

# **Impact Of The EU Carbon Border Adjustment Mechanism (CBAM) On Finnish Metal Exports**

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Author	Publication type	Completion year
Sepehr Sadeghi	Thesis, UAS	2026
	Number of pages	
49		
Title of the thesis		
<b>Impact of the EU Carbon Border Adjustment Mechanism (CBAM) on Finnish metal exports</b>		
Degree, Field of Study		
Bachelor's in business administration (UAS), International Business		
Abstract		
<p>Climate policy has become an increasingly important factor shaping international trade within the European Union. The Carbon Border Adjustment Mechanism (CBAM) is a key EU policy instrument designed to address carbon leakage by applying a carbon cost to certain imported emission-intensive products. As a highly export-oriented country with a strong metal industry, Finland is directly affected by this regulatory development.</p> <p>The objective of this thesis is to examine the impact of CBAM on Finnish metal exports to the European Union, focusing on regulatory and administrative requirements, export performance, and potential future carbon cost exposure. The study applies a qualitative research design supported by descriptive statistical analysis and relies exclusively on secondary data, including EU policy documents, national reports, and official trade statistics.</p> <p>The findings indicate that CBAM introduces new reporting and compliance obligations that increase administrative costs for firms involved in metal exports. Descriptive trade data show a recent decline in Finnish metal export volumes and values to the EU, although these developments cannot be attributed solely to CBAM. Scenario-based analysis suggests that future CBAM-related carbon costs could be significant for emission-intensive metal products. Overall, CBAM is likely to pose both challenges and strategic opportunities for Finnish metal exporters in EU markets.</p>		
Keywords		
CBAM, Finnish metal exports, EU trade policy, carbon leakage, metal industry		

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## 1 Introduction

In the European Union (EU), the climate crisis is increasingly reflected in new regulations which are changing the economy, industry, and international trade. The European Green Deal is designed to monitor trade, by requiring climate considerations to be built into decision making. The European Commission (2019) set the goal of climate neutrality by 2050. To achieve this goal, the EU is developing trade-related regulatory tools to succeed in achieving climate objectives and trying to reduce transboundary greenhouse gas emissions.

Böhringer et al. (2012) explain that the most important key concern is carbon leakage emission intensive production shifting from jurisdictions with stricter climate rules to those with looser ones which can strengthen firms' competitiveness while weakening climate policy outcomes [BM2.1]. These concerns underpin the EU's Carbon Border Adjustment Mechanism (CBAM). This is called a climate-related trade instrument that aligned with the EU Emissions Trading System (EU ETS). European Commission (2021a) states that under CBAM, certain imports must face carbon costs comparable to those paid by EU producers under the EU ETS.

For importers who produce high emission goods, CBAM requires reporting of embedded emissions in and after the transition period, the purchase of CBAM certificates is priced in line with the EU ETS administration. The first phase targets carbon-intensive sectors exposed to international competition, including iron, steel, aluminum, cement, fertilizers, electricity, and hydrogen. European Commission (2021a) and European Union (2023) note that implementation has been beginning with monitoring, reporting, and verification requirements and then moving to financial obligations.

In Finland, manufacturing provides a large share of value added and improve employment. In this case exports are basement of economic performance. Metals and metal products consistently rank at the top of export categories in Finland and much of that export is shipped to EU. Therefore, and change in EU trade rules affects quickly on Finnish metal exporters (Ministry of Economic Affairs and Employment 2022; Finnish Customs 2024; Finnish Customs 2025; Statistics Finland 2025).

CBAM affects iron, steel, and aluminum producers most directly, as well as firms within related supply chains. These companies must expand emissions reporting and may tolerate higher costs due to CBAM puts a price on embedded emissions; compared to, firms with lower emissions or cleaner production line that conclude in getting benefit as requirements tighten (Porter & van der Linde 1995; Böhringer et al. 2017; European Commission 2021a; Ministry of Economic Affairs and Employment 2022).

Böhringer et al. (2012), Branger & Quirion (2014), and Mehling et al. (2019) concentrate on carbon leakage and the climate–trade issues, typically at the EU or global level, while much of the CBAM literature argues policy design, legal questions, or the impact on the economy. Recently, Etna (2022) and the Ministry of Economic Affairs and Employment (2022) have tested possible implications for Finland in country-level assessments, but detailed evidence on sector reaction and changing in export patterns remains limited. Few studies bring official policy requirements together with trade data to assess how Finnish metal exports may respond under CBAM.

