IIIEE Theses 2026:11

Environmental Management under Uncertainty

How the Swedish Manufacturing Industry Navigates a Changing World

Viktor Karlsson

Supervisor

Samson Mukanjari

Thesis for the fulfilment of the
Master of Science in Environmental Management and Policy
Lund, Sweden, May 2026

LUND UNIVERSITY

iiiee
THE INTERNATIONAL INSTITUTE FOR INDUSTRIAL ENVIRONMENTAL ECONOMICS

© You may use the contents of the IIIEE publications for informational purposes only. You may not copy, lend, hire, transmit or redistribute these materials for commercial purposes or for compensation of any kind without written permission from IIIEE. When using IIIEE material you must include the following copyright notice: 'Copyright © Viktor Karlsson, IIIEE, Lund University. All rights reserved' in any copy that you make in a clearly visible position. You may not modify the materials without the permission of the author.

Published in 2026 by IIIEE, Lund University, P.O. Box 196, S-221 00 LUND, Sweden,
Tel: +46 – 46 222 02 00, Fax: +46 – 46 222 02 10, e-mail: iiiee@iiiee.lu.se.

ISSN 1401-9191

Acknowledgements

First thing first. Thank you, Samson Mukanjari, for embracing a messy and conceptual idea and supporting its transformation into something substantial. The deep engagement with the topic, thoughtful guidance, and accurate feedback challenged me to refine both thinking and writing throughout the writing process. Without this support and encouragement, this thesis would not have turned out the way it did.

I would also like to thank Gustav Osberg for facilitating helpful peer-review sessions and providing valuable methodological feedback during the early stages of the writing process. These insights and the constructive input contributed meaningfully to the development of the thesis.

Furthermore, I want to thank Mats Tedenvall for sharing my interest in the topic and believing in its potential, motivating me to continue developing the idea. I also greatly appreciated the practitioner insights of how Swedish firms approach environmental management in a new global order.

Thirteen anonymous sustainability professionals at offices all over Sweden also deserves special thanks. This study would not have been possible to conduct without their willingness to dedicate valuable time to contribute with insights into their daily work, as well as generously sharing their expertise, perceptions, and opinions.

Most of all, I would like to thank my wonderful peer students and friends from Insti's thirty-first batch. Thank you for providing relevant feedback all the way from the interdisciplinary research design course, during the peer review sessions, and all the way to the final hand-in. Thank you for being by my side and for being awesome human beings and friends.

Abstract

Firms operate in an increasingly uncertain world characterized by armed conflict, unstable trade regimes, and shifting environmental regulations. The Swedish manufacturing industry is exposed to these uncertainties through its reliance on export markets, global supply chains, energy-intensive production, and EU sustainability reporting regulation. This thesis explores how perceived uncertainty among sustainability professionals in the Swedish manufacturing industry influences firm's environmental management performance. The study applied a qualitative case study design based on semi-structured interviews and document analysis. The findings demonstrate that sustainability professionals perceive geopolitical, economic, and environmental policy uncertainty, and that perceived uncertainty influence environmental management performance. In particular, uncertainty caused by the dismantling of sustainability reporting standards appear to negatively affect environmental disclosure, investments, and hiring. This suggests that not only policy dismantling itself, but also signals of potential regulatory relaxation, may reduce compliance-related environmental expenditures and hiring more immediately than perceived uncertainty related to tariffs and energy prices. The findings are relevant for firms with perceived uncertainty about sustainability reporting requirements, as they could achieve environmental management leadership and shape industry standards by maintaining environmental management capacity. The findings are also relevant for policymakers in the EU institutions who could acknowledge the risk for reduced environmental investments when policy dismantling is proposed. This thesis proposes further research into whether uncertainty caused by dismantling of standards for sustainability reporting affects environmental management performance in a different way than uncertainty caused by the introduction of stricter reporting standards.

Keywords: environmental management, uncertainty, stakeholder, real option, Omnibus

Executive Summary

Problem definition

Sustainability professionals with decision-making authority over environmental management strategies operate in an increasingly uncertain world. Along with a growing risk for being exposed to extreme weather events caused by global warming, firms are also affected by shifting regulatory, economic, and geopolitical landscapes. A source of uncertainty with particular importance for sustainability professionals is the EU Omnibus I package that dismantles recently implemented standards for sustainability reporting. While researchers have examined how geopolitical, economic, and environmental policy uncertainty affect firm-level investments and employment, there is limited empirical knowledge about how perceived uncertainty influence environmental management performance within firms.

The Swedish manufacturing industry constitutes a relevant case for a study of environmental management activities under perceived uncertainty. A major reason for this is that Swedish manufacturing firms are strongly embedded in global value chains with energy imports and exports of produced goods, while being subject to EU requirements for sustainability reporting. Large Swedish manufacturing firms are therefore faced by uncertainty stemming from energy market disruptions caused by geopolitical instability, new trade regimes, and shifting EU regulations.

Aim and Research Questions

This thesis aims to explore how geopolitical, economic, and environmental policy uncertainty influence the environmental management performance of Swedish manufacturing firms.

To achieve this aim, the following Research Questions (RQs) are applied:

> **RQ1.** Do sustainability professionals at Swedish manufacturing firms perceive the external environment as uncertain in geopolitical, economic, and environmental policy terms?
>
> **RQ2.** How are the environmental policy, objectives, processes, organisation, monitoring, disclosure, and expenditures at Swedish manufacturing firms influenced by geopolitical, economic, and environmental policy uncertainty?
>
> **RQ3.** How do Swedish manufacturing firms adapt their environmental management strategies in response to geopolitical, economic, and environmental policy uncertainty?

Methodology

This thesis was built on a qualitative research design based on an explorative case study of the Swedish manufacturing industry. The study focused on how different forms of perceived uncertainty influenced the environmental management performance of Swedish manufacturing firms in 2025. Swedish publicly listed firms in the manufacturing industry with 250-1000 employees or €50-€450 turnover was the targeted scope. The research design evolved iteratively through synthesis of a conceptual framework and emerging insights from collected data. Data was collected through semi-structured interviews with sustainability professionals and document analysis of sustainability reports and environmental policies. The collected data was triangulated and analysed by thematical coding based on an abductive approach.

Main findings

This paper finds that sustainability professionals in the Swedish manufacturing industry perceive the external environment as uncertain in geopolitical, economic, and environmental policy terms. The perceived uncertainty was mainly related to armed conflicts, trade regimes, and shifts of EU-level environmental regulations. While few firms adjusted their environmental action plans, policies, or key performance indicators in times of perceived uncertainty, multiple firms increased their environmental targets and many firms reduced environmental reporting, spending, and hiring. Several sustainability professionals indicated that the changed reporting standards, downsized environmental budgets, and reduced number of sustainability employees were related to dismantling of the legal requirements for sustainability reporting.

The findings suggest that geopolitical and economic uncertainty constitutes potential future influencers of environmental management, mostly by affecting expected energy prices and tariff rates. Environmental policy uncertainty driven by a proposed dismantling of EU-level sustainability reporting standards have influenced environmental management performance in the Swedish manufacturing industry during 2025. This suggests that the immediate perceived uncertainty of whether compliance-related environmental investments would be required influenced environmental management performance more than uncertainty related to tariffs and energy prices.

By studying seven dimensions of environmental management performance separately, this paper finds potential alignment of two diverging theories. The postponing of long-term environmental investments under perceived uncertainty is in line with real options theory. The adoption of more ambitious environmental targets under perceived uncertainty could be explained by intensified stakeholder pressure for environmental commitments.

Many firms applied a wait and see approach to the dismantling of the legally binding sustainability reporting standards, but some cut major parts of their environmental management activities, and others developed voluntary reporting standards and emission calculations. These findings indicate that many firms reacted to the shifting policy landscape by adapting or reserving the right to play. Some firms took more active roles in shaping the future of the industry by implementing voluntary measures based on stakeholder preferences.

Conclusions and Recommendations

The thesis explored the previously undiscovered relationships between perceived uncertainty and environmental management performance through a qualitative case study of the Swedish manufacturing industry in 2025. For Swedish manufacturing firms faced with uncertainty about legal sustainability reporting requirements, it is relevant that competitors can be expected to apply less strict reporting standards and postpone investments and hiring. This constitutes opportunities for firms to achieve environmental leadership by maintaining environmental management capacity and shaping industry standards. The main policy implication is that dismantling of sustainability reporting requirements with the purpose of improving competitiveness risks causing less environmental investments. EU-level policymakers are therefore recommended to consider such risks when policy dismantling is proposed or analysed.

Table of Contents

ACKNOWLEDGEMENTS ..... **I**

ABSTRACT ..... **II**

EXECUTIVE SUMMARY ..... **III**

LIST OF FIGURES ..... **VI**

LIST OF TABLES ..... **VI**

1 INTRODUCTION **2**

1.1 Problem Definition 2
1.2 Aim and Research Questions 3
1.3 Scope and Delimitations 3
1.4 Ethical Considerations 4
1.5 Audience 5
1.6 Disposition 5

2 LITERATURE REVIEW **7**

2.1 Perceived Uncertainty 7
2.1.1 Geopolitical Uncertainty *8*
2.1.2 Economic Uncertainty *9*
2.1.3 Environmental Policy Uncertainty *9*
2.1.4 Managing Uncertainty *11*
2.2 Environmental Management 12
2.2.1 Environmental Management Performance *12*
2.3 Environmental Management under Uncertainty 13
2.3.1 Environmental Investments as Real Options *14*
2.3.2 Stakeholder Pressure for Environmental Performance *14*
2.4 Conceptual Framework of Uncertainty and Corporate Environmental Performance 15

3 METHODOLOGY **17**

3.1 Research Design 17
3.2 Data Collection 18
3.2.1 Qualitative Interview Study *18*
3.2.2 Qualitative Document Analysis *22*
3.2.3 Sampling *22*
3.3 Data Analysis 24

4 RESULTS **26**

4.1 Perceived Uncertainty among Sustainability Professionals in the Swedish Manufacturing Industry 26
4.1.1 Geopolitical Uncertainty *26*
4.1.2 Economic Uncertainty *27*
4.1.3 Environmental Policy Uncertainty *28*
4.1.4 Other Forms of Uncertainty *29*
4.2 Environmental Management Performance under Uncertainty 30
4.2.1 Environmental Policy under Uncertainty *31*
4.2.2 Environmental Objectives under Uncertainty *32*
4.2.3 Environmental Processes under Uncertainty *32*
4.2.4 Environmental Organisation under Uncertainty *32*
4.2.5 Environmental Monitoring under Uncertainty *33*
4.2.6 Environmental Disclosure under Uncertainty *33*
4.2.7 Environmental Expenditures under Uncertainty *33*

4.2.8 Firm-level Environmental Management Performance under Uncertainty *34*
4.3 MECHANISMS BETWEEN UNCERTAINTY AND ENVIRONMENTAL MANAGEMENT PERFORMANCE 34
4.3.1 Environmental Management Performance under Geopolitical Uncertainty *35*
4.3.2 Environmental Management Performance under Economic Uncertainty *35*
4.3.3 Environmental Management Performance under Environmental Policy Uncertainty *36*
4.3.4 Stakeholder influence on Environmental Management Performance *37*
4.4 REACTIONS TO PERCEIVED UNCERTAINTY 38

5 DISCUSSION 40

5.1 PERCEIVED UNCERTAINTY AMONG SUSTAINABILITY PROFESSIONALS 40
5.2 INFLUENCE ON ENVIRONMENTAL MANAGEMENT PERFORMANCE FROM PERCEIVED UNCERTAINTY 40
5.2.1 Postponed Environmental Investments *41*
5.2.2 Stakeholder pressures under Uncertainty *42*
5.2.3 The combined effect of Policy Dismantling and Uncertainty on Environmental Management Performance *42*
5.3 ENVIRONMENTAL MANAGEMENT STRATEGIES UNDER UNCERTAINTY 43
5.3.1 Applied Actions under Perceived Uncertainty *43*
5.3.2 Strategic Postures under Perceived Uncertainty *44*

6 CONCLUSIONS 45

6.1 PRACTICAL IMPLICATIONS AND RECOMMENDATIONS FOR PRACTITIONERS 45
6.2 RECOMMENDATIONS FOR FURTHER RESEARCH 46

BIBLIOGRAPHY 47

List of Figures

Figure 1. Conceptual Framework of Corporate Environmental Performance 13

Figure 2. Conceptual Framework of Uncertainty and Corporate Environmental Performance 15

Figure 3. Environmental Management Performance under Perceived Uncertainty 31

List of Tables

Table 1. Definition of Geopolitical, Economic, and Environmental Policy Uncertainty 10

Table 2. Indicators of Environmental Management Performance 20

Table 3. Firm Sample by Manufacturing Industry 24

Table 4. Perceived Factors of Geopolitical Uncertainty 27

Table 5. Perceived Factors of Economic Uncertainty 28

Table 6. Perceived Factors of Environmental Policy Uncertainty 29

Table 7. Other Perceived Factors of Uncertainty 30

Table 8. Environmental Management Performance under Perceived Uncertainty by Firm 34

1 Introduction

The world is becoming increasingly uncertain both from a geopolitical and an economic perspective (Caldara & Iacoviello, 2022; Davis, 2016). Davies *et al.* (2025) record an increased intensity of state-based armed conflict over the past years, which contributes to geopolitical instability. In the economic domain, the global trade policy uncertainty spiked in 2025, following a decreased predictability of the United States' trade regime (Caldara *et al.*, 2020). The shaking geopolitical and economic circumstances are also manifested through individual perceptions. Business leaders, government officials, and researchers are perceiving geoeconomic confrontation and state-based armed conflict as the two main global risks (World Economic Forum, 2026).

Simultaneously, climate risks are beginning to materialise. Global warming has intensified the risks of flooding, wildfires, forced migration and damaged ecosystems (IPCC, 2023). In recent years, however, the intensified occurrence of heatwaves and extreme weather events have not translated into greater relative attention for environmental issues among business leaders and policymakers. At a time when geopolitical and economic risks are being considered increasingly important, extreme weather events have fallen from being considered the most material risk in 2024 to the third most important risk in 2026 (World Economic Forum, 2026). Decision-makers seem to have shifted their focus away from environmental concerns.

A corresponding down-prioritization of environmental issues could be observed in the European political sphere. Following the election to the European Parliament, a new European Commission was appointed in December 2024 with a mandate to improve business competitiveness and reduce administrative burden. In line with this, the Omnibus I package was presented on the 26th of February 2025 (European Commission, 2025). Omnibus I is a simplification package, whose main implication was that many EU firms no longer had to report under the new Corporate Sustainability Reporting Directive (CSRD). For firms subject to this policy dismantling, the rapid policy shift could also enhance regulatory uncertainty, in addition to the arising geopolitical and economic uncertainties.

A stable and predictable regulatory landscape may reduce uncertainty by providing clear rules and expectations. Rapid policy shifts operate in the opposite direction. When the mandated standard for sustainability reporting shifts, ambiguity arises not only about which standards the firms should report under but also which regulations that will follow in the future. The dismantling of a regulation for sustainability reporting may therefore spark uncertainty about the regulators' expectations for corporate sustainable practices. Sustainability professionals are now faced with the challenge to respond to policy uncertainty with appropriate environmental management strategies, while simultaneously navigating increased uncertainties related to geoeconomic confrontation and state-based armed conflict.

1.1 Problem Definition

Previous studies have examined how geopolitical, economic, and environmental policy uncertainty affect firm-level investments and employment (Bloom, 2009; Baker *et al.*, 2016; Caldara & Iacoviello, 2022; Palikhe *et al.*, 2024), but there is limited empirical knowledge of how sustainability professionals perceive these uncertainties and how such perceptions influence environmental management performance inside firms. Hoffmann *et al.* (2008) found that the introduction of the European Emission Trading Scheme (EU ETS) made sustainability professionals within European industry perceive regulatory uncertainty. Similar studies are however missing for other forms of perceived uncertainty. Previous studies have also identified relationships between different forms of uncertainty and environmental operational performance for US firms (Guenichi *et al.*, 2023), but the potential links between uncertainty

and environmental management performance remain undiscovered. Researchers are also reaching contrasting conclusions as to whether the relationship between uncertainty and environmental operational performance is positive or negative (Jia & Li, 2020; Huang *et al.*, 2025). In sum, existing research suggest that perceived uncertainty matters for corporate decision-making, but little is known about how sustainability professionals adapt environmental management strategies when they experience external uncertainty.

Swedish manufacturing firms provide a relevant setting for studying these questions, as they are simultaneously exposed to environmental policy uncertainty, geopolitical uncertainty, and economic uncertainty. EU Technical Expert Group on Sustainable Finance (2019) classify manufacturing as a high climate-impact sector, and the Swedish manufacturing firms is a major source of industrial emissions (Eurostat, 2026), while also being strongly embedded in export markets, global supply chains, EU regulations, and energy-intensive production systems. In addition, large Swedish manufacturing firms have been directly affected by changes in EU sustainability reporting requirements through the Omnibus. This makes the sector particularly relevant for studying how uncertainty around sustainability reporting obligations, environmental expectations, trade conditions, energy prices, and industrial transformation affects environmental management. Studying Swedish manufacturing firms therefore enables an examination of how sustainability professionals respond to uncertainty in a sector where environmental management is both strategically important and externally pressured.

1.2 Aim and Research Questions

The aim of this thesis is to explore how geopolitical, economic, and environmental policy uncertainty influence the environmental management performance of Swedish manufacturing firms.

To achieve this aim, the following Research Questions (RQs) will be applied:

> **RQ1**. Do sustainability professionals at Swedish manufacturing firms perceive the external environment as uncertain in geopolitical, economic, and environmental policy terms?
>
> **RQ2.** How are the environmental policy, objectives, processes, organisation, monitoring, disclosure, and expenditures at Swedish manufacturing firms influenced by geopolitical, economic, and environmental policy uncertainty?
>
> **RQ3.** How do Swedish manufacturing firms adapt their environmental management strategies in response to geopolitical, economic, and environmental policy uncertainty?

1.3 Scope and Delimitations

To answer the research questions, the temporal and geographical scope must expose sustainability professionals to geopolitical, economic and environmental policy uncertainty. Indices for geopolitical, economic, and environmental policy uncertainty demonstrates spikes in 2025 (Caldara & Iacoviello, 2022; Davis, 2016; Gavriilidis *et al.*, 2026). Therefore, the temporal scope of the study is set to 2025.

A significant event during 2025 with potential effects on uncertainty of sustainability professionals is the EU Omnibus package. For firms to be targeted by this policy, they need to be headquartered in the EU. To narrow the analysis to one legal jurisdiction, while still enabling a sufficient sample of firms, the analysis will focus on Swedish firms. Apart from being exposed to a potential source of environmental policy uncertainty, indices developed by Caldara *et al.*

(2026) and Armelius *et al.* (2017) also record high levels of geopolitical and economic uncertainty in Sweden under 2025, which further enhances the relevance of Sweden as the geographical scope.

