report direct and indirect Scope 3 emissions, which would put a higher burden on the companies occupied in indirect emission activities because of their customers (Engler, 2023). Moreover, this California Climate Accountability requires all the companies to report Scope 3 emissions in contrast to the Securities and Exchange Commission (SEC)'s which proses a rule that implies to only firms who has determined that its Scope 3 emissions are material and set Scope 3 reduction targets (Cooley, 2023). This is an example, but it is high probable that other countries are going to develop rules likewise. Since the situation is becoming more legislative, it is gaining prominence to correctly account for carbon emissions within the supply and value chains.

E-liability offers a solution to faults in Scope 3 emissions with its accounting rules for "cradle-to-gate" emissions familiar to cost accounting and provides a reliable method to count for emissions as discussed within this thesis. Managing E-liabilities are expected to propel companies to change their processes and product

designs to decrease the liabilities transferred downstream. In a very recent study, Zhang investigated the case for ELM in the Automotive Industry. Zhang (2024) highlighted the practicalities of E-liability as it allows the company to put efforts in making changes within a group of rather suppliers by focusing on tier-1 ones in an industry with crowded supply chains. Secondly, by including suppliers in their reports, increasing supplier engagement in reduction activities, and lastly increasing the traceability and transparency of emissions within the supply chain drifting apart from the industry averages and estimations to accurately reported amounts.

ELM requires companies to reverse their emissions immediately in the same period as they occur. Thus, carbon offset assets and technologies in developing them gains importance. Meta, the parent company of several social media platforms such as Facebook, Instagram and WhatsApp, has partnered with Catona Climate, a climate finance company who trades nature-based carbon removal projects to partners, to offset 6.75 million tons of carbon emissions in advance for years 2027 to 2035. The deal includes a portfolio of native reforestation, agroforestry, and the implementation of sustainable agricultural practices projects (Lee, 2023). As actions towards purchasing removal assets accelerate, the number of companies developing and monitoring removal asset projects will escalate.

ELM guides the followers on allocating capital to removal assets that match the duration of their accounted emissions, which may include a series of transactions repeatedly or creating a vast portfolio of different type of both nature based and technology based removal technologies. Roston et al. (2023) expected that even abiotic processes such as direct-capture-to-rock was way more expensive than forestation, given the deviation risks in forestation and accurate permanency of abiotic processes, the prices of abiotic processes would decrease distinctively over a

course of time. Moreover, from the investor point of view, under ELM the firms that are unable to manage their emissions with correct removal assets would need more capital to cover emissions today and in the future, which in turn makes their cost of capital higher and makes them perceived as leveraged firms and riskier investments.

It is crucial to understand if the perceptions of decision makers response the anticipated contributions of ELM to sustainable finance and achieving net zero claims. Pros and cons of integrating ELM factors in the corporate strategy, as well as willingness to consider laying the foundation for this novel approach in the eyes of decision makers and other stakeholders, is investigated through this research. BWM approach and in-depth interview questions are used to reach the aim of the research.

It is concluded in this study that early adoption would be considered a competitive advantage by signaling confident sustainability performance to the stakeholders. To add more, early adapters could be the pioneers in the development process of different dimensions to the framework. Certainly, ELM is under ongoing improvement processes nowadays.

Providing insights for the literature is another worthwhile outcome of this study. The feasibility of integrating ELM in corporate strategies to achieve a consolidated framework on 'netting emissions' first by halting and then reversing, is a significant step forward. Once perceived as an applicable unified framework, markets would look out for permanent removal resources, develop, and popularize efficient solutions. In addition, entities would be encouraged to adjust their processes to decrease immediate emissions rather than funding costly removal assets later. Having all these together, international obligations with clear borders can be set to reach "net zero" with confidence.