This thesis examines how CBAM reshapes the conditions of metal exports of Finland to the EU through legal, administrative, and market perspectives. It focuses on the compliance duties CBAM creates for exporters and importers, and early movements in export values and volumes during rollout.

## 1.1 Background

Global climate policy has shifted from general aspects to quantified targets and are using tools such as emissions fees and stricter regulation. Böhringer et al. (2012) note that this new approach is increasingly shaping firms' production and countries trade. In the EU, this shift is anchored in the 2019 climate agenda, which links decarbonization to industrial policy and trade. As result the long-term goal is climate neutrality by 2050, and the policy path has since been tightened through “Fit for 55,” which aims to reduce the amount of greenhouse gas emissions by 55% by 2030 compared with 1990 levels (European Commission 2019).

CBAM was designed to fill the gap in the EU Emissions Trading System (EU ETS) by addressing carbon leakage risks in trade-exposed and emission-intensive sectors (European Commission 2021a). As Böhringer et al. (2012) and Branger & Quirion (2014) explain, under the EU ETS, covered installations must surrender allowances for verified emissions, creating a cost that can encourage relocation to jurisdictions with weaker rules, and in the meantime undermining both competitiveness and emissions cuts.

CBAM extends a similar carbon-cost logic to certain imports. Importers must report embedded emissions in and, after the transition phase, purchase CBAM certificates priced in line with the EU ETS. Rollout includes monitoring, reporting, and verification. In the next step shift to payment and annual surrender based on verified figures (European Commission 2021a; Mehling et al. 2019; European Union 2023).

Finland's economy is export-oriented, with manufacturing central to value added and jobs, and the EU a key market for Finnish goods (Ministry of Economic Affairs and Employment 2022; Finnish Customs 2024; Statistics Finland 2025). Metals and metal products form a

major share of exports, largely destined for EU countries, so EU climate-trade rules transmit quickly into Finnish firms' costs, reporting practices, and customer demands (Finnish Customs 2024; Statistics Finland 2025).

CBAM adds pressure most directly for Finnish iron, steel, and aluminium producers in CBAM-covered chains: even before payments, firms need credible emissions data, internal systems, and supply chain information flows to meet reporting and verification expectations. Research by European Commission (2021a), Mehling et al. (2019), and European Union (2023) highlights that over time certificate costs paid by importers can influence EU buyers' sourcing decisions and price dynamics, potentially rewarding lower-carbon production.

Against this backdrop, assessing CBAM's implications for Finnish metal exports requires a clear view of the mechanism's rules and administration. The next section therefore outlines CBAM's policy design and core requirements as the basis for evaluating regulatory, paperwork, and financial effects on Finnish metal shipments.

## 1.2 CBAM Overview and Policy Framework

The EU advances its climate goals through CBAM, that uses more carbon-cost pressure to the selected imports. The literature on carbon leakage by Böhringer et al. (2012) and Branger & Quirion (2014) shows that the logic is clear, if carbon pricing applies only inside the EU, emission-intensive production can shift to jurisdictions with weaker rules, which weakens emissions reduction and distorts competition. CBAM is meant to reduce that incentive by aligning the carbon cost of certain imported goods with the cost faced by EU producers under the ETS (European Commission 2021a).

CBAM starts with a narrow scope: sectors with high embedded emissions and strong exposure to international competition. In the first phase, it covers iron and steel, aluminum, cement, fertilizers, electricity, and hydrogen, with product coverage defined through customs codes. In the policy framework discussions, European Commission (2021a) and European Union (2023) explain that the scope can change later, but the initial design clearly prioritizes the "leakage-risk" industries rather than trying to cover everything at once.

During the transition period, importers of covered goods mainly face reporting duties, they must disclose embedded emissions using CBAM rules, even though certificate payments are not yet required. It forces firms to build regular measurement routines, align data across supply chains, and expose weak points in monitoring and verification areas that tend to be underestimated in policy discussions. However, often determine whether the instrument works in practice (European Commission 2021a; Mehling et al. 2019; European Union 2023).

Once financial obligations apply, authorized importers must buy and surrender CBAM certificates that correspond to verified embedded emissions. Due to certificate prices track the EU ETS allowance price. The carbon cost on imports goes up and down with the ETS market rather than being constant politically. This mechanism is responsive, but it also means companies will face carbon-price volatility and will need strategies to manage it (European Union 2023).