The thesis focuses on manufacturing firms (sector C in the NACE industry classification) that produces goods such as electronics, machinery, and pharmaceuticals (EU, 2025). Many Swedish manufacturing firms are exposed to potential environmental policy uncertainty related to corporate environmental management, as they were included in the scope of CSRD but got exempted due to Omnibus I. Originally, CSRD applied to EU firms that exceeded at least two of the three criteria (1) €25 million balance sheet, (2) €50 million turnover, and (3) 250 employees, and to publicly listed Small and Medium-sized Enterprises (SMEs) (European Parliament, 2026). After Omnibus I, the employee threshold increased to 1000, and the turnover threshold increased to €450 million (Council of the EU, 2025). This makes sustainability professionals from firms with 250-1000 employees or €50-€450 turnover relevant interview respondents, as their firms have been exempted from the CSRD requirements, and thereby potentially make them affected by regulatory uncertainty.

The final scope is set to publicly listed Swedish manufacturing firms with 250-1000 employees or €50-€450 turnover. Among the Swedish manufacturing firms targeted by Omnibus I, this excludes manufacturing SMEs and private entities. While the exclusion of SMEs risks losing out on important perspectives of how smaller firms with limited resources are handling extensive regulatory requirements, these firms are less likely to have well-developed environmental management organisation and thereby a worse fit for this thesis. Publicly listed Swedish manufacturing firms with 250-1000 employees or €50-€450 turnover are also especially relevant in relation to the temporal scope of 2025, as they were supposed to report under CSRD for 2025 before the policy was postponed and dismantled. The focus on publicly listed rather than private firms narrow the scope down to firms with more publicly available data, while still being a relatively large population (N=58) and thereby enabling a sufficient sample size.

1.4 Ethical Considerations

This thesis was written in collaboration with the sustainability consultancy 2050 Consulting. The collaboration has enhanced practitioner relevance by helping to ensure that the studied forms of uncertainty and indicators of environmental management was relevant from the perspective of sustainability professionals. The thesis was conducted without financial support from any external organisation, which mitigates the risks for economic dependence or conflicting interests. However, the potential risk of influence based on business interests from the collaborating organisation was acknowledged. To preserve academic integrity, it was agreed that the collaborating organization would not influence the research focus, analysis or conclusions, but instead function solely as a source of information and practical insights.

This study took ethical responsibilities towards the research participants seriously and therefore implemented appropriate measures to preserve voluntariness, confidentiality and courtesy. The thesis followed the principle of prior informed consent. Prior to the interviews, respondents were informed about their right to decline answering questions and to withdraw from the interview at any time. The respondents and their firms were also anonymised both by omitting names and by excluding information that could be traced to a specific firm. Because of the voluntary participation and anonymisation of answers, there is no cause to believe that the research participants may suffer any damage or disadvantage from contributing to the study.

All gathered data of the study was safely handled and stored. With consent from the respondents, the audio was recorded from all interviews and saved directly to the computer. The audio files were then transcribed in Microsoft Word and key quotes were translated to

English. To ensure confidentiality and avoid data leakage, no digital generative AI platforms was used for recording, transcription or translation purposes. The recorded data was viewed only by the researcher and will remain safely stored until it is deleted.

The research design has been reviewed against the criteria for research requiring an ethics board review at Lund University and has been found to not require a statement from the ethics committee.

1.5 Audience

This study may be useful for researchers, sustainability practitioners and environmental policymakers. For researchers in the corporate sustainability domain, this study may provide insights of how corporate environmental management could be influenced by perceived uncertainty. Policy analysis researchers may learn about how EU-level policy affects national industries from a firm-level perspective. The thesis could also provide qualitative insights for researchers interested in uncertainty.

Sustainability practitioners and managers in Swedish manufacturing industry may get good use of this thesis. Decision-makers within Swedish manufacturing firms could learn from environmental management strategies applied by other firms in the same industry under uncertain conditions. The environmental management strategies applied by Swedish manufacturing firms could also be relevant knowledge for their customers, suppliers, auditors, consultants, investors, and competitors.

For policymakers, this thesis may spread awareness of the firm-level impacts from policy decisions. This may be useful for politicians and administrators at the EU level or in countries with impact of the geopolitical and macroeconomic development. The thesis highlights the, often hidden or unintended, consequences that shifting policy regimes may have on perceived uncertainty and environmental management in a corporate setting.

1.6 Disposition

This thesis is structured around six chapters, each contributing to the study of how environmental management in the Swedish manufacturing industry is influenced by external uncertainty.

Chapter 1 has offered an Introduction to why the Swedish manufacturing sector provides a relevant setting to explore how environmental management is affected by geopolitical, economic and environmental policy uncertainty.

Chapter 2 provides a Literature Review focused on different forms of uncertainty and environmental management. This review of the literature ends by combining the existing research from multiple disciplines to a conceptual framework of uncertainty and corporate environmental performance.

Chapter 3 describes the Methodology for this research, including the overall research design, and the applied methods for data collection and data analysis.

Chapter 4 presents the Results derived from the empirical data, focusing on perceived uncertainty among sustainability professionals, environmental management performance under uncertainty, mechanisms of how uncertainty influence environmental management and applied environmental management actions under perceived uncertainty.

Chapter 5 presents a Discussion where the findings are interpreted in relation to existing literature. The discussion is structured around the three research questions.

Chapter 6 complete the thesis by presenting Conclusions of the main findings, offering practical recommendations for sustainability practitioners and policymakers, and suggesting potential avenues for future research.

2 Literature Review

This study explores how perceived uncertainty among sustainability professionals in the Swedish manufacturing industry influences environmental management. The following literature review on this topic addresses uncertainty, environmental management performance, and environmental management under uncertain conditions. Drawing on the uncertainty trinity, the review focuses on geopolitical, economic and environmental policy uncertainty. The relationships between these forms of uncertainty and corporate environmental performance are then examined through the lenses of real options theory and stakeholder theory. Existing literature demonstrates that external uncertainty matters for firm-level investment decisions and environmental operational performance, but little is known about how perceived uncertainty affects environmental management in the Swedish manufacturing industry. There is also limited knowledge about which strategies the firms apply when uncertainty is perceived by sustainability professionals. The literature review concludes by constructing a novel theory-informed conceptual framework that links geopolitical, economic and environmental policy uncertainty to corporate environmental performance.

2.1 Perceived Uncertainty

Uncertainty has long been studied across multiple disciplines, resulting in diverse conceptualisations of the phenomenon (Bevan, 2022). In the 1920s, economists identified uncertainty as a distinct concept, distinguishing it from risk through its lack of measurability and know probabilities (Knight, 1921; Keynes, 1921). In the management domain, Milliken (1987) describes uncertainty as unpredictable change, while Duncan (1972) argues that two key dimensions of uncertainty from an organisational perspective are the number of factors to consider and the change of these factors. Within the field of policy analysis, uncertainty has been described as a spectrum from total ignorance to deterministic knowledge, particularly in relation to environmental policy (Walker *et al.*, 2003).

The complexity of natural systems makes uncertainty a central concern in environmental research and governance. Climate modelling scholars have identified uncertainties arising from shifts and feedback loops within Earth systems over time (Knutti *et al.*, 2008; Monier *et al.*, 2015; Kutiel, 2019). Uncertainty within natural systems also interacts with uncertainty in social and technical systems (Brugnach *et al.*, 2008; Brown, 2004; Tan *et al.*, 2024). Environmental policy aims to manage uncertainty within these complex systems (Smith & Stern, 2011; Sigel *et al.*, 2010; Dixit & Pindyck, 1994). Nature-related uncertainty may be addressed through stringent environmental policy and application of the precautionary principle for activities with potential to cause severe negative impacts (Walker *et al.*, 2003; Hassler *et al.*, 2018). Complex feedback effects in the social-ecological systems also create uncertainty that complicates corporate management (Polasky *et al.*, 2011), making managerial interpretations of uncertainty increasingly important.

Perceived uncertainty has emerged as a particularly important concept in studies of organisational decision-making under uncertain conditions. Hoffmann *et al.* (2008) argue that perceived uncertainty, defined *as "an individual's perceived inability to predict the future state"*, is the most useful measure for studies of individual corporate decision-makers, as decisions are driven by perceptions rather than objective truth. This perspective is particularly relevant given that conceptualisations of uncertainty differ considerably across research fields, resulting in overlapping and sometimes contradictory uses of the concept. Walker *et al.* (2003) propose to address this problem by defining uncertainty as *"any deviation from the unachievable ideal of completely deterministic knowledge of the relevant system"*. However, such an all-encompassing definition inevitably dilutes the concept and risks making it less precise. A more fruitful approach to

handling ambiguities and inconsistencies across uncertainty frameworks is therefore to examine perceived uncertainty among firm-level practitioners (Duncan, 1972; Bevan, 2022).

Firms must manage multiple forms of uncertainty in their strategic decision-making. Carney (2016) conceptualises this ambiguity as an uncertainty trinity, consisting of geopolitical uncertainty, economic uncertainty, and policy uncertainty. The uncertainty trinity has recently gained increased attention among scholars (Caldara & Iacoviello, 2022; Tan *et al*, 2024; Chowdhury *et al*., 2025). While the conceptualisation proposed by Carney (2016) includes policy uncertainty broadly, this paper focus specifically on environmental policy uncertainty. Environmental policy uncertainty is an emerging concept proposed by Palikhe *et al.* (2024). Uncertainty related to environmental policy constitutes an important component of policy uncertainty with demonstrated effects on key dimensions of environmental management (Tan *et al*., 2024, Meng *et al*., 2026). Against this background, the following sections provide a brief review of geopolitical, economic, and environmental policy uncertainty before examining how firms manage uncertainty.

2.1.1 Geopolitical Uncertainty

Rapid shifts in the global geopolitical landscape have made perceived geopolitical uncertainty an increasingly important concern for corporate strategy and environmental management. Gabriel *et al.* (2026) identify armed conflict, terrorism and social unrest as major sources of geopolitical uncertainty. For instance, the wars in Ukraine and Gaza have significantly increased the geopolitical uncertainty (Gabriel *et al*., 2026). As geopolitical instability has become increasingly recognised as an important challenge for corporate management, scholarly interest in examining geopolitical uncertainty has expanded (Caldara & Iacoviello, 2022).

The most widely used approach for examining geopolitical uncertainty is through measures of geopolitical risk (Caldara & Iacoviello, 2022; Jin *et al*., 2023; Gabriel *et al*., 2026). Geopolitical risk encompasses geopolitical acts as well as threats of committing such acts (Gabriel *et al*, 2026). Caldara and Iacoviello (2022) define geopolitical risk as the *"threat, realization, and escalation of adverse events associated with wars, terrorism, and any tensions among states and political actors that affect the peaceful course of international relations"*. They also develop a quantitative newspaper-based index to track the evolution of geopolitical uncertainty since 1985. High levels of geopolitical risk are associated with lower firm-level investments, especially in industries disproportionately exposed to geopolitical uncertainty (Caldara & Iacoviello, 2022). While the topics covered in newspaper articles have proven to constitute good indicators of uncertainty, newspaper-based indices are limited to measure public or media-level uncertainty and might therefore not fully catch the uncertainty sustainability professionals perceive inside firms.

Perceived geopolitical uncertainty is particularly relevant for firm-level investment decisions in an unstable world. Hoffmann *et al.* (2008) argue that managerial decisions in the European industry are influenced by the perceived uncertainty rather than some objective uncertainty. As this paper conducts a qualitative study of how geopolitical uncertainty influence corporate decision-making, the definition of geopolitical risk from Caldara and Iacoviello (2022) is combined with the definition of perceived uncertainty by Hoffmann *et al.* (2008). Accordingly, this paper defines geopolitical uncertainty as *"an individual's perceived inability to predict the future state of threat, realization, and escalation of adverse events associated with wars, terrorism, and any tensions among states and political actors that affect the peaceful course of international relations"* (Table 1).

Geopolitical uncertainty is closely interconnected with nature-related uncertainty (Tan *et al*., 2024). One central component of this relationship is that fossil fuels both contribute to environmental degradation and are exposed to geopolitical conflicts. As a result, the prices of oil and natural gas are related to both geopolitical risk and climate risk (Jin *et al*., 2023). In the

short run, the interconnected structure of the energy market, including the role of fossil fuels in electricity production, makes both fossil and renewable energy exposed to geopolitical uncertainty (Gabriel *et al.*, 2026).

2.1.2 Economic Uncertainty

Economic uncertainty has significant influence on firm-level investment decisions. Jana *et al.* (2022) argues that financial stress induced by recurrent unexpected "Black Swan" events affects economies globally. The global market uncertainty, measured as stock price volatility, peaked during the global financial crisis 2008 and the COVID-19 pandemic in 2020 (Smales, 2022). Bloom (2009) argues that macroeconomic uncertainty makes firms, on an aggregate level, temporarily pause hiring and investments. Along similar lines, Alfaro *et al.* (2018) demonstrate that firms, and especially financially constrained entities, tend to cut investments and hiring when they are exposed to economic uncertainties related to exchange rates and economic policy.

One important source of economic uncertainty for firms and financial markets is economic policy. Baker *et al.* (2016) introduce a quantitative newspaper-based index to measure economic policy uncertainty. The index spikes in times of political elections, fiscal policy disputes and political shocks. Economic policy uncertainty causes reduced investments and hiring for firms and increased volatility in financial markets (Baker *et al.*, 2016). Gulen and Ion (2016) also conclude that the economic form of policy uncertainty decreases firm-level capital investments, especially for firms with irreversible investments and high dependence of government spending. As Baker *et al.* (2016) focuses on economic policy uncertainty in the US, its relevance in other parts of the world is somewhat limited. Uncertainty in US financial markets nevertheless spreads across the global economy (Smales *et al.*, 2022), making economic policy uncertainty relevant beyond the American context.

Trade policy represents another important source of economic uncertainty for firms engaged in international markets. This dimension of economic uncertainty, including shifts in tariff rates and other barriers to trade, is commonly measured through trade policy uncertainty, based on a newspaper-based index, textual analysis of firms' earning calls, and aggregate tariff rates (Caldara *et al.*, 2020). Caldara *et al.* (2020) detect peaks of trade policy uncertainty during the Nixon and Ford administrations in the 1970s and during the first Trump administration. In general, higher trade policy uncertainty reduces firm-level investments (Caldara *et al.*, 2020).

Economic uncertainty encompasses several interconnected dimensions related to financial markets, economic policy, and international trade (Tan *et al.*, 2024; Baker *et al.*, 2016). These aspects of economic uncertainty are defined by key words related to fiscal and monetary policy (Baker *et al.*, 2016), key words related to tariffs and other barriers to trade (Caldara *et al.*, 2020), and stock market volatility (Bloom, 2009). The market, policy, and trade dimensions of economic uncertainty could be combined with the definition of perceived uncertainty by Hoffmann *et al.* (2008) to construct a definition of economic uncertainty with relevance for individual decision-making in a corporate setting. Accordingly, this paper defines economic uncertainty as *"an individual's perceived inability to predict the future state of the financial markets and the fiscal, monetary, and trade policy"* (Table 1).

2.1.3 Environmental Policy Uncertainty

Uncertainty surrounding environmental policy and regulation has become an important challenge for corporate management and investment decisions. Amit and Schoemaker (1993) argue that corporate management is strongly influenced by uncertainty related to changes government policies and regulations Hoffmann *et al.* (2008) term this phenomenon regulatory uncertainty and define it as *"an individual's perceived inability to predict the future state of the regulatory*

environment". Jordan and Moore (2020) argue that formative moments in the policy process are characterised by high levels of uncertainty, meaning that firms' exposure to regulatory uncertainty can be expected to spike during such periods. For instance, the introduction of EU ETS created regulatory uncertainty among sustainability professionals (Hoffmann *et al.*, 2008). While regulatory uncertainty is a well-researched concept, more recent studies tend to use the concept of "policy uncertainty" instead (Tan *et al.*, 2024). This paper therefore uses the two concepts interchangeably.

Environmental policy uncertainty captures uncertainty related specifically to public policies addressing the natural environment (Palikhe *et al.*, 2024). Palikhe *et al.* (2024) construct a quantitative newspaper-based index for environmental policy uncertainty. They identify spikes in the index when environmental taxes and cap-and-trade systems are proposed and implemented, when environmental regulations and standards are revoked, and in connection with elections relevant for environmental policy. Palikhe *et al.* (2024) also compare the index for environmental policy uncertainty with an index for environmental policy. While these two indices are relatively correlated over time, the environmental policy uncertainty index demonstrates multiple significant spikes that are unrelated to actual decisions on environmental policy, but instead regarding the future direction of environmental regulation. Palikhe *et al.* (2024) conclude that environmental policy uncertainty reduced firm-level investments, especially in industries with high exposure to environmental regulations.

Perceived environmental policy uncertainty can be conceptualised by combining the policy-oriented approach of Palikhe *et al.* (2024) with the perceptual definition of uncertainty proposed by Hoffmann *et al.* (2008). Palikhe *et al.* (2024) do not present a definition of environmental policy uncertainty, but use key-word combinations related to uncertainty, environmental policy, pollution, climate change, energy, and biodiversity to detect environmental policy uncertainty from newspaper articles. To incorporate the perceptual aspect into environmental policy uncertainty, the definition of regulatory uncertainty proposed by Hoffmann *et al.* (2008) is used as a basis for constructing a qualitative definition of the concept. This paper defines environmental policy uncertainty as *"an individual's perceived inability to predict the future state of the public policy related to pollution, climate change, energy, and biodiversity"* (Table 1).

Table 1. Definition of Geopolitical, Economic, and Environmental Policy Uncertainty

Forms of Uncertainty	**Definition**
Geopolitical Uncertainty	An individual's perceived inability to predict the future state of threat, realization, and escalation of adverse events associated with wars, terrorism, and any tensions among states and political actors that affect the peaceful course of international relations.
Economic Uncertainty	An individual's perceived inability to predict the future state of the financial markets and the fiscal, monetary, and trade policy.
Environmental Policy Uncertainty	An individual's perceived inability to predict the future state of the public policy related to pollution, climate change, energy, and biodiversity.