5.3 Academic and practical contributions

This study has both academic and practical implications. The research emphasizes ELM integration in firms and notions on using ELM framework suggested carbon removal asset technologies on the road to carbon reduction strategies. In the literature, there are limited studies about ELM, though the increasing need for remarkable emission reductions and sustainable finance. Academic contributions are providing a deeper understanding of the qualitative aspects of ELM integration in corporate firms and contributing to the literature on sustainability. Moreover, practical contributions are offering actionable insights for corporate policymakers, and other stakeholders on the qualitative benefits and challenges of ELM integration. These conclusions provide significant indications for the entities engaging in emissions liability practices, regulators and researchers studying this topic. With respect to the first, the criteria and method proposed in this study helps decision makers while considering incorporating ELM strategy. Actionable insights are provided, perceived risks and benefits are examined. The outcomes may encourage entities and stakeholders within their supply chain, to put into practice the factors of ELM even in pilot cases. Corporate executives participated in the study state that it is beneficial to be given the opportunity to review this novel approach and are ready to explore further the factors which can be adapted. With respect to the policy makers of regulations, there are several implications that the concept needs to be provided by regulations. Since ELM is perceived operable, policymakers of carbon emissions and offset management lacking a unified outline strategy shall consider ELM in shaping the future. With respect to academic researchers, criteria to be evaluated are in evidence. While ELM is still an ongoing development and experimentation process, they need the perceptions of policymakers and leading firms. The participation of the

corporate world and companies in this matter, where we haven't made much progress under state control and regulations so far, is valuable because they can make decisions more swiftly and move forward faster. However, to achieve this, they need the right motivation. The researchers shall put emphasis on the cost reductions, how the concept mitigate current and future risks and differentiate entity from its competitors. Success stories of proven practice and pilot studies shall be provided and attached to the concept future articles.

5.4 Limitations and further research

There are certain limitations of the study. First, the sample used. The number of respondents is limited to five who have been working in two different companies in Türkiye. This limitation is due to time and budget constraints and reduces the ability to generalize the findings. However, this research provides significant feedback on a newly proposed framework from corporate decision makers from two of the sustainability pioneer companies in the industry of software and services for energy management and banking in Türkiye. Future studies may be replicated including more participants from different sectors. In addition, various regions may be studied. Second, the study examines corporate decision makers' and industry experts' perceptions of the concept. In further studies, investors and end-users, who are the customers of the companies in this research, may also be interviewed to further develop the theory, address possible challenges in real life and understand the tendencies from different stakeholders. Third, this study opens up avenues for future studies to use multiple criteria decision-making methods other than BWM to calculate the weights of the criteria. Lastly, this research does not focus on a specific sector, the data is collected from "software and services for energy management" and

“banking” sectors. There is a great opportunity for future research to explore more on industry-based evidence individually. To conclude, with future research while considering the outcomes of this study could contribute worthwhile data to carbon accounting research and applications in the context of corporate management in this regard.

APPENDIX A

ETHICS COMMITTEE APPROVAL

T.C.
BOĞAZİÇİ ÜNİVERSİTESİ REKTÖRLÜĞÜ
Sosyal ve Beşeri Bilimler İnsan Araştırmaları Etik Kurulu (Sbinarek)

Sayı : E-84391427-050.04-205798 05.11.2024
Konu : 2024-63T Kayıt Numaralı Başvurunuz Hakkında

Sayın Doç. Dr. Ali ÇOŞKUN

Tez danışmanlığını yürüttüğünüz öğrenciniz Efser Çopur'un "Kurumsal Karbon Raporlamasında Emisyon Yükümlülük Yönetimi Çerçevesine Bakış Açısının İncelenmesi" başlıklı projesi ile Boğaziçi Üniversitesi Sosyal ve Beşeri Bilimler İnsan Araştırmaları Etik Kurulu (SBİNAREK)'e yaptığınız 2024-63T kayıt numaralı başvuru 30.10.2024 tarih ve 2024/08 sayılı kurul toplantısında incelenmiş ve projeye etik onay verilmesi uygun bulunmuştur.