Embedded-emissions accounting follows a defined method. The basic aim is to measure emissions from production, and in some cases relevant indirect emissions, using EU-set rules and verification. If credible, verified data are missing, the system can rely on default values. Policy guidance from European Commission (2021a) and European Union (2023) indicates that those defaults are intentionally conservative, which creates a clear incentive: firms that can prove lower emissions are less exposed than firms that cannot. In practice, CBAM therefore rewards not just cleaner production, but also better documentation, often the first real barrier for exporters.

CBAM also tries to avoid double charging. Where a foreign producer has already paid an explicit carbon price that meets the regulation's criteria, the importer can receive an adjustment that reduces the number of certificates to surrender. Beyond fairness, this feature is a signal: the EU is effectively encouraging other jurisdictions to adopt carbon-pricing tools that are legible and comparable to the EU ETS. Whether that produces cooperation or conflict will depend on how widely partners accept the EU's definition of "equivalent" climate pricing (European Union 2023).

Operationally, CBAM depends on shared enforcement. The European Commission sets the framework and technical methods, member states designate competent authorities to supervise declarants, and customs authorities identify covered goods and check documentation at the border. This division of labor makes sense, but it also means compliance quality will vary if national capacity differs, which is important for firms planning across multiple EU entry points. (European Commission 2021a; European Union 2023).

For Finland's metal exporters, the key shift is that market access increasingly depends on verifiable carbon information, not only on product quality and price. Even before certificate costs become material, exporters in iron, steel, and aluminum supply chains may face tighter data demands from EU buyers: emissions figures that are consistent, auditable, and comparable across suppliers.

That pushes internal changes to new record-keeping routines, clearer allocation of responsibility for emissions data, and investments in measurement systems. Later, when certificate costs are fed into import pricing, carbon efficiency can become a real competitive variable: low-emission producers gain room to defend margins, while higher-emission producers risk

being priced out or forced into costly adjustments (European Commission 2021a; Mehling et al. 2019; European Union 2023).

CBAM also sits in a sensitive political space. The EU frames it as a climate measure designed to treat domestic and foreign products consistently, but many partners see border carbon pricing as a trade barrier in environmental clothing. That tension matters for exporters because it can shape retaliation risks, diplomatic friction, and future rule changes factors that firms cannot control but must plan around.

### 1.3 Problem statement and research gap

Studies by Böhringer et al. (2012), Branger & Quirion (2014), and Mehling et al. (2019) show that CBAM research has grown quickly, but much of it still concentrates on high-level design questions and modelled economy-wide effects. Those studies are useful for mapping potential directions, yet they often miss what decides outcomes for firms: the administrative burden of compliance, the reliability of emissions data across supply chains, and the way buyers respond in real contracts and procurement choices.

Country-focused assessments for Finland exist, but they tend to stay at an aggregate level and rarely connect CBAM's legal and procedural requirements with detailed export patterns and sector behavior. Findings reported by Etna (2022) and the Ministry of Economic Affairs and Employment (2022) suggest that it remains unclear where the main pressure points will fall for Finnish metal exporters: which tasks expand most, which data gaps are most costly, and what early trade signals (if any) appear during the rollout.

This study addresses that gap by linking CBAM's policy requirements to observed export patterns and sector-specific conditions in Finland's metal trade with the EU, with attention to compliance routines, documentation demands, and how carbon-cost exposure may evolve as CBAM moves from reporting to payments.

### 1.4 Research objectives and research questions

The main research question of this thesis examines the effects of the EU's Carbon Border Adjustment Mechanism on Finnish metal exports to the European Union regarding regulatory obligations, trade performance, and potential future carbon cost exposure.

Although CBAM formally applies to imports entering the EU customs territory from non-EU countries, the mechanism may also influence firms operating within EU supply chains. Finnish metal exporters trading with EU partners may face indirect effects through changing market conditions, increased demand for emissions data from buyers, and adjustments in

supply chain reporting practices linked to CBAM compliance. This question is further addressed through the following sub-questions:

- What regulatory and administrative requirements does CBAM impose on firms involved in Finnish metal exports to the EU?
- How have Finnish metal export values and volumes to the EU developed during the period surrounding the introduction of CBAM?
- What kinds of future carbon cost exposures may Finnish metal exporters face when CBAM becomes fully financially operational?