Much of the literature related to environmental policy uncertainty is developed under the more focused research stream of climate policy uncertainty (Tan *et al.*, 2024). This stream started when

Gavriilidis (2021) established a newspaper-based index of climate policy uncertainty that increases in times of new emissions legislation and political statements about climate policy. The measured climate policy uncertainty also spikes in times of policy dismantling, such as the US withdrawal of from the Paris Accord in 2017 (Gavriilidis, 2021). Huang (2026) studies US firms from 1987 to 2023 and concludes that climate policy uncertainty reduces corporate investments, especially for irreversible investments and for firms with limited financial resources or high exposure to climate change. Previous research also suggests that climate policy uncertainty negatively impacts firm-level employment and firm performance (Xu & Yang, 2025; Huang, 2026). This aligns well with what Palikhe *et al.* (2024) has discovered for the broader concept of environmental policy uncertainty and therefore support the relationships between environmental policy uncertainty and lower firm-level investments.

Manufacturing firms may also perceive uncertainty stemming from environmental policy dismantling. Jordan *et al.* (2013) define policy dismantling as *"cutting, diminution or removal of existing policy"*. Policy dismantling is especially prevalent for environmental policy, which could be explained by the high prevalence of vested interest groups and low visibility of immediate benefits (Jordan & Moore, 2020). Jordan *et al.* (2013) include effects as one of four analytical dimensions of policy dismantling and emphasize that environmental policy dismantling may influence firms in heavy industry. Despite the identification of environmental policy dismantling as a relevant research topic, little empirical emphasis has yet been put on the effect dimension in studies of policy dismantling (Cejudo & Olvera, 2025). The literature review identified no empirical studies examining the firm-level effects of environmental policy dismantling. The connection between dismantling of environmental policy and policy uncertainty has nevertheless been verified through quantitative studies of uncertainty (Palikhe *et al.*, 2024; Gavriilidis, 2021).

2.1.4 Managing Uncertainty

Perceived uncertainty constitutes a central challenge for sustainability professionals involved in decision-making within the manufacturing industry. Duncan (1972) studies perceived uncertainty among individuals in industrial organisations' decision-making units and concludes that it increases when many external factors must be considered, and that changes in these factors create even greater uncertainty. Uncertainty in the business environment is a complex issue with important implications for firm-level strategic management (Miles *et al.*, 1978; Thompson, 1967). Thompson (1967) argues that uncertainty, stemming from limited understanding of cultural cause–effect relationships, contingency, and the independent components of the internal organisation, constitutes a fundamental problem for complex organisations.

Firms commonly respond to uncertainty cautiously by postponing investments and hiring (Bloom, 2009; Gulen & Ion, 2016). The negative relationship between uncertainty and corporate investments holds true for geopolitical, economic, and environmental policy uncertainty (Caldara & Iacoviello, 2022; Kang *et al.*, 2014; Palikhe *et al.*, 2024). Firm-level cuts in response to uncertainty has also been observed in the management literature. A particularly influential contribution in this regard is Courtney *et al.*'s (1997) identification of *reserve the right to play* as one of three available strategic postures available to firms operating under uncertainty. This strategic posture is characterised by reacting to external uncertainty by staying in the game but avoiding premature investments. When firms chose to reserve their right to play, this is commonly executed through options designed to minimize losses in worst-case scenarios (Courtney *et al.*, 1997).

Firms may also respond to perceived uncertainty either by raising the sails and go where the wind takes them, or by installing an engine and set a new direction. In addition to reserving the

right to play, Courtney *et al.* (1997) propose *adapt to the future* and *shape the future* as two alternative strategic postures to manage uncertainty. The strategic posture of adapting to the future takes the current industry structure for given and aims to capture opportunities in the existing market through quick responses to market developments. Shaping the future focuses on playing a leadership role in how the industry operates and could for instance be operationalised by investments in new technologies or establishment of new standards (Courtney *et al.*, 1997).

2.2 Environmental Management

Corporate environmental management has developed in response to growing stakeholder expectations regarding firms' environmental impacts. Freeman (1984) argues that firms should not only be responsible for delivering profits to their shareholders but instead consider all stakeholders. Stakeholders are *"any group or individual who can affect, or is affected by, the achievement of a corporation's purpose"*, including owners, customers, suppliers, competitors, governments, and environmentalists (Freeman, 1984). The consideration of multiple stakeholders is an important basis for corporate social responsibility, i.e. voluntary corporate practices with consideration for economic, social, and environmental dimensions (Crane *et al.*, 2008). When firms seek to create value not only for shareholders but also for broader stakeholder groups, greater attention tends to be directed toward environmental and social impacts. The communication with stakeholders is commonly carried out through disclosure of ESG (Environmental, Social and Governance) performance (Li *et al.*, 2021).

Environmental management has become an increasingly important way for manufacturing firms to address environmental impacts and respond to stakeholder expectations. Etim *et al.* (2026) argue that the evolution of environmental management in heavy polluting industries has been driven by stakeholder pressure and the increasing implementation of environmental management systems such as ISO 14001. This environmental management represents the practical implementation of corporate environmental responsibility (Etim *et al.*, 2026). The following subsections will review the existing literature of how the performance of the environmental management can be measured.

2.2.1 Environmental Management Performance

The environmental management activities coordinated by sustainability professionals are important for corporate environmental performance. Yang *et al.* (2011) argue that environmental performance is useful to measure the degree to which an organisation improves its performance with respect to environmental responsibilities. The corporate environmental performance construct consists of two components (Xie & Hayase, 2007; Trumpp *et al.*, 2015). The first component is environmental management performance, which incorporates objectives, processes, and other means to improve the environmental performance. Trumpp *et al.* (2015) define environmental management performance as the *"strategic level of environmental performance [that] focuses on management principles and activities with regard to the natural environment"*. The second component of corporate environmental operational performance is environmental operational performance, which considers the end results from the environmental management (Xie & Hayase, 2007; Trumpp *et al.*, 2015).

Environmental management performance can be evaluated based on how effectively firms implement different environmental management practices. Trumpp *et al.* (2015) examine existing literature and propose a framework with five sub-dimensions: environmental policy, environmental objectives, environmental processes, organisational structure, and environmental monitoring. In addition to the five proposed sub-dimensions, Trumpp *et al.* (2015) also discover environmental disclosure and environmental investments. the review of the literature related conducted by While environmental disclosure is often framed as a distinct concept focusing on

stakeholder communication, it is also a crucial dimension of successful environmental management (Jung *et al.*, 2001; Trumpp *et al.*, 2015; Tadros & Magnan, 2021). Additionally, environmental management and environmental research and development require financial resources, which makes environmental expenditures another key dimension of environmental management performance (Lefebvre *et al.*, 2003; Trumpp *et al.*, 2015; Sarhan & Gerged, 2023). This thesis applies the framework of corporate environmental performance proposed by Trumpp *et al.* (2015), with additions of environmental disclosure and environmental expenditures as dimensions of environmental management performance (Figure 1).

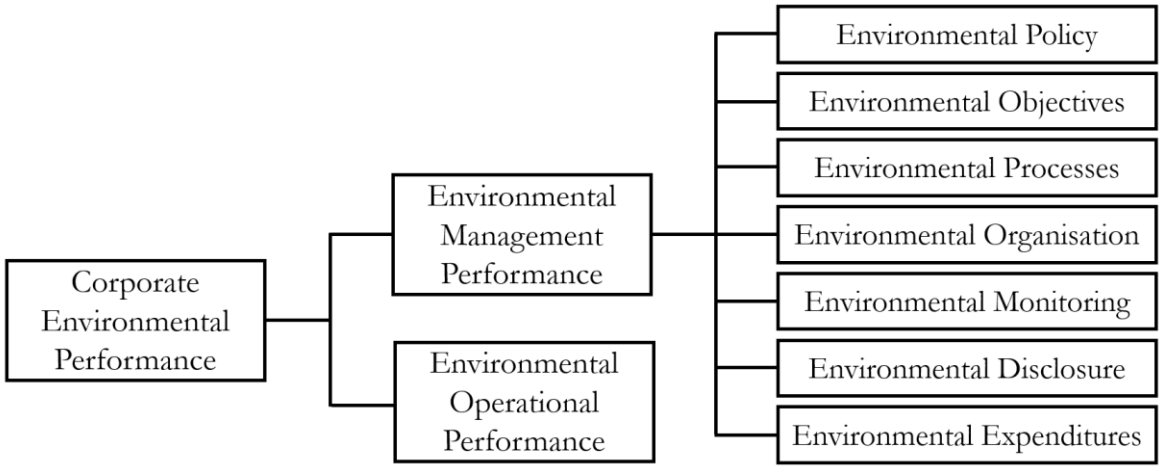


Figure 1. Conceptual Framework of Corporate Environmental Performance

Environmental operational performance reflects the environmental outcomes generated through environmental management activities (Trumpp *et al.*, 2015). This dimension represents the outcomes of the environmental management performance, and is commonly measured through direct environmental impacts such as carbon dioxide emissions, waste generation, energy consumption, and water consumption (Trumpp *et al.*, 2015). Ali *et al.* (2022) argue that green initiatives by firms improves their green performance and demonstrates that environmental management practices have a significant positive effect on environmental operational performance. The content of environmental operational performance is also corresponding to the environmental component of ESG performance. As environmental operational performance and sustainability performance are commonly measured through similar types of indices and demonstrate consistent results (Jia & Li, 2020), this study treats findings related to ESG performance as indicative for potential relationships involving environmental operational performance. The treatment of two distinct but interrelated concepts as similar constitutes a limitation, but their previously demonstrated conceptual and empirical similarities suggest that such comparisons can still contribute meaningfully to the analysis.

2.3 Environmental Management under Uncertainty

Sustainability professionals in the manufacturing industry must strategically manage environmental investments and practices under uncertain conditions. Hoffmann *et al.* (2008) demonstrate that sustainability professionals at European industrial firms can perceive uncertainty. When this uncertainty occurs, environmental managers' internal advocacy and inspirational goals become more important in relation to formalised environmental management systems (Parker, 2016). While there is limited research on the strategies firms apply to guide their environmental management in uncertain situations, Courtney *et al.* (1997) argue that strategies under uncertainty consists of strategic postures (i.e. reserve the right to play, adapt to the future and shape the future) and applied actions based on these postures. By combining

this dual notion of strategy with Trumpp *et al.*'s (2015) well-aligned definition of environmental management performance presented above, this thesis defines environmental management strategies as *"postures and actions with regard to the natural environment"*. Despite the limited academic attention directed towards environmental management under uncertainty, real options theory and stakeholder theory could provide a theoretical foundation. The following sections therefore review these theoretical perspectives in greater detail.

2.3.1 Environmental Investments as Real Options

Environmental management in manufacturing firms may be negatively affected by uncertainty through postponed environmental investments. Previous research demonstrates that impactful environmental management requires environmental investments (Lefebvre *et al.*, 2003; Trumpp *et al.*, 2015). Such investment decisions are however sensitive to external uncertainty (Jia & Li, 2020). Dixit and Pindyck (1994) argue that firm-level environmental investments are characterised by partial or complete irreversibility and uncertain rewards in terms of profits and losses, but also some leeway about the timing. In times of uncertainty, firms can therefore decide to postpone environmental investments until there is more information about the future (Dixit & Pindyck, 1994). Along similar lines, McDonald and Siegel (1986) argue that risk-averse investors should postpone irreversible projects until the expected benefits are twice the investment costs. Dixit and Pindyck (1994) argue that the common neglect of the interactions between irreversibility, uncertainty, and timing often leads to overestimations of the direct effects of public policy and underestimations of uncertainty. They therefore propose that investments should be understood as real options rather than future profit streams (Dixit & Pindyck, 1994)

Real options theory offers one explanation of how perceived uncertainty could influence environmental management. Jia and Li (2020) build on real options theory to argue that external uncertainty discourages long-term investments in corporate sustainability. Their study demonstrates that economic uncertainty, nature-related uncertainty, and political instability negatively affect environmental operational performance globally, with postponed sustainable investments as the underlaying mechanism (Jia & Li, 2020). Huang (2026) similarly applies real options theory to explain why climate policy uncertainty negatively affects corporate investments, especially for firms with high climate exposure, financial constraints and irreversible investments. Real options theory is also applied by Chowdhury *et al.* (2025) when they demonstrate a negative relationship between geopolitical risk and sustainability-related activities.

2.3.2 Stakeholder Pressure for Environmental Performance

Stakeholders are important for environmental management under uncertainty. Brugnach *et al.* (2008) argue that decision-makers' perceived uncertainty is influenced by stakeholders in the social system, which makes stakeholder considerations central for natural resource management under uncertainty. Similar conditions prevail for decision-making in a corporate setting. Management literature suggests that stakeholders, such as customers, suppliers, governments, competitors and shareholders, are important external factors for management under uncertainty (Duncan, 1972; Milliken, 1987). When firms are considering their stakeholders, they may be motivated to take responsibility for impacts on the natural environment through implementing practices beyond regulatory requirements and economic profitability (Crane *et al.*, 2008; González Sánchez *et al.*, 2026). These practices could be conceptualised as environmental management, under which stakeholder engagement is a key factor (Xie & Hayase, 2007). As stakeholder considerations are central to both environmental management and management under uncertainty, stakeholder pressure for environmental responsibility can be expected to influence environmental management under uncertain conditions.

Stakeholder theory suggests that uncertainty may strengthen external pressure for corporate sustainability commitments. Based on stakeholder theory, Huang *et al.* (2025) argue that investors and civil society actors intensify their pressure for sustainability commitments when there is external uncertainty related to environmental policy. Therefore, genuine and proactive environmental investments in times of uncertainty can foster stakeholder trust and build flexibility. Huang *et al.* (2025) demonstrate that climate policy uncertainty is a significant driver of ESG performance through these mechanisms. Also based on stakeholder theory, Perakis (2023) argues that climate policy uncertainty increases the need for firms to send good signals to their stakeholder, which in turn positively affects ESG performance. Taken together, stakeholder theory suggests that environmental policy uncertainty improves environmental operational performance through increased stakeholder pressure for legitimate sustainability signalling.

2.4 Conceptual Framework of Uncertainty and Corporate Environmental Performance

Perceived uncertainty may influence environmental management at manufacturing firms through multiple interconnected mechanisms. To explore the potential relationships between different forms of uncertainty and environmental management performance, a conceptual framework is developed (Figure 2). The conceptual framework builds on the uncertainty trinity from Carney (2016), and applies the definitions of geopolitical, economic and environmental policy uncertainty developed in the literature review (Table 1). Environmental management performance is conceptualised building on Trumpp *et al.* (2015) (Figure 1). By combining concepts and identified relationships developed by scholars from multiple disciplines, the potential uncertainty-induced influence on environmental management performance is situated within previous research. The remaining of this section explains how uncertainty may influence environmental management through the two opposing mechanisms of postponed environmental investments and increased stakeholder pressure.

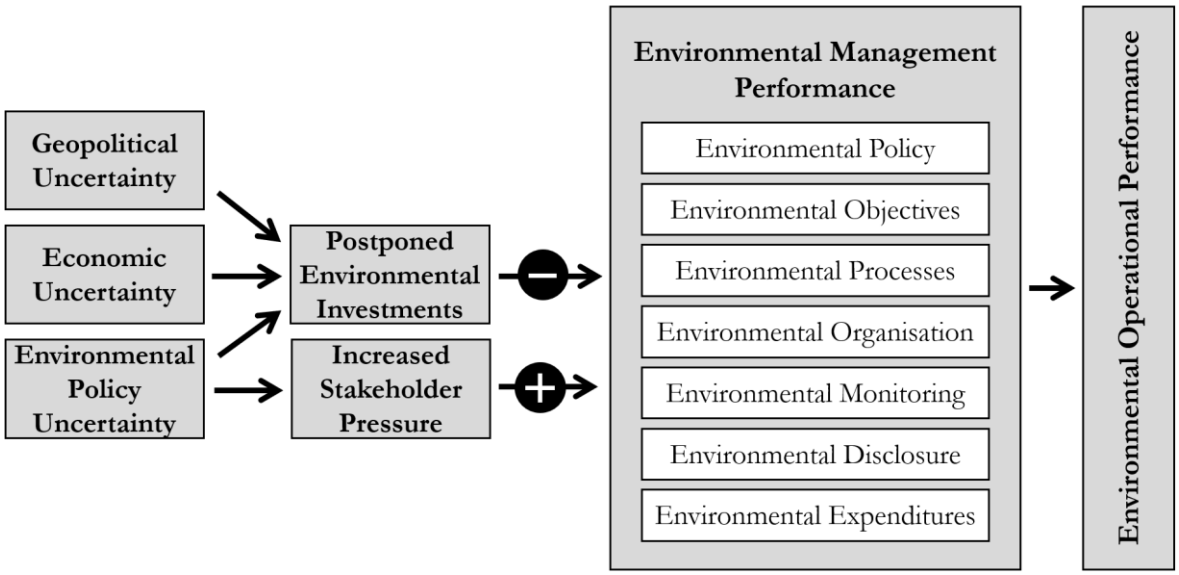


Figure 2. Conceptual Framework of Uncertainty and Corporate Environmental Performance

Perceived uncertainty from geopolitical, economic and environmental policy sources may influence the environmental management negatively through postponed environmental investments. These potential relationships are illustrated by arrows in the conceptual framework. Drawing on real options theory, Jia and Li (2020) argue that economic policy

uncertainty, political uncertainty, and environment-related uncertainty make firms postpone long-term environmental investments. Similarly, Chowdhury *et al.* (2025) demonstrate a negative relationship between geopolitical uncertainty and sustainability, channelled through financial constraints. This aligns with quantitative empirical studies which finds that geopolitical, economic and environmental policy uncertainty are associated with lower firm-level investments (Caldara & Iacoviello, 2022; Bloom, 2009; Alfaro *et al.*, 2018; Caldara *et al.*, 2020; Palikhe *et al.*, 2024; Huang, 2026). As existing uncertainty literature focuses mainly on firm-level investments, the transferability to specific dimensions environmental management is limited. The relationship between perceived uncertainty and environmental management practises therefore needs further exploration. The conceptual framework is constructed to organize such exploration. While environmental investments only constitute one of many components of environmental management performance, uncertainty-induced financial prudence could potentially decrease the resources allocated to environmental management practices. The decreased resource allocation may in turn affect the ambition level of environmental objectives and policies, and negatively impact the environmental processes, organisation, monitoring, and disclosure.

Environmental policy uncertainty may also strengthen environmental operational performance through intensified stakeholder pressure for environmental commitments, as illustrated by a second mechanism in the conceptual framework. Based on stakeholder theory and legitimacy perspectives, Huang *et al.* (2025) argue that uncertainty related to environmental policy could increase the external pressure on firms to demonstrate that they are sustainable. This suggested relationship is backed up by empirical observations (Persakis, 2024; Huang *et al.*, 2025). Guenichi *et al.* (2023) demonstrate a positive relationship between environmental policy uncertainty improves environmental operational performance, combined with a negative influence on environmental operational performance from geopolitical uncertainty. Firms can be expected to demonstrate increased ambition level of their environmental management through stricter environmental targets and stronger environmental disclosure. To make these environmental commitments legitimate and sustainable in the long term, firms may also improve their environmental policy, processes, organisation, monitoring, and budgets.