Bu karar tüm üyelerin toplantıya on-line olarak katılımıyla ve oybirliği ile alınmıştır. Onay mektubu tüm üyeler adına Komisyon Başkanı tarafından e-imzalanmıştır. Bilgilerinizi rica ederiz.

Saygılarımızla,

Dr. Öğr. Üyesi Işıl ERDUYAN
Kurul Başkanı

Bu belge, güvenli elektronik imza ile imzalanmıştır.
Belge Doğrulama Kodu : 0BTG-E90B-0A85 Belge Doğrulama Adresi : https://www.turkiye.gov.tr/bogazici-universitesi-ebys

Adres: Boğaziçi Üniversitesi 34342 Bebek/ İstanbul
Telefon No: Faks No:
e-Posta: İnternet Adresi: www.bogazici.edu.tr
Kep Adresi: bogaziciuniversitesi@hs01.kep.tr

Bilgi İçin: Nurşen MUNAR
Mühendis
Telefon No: 0 212 359-6749

APPENDIX B

THE INTERVIEW GUIDE IN ENGLISH

1. Could you tell us a little about yourself?

2. How many years have you been working in this company?

3. Can you give information about your previous work experience and current job position? What responsibilities do you have in the company?

4. Have you heard of the Emissions Liability Management concept before today?

5. In light of the information provided today, what is your perspective on the Emissions Liability Management concept?

6. What do you think about the applicability of the Emissions Liability Management concept within the scope of corporate carbon responsibility?

7. What would you consider to be the overall benefits of implementing this concept?

8. What would you consider to be the general risks of implementing this concept?

9. To what extent do you think ELM should be considered as a means of net zero carbon emissions from industrial activities?

10. Do you think that ELM implementation will lead institutions to reduce their carbon emissions from the beginning?

11. What do you think about creating a portfolio of carbon removal technologies according to ELM and its sustainability in terms of company strategy?

12. Do you think the implementation of ELM will have an impact on carbon removal technologies?

13. How do you think integrating ELM into company strategy will be received by internal and external stakeholders? What signal does it send to stakeholders?

14. Considering the possibility of countries and commissions creating forward-looking obligations on this issue, what do you think about early and voluntary adoption of such a concept? Is it an advantage or a disadvantage?

15. Are there any criteria (other than those asked for the BWM Method) that you would consider when deciding to switch to such a concept? If so, what are they?

16. Do you have any other comments, opinions or suggestions regarding the subject of the interview?

17. What would you like to say in the conclusion and evaluation section?

APPENDIX C

WEIGHTS OF THE CRITERIA ACCORDING TO IN-DEPTH INTERVIEWS WITH THE RESPONDENTS

Criteria and Sub-criteria	E-1	E-2	E-3	E-4	E-5
C1	0.12979	0.38479	0.20475	0.12	0.14618
SC11	0.53846	0.77885	0.46667	0.20238	0.65
SC12	0.15385	0.07692	0.46667	0.07143	0.125
SC13	0.30769	0.14423	0.06667	0.72619	0.225
C2	0.12979	0.22819	0.32493	0.4	0.38538
SC21	0.23279	0.41935	0.22581	0.47514	0.25385
SC22	0.57692	0.22581	0.22581	0.28177	0.16923
SC23	0.13968	0.22581	0.12903	0.18785	0.09231
SC24	0.05061	0.12903	0.41935	0.05525	0.48462
C3	0.03708	0.04474	0.02671	0.04	0.14618
SC31	0.0625	0.2857	0.5417	0.2917	0.65
SC32	0.2625	0.5714	0.2917	0.1667	0.225
SC33	0.6750	0.1429	0.1667	0.5417	0.125
C4	0.42645	0.15213	0.13650	0.24	0.06645
SC41	0.22678	0.07317	0.25862	0.07843	0.18367
SC42	0.13607	0.12195	0.17241	0.50980	0.18367
SC43	0.58315	0.65854	0.46552	0.13725	0.10204
SC44	0.05400	0.14634	0.10345	0.27451	0.53061