### 1.5 Scope, delimitations and structure of thesis

This work looks at Finland's metal-sector exports tied to CBAM rules or its supply networks, heading into EU countries. Starting points shift attention turns to data once the provisional stage of CBAM began, though past figures help describe shifts when possible. From here, sources shape up differently: laws from the EU, government papers, verified trade numbers, research articles on carbon policies, market effects, and industry strength pile in. Each piece stems from existing material, nothing fresh is gathered. Timing matters less than what fits. Earlier trends appear only if records allow. Focus stays narrow, never straying beyond available proof. Details build slowly, layer by layer, without stretching claims.

## 2 Literature review and theoretical framework

The theoretical framework of this thesis combines three complementary perspectives that help explain how CBAM may influence international trade, firm behavior, and industrial competitiveness. These perspectives are: (1) trade regulation and non-tariff barrier theory, (2) institutional theory, and (3) the literature on environmental regulation and competitiveness, particularly the Porter Hypothesis. Together, they provide an analytical basis for interpreting the regulatory, administrative, and economic impacts of CBAM on Finnish metal exports to the European Union.

A fresh look begins here, moving ahead from earlier points about policy. This section rests on ideas that help make sense of how CBAM shapes trading patterns, company choices, because of competitive pressures. Key viewpoints come into play when studying these ideas around rules guiding international exchange beyond just tariffs appear alongside thoughts on organizational routines. Another piece grows from studies linking green policies with market strength yet framed through established structures shaping decisions.

### 2.1 CBAM and carbon leakage literature

The existing literature on the Carbon Border Adjustment Mechanism (CBAM) provides insights into its role in international climate policy, carbon leakage prevention, and trade regulation. Previous studies examine the potential implications of CBAM for global trade patterns, emission-intensive industries, and regulatory compliance requirements. Attention has been given to sectors with high carbon intensity, where new border regulations may introduce additional reporting obligations and adjustment costs for firms.

Research also discusses the broader economic implications of CBAM, including its potential effects on competitiveness, market access, and industry adaptation. In addition, several studies explore the role of CBAM within the European Union's broader climate policy framework and its contribution to reducing carbon leakage while encouraging cleaner production practices in global supply chains.

Before CBAM came along, scholars already investigated carbon leakage. Simulation results reported by Böhringer et al. (2012) suggest that when one area tightens climate rules, industries that produce heavy emissions might shift elsewhere especially where regulations are looser. Computer models suggest this movement happens especially when there's nothing stopping it. Emissions can travel across borders just like goods do. Because of this, some governments considered border adjustments on carbon. The idea was never just about fairness in trade it also aimed to keep climate goals intact. Not acting could weaken progress made at home.

Lately, CBAM has sparked more attention in both policy circles and research. Instead of just guessing, many researchers turn to modeling tools like general or partial equilibrium setups to trace possible shifts in trade, industry activity, and worldwide emissions. Depending on how it's built, which industries fall under their scope, and how other countries react, outcomes may differ sharply. Some findings suggest it could slow down carbon leakage while giving EU climate efforts a boost. That said, results aren't uniform across studies, shaped heavily by assumptions baked into each model. Early work by Branger and Quirion in 2014, followed by Böhringer and others three years later, helped lay groundwork for this line of inquiry.

National reviews by Etila (2022) and the Ministry of Economic Affairs and Employment (2022) now start to look at how CBAM affects each country. In Finland's case, early findings show impacts will differ by sector some feel it more, especially heavy industry and firms that sell goods abroad. While extra paperwork and fees may be burdensome, others might gain ground if their carbon footprint is already small. Because lower-emitting factories could face fairer terms overseas, the shift isn't all downsides. Still, which businesses win or struggle depends heavily on how they operate today. Therefore, outcomes split along existing environmental performance lines. Thus, not every firm faces the same pressure under the new system.

A central topic in the literature on CBAM concerns the administrative and regulatory challenges associated with monitoring, documenting, and verifying embedded emissions in imported goods. Firms are required to maintain detailed records regarding production processes, energy sources, and emission levels across supply chains to meet reporting obligations. Mehling et al. (2019) note that these transparency and documentation requirements can create significant compliance burdens, particularly for smaller firms that may lack specialized resources for environmental monitoring and reporting. While larger firms may be better positioned to absorb these administrative demands, differences in organizational capacity can lead to uneven adjustment across industries.