Improved or worsened environmental management practices can also be expected to influence firm-level environmental operational performance, such as energy use, air pollution, and waste generation. Previous literature divides corporate environmental performance into environmental management performance and environmental management performance (Xie & Hayase, 2007; Trumpp *et al.*, 2015), where the environmental management have been demonstrated to influence the operational output (Ali *et al.*, 2022). As the performance of environmental management is hard to measure quantitatively, the literature of how uncertainty influence corporate environmental performance has mainly focused on indexes related to the environmental operational performance component (Guenichi *et al.*, 2023; Persakis, 2024; Huang *et al.*, 2025; Chowdhury *et al.*, 2025). One notable exemption is that Meng *et al.* (2026) finds that uncertainty related to environmental policy increases hiring of executives with environmental experience in China. As environmental management has demonstrated influence on environmental output, it is possible that environmental management performance mediates between postponed environmental investments and declined environmental operational performance, and between increased stakeholder pressure and improved environmental operational performance. The conceptual framework illustrates this by placing environmental management performance between the suggested mechanisms fur uncertainty influence and the end output as environmental operational performance.

3 Methodology

This research was designed as an explorative case study of the Swedish manufacturing industry, focusing on how the environmental management performance was influenced by external uncertainty in 2025. The design evolved iteratively through synthesis of a theory-derived conceptual framework and emerging insights from collected data. The qualitative methods for data collection consisted of semi-structured interviews with sustainability professionals and document analysis of sustainability reports and environmental policies. Finally, the collected data was analysed by thematical coding based on an abductive approach.

3.1 Research Design

This thesis applied a qualitative research approach to explore how geopolitical, economic, and environmental policy uncertainty influence environmental management in the Swedish manufacturing sector. Qualitative research explores the meaning individuals or groups ascribe to a social problem (Creswell & Creswell, 2018). This was performed by exploring the meaning sustainability professionals ascribe to environmental management under uncertainty. Moreover, Creswell and Creswell (2018) argue that qualitative research typically involve emerging questions and procedures. This was particularly relevant given the limited research attention directed toward environmental management under uncertainty. The study also drew on previous literature to explore the underlying mechanisms behind theory-derived relationships in greater depth. The exploratory nature of the research problem, together with the novel combination of theories from multiple disciplines, made a qualitative research approach applicable.

The thesis was designed as an explorative case study of the Swedish manufacturing industry. Case studies are well-suited for in-depth research of complex social phenomena such as organizational processes and commonly address "how" questions (Yin, 2018). How sustainability professionals in the Swedish manufacturing industry make decisions under perceived external uncertainty constitutes such a complex social problem, which makes the case study design a good fit. Yin (2018) also argues that the case study design fits research of contemporary phenomenon in a real-word context where the behavioural events are outside the researchers' control. This aligns with this papers' exploration of environmental management decision-making in an industry that is currently faced with multiple forms of uncertainty.

A case study copes with a technically distinctive situation with many variables, benefits from prior theoretical propositions, and relies on triangulation from multiple sources of evidence (Yin, 2018). The distinctive and complex situation explored in this thesis is the corporate environmental management of the Swedish manufacturing sector in 2025. The research design, data collection, and data analysis in this multi-variable context is guided by a conceptual framework based on uncertainty theory, stakeholder theory, real options theory, and the concept of environmental management performance. To develop a more holistic understanding of the diverse variables of interest, the method for data collection combined qualitative document analysis of sustainability reports and environmental policies of the studied firms with semi-structured interviews with one sustainability professional of each studied firm.

The research design was built on an abductive logic, combining theory with new empery through an iterative process (Timmermans & Tavory, 2012). To guide the research, qualitative studies may apply theoretical models with constructs and hypotheses of certain actions or use collected data to build new themes and models (Creswell & Creswell, 2018). The abductive logic enabled this paper to combine relevant dimensions of both. Through a qualitative research design based on a case study with an abductive analysis, this thesis combined a theory-informed conceptual framework with novel insights from additional constellations of data based on in-depth study of the environmental management in the Swedish manufacturing industry. The abductive

research design is well-aligned with a relatively specific research aim and research questions with both theory-informed and exploratory elements. This suits well with the combination of descriptive and exploratory research questions of this thesis.

3.2 Data Collection

The applied methods for collection of data about environmental management under uncertainty in the Swedish manufacturing industry were an interview study and a document analysis. Through qualitative semi-structured interviews with Swedish sustainability managers within the manufacturing industry, their perceived uncertainty and stated responses could be collected. These findings were then triangulated with a qualitative document analysis of sustainability reports and environmental policies.

3.2.1 Qualitative Interview Study

The main method for data collection was a qualitative interview study. As this case study aims to explore how different forms of uncertainty influence the environmental management performance of the Swedish manufacturing industry, the environmental management of firms within the industry was studied. Therefore, 13 firms in the manufacturing industry were identified as units of analysis. One sustainability professionals at each firm were identified as research subjects. Through the collected information from these interview respondents, it was possible to explore the perceived uncertainty with relevance for the environmental management, learn about how key dimensions of their environmental management developed over time, and get their perceptions of how uncertainty influenced the environmental management practices of their firm. The choice of sustainability managers as research subjects is aligned with Hoffmann *et al.* (2008), who investigates perceived regulatory uncertainty at industrial firms by surveying environmental managers. While multiple respondents at each firm would have provided a more nuanced picture of each unit of analysis, this study prioritised obtaining observations from a larger number of firms within the studied industry to capture a broader range of perspectives and develop a more holistic understanding of perceived uncertainty and environmental management performance across the industry.

All the conducted interviews were digital, using the online meeting platform Zoom. This setting facilitated interviews with sustainability professionals from different Swedish cities and increased the number of participants who had opportunity to attend the interviews. The digital approach also constitutes some limitations. Qualitative studies are typically conducted in the natural setting through direct interaction with participants at the site where the research problem occurs (Creswell & Creswell, 2018). The natural setting enables a more holistic understanding, and the familiar environment encourages more in-depth reflections. Several respondents indicated that most of their professional meetings are conducted virtually, suggesting that digital interviews may in some respects constitute part of their natural working environment.

The interviews were distributed over a period of three weeks, from the 27th of March to the 17th of April. The respondents therefore had similar information about the external environment of their firms. This mitigates the risk for biases caused by changes in the external environment during the period when the interviews were conducted and is enhanced by the study's' focus on 2025. All interviews were conducted in Swedish as this was the native language for all respondents.

Before the interview, the respective respondent received an email with a brief presentation of the researcher, the aim of the thesis, the selection criteria of respondents, and practitioner relevance. The email also included a formal consent form to ensure that the respondent had been familiarised with the thesis, and informed about the anonymisation, confidentiality, safe

handling of information and rights at any point or withdraw consent. The consent form also informed that the interview would be recorded, transcribed, translated and analysed. For cases when respondents did not sign the consent form before the interview, the consent was provided orally before the interview started, and the consent form was formally signed after the interview took place. All the 13 respondents gave their prior informed consent.

An interview guide was developed to guide the interview. Building on Creswell and Creswell (2018), this interview protocol consisted of an introduction, an opening question, content questions, and a closing. The introduction ensured that the general information about the aim and structure of the interview from previous emails and consent forms was received and provided opportunity for the respondent to ask questions before the interview began. As an opening question, the respondent was asked to introduce themselves and their role at the firm. This gave a smooth start to the interview and provided organisational context to the unit of analysis. The interview ended with an opportunity for the respondent to ask any remaining questions or add something they thought was missing in the conversation until then.

The content section of the qualitative interview study had a semi-structured design with open-ended questions. This design ensured that certain relevant themes were addressed but still enabled follow-up questions to gain a richer understanding of the issue at hand. Hence, while using existing literature as a starting point, the study did not solely rely on topics from the questionnaire and instruments developed by other researchers but adhered to the qualitative characteristics of using the researcher as key instrument (Creswell & Creswell, 2018).

As the thesis aims to explore manufacturing firms' environmental management under uncertainty, the content of the interview study took inspiration from qualitative research on perceived uncertainty and environmental management performance at manufacturing firms. The first two content questions of the survey questionnaire related to the theme of uncertainty and explored how sustainability professionals at Swedish manufacturing firms perceived geopolitical, economic, and environmental policy uncertainty through subjective interpretations by the respondents. As a first control question, the respondents were asked if uncertainty in the external environment affects their ability to make relevant forecasts to determine their firm's sustainability strategy, drawing on formulations from Hoffmann *et al.* (2008) and Courtney *et al.* (1997). Further building on Hoffmann *et al.* (2008), the sustainability professionals with any perceived uncertainty were thereafter asked about the key factors creating that uncertainty.

How the environmental management performance at Swedish manufacturing firms is influenced by the perceived geopolitical, economic, and environmental policy uncertainty was explored through themes related to seven dimensions of environmental management performance, drawing on Trumpp *et al.* (2015), Jung *et al.* (2001), and Lefebvre *et al.* (2003) (Table 2). More specifically, the study applied a simplified version of the framework from Trumpp *et al.* (2015), where one measurable indicator was used for each of the five dimensions of environmental management performance. The environmental reporting dimension from Jung *et al.* (2001) and the environmental expenditure dimension from Lefebvre *et al.* (2003) were also included and paired with one measurable indicator each.

Table 2. Indicators of Environmental Management Performance

Dimension	**Source**	**Indicator**
Environmental Policy	Trumpp *et al.* (2015)	Environmental Policies
Environmental Objectives	Trumpp *et al.* (2015)	Environmental Targets
Environmental Processes	Trumpp *et al.* (2015)	Environmental Action Plans
Environmental Organisation	Trumpp *et al.* (2015)	Number of Sustainability Employees
Environmental Monitoring	Trumpp *et al.* (2015)	Key Performance Indicators
Environmental Disclosure	Jung *et al.* (2001)	Environmental Reporting Standard
Environmental Expenditures	Lefebvre *et al.* (2003)	Environmental Investments and Budget

A qualitative approach to environmental management performance enables a more nuanced understanding of environmental management practices than quantitative disclosure-based measures alone. Early conceptualisations of environmental management performance emphasise that the concept consists of qualitative measures which require corporate judgement to measure (Xie & Hayase, 2007; Azzone *et al.*, 1996). More recent studies have instead measured environmental management performance through quantitative analysis of disclosed information to enhance construct validity (Trumpp *et al.*, 2015; Ali *et al.*, 2022). While a quantitative design improves theoretical construct validity and makes it possible to test relationships with other concepts, it is associated with major limitations. As key dimensions such as environmental processes, organisation, and monitoring, are commonly not fully disclosed in sustainability reports or similar official documents, quantitative studies of environmental management performance are limited to examinations of disclosed data. Disclosed information does not necessarily represent the actual performance, weakening the construct validity of such measure in relation to its original purpose, even though quantitative research of how environmental management performance relates to concepts such as environmental operational performance remain important theoretical contributions. New qualitative studies of environmental management performance could examine the underlying meaning behind quantitatively identified conceptual relationships in a more granular and nuanced manner.

The chosen indicators for the interview study represent one key parameter of environmental policy, objectives, processes, organisation, and monitoring (Trumpp *et al.*, 2015), environmental disclosure (Jung *et al.*, 2001), and environmental expenditures (Lefebvre *et al.*, 2003) (Table 2). The indicators were chosen and modified to suit the context of the study. Each chosen indicator represents dimensions of environmental management at Swedish manufacturing firms that could be qualitatively assessed whether they have improved or declined as a response to uncertainty during 2025. Based on this, the interview study included questions about whether the overall ambition level of the environmental policies, targets, action plans, and key performance indicators shifted. To investigate the environmental organisation, the interview covered adjustments in the number of full-time equivalents of sustainability employees, including consultants. The interview also included questions about shifts in the financial resources allocated to environmental investments and budgets to explore the environmental expenditures.

To cover the measured indicators in depth in a single interview, only one indicator was chosen for each dimension. A limitation from using one indicator per dimension is that the operationalisation is not aligned with previous studies, which reduce both content validity and the construct validity. As the conceptualisation of the indicators differs from earlier research, comparisons with previous studies become more difficult, and the extent to which previously identified relationships with other concepts apply to this study becomes more uncertain. Environmental management performance can nevertheless still be considered an emerging concept that has partly diverged from its original qualitative conceptualisation. It is therefore relevant to explore new variations of the concept. Rather than deductively applying the existing concept of environmental management performance, this thesis develops a conceptual framework situated within existing literature of uncertainty and environmental management performance, while also applying a novel exploratory design informed by practitioners and open to unexpected discoveries through an iterative process.

In addition to the questions about perceived uncertainty and seven dimensions of environmental management performance, the respondents were asked to state whether any of the shifts in the environmental management could be attributed to some factors behind the perceived uncertainty. As the uncertainty-related questions were asked before the questions related to environmental management practices, the respondents could be expected to have considered their perceived uncertainty when the questions about environmental management were answered. By also asking the respondents to explain their view of how certain factors of uncertainty relate to dimensions of environmental management performance, the semi-structured interview also added meaningful details of these social mechanisms.

To explore what environmental management strategies Swedish manufacturing firms are applying under geopolitical, economic, and environmental policy uncertainty, questions were asked about the immediate reactions and future-looking strategies that was applied in response to perceived uncertainty shocks with relevance for the environmental management. These questions were open-ended. If needed, the answers were followed up with additional questions following a semi-structured approach to get a fuller picture of the applied strategies.

Previous qualitative studies of uncertainty and environmental management performance in the manufacturing industry have applied surveys (Xie & Hayase, 2007; Hoffmann *et al.*, 2008). Compared to interviews, surveys can include a larger sample and hence increase generalisability. However, interviews can go deeper and explore perceptions, and stated actions, reactions, and mechanisms. This adds nuance and details. An interview study also introduces the possibility to ask follow-up questions, thereby enhancing clarity.

A pilot interview with a sustainability professional was conducted in January 2026 to refine the research questions and interview design. The interviewee was identified through personal connections. The main findings include the need for questions about the organizational context, such as number of employees at the sustainability department, and that a question about budget was more applicable as budget and investments. Based on the pilot study, the scheduled length of the interviews was extended from 30 minutes to 60 minutes, to utilize the full potential of the follow-up questions associated with the semi-structured format.

As the researcher plays a central and interactive role when interviews are conducted, it is important to stay reflexive. Through conscious and critical reflection about the own position, potential bias could be mitigated. By being attentive to the way questions were framed, the questions could become more neutral and the following answers more representative of reality.

3.2.2 Qualitative Document Analysis

The second applied method for data collection was a qualitative document analysis. The document analysis focused on sustainability reports and environmental policies. In the Swedish manufacturing industry, sustainability reports from the previous year are published in April together with the annual report of the previous year. This enabled analysis of sustainability reports from the studied year of 2025. To explore year-to-year improvements and declines of environmental management performance dimensions, sustainability reports from 2024 were also included in the study. The second type of document used in the study was the latest version of the main environmental policy of each firm. For firms that has merged the environmental policy with other policies, such as quality or occupational health and safety, the environmental component of this policy was applied.

Qualitative analysis of the sustainability reports can provide officially published information about environmental management practices of the studied firms. While information about perceived uncertainty and applied strategies could be described with more detail in qualitative semi-structured interviews with directed questions and possibilities to ask follow-up questions, public documents have been verified by multiple individuals and are therefore less subjective. By combining qualitative document analysis with the findings from the interview studies, a fuller and more reliable picture emerges. Such triangulation from multiple types of data sources is a key characteristic of case studies (Yin, 2018).

The document analysis covered all the seven studied dimensions of environmental management performance. The public environmental policies and equivalent policies of 13 firms were analysed to explore if they were updated in 2025. For environmental objectives, processes, organisation, monitoring, and expenditures, a comparison of the presented targets, action plans, sustainability employees, key performance indicators, and taxonomy investments in the 2024 and the 2025 reports was used to explore shifts in level of ambition. Finally, the structure of the report itself and which data point that have been left out indicates if the level of ambition for the reporting standard has been adjusted.

3.2.3 Sampling

This paper is studying publicly listed Swedish manufacturing firms with 250-1000 employees or €50-€450 turnover over the year of 2025. Through searches in the FactSet financial database in March 2026, 58 firms which fulfilled these criteria was identified. This constitutes the population size of the study to 58. To increase external validity, the study applied a random selection of firms within the population. A randomized initial sample of 30 firms was drawn.

To explore the meanings among the 30 randomly sampled units of analysis, one sustainability professionals at each firm were identified as research subjects for the interview study. This thesis defines sustainability professional as the employee with the overall responsibility for environmental management at the firm. For firms with subsidiaries, the sustainability professional at group level was picked as respondent. If there were more than one sustainability professional at this group level, the manager or director was interviewed. For some of the studied firms, the sustainability professional was not only responsible for environmental management or sustainability, but also human resources, corporate finance, or operations.

The respondents were contacted though emails and phone calls. If an email address to the firms' sustainability professional was available on the official website or in sustainability report, a formal interview request was sent to that email. If no information about sustainability professionals was provided in publicly available sources, the procedure continued through emails to other employees within the firm. To maximise response rate, a follow-up email was

sent after two weeks, and phone calls was made after three weeks to all firms that had not yet responded to emails.

In the end, 13 sustainability professionals responded and agreed to take part in the research. All respondents had been working at the firm during the temporal scope of 2025. This makes the final sample size 13, corresponding to a response rate of 43%. 13 interviews enable broad coverage within the manufacturing sector while still being feasible within the time limitations. The official title of the 13 respondents in the final scope had different titles, including Sustainability Director, Sustainability Manager, Head of Sustainability, Senior Vice President People and Planet, Chief Financial Officer, Quality and Sustainability Director, Head of Technology and Quality, and Quality, Sustainability, Health, and Safety Engineer. All of them were responsible for environmental management.

The final sample constitutes a god representation of the population. Out of the firms in the initial sample, 13 did not have a sustainability professional who replied in a sufficient way, despite follow-up emails and phone calls. Furthermore, four sustainability professionals declined to take part in the interview study, because of time constrains or confidentiality concerns. A response rate of 43% might have introduced selection bias. However, the characteristics of the final sample is relatively representative for the studied population. The gender distribution in the final sample of 13 respondents consisted of 7 men and 6 women (54% men). While the gender distribution was not assessed among all sustainability professionals in the population, the initial scope of 30 sustainability professionals consisted of 50% men and 50% women. The average turnover among firms studied the final sample (€193 million) was also comparable that of the population (€173 million).