C5	0.17305	0.11409	0.20475	0.12	0.10963
SC51	0.2625	0.5417	0.1667	0.1571	0.1667
SC52	0.6750	0.1667	0.5417	0.1	0.2917
SC53	0.0625	0.2917	0.2917	0.7429	0.5417
C6	0.10383	0.07606	0.10237	0.08	0.14618
SC61	0.50781	0.04184	0.16923	0.22222	0.10204
SC62	0.29688	0.47699	0.48462	0.59259	0.53061
SC63	0.04688	0.19247	0.25385	0.11111	0.18367
SC64	0.14844	0.28870	0.09231	0.07407	0.18367

APPENDIX D

LOCAL AND GLOBAL WEIGHTS OF SUB-CRITERIA BY TWO METHODS

Table D1. Local and Global Weights of Sub-Criteria by Geometric Mean

Criteria and Sub-criteria	Local Weights	Normalized Local Weights	Global Weights	Normalized Global Weights
C1	0.17814			
SC11	0.48099	0.57550	0.08568	0.11249
SC12	0.13759	0.16462	0.02451	0.03218
SC13	0.21720	0.25988	0.03869	0.05080
C2	0.27180			
SC21	0.30545	0.35069	0.08302	0.10900
SC22	0.26878	0.30859	0.07306	0.09591
SC23	0.14782	0.16971	0.04018	0.05275
SC24	0.14895	0.17101	0.04049	0.05315
C3	0.04816			
SC31	0.28358	0.34735	0.01366	0.01793
SC32	0.27735	0.33971	0.01336	0.01754
SC33	0.25550	0.31295	0.01230	0.01616
C4	0.16982			
SC41	0.14395	0.17930	0.02445	0.03210
SC42	0.19301	0.24040	0.03278	0.04303
SC43	0.30180	0.37589	0.05125	0.06729
SC44	0.16412	0.20441	0.02787	0.03659

C5	0.13969			
SC51	0.22834	0.28449	0.03190	0.04188
SC52	0.28183	0.35113	0.03937	0.05169
SC53	0.29247	0.36439	0.04085	0.05364
C6	0.09888			
SC61	0.15215	0.17045	0.01504	0.01975
SC62	0.46431	0.52017	0.04591	0.06028
SC63	0.13613	0.15251	0.01346	0.01767
SC64	0.14002	0.15687	0.01385	0.01818

Table D2. Local and Global Weights of Sub-Criteria by Experience

Criteria and Sub-criteria	Local Weights	Global Weights	Normalized Global Weights
C1	0.19078		
SC11	0.49875	0.09515	0.09515
SC12	0.16968	0.03237	0.03237
SC13	0.33157	0.06326	0.06326
C2	0.27963		
SC21	0.33100	0.09256	0.09256
SC22	0.32848	0.09185	0.09185
SC23	0.16120	0.04508	0.04507
SC24	0.17933	0.05015	0.05015
C3	0.04959		

SC31	0.31217	0.01548	0.01548
SC32	0.29794	0.01478	0.01478
SC33	0.38993	0.01934	0.01934
C4	0.23622		
SC41	0.16061	0.03794	0.03794
SC42	0.23993	0.05668	0.05668
SC43	0.41027	0.09691	0.09691
SC44	0.18918	0.04469	0.04469
C5	0.14683		
SC51	0.26154	0.03840	0.03840
SC52	0.36629	0.05378	0.05378
SC53	0.37222	0.05465	0.05465
C6	0.09694		
SC61	0.24232	0.02349	0.02349
SC62	0.46504	0.04508	0.04508
SC63	0.14226	0.01379	0.01379
SC64	0.15038	0.01458	0.01458

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