Research by Branger (2014) and Quirion (2014) shows how hard it is to track hidden emissions, a key barrier when putting these systems in place. Because precise tracking needs shared methods, trustworthy reports from overseas suppliers, yet strong checks on accuracy. Without access to solid information, authorities might fall back to standard estimates this tends to hurt businesses with cleaner operations if they cannot prove lower output.

Starting off, the transition phase under CBAM aims to ease administrative hurdles by giving time for both officials and businesses to strengthen their capabilities ahead of full cost enforcement. Research by Mehling et al. (2019) shows that though gradual rollouts like this often lower chances of non-compliance and economic ripple effects according to research on rule application they depend heavily on well-defined directions, open dialogue, plus solid help

for impacted companies. When it comes to Finland's metal exporters, handling CBAM might mean setting up systems to track carbon output, working closely with international buyers and vendors, along with weaving required climate data into current paperwork routines.

Besides outlining new rules, fresh documents from the European Commission's tax department show how tricky CBAM's paperwork can be. Because it sets fixed numbers, ways to compute emissions, along with forms to file during trial phases, companies must now line up their data tools carefully importers especially must sync closely with overseas suppliers (European Commission – DG TAXUD 2023).

Looking at existing studies, it becomes clear that CBAM could influence trade, rules, and technological change in several ways. While it might curb emissions shifting and boost the environmental impact of Europe's climate efforts, it also brings added paperwork along with possible shifts in how firms compete within high-emission industries. Following this, the upcoming section pulls together these insights to spotlight a particular missing piece in current research, namely, the lack of real-world data examining how CBAM affects Finland's metal shipments to European countries.

## 2.2 CBAM as governance instrument

CBAM has increasingly been discussed in literature as a policy instrument within international climate governance. Mehling et al. (2019) explain that the mechanism connects climate policy with international trade by linking market access to the carbon intensity of imported products. In this context, CBAM functions not only as a carbon pricing mechanism but also as a regulatory tool that aligns external producers with the environmental standards established under the EU Emissions Trading System (ETS). Consequently, the mechanism reflects an emerging approach in climate policy that integrates trade measures with broader efforts to reduce global emissions.

A different strand of research examines the legal framework behind CBAM, probing its consistency with World Trade Organization standards alongside effects on global climate efforts. Analyses by Mehling et al. (2019) and Branger and Quirion (2014) show that while some scholars explore room within WTO exemptions for ecological initiatives, others inspect structural traits like equal treatment across local and international firms to assess compliance potential. Often, these analyses point to clear emissions assessment methods as vital, linking trust in the mechanism to coherence with Europe's own decarbonization strategies.

Looking at how rules shape behavior, CBAM often comes up as something that could push non-EU nations to set up or tighten carbon pricing systems. Since the EU accounts for

existing carbon costs abroad when determining CBAM payments, it gives trade allies a reason to introduce similar measures, lowering what they owe at the border. Thus, one role assigned to CBAM involves spreading carbon pricing practices globally, aiming to cut greenhouse gases well outside European borders.

During the initial stage of CBAM implementation, importers are required to apply strict methodologies to calculate emissions data associated with imported goods, even though the purchase of CBAM certificates is not yet required. Oversight during this phase focuses on monitoring, reporting, and verifying the carbon content embedded in products. Although the obligation to purchase certificates is suspended, compliance with precise calculation and reporting procedures remains mandatory under methodological guidance issued by the European Commission, Directorate-General for Taxation and Customs Union (DG TAXUD) (European Commission, 2023).

Even though specific facility numbers might be missing, those bringing goods into the region can rely on standardized figures provided by the European Commission to declare stored emissions temporarily. Published under methodological notes, these baseline metrics cover major types of products affected, helping firms meet requirements throughout the current CBAM trial stage yet actors are still prompted to supply exact site-level details whenever feasible (European Commission – DG TAXUD 2023).

Starting off, the transition phase under CBAM aims to ease administrative hurdles by giving time for both officials and businesses to strengthen their capabilities ahead of full cost enforcement. Evidence discussed by Mehling et al. (2019) shows that though gradual rollouts like this are often lower chances of non-compliance and economic ripple effects according to research on rule application they depend heavily on well-defined directions, open dialogue, plus solid help for impacted companies. In case of Finland's metal exporters, handling CBAM might mean setting up systems to track carbon output, working closely with international buyers and vendors, along with weaving required climate data into current paperwork routines.