The distribution of the 13 studied firms across sub-industries is also representing the manufacturing industry well. The 58 identified Swedish publicly listed manufacturing firms with 250-1000 employees or €50-€450 was producing or refining electronics (26%), consumer products (22%), medical products (22%), machinery (17%), or raw materials such as wood, oil and metal (12%). The sub-industrial distribution in the final sample consisted of 31% consumer products, 23% electronics, 15% medical products, 15% machinery, and 15% raw materials. All the identified broad sub-industries in the Swedish manufacturing industry are thereby represented in the final sample. Consumer product manufacturing is relatively overrepresented in the final sample, and medical manufacturing is relatively underrepresented. As the distribution per sub-industry in the final sample is still comparable with the population, the study is unlikely to suffer from major selection bias on this aspect.

Table 3. Firm Sample by Manufacturing Industry

Industry	**Sample**	**Population**
Consumer Product Manufacturing	4 (31%)	13 (22%)
Electronics Manufacturing	3 (23%)	15 (26%)
Raw Material Manufacturing	2 (15%)	7 (12%)
Medical Manufacturing	2 (15%)	13 (22%)
Machinery Manufacturing	2 (15%)	10 (17%)
Total Sum	**n = 13**	**N = 58**

3.3 Data Analysis

The method for data analysis followed an abductive logic. Timmermans and Tavory (2012) describes the abductive approach as an iterative process where theoretical conceptualisations and qualitative empirical findings are combined to reach new insights related to the aim of the thesis. Abduction makes good use of previous theoretical knowledge, while still allowing for creative data interpretation and inclusion of unexpected findings. Following Hulst and Visser (2024), this abductive analysis embraced surprises, used knowledge creatively to theorize, and iterated through the research process. These principles were applied by starting from a conceptual framework based on previous theoretical knowledge of uncertainty and environmental management performance, incorporating additional unexpected input from the qualitative interview study, and iteratively developing the analysis based on this.

The data sources consisted of interview transcripts, sustainability reports, and environmental policies. Data from these sources was thematically coded based on the conceptual framework of uncertainty and corporate environmental performance and additional frequently occurring themes from the interviews. The main tool for coding was the digital software NVivo 15. The possibility to upload and display all transcripts, sustainability reports, and environmental policies into one combined project and code based on themes enabled structured and displayable analysis.

To analyse the perceived uncertainty among sustainability professionals in the manufacturing sector, all mentioned factors of uncertainty were highlighted in the interview transcripts. The data reduction of perceived uncertainty was then structured around a three-step approach for aggregation. This formalised approach of data aggregation reduces the risk for biases to influence the analysis. Drawing on the three-step approach from Hoffmann *et al.* (2008), the indicated factors behind the perceived uncertainties were identified from the interviews, grouped into topics that referred to similar issues, and categorised into different forms of uncertainty. The goal of the intermediate step with grouping of similar issues was to reduce data complexity. When the common themes had been identified, the theory-derived definitions of different forms of uncertainty proposed by this paper were applied to categorise the groups into geopolitical uncertainty, economic uncertainty, environmental policy uncertainty and other forms of uncertainty (Table 1).

The development of environmental practices caused by uncertainties in 2025 were analysed through identifying the indicators for the seven dimensions of environmental management performance (i.e. environmental policies, environmental targets, environmental action plans, number of sustainability employees, key performance indicators, environmental reporting standard, and environmental investments and budget) from the transcripts, sustainability reports and environmental policies. Each dimension was coded into "1", "-1" or "0" for the 13 studied firms, where "1" indicate improved performance, "-1" indicate declined performance, and "0" indicate no changes in performance. The coded responses were analysed to identify potential patterns between firms or groups of firms. Coding in NVivo was also utilised to identify relationships and mediating factors between uncertainties and environmental management practices. The data of how environmental management strategies applied by Swedish manufacturing firms under geopolitical, economic, and environmental policy uncertainty was coded as responses to perceived forms of uncertainty in NVivo. This analysis focused on responses to Omnibus, as uncertainty related to this was perceived by most of the respondents.

The interviews were conducted, transcribed, and analysed in Swedish. As some concepts might have a slightly different meaning in Swedish and English, the transferability as compared to other similar studies done in English is somewhat limited. This study considered it being more important for respondents to talk freely and elaboratively in their native language than achieving optimal conceptual transferability. To mitigate the limitation of concepts not fully aligning, follow-up questions was asked to ensure that the respondents got their message through and thereby enable proper translation.

4 Results

The findings of the interview study and document analysis provide insights into how firms in the Swedish manufacturing industry perceive and respond to uncertainty in their environmental management. Sustainability professionals, hereafter referred to as S(1,2,3, … 13), perceive a range of uncertainties and adjust their environmental practices. The chapter is organised into four main sections. It begins by examining perceived uncertainty, before considering environmental management performance under uncertainty. The third section explores the mechanisms linking uncertainty to environmental management performance, and the final section discusses firms' responses to perceived uncertainty.

4.1 Perceived Uncertainty among Sustainability Professionals in the Swedish Manufacturing Industry

Sustainability professionals at Swedish manufacturing firms are perceiving uncertainty in the external environment. Twelve interview respondents (S1-S6, S8-S13) indicate that uncertainty in the external environment affects their ability to make relevant forecasts to determine the firm's sustainability strategy. Only one respondent (S7) answer that they don't think that uncertainty has impacted their work with sustainability. That nearly all the thirteen interviewed sustainability professionals are perceiving uncertainties suggests that environmental management practices and strategies at Swedish manufacturing firms are exposed to external uncertainty.

The Sustainability professionals perceive geopolitical, economic and environmental policy uncertainty. Eleven respondents (S1-S6, S8-S12) experience uncertainty that could be categorised as environmental policy uncertainty. This makes environmental policy uncertainty the most frequently observed form of uncertainty in the studied industry. Geopolitical uncertainty was perceived by eight respondents (S1-S3, S8-S12). Uncertainty related to economic factors was reported by six respondents (S1, S3, S9, S10, S12, S13). In addition, four respondents (S3, S10, S11, S13) experienced uncertainty that did not fall under any of these three forms of uncertainty. The remaining of this section presents the perceived factors of geopolitical, economic, and environmental policy uncertainty, as well as other forms of perceived uncertainty.

4.1.1 Geopolitical Uncertainty

In total, eight of the interviewed sustainability professionals at Swedish manufacturing firms indicate that they are perceiving geopolitical uncertainty. When asked about the factors behind the perceived uncertainty, two respondents (S1, S3) state "geopolitical" in a broad sense. Four respondents (S2, S8, S11, S12) are more specific and mention geopolitical uncertainty directly related to armed conflict or threat thereof. These factors are security policy and war. For instance, S8 express that:

> *"Right now, the security policy situation is the largest challenge, which actually may be the major driver of many other consequences we see. What we pick up on most rapidly, I would say, is of course the price of material and the market's willingness to invest in, for example, solar plants or batteries and so forth."*

Uncertainty stemming from Energy-related tensions is a commonly perceived issue among sustainability professionals in the studied industry. Three respondents (S1, S9, S10) mention oil, oil prices, or energy crisis in a way that clearly relates to geopolitical tensions. S1 and S9 brings up the oil crisis, oil prices, and cost of transportation in relation to geopolitical threats. S10 put it in the following way:

"There are [these] energy crises and these geopolitical conflicts that are ongoing and affect the entire world market."

Table 4. Perceived Factors of Geopolitical Uncertainty

Armed Conflicts (4)
war (3), security policy
Energy-related Tensions (3)
oil, oil price, energy crisis
Unspecified Geopolitical Uncertainty (2)
geopolitical (2)

The digits within parenthesis represent the number of sustainability professionals stating the respective factor. The bolded themes represent groupings of factors related to similar issues. If a sustainability manager refers to more than one factor related to the same issue, they are only counted once in aggregated numbers of each theme. 8 sustainability professionals mentioned any factor related to geopolitical uncertainty.

4.1.2 Economic Uncertainty

Six sustainability professionals state economic factors as an explanation to their perceived uncertainty about the external environment. From the three defined forms of uncertainty, economic uncertainty thereby has the least observations. Five of six respondents (S1, S3, S9, S10, S12) with perceived economic uncertainty mentioned some trade-related issue (i.e. tariffs, export subsidies or sanctions). While three respondents (S1, S3, S10) mention tariffs straight away, one respondent (S12) speaks about day-by-day communication from Trump and the relations between the US and its neighbouring countries. Another perceived trade policy uncertainty is export subsidies, explained by S9 as:

> *"China has paid the value added tax for [firms] for what is exported to, among other places, Europe. And now [the firms] should suddenly pay value added tax. Our suppliers should start paying value added tax on some goods, which will force us to increase our prices as much as them and evaluate how we work with China, among other places, in the future."*

Several sustainability managers in the Swedish manufacturing sector reported economic uncertainty related to the macroeconomy and the markets. Two respondents (S1, S10) expressed perceived economic uncertainty in a broad sense, such as the economy or the economic condition. Slightly more directed towards specific markets, two respondents (S1, S13) expressed concerns about uncertainty of the inflation and the state of the operating market.

Table 5. Perceived Factors of Economic Uncertainty

Trade Policy Uncertainty (5)
tariffs (3), sanctions, export subsidies, Trump's threat of tariffs
Market Uncertainty (2)
state of the market, inflation
Unspecified Economic (2)
economy, economic condition

The digits within parenthesis represent the number of sustainability professionals stating the respective factor. The bolded themes represent groupings of factors related to similar issues. If a sustainability manager refers to more than one factor related to the same issue, they are only counted once in aggregated numbers of each theme. 6 sustainability professionals mentioned any factor related to economic uncertainty.

4.1.3 Environmental Policy Uncertainty

The most frequently perceived uncertainty among sustainability professionals in the studied scope is environmental policy uncertainty. Among the ten respondents who mention factors related to environmental policy uncertainty, seven respondents (S1, S3-S5, S9-S11) refer to uncertainty about the future state of the EU directive on reporting, CSRD. The dismantling of CSRD, namely the Omnibus directive, is explicitly mentioned by four respondents (S1, S3, S6, S12). These types of environmental policy issues are top of mind for many of the respondents when they are asked about key factors behind the uncertainty in the external environment that affects their ability to make relevant forecasts for their environmental management. For instance, the immediate answer from S1 was:

> *"One part is the regulatory aspect of course, that CSRD, then came the Omnibus. What comes next? It will probably be some reporting standard for the firms that got out of scope for CSRD as they decreased the scope extremely much. It was obviously a lot of firms which got out of scope. And all those firms, how should they report? What guidelines and standards should we follow? So, we have been fumbling around a little there."*

The shifting emphasis on sustainability and climate change mitigation in political statements clearly seem to have affected corporate sustainability in Sweden. Two additional sustainability professionals (S5, S8) point out environmental policy dismantling with broader wording, such as new unsustainable trajectories, shifted path dependencies and changing regulatory regimes. One respondent (S6) specifically refers to the unclear character in many political statements and how that affects firm-level decision-making:

> *"The unclarity around what has been communicated from the EU-level, what has been communicated from our politicians, and what is happening in the US of course with that president, has maybe made the company think that yes, it was important to put sustainability on the agenda [but] it may not be as important now. And there is some unclarity and so forth. It becomes hard for a firm like us to understand where the level of ambition should be."*

The findings demonstrate that environmental policy uncertainty can stem from multiple levels of governance. Apart from CSRD and Omnibus, four respondents (S3, S5, S9, S10) perceive other EU environmental policies as factors creating uncertainty in the external environment. Multiple sustainability professionals refer to Corporate Sustainability Due Diligence Directive and the digital product passport. Other EU-level environmental policies that are brought up are

EU taxonomy, Ecodesign, EU Deforestation Regulation. Three respondents (S3, S5, S6) indicate that the direction of the environmental policies from the Swedish government is a source of uncertainty. Although all the interviewed sustainability professionals work for firms with headquarters in Sweden, four of them (S4, S6, S11, S12) indicate that their strategies are affected by uncertainty related to US environmental policy. These uncertainties are caused by the US energy policy, the US withdrawal from the Paris agreement, and the US overall approach to sustainability. For instance, S11 express that the Trump administration's negative attitudes towards renewable energy and global climate targets constitutes a trend that affects how businesses think. Four respondents (S1-S3, S10) are also describing factors behind the uncertainty in more unspecified terms similar to legislation, but still clearly relate it to environmental policy.

Table 6. Perceived Factors of Environmental Policy Uncertainty

Sustainability Reporting (7)
CSRD (7), reporting standards
Environmental Policy Dismantling (6)
Omnibus (4), unsustainable paths, unstable sustainability laws
EU Environmental Policy (4)
Corporate Sustainability Due Diligence Directive (2), digital product passport (2), EU taxonomy, EU rules, Ecodesign, EU Deforestation Regulation
US Environmental Policy (4)
US approach to sustainability (3), US withdrawing from Paris agreement (2), US renewable energy policy (2)
Swedish Environmental Policy (3)
Swedish government (2), national unsustainable paths
Political Communication (1)
Unspecified Environmental Policy (4)
regulatory, legislation, legislative framework, legal requirements

The digits within parenthesis represent the number of sustainability professionals stating the respective factor. The bolded themes represent groupings of factors related to similar issues. If a sustainability manager refers to more than one factor related to the same issue, they are only counted once in aggregated numbers of each theme. 11 sustainability professionals mentioned any factor related to environmental policy uncertainty.

4.1.4 Other Forms of Uncertainty

Not all factors that creates perceived uncertainty among the interviewed sustainability professionals are related to geopolitics, economy or environmental policy. Four respondents (S3, S10, S11, S13) refer to other forms of perceived uncertainty. Two of these factors fulfil some criteria of the definition for environmental policy uncertainty but lacks either the environmental component or the policy component. More specifically, one respondent (S11) indicates that Trump's approach to Diversity, Equity, and Inclusion is an external factor that creates uncertainty. Another respondent (S10) refers to uncertainty caused sustainability-related factors that are not directly linked to environmental policy, but rather to societal sentiments where the public seems to be less concerned with sustainability and environmental issues:

"It is such a tendency today, a public conception of sustainability issues, climate issues and so on, that you take a bit of a Trump approach and downplay the challenges we are facing, and then the value-creating sustainability work will be pushed back […]. It is not related to legal frameworks or politics, but it is actually humans' and organisations' values in relation to this in society."

Four respondents (S3, S10, S11, S13) perceive stakeholder-related factors of uncertainty in the external environment. These were related to uncertainties in demands and expectations from customers, suppliers, and competitors. For instance, S11 express uncertainty caused by lack of transparency in the global supply chains. Two sustainability professionals (S3, S10) express uncertainty about future customer demands and one sustainability professional (S13) state that it is hard to know how competition from firms based in Asia could affect the financial performance of the firm. S13 also refer to uncertainty caused by unpredictable shifts in technological developments.

Table 7. Other Perceived Factors of Uncertainty

Stakeholders (4)
customer demands (2), supply chains, Asian competitors
Societal Urgency for Sustainability (1)
Technological Shifts (1)
Regulatory Uncertainty (1)
Trump's Approach to Diversity, Equity, and Inclusion

The digits within parenthesis represent the number of sustainability professionals stating the respective factor. The bolded themes represent groupings of factors related to similar issues. If a sustainability manager refers to more than one factor related to the same issue, they are only counted once in aggregated numbers of each theme. 4 sustainability professionals mentioned any factor related to other forms of uncertainty.

4.2 Environmental Management Performance under Uncertainty

All the seven dimensions of environmental management performance is affected for at least one of studied firms. The document analysis and the interview study indicate that the environmental disclosure, the environmental expenditures, and the environmental organisation is negatively influenced by external uncertainty. Five firms in the studied scope makes their environmental objectives more ambitious and few firms in the studied scope adjust their environmental policy, environmental processes or environmental monitoring.

The firm with a sustainability professional that is not perceiving any relevant uncertainty in the external environment is not demonstrating any adjustments in terms of environmental management performance. This respondent (S7) did not make any major changes to prepare for CSRD and continues with the same environmental management systems, key performance indicators and actions plans as previous years. The following section presents how the remaining twelve firms perform in terms of environmental policy, objectives, processes, organisation, monitoring, disclosure, and expenditures.

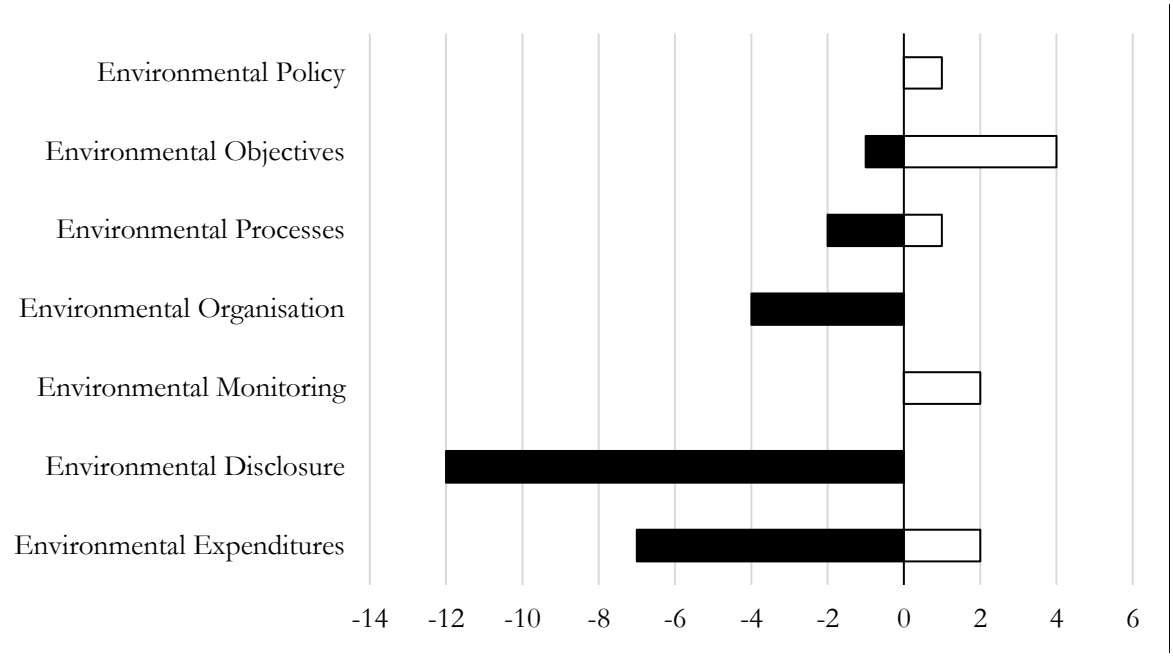


Figure 3. Environmental Management Performance under Perceived Uncertainty

The black bars represent the number of sustainability managers that indicated declined environmental management performance because of uncertainty in 2025. The white bars represent the number of sustainability managers that indicated improved environmental management performance because of uncertainty in 2025. Indications of unchanged environmental management performance are excluded from the figure for that specific dimension.

4.2.1 Environmental Policy under Uncertainty

The environmental management of the studied firms is guided by an environmental policy or corporate sustainability policy. The interview study and document analysis identify two firms whose environmental policies have been updated during 2025. S9 improve their environmental policy during the studied temporal scope to increase consistency with the regulatory-imposed reporting frameworks. Another respondent (S10) updates the environmental policy by tying it closer to the overall purpose of the firm, without any major effect on the overall level of ambition of the environmental policy. As the overall level of ambition in this policy is not improving or declining, it interpreted as an unchanged. Taken together, the identified uncertainty-induced changes on environmental policy performance among the studied firms is a moderate increase.

Based on the document analysis and the interview analysis, most of the studied firms have an environmental policy dated somewhere between 2020 and 2024, meaning that most of the firms did not update their environmental policy in 2025. One respondent (S11) state that they will update their environmental policy in 2026. The identified implementation years of the current environmental policies suggest that the average interval between policy updates appears to be approximately five years. Given the number of studied firms, the observation that two firms updated their environmental policies during 2025 therefore appears to represent a year with a relatively normal level of environmental policy revision.

4.2.2 Environmental Objectives under Uncertainty

The study demonstrates that firms in the Swedish manufacturing industry have environmental objectives. Based on document analysis and interviews with sustainability professionals, it is possible to conclude that many targets are based on standards from the United Nations, Greenhouse Gas Protocol or Science Based Targets Initiative. This dimension of environmental management performance has improved among the studied firms in 2025. In sum, four firms set more ambitious targets, and one firm reduce their environmental targets due to external uncertainty.

The environmental objectives increase for four of the studied firms in 2025. S1 state that Omnibus made them narrow their focus to the environmental aspects of sustainability and set more ambitious environmental targets. According to their sustainability report, 2025 was the first time the firm established a target for reductions of greenhouse gas emissions on a group level. Another respondent (S2) state that they have made the carbon dioxide targets more ambitious and tied it to the salary bonus systems to create incentives for key internal stakeholders. While S5 in not explicitly mention changed environmental targets in 2025, their sustainability report suggests that the new climate targets for scope 3 emissions (i.e. emissions from the suppliers and users in the value chain) was introduced in 2025. S8 express that they have a strategy where they make continuous improvements of the level of ambition for their environmental targets every year. Taken together, four of the studied firms increase their environmental objectives in 2025 and one of them ties it explicitly to external uncertainty. Further, S6 have started the process to apply Science Based Targets in 2026 and committed to this in their sustainability report for 2025.

In 2025, one studied firm decides to cancel a previously commitment to increase the ambitiousness level of their environmental objectives. More specifically, S10 states that Omnibus made the firm opt out of their plans to set Science Based Targets. Triangulation with sustainability reports from 2024 and 2025 confirms that the rest of the studied firms are not changing their environmental objectives during 2025. Among these firms, F9 indicate that their current targets were set in 2024, based on the Science Based Targets Initiative.

4.2.3 Environmental Processes under Uncertainty

The results are not demonstrating any major changes in the environmental processes. Most respondents (S1-S6, S8, S9, S12) indicate that their action plans are continuing as planned. This is also confirmed by the sustainability report of these firms, whose content is not indicating any major changes in routines for processes and action plans.

A few respondents state that their actions plans are changed due to perceived uncertainty, but the direction of change differs. One respondent (S11) indicates that the work with action plans have increased during 2025, for instance with carbon reduction and energy recovery. Others indicate that external uncertainty has declined their performance in the process dimension of environmental management. Two respondents (S10, S13) state that their climate reduction plans would have been more extensive if they would have stayed in the scope of CSRD. The findings demonstrate shift in the environmental process explained by environmental policy uncertainty, but the summarized changes on an industry level are of a relatively low magnitude.

4.2.4 Environmental Organisation under Uncertainty

The environmental organization decreased for several of the twelve firms with perceived uncertainties. This has been measured through number of employed sustainability professionals. When the CSRD was implemented, some firms employed their first centralised sustainability professional at the head quarter as a response (S1, S2, S9-S11). Most of these employees kept

their position after the Omnibus package (S1, S2, S9, S11). One respondent (S10) nevertheless indicate that the full-time position was replaced by a half-time consultant due to the uncertain environmental regulations on the EU-level. This absence of a dedicated sustainability professional in this firm is supported by the document analysis of their sustainability report.

Other firms kept their existing organisation when the extended sustainability reporting requirements were implemented and instead handled the increased administration through consultants. Three sustainability professionals from such firms (S1, S3, S12) cut their external environmental consultancy hours as a response to the Omnibus package. The interview study and document analysis of the remaining firms do not report any changes of the environmental organisation in 2025.

4.2.5 Environmental Monitoring under Uncertainty

The environmental monitoring developed improved for a few of the firms with sustainability professionals that perceive uncertainty in the external environment. Two respondents (S2, S12) indicate adjusted environmental key performance indicators in a more ambitious direction during 2025. S12 express that they have set new key performance indicators for waste and circular economy. S2 is improving their work with key performance indicators and putting more emphasis on them in their communication with subsidiary firms. None of the firms tie these changes directly to external uncertainty. The sustainability reports and interviews with the other ten firms did is not pointing towards any adjustments of the environmental monitoring.

4.2.6 Environmental Disclosure under Uncertainty

All respondents with perceived external uncertainty indicate that the number of reported data points in the environmental disclosure reduced because of the Omnibus package. Five respondents (S3-S6, S9) work for firms with more than 500 employees and were therefore required to report under CSRD for 2025. However, the Omnibus introduced phase-in provisions for some of the datapoints under CSRD, for instance on biodiversity. Two of the sustainability professionals from these firms (S3, S4) explicitly mentioned in the interview that they decided to leave out datapoints that Omnibus allowed them to. The document analysis of the sustainability reports find that the remaining three firms did the same. The firms with less than 500 employees (S1, S2, S7, S8, S10-13) were originally supposed to start reporting under CSRD for 2025 but got exempted due to Omnibus. None of these firms report fully under CSRD, but they still approach the sustainability reporting in different ways.

Five respondents (S2, S3, S4, S10, S13) state that they minimised the amount of reporting. On the contrary, four respondents (S1, S8, S11, S12) keep central components of the CSRD requirements. For instance, S11 combined many of the datapoints from CSRD with the datapoints from Global Reporting Initiative to construct a reporting standard fitting the firm and its stakeholders.

4.2.7 Environmental Expenditures under Uncertainty

The environmental expenditure component of environmental management performance reduced under 2025, according to seven respondents (S1, S3, S6, S8, S10, S12, S13). These reductions of sustainability-related capital investments and operational costs have a many different explanations. Some respondents (S8, S12) refer to market conditions and financial constraints. For instance, S12 express that the dual responsibility of operations and sustainability sometimes forces them to allocate more time and financial resources to production. Others (S1, S3, S6, S10, S13) indicate that more resources would have had to be allocated to the sustainability budgets if Omnibus was not implemented.

Some firms in the studied industry did not cut investments. One respondent (S11) report increased environmental expenditures for 2025. This firm have a designated sustainability budget that increased during 2025. While this was not mentioned by S5, the document study demonstrates an increase of environmentally sustainable investment under the EU taxonomy between 2024 and 2025 for this firm. No other firms from the selected sample reported taxonomy-aligned environmentally sustainable investments in the sustainability reports of 2024 and 2025. The remaining sustainability professionals with perceived uncertainty (S2, S4, S9) claim that their environmental expenditures remain on the similar levels as the previous year.

4.2.8 Firm-level Environmental Management Performance under Uncertainty

Each studied firm demonstrated a unique pattern of change across the seven dimensions of environmental management performance (Table 8). Eight respondents (S1, S3, S4, S6, S8, S10, S12, S13) demonstrate an overall decrease in environmental management performance in 2025. Out of these, five respondents (S1, S3, S10, S12, S13) indicate that their firms demonstrated declined performance in three or more dimensions, which points towards a substantial downturn after the experienced uncertainty. These five firms differed both in terms of which wave they were part of and which forms of uncertainty they perceived as most important. Among the twelve firms with perceived uncertainty, one respondent (S9) demonstrates no overall changes in environmental management performance, and three respondents (S2, S5, S11) increase their summarised environmental management performance.

Table 8. Environmental Management Performance under Perceived Uncertainty by Firm

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13
Environmental Policy	0	0	0	0	0	0	0	0	1	0	0	0	0
Environmental Objectives	1	1	0	0	1	0	0	1	0	-1	0	0	0
Environmental Processes	0	0	0	0	0	0	0	0	0	-1	1	0	-1
Environmental Organisation	-1	0	-1	0	0	0	0	0	0	-1	0	-1	0
Environmental Monitoring	0	1	0	0	0	0	0	0	0	0	0	1	0
Environmental Disclosure	-1	-1	-1	-1	-1	-1	0	-1	-1	-1	-1	-1	-1
Environmental Expenditures	-1	0	-1	0	1	-1	0	-1	0	-1	1	-1	-1

1 = improved performance, 0 = unchanged performance, -1 = declined performance

4.3 Mechanisms between Uncertainty and Environmental Management Performance

The interview respondents present many ways in which different forms of perceived uncertainty could influence environmental management performance. While these mechanisms are mainly hypothetical for geopolitical and economic uncertainty, there are indications that environmental policy uncertainty seem to have influenced the performance of the environmental management in the studied firms. Business-to-business customers and investors are also being described in terms of important drivers of environmental management. The following subsections presents these stated mechanisms in more detail.

4.3.1 Environmental Management Performance under Geopolitical Uncertainty

The findings demonstrate that perceived factors of uncertainty related to geopolitical issues has potential to influence the environmental management performance of Swedish manufacturing firms. Four respondents (S8, S9, S11, S12) perceive factors categorized as geopolitical uncertainty as the main form of uncertainty that influences sustainability strategy. Two of these respondents (S9, S11) demonstrate moderate improvements of their environmental management activities, while the other two (S8, S12) convey a small regression in the studied period. Four additional respondents (S1-S3, S10) perceive some geopolitical uncertainty but not do not consider it the most important form of uncertainty.

The interview study conveys that geopolitical uncertainty may affect investment decisions. One respondent (S1) explains how geopolitical uncertainty in regions with energy production constitutes a risk for higher energy prices for production and transportation, which in turn creates hesitancy to invest in renewable energy in production. Similarly, another sustainability professional (S10) indicates that financial forecasts are affected by higher energy costs caused by geopolitical uncertainty in energy-producing countries. S10 concludes by stating that it is very difficult to know how one should invest in a turbulent world.

Several sustainability managers express similar concerns. For instance, S12 explains that geopolitical uncertainty in regions with energy production has a two-fold effect on the firms' finances. First, increased energy costs may cause higher input costs. Secondly, the transaction costs might increase as they are forced to reallocate resources to secure production input. Combined, the financial constraints from these two effects force the firm to down-prioritize other processes. Another respondent (S8) explains that the ongoing war in Ukraine increase prices on wood, oil, and gas, which affect estimated costs of projects and might lead to postponed investments.

Apart from financial constraints, geopolitical uncertainty may also shift the attitudes of internal and external stakeholders in ways that make environmental initiatives more difficult to justify and prioritise. For instance, S9 stipulates that geopolitical issues have made investors ask less sustainability-related questions and instead focus entirely on the financial aspects. Another respondent (S2) expresses a sustained interest among investors, but difficulty convincing internal stakeholders to pursue a sustainable path in times of geopolitical uncertainty:

> *"It is hard to motivate a salesperson who drives all over Sweden and stops and does not get home to their family because they have to charge electricity and it takes more time than refuelling with petrol and they get much shorter distances, when the whole world is being bombed."*

Geopolitical uncertainty could also pose opportunities for corporate environmental responsibility for some branches of the manufacturing industry. S8 states that the shifting energy market might create an opportunity for them to increase margins. Respondent S10 indicates that although disrupted energy markets caused by geopolitical uncertainty negatively affect corporate finances in the short term, they may also generate increased long-term demand for the firm's products.

4.3.2 Environmental Management Performance under Economic Uncertainty

The study contains two sustainability professionals (S10, S13) who perceive factors related to economic uncertainty as the main form of uncertainty in their forecasts. Both these respondents also indicate significant decreases of their summarized environmental management

performance. Four additional respondents (S1, S3, S9, S12) points out some economic uncertainties in their strategic environmental management.

The findings suggest that environmental management performance can be negatively influenced by uncertain market conditions. S1 explains how economic shocks have caused inflation of input goods and pushed a turn back from renewable energy to fossil fuels. S10 states that rapid shifts in tariff levels and stock prices make it difficult to predict the future of the firms' finances, which in turn affects the work with sustainability. The second responded for which economic uncertainty was top of mind (S13) indicates that the global economic condition, the global competition and technological shifts have affected corporate profits and created a risk that environmental management might have to be deprioritised. Other respondents (S3, S9) state that their firms would cut environmental investments, such as climate compensation, rather than making a net loss. On this topic, S13 states:

> *"There is so much going on. It is so tough to run a business that there is now a risk that environmental work, sustainability work, must be somewhat deprioritized."*

While five respondents (S1, S3, S9, S10, S12) perceive uncertainty in the external environment related to trade policy, none of the firms use this uncertainty as an explanation for their environmental management performance in 2025. Some sustainability professionals (S1, S3) are nevertheless stating that tariffs might influence their environmental management in the future. S3 also points out that their industry is usually not first to be exposed to tariffs and argues that some product owners might be more affected than sub-contractors who spread the risk over many different products.

4.3.3 Environmental Management Performance under Environmental Policy Uncertainty

This study contains eleven respondents (S1-S6, S8-S12) that perceive factors related to environmental policy uncertainty. All these respondents mentioned either Omnibus, CSRD or unstable regulations as one of the factors causing this uncertainty. All respondents with perceived uncertainty demonstrate regression in the disclosure dimension of environmental management performance, which indicates that this dismantling-induced environmental policy uncertainty influences environmental management negatively. Five of these respondents (S1, S2, S6, S8, S12) are however reporting increased level of ambition in their environmental objectives.

Respondents express that environmental policy uncertainty can influence environmental management by introducing a risk of unnecessary compliance-related investment. While most respondents indicate that the reduced legal obligations on sustainability reporting led to less environmental expenditures and environmental disclosure, the reduced spending and reporting often started already in the stage of uncertainty. S8 emphasizes that the dismantling of a sustainability-related EU directive before it enters into force creates uncertain conditions and makes it hard to invest. Augmenting in a similar way, S12 expresses how shifted legal requirements creates a trade-off between uncertain compliance-investments and investments aimed at financial competitiveness.

> *"It is like gas and break and gas and break and gas and break, which means that you eventually must reach the point where we decide to wait and see where we should put our resources. Beauce if we always should fulfil all requirements that everybody come up with all the time, we will need to spend a lot of*

money and resources on that. Which you then need to take from something else, for example marketing, product development, product refinement and machinery investments."

The attitudes towards Omnibus and its influence on environmental management performance diverge among the sustainability professionals. Many respondents (e.g. S1, S4, S6, S8, S11) indicate that the strict reporting standards introduced by CSRD forced them to attain a steep learning curve and improve the environmental management practices. While high expectations on environmental management were appreciated by some sustainability professionals, there was still a broad consensus among respondents (e.g. S1, S2, S4, S10, S11, S13) that the complexity and number of measuring points in CSRD was too extensive. When policymakers on the EU level listened to the complaints and implemented simplifying Omnibus package, many sustainability professionals remained concerned. A common critique of Omnibus expressed by multiple sustainability professionals (S3, S5, S11-S13) is that the shifting regulatory landscape is a source of confusion. On the contrary, several respondents (S8, S10, S12) indicate that the reduced reporting requirements make it possible for the firms to reallocate resources from reporting to operational environmental management.

The findings also demonstrate that environmental policy uncertainty seems to interact with pre-existing organizational dynamics. For instance, one respondent (S10) explains that actors within the firm, who always thought sustainability reporting was unnecessary administration without any value-creation, intensified their criticism when Omnibus was presented and pushed for cuts in environmental expenditures. This demonstrates that dimensions of environmental management performance can be affected by complex internal pressures and social interactions fuelled by external environmental policy uncertainty.

4.3.4 Stakeholder influence on Environmental Management Performance

Four sustainability professionals (S3, S10, S11, S13) perceive stakeholder-related uncertainty. While they are mostly not perceived as sources of uncertainty, all the 12 sustainability professionals that experienced external uncertainty also indicate external stakeholder pressures. Two key stakeholders for many of the interviewed sustainability managers are customers and shareholders.

Many sustainability managers are affected by their business-to-business customers. Twelve respondents (S1-S6, S8-S13) refer to this type of stakeholder as a pushing factor in their sustainability work. While some respondents (e.g. S12) are unaware of the motives behind the customer requests, many respondents (S4-S6, 68) indicate that customer requests of environmental disclosure often stem from legal requirements at the customers' end. There are also several business-to-business customers with requests beyond compliance. Many respondents are for instance receiving product-specific requests such as sustainable materials (S5, S10), circularity considerations (S4), or carbon dioxide footprint calculations (S5, S10, S12). For the overall environmental management, two respondents (S1, S3) mention requests for Science Based Targets from key customer and one respondent (11) need to provide an environmental policy. The interview study also demonstrates that customers could be influenced by uncertainty. For instance, one sustainability manager (S6) indicates that geopolitical uncertainty among customers postpones activities.

The findings indicate that shareholders and investors are considered as key stakeholders by many sustainability professionals in the Swedish manufacturing industry. Nine respondents (S1-S3, S5, S6, S9-S12) state that their environmental management is affected by investors. Several respondents (S1, S2, S6, S9, S12) are for instance indicating that their sustainability reports and communication are influenced by shareholder expectations. While one respondent (S5)

experiences a sustained investor pressure for sustainability, others (S2, S9) report a declined interest for sustainability due to Omnibus or a shifted attention to geopolitical uncertainty. Two respondents (S10, S12) state that the CSRD requirements covered way more datapoint than the shareholders were interested in. At the other end of the spectrum, some sustainability professionals highlight that a strong sustainability profile can attract investors. S11 focus on ESG ratings:

> *"There is quite a lot of capital on the market that is restricted to firms that comply with certain sustainability standards. To attract capital, you need a good ESG rating."*

To conclude, stakeholders such as customers and investors are being explained as important drivers of environmental management. When stakeholders are important but hard to predict, this causes perceived uncertainty among some sustainability managers. In addition to the uncertainty that sustainability managers can perceive, they also indicate that stakeholders can perceive uncertainties which affects their pressures for environmental management.

4.4 Reactions to Perceived Uncertainty

The study finds that sustainability professionals are reacting differently to perceived uncertainty. While several respondents highlight geopolitical and economic uncertainty as important, not many are indicating that external shocks associated with these forms of uncertainty directly affects environmental management performance under 2025. On the contrary, the EU-level dismantling of sustainability reporting requirements influence some environmental management practices for most studied manufacturing firms in Sweden. This external shock enables exploration of the strategies applied by the respondents. Therefore, the remaining of this section focuses on presenting the environmental management activities that sustainability managers applied when they were exposed to the EU Omnibus package.

For many firms, Omnibus came as a surprise. A sustainability professional (S6) explains how they read about the proposal in a business newspaper and started to send emails within the organization. When the new Omnibus directive was proposed, many conversations started to take place within the Swedish manufacturing firms. One respondent (S5) had a dialogue with the industry organization, another (S6) had conversations within a business network initiated by their main owner and a third (S1) consulted the auditors.

The reactions to the Omnibus directive diverge. Four respondents (S1, S10, S12, S13) report that their immediate reaction to the environmental policy withdrawal was to cut major parts of their environmental management activities. For instance, S1 "pulled the break" and S13 "put the pen down". One respondent (S10) explains that their first decision was to substantially cut the work with environmental management and put the documents in a folder, and one respondent (S12) took a step back and saved their resources. These four respondents also demonstrate negative results in their measured environmental management performance. S13 explains their applied actions in the following way:

> *"When Omnibus came, it was somewhat unclear. It came as a proposal. Would it align with the Swedish rules and legislations and so forth? But we still decided to go for the decision that, okay, we paus it."*

Other sustainability managers (S3-S6, S8, S9) apply a more reserved strategy. For instance, S4 indicates that they do not believe in anything before it has happened and rather apply more of a wait and see approach. Some respondents adapt to the current legislative requirements, but do not seem to be fully aware of what is to come. One of them is S5, who states that:

> *"We largely act based on what is currently effective and, as of now, we have not even looked into which reliefs that could potentially apply to us in 2026."*

Finally, some respondents (S2, S11) react to the Omnibus directive with more proactive strategies beyond compliance. These firms tend to adjust their reported datapoints and external auditing practices after the policy dismantling but also apply other recognized standards and voluntary emission calculations. S2 explains how they strive to continue being a sustainable firm:

> *"We are a sustainable business, and we should continue being a sustainable business. So, we decided to keep working, maybe not as if, but stick to the plans we had and update our reporting and follow up in a way that really has sharpened our reporting towards the firms and clarified. We get transparent reporting according to the GHG protocol and start preparing to join SBTi, that is Science Based Targets initiative."*

Sustainability managers at Swedish manufacturing firms act differently in response to environmental policy uncertainty caused by shifted sustainability reporting requirements. Several firms pulled the break, others followed the route, and a third group tried to find new ways. A common characteristic across the studied firms is that all respondents report some organisational response related to the Omnibus package.

5 Discussion

This chapter discusses the findings of the study in relation to existing literature, providing insights into how perceived external uncertainty shapes environmental management performance among Swedish manufacturing firms. The chapter is organised into three main sections. The first section considers whether sustainability professionals perceive the external environment as uncertain in geopolitical, economic, and environmental policy terms. The second examines whether and how these forms of perceived uncertainty influence environmental policies, targets, action plans, staffing, monitoring, reporting, and expenditures. The final section discusses the environmental management strategies adopted by sustainability professionals in response to perceived uncertainty.

5.1 Perceived Uncertainty among Sustainability Professionals

The findings demonstrate that sustainability professionals perceive uncertainty across geopolitical, economic, and environmental policy domains. This supports Hoffmann *et al.*'s (2008) finding that sustainability managers can perceive regulatory uncertainty caused by environmental policy. While Carney (2016) identifies geopolitical, economic, and policy uncertainty as part of the uncertainty trinity, and previous studies have measured similar forms of uncertainty through newspaper-based indices (Caldara & Iacoviello, 2022; Baker *et al.*, 2016; Palikhe *et al.*, 2024), this study adds a firm-level perceptual perspective. In the case studied, environmental policy uncertainty appears to be the most important form of uncertainty, both in terms of the number of references and in terms of what respondents describe as having the greatest influence on environmental management.

The most frequently perceived source of uncertainty among the interviewed sustainability professionals was the dismantling of sustainability reporting requirements through the EU Omnibus package. The reduction of required datapoints and exclusion of many firms from the previously adopted reporting requirements can be understood as a diminution of existing policy, and therefore as a form of policy dismantling in the sense described by Jordan *et al.* (2013). Although the CSRD covers environmental, social, and governance dimensions of corporate sustainability, its extensive environmental reporting requirements make it directly relevant to corporate environmental performance. In this case study, the dismantling of sustainability reporting requirements therefore emerges as a major source of perceived environmental policy uncertainty. This finding is consistent with Jordan and Moore's (2020) argument that formative moments in the policy process are characterised by uncertainty, and with previous studies showing that references to environmental policy uncertainty increase during episodes of environmental policy dismantling (Palikhe *et al.*, 2024; Gavriilidis, 2021).

5.2 Influence on Environmental Management Performance from Perceived Uncertainty

The document analysis and interviews suggest that all seven dimensions of environmental management performance shifted to some extent among firms included in the case study. This supports the relevance of the five dimensions of environmental management performance identified by Trumpp *et al.* (2015) and indicates that the qualitative indicators applied in this study could capture both improvements and declines in environmental management. The addition of environmental disclosure and expenditures as additional dimensions also proved analytically meaningful, as the indicators of these dimensions demonstrated observable variations.

A central contribution of this study is the exploration of the relationship between perceived uncertainty and environmental management performance. All firms in which a sustainability

professional perceived uncertainty demonstrate shifts in at least one of the dimensions of environmental management performance, which indicates some influence from uncertainty. Previous research has argued that environmental operational performance, such as emissions, pollution and waste, can be influenced by geopolitical, economic, and climate policy uncertainty (Guenichi *et al.*, 2023; Jia & Li, 2020; Chowdhury *et al.*, 2025). As this qualitative study finds that environmental management performance also can be affected by perceived uncertainty, it is possible that the environmental management mediates between external uncertainty and environmental operational performance. On an industry level, the magnitude of the observed performance changes of the environmental management is however small and ambiguous. The studied firms are generally leaving most dimensions of their environmental management unchanged, despite perceived uncertainty.

The dimensions most consistently associated with declining performance were environmental disclosure, environmental expenditures, and environmental organisation. Most important of these was environmental disclosure, followed by environmental expenditures and environmental organisation. The findings of reduced environmental budgets and employment for firms with perceived uncertainty is aligned with previous studies that detect negative relationships between external uncertainty and firm-level investments (Jia & Li, 2020; Caldara & Iacoviello, 2022; Palikhe *et al.*, 2024) and between external uncertainty and firm-level hiring (Bloom, 2009; Baker *et al.*, 2016; Xu & Yang, 2025). However, it contradicts Meng *et al.* (2026) who found a positive relationship between environmental policy uncertainty and hiring of environmental expertise. The declined environmental disclosure among all studied firms with perceived uncertainty represents a particularly important contribution, as such outcomes have not been observed in previous literature. Several studied firms with perceived external uncertainty improved their environmental objectives under uncertainty. This is also a new finding in relation to existing literature.

The findings of this study indicate that uncertainty can influence environmental management, as all measured types of uncertainty was perceived and all studied dimensions of environmental management performance shifted for at least one of the studied firms in the studied period. However, the qualitative nature of this study makes it impossible to establish causal links between types of uncertainties and dimensions of environmental management performance. Through the respondents stated reactions to perceived uncertainties the findings suggest possible mechanisms through which perceived uncertainty may influence environmental management performance. These mechanisms will now be explored in greater detail.

5.2.1 Postponed Environmental Investments

Most firms in the studied industry reduced their environmental expenditures at a time characterised by a large extent of uncertainty. Several sustainability professionals decided to cut environmental investments already when Omnibus was proposed, meaning that it was not certain if it would be adopted. One commonly mentioned rationale behind the reduced expenditures already at a stage of uncertainty was a prioritisation of productive investments intended to increase profits over compliance-related investments with a risk that they would end up not being necessary. This mechanism is aligned with the postponed environmental investments suggested by real options theory (Jia & Li, 2020). As McDonald and Siegel (1986) argue that risk-averse investors may postpone irreversible projects until the expected benefits are sufficiently high relative to investment costs, the postponed environmental investments suggest that, under uncertainty, firms did not perceive the expected benefits of these investments as high enough to justify proceeding. This is also in line with Palikhe *et al.* (2024) who argues that environmental policy uncertainty reduces firm-level investments, especially in industries that are especially exposed to environmental regulations.

Economic and geopolitical uncertainty were perceived as potential future constraints on environmental investment, while environmental policy uncertainty was the main current driver of postponement. According to the sustainability professionals of the studied firms, economic and geopolitical uncertainty have not yet caused postponed investments but might do so in the future through effects on the firm-level finances. The mechanisms that in the future might make economic uncertainty reduce environmental investments is that worsened market conditions or tariffs could force firms to focus on making the business go around instead of spending money on environmental initiatives. A similar mentioned relationship that might affect environmental investments in the future is that armed conflicts might increase energy prices and thereby cause postponed environmental investments. For this study, it could be concluded that the postponement of investments under uncertainty suggested by real options theory are somewhat mentioned by respondents in relation to all types of uncertainty from the trinity, but that the mechanism seems to be most applicable for environmental policy uncertainty among the studied Swedish manufacturing firms in 2025. One possible explanation is that the Omnibus package created immediate uncertainty regarding whether compliance-related environmental investments would be required, whereas uncertainty related to tariffs and energy prices appears to have had a less direct effect on environmental management performance.

5.2.2 Stakeholder pressures under Uncertainty

All sustainability professionals with perceived uncertainty indicate external stakeholder pressures. Multiple firms indicate that the ambition level of their environmental targets increase in times of uncertainty. One potential explanation for this is increased stakeholder pressure for environmental commitments. This would align with previous studies who draws on stakeholder theory to suggest that stakeholder demands in uncertain times makes firms signal preparedness and environmental commitments (Persakis, 2024; Huang *et al.*, 2025). The most prevalent stakeholder pressures related to environmental management in the studied industry, however, seem to be customer and investor pressure for environmental disclosure. Several firms indicate that the geopolitical and environmental policy uncertainty have reduced the stakeholder demands for environmental disclosure. The study also finds declined performance in the disclosure dimension of environmental management for all studied firms with perceived uncertainty.

5.2.3 The combined effect of Policy Dismantling and Uncertainty on Environmental Management Performance

The EU Omnibus package has been demonstrated to constitute the major source of perceived uncertainty among Sustainability professionals in the studied industry. While the Omnibus package creates perceived uncertainty about the future EU environmental policy, the dismantling of the legally mandated sustainability reporting standard also shifts the regulatory requirements. This study demonstrates that relevant decision-makers perceived uncertainty and state that their environmental management have been adjusted as a response, which indicates that uncertainty is one reason for the decreased environmental performance. This is further enhanced by descriptions of how environmental expenditures and hiring was cut already at the proposal stage of the policy process, rather than when the policy was adopted. However, as the environmental disclosure decreased for all firms with sustainability professionals who perceived uncertainty related to the EU Omnibus package, it is likely that the reduced regulatory requirements for sustainability reporting was a major source behind the reversed performance of this dimension. Whether the declined performance in the expenditure and organisational dimensions of environmental management was a consequence mainly of reduced reporting requirements or of the uncertainty caused by this dismantling is not possible to determined based on the findings from this study.

It may also be discussed whether policy dismantling of administrative requirements could improve corporate environmental performance. Here, the study presents opposing findings. Many sustainability professionals express negative attitudes towards rapid regulatory shifts, while appreciating reduced administrative burden. Which of these effects that triumphs the other varies between the respondents. Many sustainability professionals have been employed to manage CSRD, and all except one kept their position despite Omnibus. As less work is now required for sustainability reporting, many of the sustainability professionals themselves state that they will spend more time on environmental processes and activities directed towards emission reductions. It is therefore theoretically possible that one combined effect of CSRD and Omnibus is that firms first employed a specialized sustainability professional at group level and then directed their work description to emission-reducing activities when the reporting requirements were dismantled. However, only one of the firms has demonstrated increased work with action plans and other processes at the year of the policy dismantling. Despite the limited evidence of improved environmental performance caused by policy dismantling, it is nevertheless true that almost all sustainability professionals express that CSRD was too extensive and many express gratitude that this was acknowledged by policymakers.

The study demonstrates that a dismantling of reporting requirements is not only reducing the standards of sustainability reporting but also shifting the perceived expectations of corporate environmental performance. That firms adjust the number of datapoints in their sustainability reports in response to the Omnibus does not necessarily demonstrate reduced voluntary commitments through corporate environmental responsibility, at least not for firms whose environmental strategy is built mainly on regulatory compliance. However, the environmental policy dismantling may affect the expected direction of future policies and thereby the trajectory of the whole industry. When long-term political commitments towards climate change mitigation are starting to be questioned, the shifts of envisioned paths may make firms reconsider their strategic positioning.

5.3 Environmental management strategies under Uncertainty

The perceived environmental policy uncertainty caused by Omnibus made the studied firms in the Swedish manufacturing industry adjust their environmental management strategies in different ways. It should be noted that these applied strategies in response to dismantled sustainability reporting regulations are not necessarily generalisable to other industries or geographical contexts, and certainly not for all cases of environmental policy uncertainty or policy dismantling. Despite the limited generalisability, this study could still provide relevant knowledge of possible ways to adjust environmental management in response to perceived uncertainty caused by policy dismantling. Drawing on the definition of environmental management strategies presented in the literature review, the remaining of this discussion will be dedicated to the actions and strategic postures regarding the natural environment, applied by sustainability professionals under perceived uncertainty. To focus the discussion, it will be centered around the commonly perceived uncertainty related to the EU Omnibus package.

5.3.1 Applied Actions under Perceived Uncertainty

The immediate reactions to the Omnibus package differed between firms. While some applied a wait and see approach, others reacted by immediately reducing the ambition level for environmental reporting and cutting the associated expenditures and consultancy hours. A third group of firms applied a more proactive approach that involved own initiatives to find suitable reporting standards and applying voluntary emission calculations.

5.3.2 Strategic Postures under Perceived Uncertainty

The diverging reactions to the Omnibus package demonstrate that sustainability managers are employing different strategies in their environmental management in times of external uncertainty. The actions could be translated into different strategic postures from which they might have emerged. Some sustainability professionals demonstrate a short horizon and apply more of a wait and see approach, with similarities to the strategic posture adapting to the future (Courtney *et al.*, 1997). Other firms react to the potential dismantling by immediately reducing environmental expenditures. This aligns with the strategic posture of reserving the right to play by Courtney *et al.* (1997). A third group of firms apply more proactive strategies beyond compliance, built around leading the industry and applying voluntary measures based on stakeholder wishes rather than legal requirements. This shares characteristics with the strategic posture of shaping the future (Courtney *et al.*, 1997). While Courtney et al. (1997) focus on the financial and managerial components of strategy under uncertainty, this study suggests that their strategic postures also could be applied to conceptualise strategic postures for environmental management under uncertainty.

6 Conclusions

This thesis explored the connections between perceived uncertainty and environmental management performance through a qualitative case study of the Swedish manufacturing industry. The findings indicate that sustainability professionals perceive uncertainty originating from geopolitical, economic, and environmental policy sources. While uncertainty related to environmental policy has received attention in previous research, the findings suggest that sustainability professionals also perceive geopolitical and economic uncertainty, extending the current understanding of uncertainty in the literature. The study further found that all firms with reported perceived uncertainty also reported changes in at least one dimension of environmental management performance. Although these findings do not establish a causal relationship, they indicate that the connections between perceived uncertainty and environmental management performance deserve further investigation.

An important source of uncertainty identified in this study was the dismantling of legal requirements for sustainability reporting. Most sustainability professionals in the case study perceived uncertainty associated with sustainability reporting standards or the dismantling of environmental policy. Furthermore, all respondents who perceived uncertainty related to the EU Omnibus package reported reduced environmental disclosure. Many sustainability professionals also described reduced environmental expenditures and hiring, following the relaxation of reporting requirements. At the same time, the study found that several firms decided on more ambitious environmental targets, while environmental policies, action plans, and key performance indicators changed only marginally. The combination of postponed environmental investments and signals to the surroundings through more ambitious environmental objectives under perceived uncertainty suggests that real options theory and stakeholder theory, which have often been presented as competing explanations, may both contribute to explaining firms' environmental management under uncertainty.

The study also found that firms in the Swedish manufacturing industry adopted different environmental management strategies in response to perceived uncertainty. Firms responded by reducing investments, initiating new environmental initiatives, or accepting the new conditions and adapting accordingly. These responses could be categorised according to the strategic postures of reserving the right to play, shaping the future, and adapting to the future, suggesting that environmental management under uncertainty can be understood through the lens of strategic postures and actions towards the natural environment. Most firms adopted adaptive or reserving strategies, whereas only a few pursued proactive environmental management strategies with potential to shape standard procedures of the industry.

This research was designed as a qualitative case study of manufacturing firms in Sweden during 2025, meaning that the findings have limited generalisability to other industrial, geographical, and temporal contexts. A further limitation is that the study relies primarily on the perceptions and accounts of sustainability professionals, which may be subject to bias. To address this limitation, factual statements were triangulated through document analysis, while participants' perceptions were analysed as subjective interpretations rather than objective representations of reality.

6.1 Practical Implications and Recommendations for Practitioners

When firms are face with uncertain sustainability reporting requirements, their internal decision-makers and external stakeholders may benefit from being informed of environmental management strategies that could be applied under such circumstances. By knowing that a commonly applied approach is to reduce disclosure, investments, and hiring, stakeholders such as customers, investors, auditors, consultants, suppliers, and competitors could adjust their

business decisions accordingly. Firms interested in playing a leadership role in shaping industry standards are recommended to maintain their environmental management capacity even when reporting requirements become uncertain.

For policymakers within EU institutions, it is of relevance that dismantling of sustainability reporting requirements with the purpose of improving competitiveness in an increasingly turbulent geoeconomic landscape risks leading to firm-level uncertainty of the overarching policy direction. While streamlined policies could reduce administrative burden, it may also introduce uncertainty which holds back investments and makes it harder to reach EU climate targets. EU level politicians and administrators are therefore recommended to take such risks into consideration when dismantling of environmental policy is proposed or analysed.

6.2 Recommendations for Further Research

This thesis recommends further research into whether uncertainty caused by the dismantling of sustainability reporting requirements affects environmental management performance differently from uncertainty caused by the introduction of stricter reporting requirements. Such comparisons are relevant as stricter regulation may create compliance-related uncertainty, while weakened regulation instead may create uncertainty about whether firms should maintain, reduce, or redirect environmental management efforts. The distinction between regulatory uncertainty caused by new policy implementation and regulatory uncertainty caused by policy dismantling might also be relevant for quantitative studies that identifies relationships between different forms of uncertainty and firm-level investments. While researchers have identified uncertainty at different stages of the policy process, potential feature differences based on the cause of the policy uncertainty have not yet been investigated.

Finally, this paper recommends further research on the relationships between perceived uncertainty and environmental management practices. Similar studies could preferably be conducted in other industries and national settings. The relationship between different types of uncertainty and environmental management performance would also benefit from being investigated through quantitative studies. These studies are recommended to include uncertainty, environmental management performance, and environmental operational performance to examine whether environmental management performance could constitute a mediating factor between uncertainty and environmental operational performance.

Bibliography

Alfaro, I, Bloom, N., & Lin, X. (2018). The Finance Uncertainty Multiplier. *National Bureau of Economic Research.* http://www.nber.org/papers/w24571

Ali, Q., Salman, A., & Parveen, S. (2022). Evaluating the effects of environmental management practices on environmental and financial performance of firms in Malaysia: the mediating role of ESG disclosure. *Heliyon, 8*(12). https://doi-org.ludwig.lub.lu.se/10.1016/j.heliyon.2022.e12486

Armelius, H., Hull, I., & Stenbacka Köhler, H. (2017). The timing of uncertainty shocks in a small open economy. *Economics Letters, 155*, 31-34. https://doi.org/10.1016/j.econlet.2017.03.016. Data downloaded from https://www.policyuncertainty.com/sweden_monthly.html on May 8, 2026.

Amit, R., & Schoemaker, P. J. H. (1993). Strategic Assets and Organizational Rent. *Strategic Management Journal, 14*(1), 33–46. https://doi.org/10.1002/smj.4250140105

Azzone, G., Noci, G., Manzini, R., Welford, R. & Young, C. W. (1996). Defining Environmental Performance Indicators: An Integrated Framework. *Business Strategy and the Environment, 5*, 69-80. https://doi.org/10.1002/(SICI)1099-0836(199606)5:2<69::AID-BSE48>3.0.CO;2-W

Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring Economic Policy Uncertainty. *The Quarterly Journal of Economics, 131*(4), 1593–1636. https://doi.org/10.1093/qje/qjw024

Bevan, L. D. (2022). The ambiguities of uncertainty: A review of uncertainty frameworks relevant to the assessment of environmental change. *Futures, 137*. https://doi.org/10.1016/j.futures.2022.102919

Bloom, N. (2009). The impact of uncertainty shocks. *Econometrica, 77*(3), 623-685. https://doi.org/10.3982/ECTA6248

Brown, J. D. (2004). Knowledge, Uncertainty and Physical Geography: Towards the Development of Methodologies for Questioning Belief. *Transactions of the Institute of British Geographers, 29,* 367-381. http://www.jstor.org/stable/3804497

Brugnach, M., Dewulf, A., Pahl-Wostl, C., & Taillieu, T. (2008). Toward a Relational Concept of Uncertainty: about Knowing Too Little, Knowing Too Differently, and Accepting Not to Know. *Ecology and Society, 13*(2). http://www.jstor.org/stable/26267972

Cejudo, G. & Olvera, J. (2025). Studying the Effects of Policy Dismantling. *SSRN Electronic Journal.* http://dx.doi.org/10.2139/ssrn.5051311

Caldara, D., Iacoviello, M., Molligo, P., Prestipino, A., & Raffo, A. (2020). The economic effects of trade policy uncertainty. *Journal of Monetary Economics, 109*, 38-59. https://doi.org/10.1016/j.jmoneco.2019.11.002. Data downloaded from https://www.policyuncertainty.com/trade_cimpr.html on May 8, 2026.

Caldara, D. & Iacoviello, M. (2022). Measuring geopolitical risk. *American Economic Review, 112*(4),1194-1225. https://www.aeaweb.org/articles?id=10.1257/aer.20191823. Data downloaded from https://www.matteoiacoviello.com/gpr.htm on May 8, 2026.

Caldara, D., Conlisk, S., Iacoviello, M., & Penn, M. (2026). Do Geopolitical Risks Raise or Lower Inflation? *Journal of International Economics, 159*. https://doi.org/10.1016/j.jinteco.2025.104188. Data downloaded from https://www.matteoiacoviello.com/gpr_country.htm on May 8, 2026.

Carney, M. (2016). *Uncertainty, the economy and policy*. Bank of England. https://www.bis.org/review/r160704c.pdf

Council of the EU. (2025). *Council and Parliament strike a deal to simplify sustainability reporting and due diligence requirements and boost EU competitiveness.* https://www.consilium.europa.eu/en/press/press-releases/2025/12/09/council-and-parliament-strike-a-deal-to-simplify-sustainability-reporting-and-due-diligence-requirements-and-boost-eu-competitiveness/

Courtney, H., Kirkland, J., & Viguerie, P. (1997). Strategy Under Uncertainty. *Harvard Business Review.*

Chowdhury, S. R., Koussis, N., Makrominas, M., & Trigeorgis, L. (2025). Geopolitical risk, uncertainty, real options, and corporate social responsibility. *Financial Review, 60*(3), 729-759. https://doi.org/10.1111/fire.12427

Creswell, J. W. & Creswell, J. D. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (5th ed.). Sage.

Crane, A., Matten, D. & Spence, L. (2008). *Corporate Social Responsibility: Readings and Cases in Global Context*. Routledge.

Davies, S., Pettersson, T., Sollenberg, M., & Öberg, M. (2025). Organized violence 1989–2024 and the challenges of identifying civilian victims. *Journal of Peace Research*, *62*(4), 1223-1240. https://doi.org/10.1177/00223433251345636

Davis, S. J. (2016). An Index of Global Economic Policy Uncertainty, *Macroeconomic Review*. Data downloaded from https://www.policyuncertainty.com/global_monthly.html on May 8, 2026.

Dixit, A. K., & Pindyck, R. S. (1994). *Investment Under Uncertainty*. Princeton University Press.

Duncan, R. B. (1972). Characteristics of organization environments and perceived environmental uncertainty. *Administrative Science Quarterly, 17*(3), 313-327. https://www.jstor.org/stable/2392145

Etim, E. E., Samuel, H. S., Akinpelu, O. O., Undie, D. A., Onotu, O. P., Ibekwe, F. A. (2026). Presentation of environmental management of corporate environmental responsibility in the oil and gas industry. *Discover Sustainability 7*(75). https://doi.org/10.1007/s43621-025-02367-3

European Commission. (2025). *Omnibus package*. https://finance.ec.europa.eu/news/omnibus-package-2025-04-01_en

European Parliament. (2026). *Corporate Sustainability Reporting Directive (CSRD)*. https://www.europarl.europa.eu/legislative-train/theme-a-european-green-deal/file-review-of-the-non-financial-reporting-directive

EU. (2025). *NACE Rev. 2.1 – Statistical classification of economic activities in the European Union*. https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/w/ks-gq-24-007

Eurostat. (2026). *Quarterly greenhouse gas emissions in the EU*. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Quarterly_greenhouse_gas_emissions_in_the_EU

Freeman, R. E. (1984). *Strategic Management: A Stakeholder Approach*. Pitman.

Gabriel, V., Miralles-Quirós, M., & Miralles-Quirós, J. (2026). Navigating tail risks: The influence of geopolitical uncertainty on clean and carbon energy. *Energy Strategy Reviews, 64*. https://doi.org/10.1016/j.esr.2026.102060

Gavriilidis, K. (2021). Measuring Climate Policy Uncertainty. *SSRN Electronic Journal*. http://dx.doi.org/10.2139/ssrn.3847388

Gavriilidis, K., Raghavan, R., & Stock, J. (2026). *The Macroeconomic Effects of Climate Policy Uncertainty*. Working Paper. https://dkaenzig.github.io/diegokaenzig.com/Papers/gkrs_cpu.pdf. Data downloaded from https://www.policyuncertainty.com/sweden_monthly.html on May 8, 2026.

González Sánchez, F. J., Martín, G. R., López Sáez, P., & Martín, A. R. (2026). Corporate Environmental Responsibility, Environmental Policy Stringency and Debt Cost in Europe. *Corporate Social Responsibility and Environmental Management 33*, 1230-1248. https://doi.org/10.1002/csr.70220.

Guenichi, H., Omri, N. A., & Khaskhoussi, T. (2023). Geopolitical risk, economic and climate policy uncertainty and ESG disclosure: evidence from US firms. *Management of Environmental Quality: An International Journal, 36*(7), 1758-1785. https://doi.org/10.1108/MEQ-09-2024-0405

Gulen, H. & Ion, M. (2016). Policy Uncertainty and Corporate Investment. *The Review of Financial Studies, 29*(3), 523-564. https://doi.org/10.1093/rfs/hhv050

Hassler, J., Krusell, P, & Olovsson, C. (2018). The Consequences of Uncertainty: Climate Sensitivity and Economic Sensitivity to the Climate. *Annual Review of Economics, 10*, 189-205. https://doi.org/10.1146/annurev-economics-080217-053229

Hoffmann, V. H., Trautmann, T., & Schneider, M. (2008). A taxonomy for regulatory uncertainty - application to the European Emission Trading Scheme. *Environmental Science & Policy, 11*(8), 712-722. https://doi.org/10.1016/j.envsci.2008.07.001

Huang, S., Foglia, M., & Pacelli, V., & Fan, Y. (2025). Substantive action: The Italian corporate ESG response to Climate Policy uncertainty. *Journal of Environmental Management, 395*. https://doi.org/10.1016/j.jenvman.2025.127948

Huang, W. (2026). The impact of climate policy uncertainty on corporate investment. *International Review of Financial Analysis, 113*. https://doi.org/10.1016/j.irfa.2026.105118

IPCC. (2023). *Climate Change 2023: Synthesis Report*. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. https://doi.org/10.59327/IPCC/AR6-9789291691647

Jana, R. K., Ghosh, I., & Goyal, V. (2022). Spillover nexus of financial stress during black Swan events. *Finance Research Letters, 48*. https://doi.org/10.1016/j.frl.2022.102892

Jia, J. & Li, Z. (2020). Does external uncertainty matter in corporate sustainability performance? *Journal of Corporate Finance, 65*. https://doi.org/10.1016/j.jcorpfin.2020.101743

Jin, Y., Zhao, H., Bu, L., & Zhang, D. (2023). Geopolitical risk, climate risk and energy markets: A dynamic spillover analysis. *International Review of Financial Analysis, 87*. https://doi.org/10.1016/j.irfa.2023.102597

Jordan, A., Bauer, M. W., & Green-Pedersen, C. (2013). Policy Dismantling. *Journal of European Public Policy, 20*(5), 795–805. https://doi.org/10.1080/13501763.2013.771092

Jordan, A. & Moore, B. (2020*). Durable by Design?: Policy Feedback in a Changing Climate*. Cambridge University Press. https://doi-org.ludwig.lub.lu.se/10.1017/9781108779869

Jung, E. J., Kim, J. S., & Rhee, S. K. (2001). The measurement of corporate environmental performance and its application to the analysis of efficiency in oil industry. *Journal of Cleaner Production, 9*(6), 551-563. https://doi.org/10.1016/S0959-6526(01)00011-7

Kang, W., Lee, K., & Ratti, R. A. (2014). Economic policy uncertainty and firm-level investment. *Journal of Macroeconomics, 39*, 42-53. https://doi.org/10.1016/j.jmacro.2013.10.006

Keynes, J. M. (1921). *A treatise on probability*. MacMillan and CO.

Knight, F, H. (1921). *Risk, uncertainty, and profit*. Houghton Mifflin.

Knutti, R., Allen, M. R., Friedlingstein, P., Gregory, J. M., Hegerl, G. C., Meehl, G. A., Meinshausen, M., Murphy, J. M., Plattner, G. K., Raper, S. C. B., Stocker, T. F., Stott, P. A., Teng, H., & Wigley T. M. L. (2008). A Review of Uncertainties in Global Temperature Projections over the Twenty-First Century. *Journal of Climate, 21(*11), 2651-2663. https://doi.org/10.1175/2007JCLI2119.1

Kutiel, H. (2019) Climatic Uncertainty in the Mediterranean Basin and Its Possible Relevance to Important Economic Sectors. *Atmosphere, 10*(1). https://doi.org/10.3390/atmos10010010

Lefebvre, E., Lefebvre, L. A., & Talbot, S. (2003). Determinants and impacts of environmental performance in SMEs. *R&D Management, 33*(3), 263-283. https://doi.org/10.1111/1467-9310.00297

Li, T., Wang, K., Sueyoshi, T., & Wang, D. D. (2021). ESG: Research Progress and Future Prospects. *Sustainability, 13*(21). https://doi.org/10.3390/su132111663

McDonald, R. & Siegel, D. (1986). The value of waiting to invest. *Quarterly Journal of Economics, 101*(4), 707–727. https://doi.org/10.2307/1884175

Meng, D., Li, Y. & Wang, L. (2026). Climate Policy Uncertainty and Corporate Green Strategy Adjustment: A Perspective on Hiring Executives With Environmental Experience. *Business Strategy and the Environment, 35*(1), 351-373. https://doi.org/10.1002/bse.70185

Miles, R. E., Snow, C. C., Meyer, A. D., & Coleman, H. J. Jr. (1978). Organizational strategy, structure, and process. *The Academy of Management Review, 3*(3), 546-562.

Milliken, F. J. (1987). Three Types of Perceived Uncertainty about the Environment: State, Effect, and Response Uncertainty. *The Academy of Management Review, 12*(1), 133–143. https://doi.org/10.2307/257999

Monier, E., Gao, X., Scott, J. R., Sokolov, A. P., & Schlosser, C. A. (2015). A framework for modeling uncertainty in regional climate change. *Climatic Change, 131*, 51-55. https://doi.org/10.1007/s10584-014-1112-5

Palikhe, H., Schaur, G., & Sims, C. (2024). Environmental Policy Uncertainty. *Journal of the Association of Environmental and Resource Economists, 11*(5). https://doi.org/10.1086/729529

Parker, T. (2016). *The Meaning of Environmental Management: An Interpretive Study of Managing Emergent or Evolutionary Environmental and Energy Strategy*. Doctoral Thesis. The International Institute for Industrial Environmental

Economics, Lund University. https://portal.research.lu.se/en/publications/990bb3f2-cf58-4447-a848-93ab89357601

Persakis, A. (2024). The impact of climate policy uncertainty on ESG performance, carbon emission intensity and firm performance: evidence from Fortune 1000 firms. *Environment, Development and Sustainability, 26*. https://doi.org/10.1007/s10668-023-03634-x

Polasky, S., Carpenter, S. R., Folke, C. & Keeler, B. (2011). Decision-making under great uncertainty: environmental management in an era of global change. *Trends in Ecology & Evolution, 26*(8), 398-404. https://doi.org/10.1016/j.tree.2011.04.007

Sarhan, A. A. & Gerged, A. M. (2023). Do corporate anti-bribery and corruption commitments enhance environmental management performance? The moderating role of corporate social responsibility accountability and executive compensation governance. *Journal of Environmental Management, 341*. https://doi.org/10.1016/j.jenvman.2023.118063

Sigel, K., Klauer, B., & Pahl-Wostl, C. (2010). Conceptualising uncertainty in environmental decision-making: The example of the EU Water Framework Directive. *Ecological Economics, 69*(3), 502-510. https://doi.org/10.1016/j.ecolecon.2009.11.012

Smales, L. A. (2022). Spreading the fear: The central role of CBOE VIX in global stock market uncertainty. *Global Finance Journal, 51*. https://doi.org/10.1016/j.gfj.2021.100679

Tadros, H. & Magnan, M. (2021). How does environmental performance map into environmental disclosure? A look at underlying economic incentives and legitimacy aims. *Sustainability Accounting, Management and Policy Journal, 10*(1), 62-96. https://doi.org/10.1108/SAMPJ-05-2018-0125

Tan, X., Zhong, Y., Vivian, A., Geng, Y., Wang, Z., & Zhao, D. (2024). Towards an era of multi-source uncertainty: A systematic and bibliometric analysis. *International Review of Financial Analysis, 95*. https://doi.org/10.1016/j.irfa.2024.103411

EU Technical Expert Group on Sustainable Finance. (2019). *Report on Benchmarks: Financing a Sustainable European Economy*. https://finance.ec.europa.eu/system/files/2019-09/190930-sustainable-finance-teg-final-report-climate-benchmarks-and-disclosures_en.pdf

Thompson, J. D. (1967). *Organizations in action: Social science bases of administrative theory*. McGraw-Hill Book Company.

Timmermans, S. & Tavory, I. (2012). Theory Construction in Qualitative Research: From Grounded Theory to Abductive Analysis. *Sociological Theory 30*(3), 167-186. https://doi.org/10.1177/0735275112457914

Trumpp, C., Endrikat, J., Zopf, C., & Guenther, E. (2015). Definition, Conceptualization, and Measurement of Corporate Environmental Performance: A Critical Examination of a Multidimensional Construct. Journal of Business Ethics, 126(2), 185-204. https://www.jstor.org/stable/24702742

Walker, W. E., Harremoës, P., Rotmans, J., van der Sluijs, J. P., van Asselt, M. B. A., Janssen, P., & Krayer von Krauss, M. P. (2003). Defining Uncertainty: A Conceptual Basis for Uncertainty Management in Model-Based Decision Support. *Integrated Assessment, 4*(1), 5–17. https://doi.org/10.1076/iaij.4.1.5.16466

World Economic Forum. (2026). *Global Risks Report 2026*. https://www.weforum.org/publications/global-risks-report-2026/

Xie, S. & Hayase, K. (2007), Corporate environmental performance evaluation: a measurement model and a new concept. *Business Strategy and the Environment, 16*, 148-168. https://doi-org.ludwig.lub.lu.se/10.1002/bse.493

Xu, F., & Yang, Y. (2025). Climate policy uncertainty and firm employment adjustment: evidence from China. *Applied Economics*, 1-19. https://doi.org/10.1080/00036846.2025.2604277

Yang, M., Hong, P., & Modi, S. B. (2011). Impact of lean manufacturing and environmental management on business performance: An empirical study of manufacturing firms. *International Journal of Production Economics, 129*(29), 251-261. https://doi.org/10.1016/j.ijpe.2010.10.017