Besides outlining new rules, fresh documents from the European Commission's tax department show how tricky CBAM's paperwork can be. Because it sets fixed numbers, ways to compute emissions, along with forms to file during trial phases, companies must now line up their data tools carefully importers especially must sync closely with over-seas suppliers (European Commission – DG TAXUD 2023).

### 2.3 Sector impacts

Research by Böhringer et al. (2017) shows that environmental trade rules have focused heavily on industries using large amounts of energy and facing global market pressures.

Because of their reliance on steady output and narrow earnings, steel and aluminum producers react strongly when new climate policies shift expenses. When emissions carry a price tag, factories may delay upgrades or redirect shipments to avoid higher charges. Long planning horizons combined with expensive equipment mean even small policy shifts can alter where plants open or close. Though responses differ across regions, one trend stands: tighter rules reshape both spending choices and cross-border flows in these heavy industries. Profitability hinges closely on how smoothly firms adapt to evolving standards.

Studies by Porter and van der Linde (1995) and Aghion et al. (2016) suggest that environmental rules often push faster tech upgrades particularly under consistent policy frameworks offering predictable future guidance. Notably, studies across industries suggest environmental rules often push faster tech upgrades particularly under consistent policy frameworks offering predictable future guidance. Take steel: signs show growing attention toward greener methods like hydrogen-driven manufacturing and enhanced reuse systems, driven by compliance needs alongside buyer preferences for lower emission outputs. Still, impacts differ widely one firm's readiness hinges on prior moves into clean infrastructure, leaving laggards using high-carbon models at a disadvantage.

Starting off differently each time, research at the industry level shows how CBAM's effect ties closely to how carbon-heavy manufacturing is abroad, whether trustworthy emission numbers exist, also whether companies can meet monitoring and validation demands. Additionally in case of Finland's metal export businesses, prior progress in using less energy and refining methods could soften some CBAM pressures provided proof of actual emissions stands up under scrutiny.

## 2.4 Theories: NTB, Institutional and Porter

Classical trade theory focuses primarily on tariffs and quotas as the main instruments through which states regulate international trade, as explained by Feenstra and Taylor (2017). However, contemporary trade relations are increasingly shaped by non-tariff measures, such as technical standards, regulatory requirements, and certification obligations that affect market access and compliance costs for firms. Environmental and climate-related measures are part of this broader category of non-tariff instruments, as they can alter the cost structure and competitive position of exporters without appearing as traditional customs duties.

Within this perspective, CBAM can be interpreted as a regulatory trade instrument that functions similarly to a non-tariff barrier. Rather than imposing a conventional import tariff, CBAM requires importers to comply with detailed reporting obligations and, in its full implementation phase, to purchase certificates reflecting the embedded emissions of imported

products. These obligations introduce additional administrative tasks, information requirements, and potential financial charges for exporters and importers trading in CBAM-covered goods. The mechanism thereby affects trade flows and competitiveness through regulatory compliance rather than through simple price-based border taxes.

One way to look at it is through how rules shape trading patterns without using tariffs. These kinds of regulations often bump up expenses tied to entering markets, handling paperwork, and staying compliant particularly tough if a company hasn't set up solid tracking for emissions yet. Because of this pressure, businesses sometimes shift where they buy materials, rework their logistics networks, or adjust long-term investments just to stay under the radar or fit into greener niches. Seen from Finland's metal sector, viewing CBAM not as a tax but as part of broader regulation shows why clean records, proper filings, and internal readiness now decide who holds an edge abroad.

Institutional theory explains how organizational behavior is shaped by external rules, norms, and social expectations rather than solely by internal strategic goals. Institutional analysis by Scott (2014) explains that organizations operate within institutional environments composed of regulatory frameworks, professional standards, and widely accepted cultural beliefs that influence decision-making and organizational practices.

Within this perspective, organizations often adapt their structures and practices in response to institutional pressures. DiMaggio and Powell (1983) identify three main forms of institutional pressure: coercive pressure arising from laws and regulations, normative pressure stemming from professional norms and expert expectations, and mimetic pressure in which organizations imitate practices perceived as successful or legitimate. Institutional theory research by Meyer and Rowan (1977) explains that through these mechanisms certain practices gradually become widely accepted and institutionalized across organizations. As a result, organizational structures frequently reflect broader institutional expectations rather than purely efficiency-driven choices.

Rules about climate, like CBAM, push companies hard to change how they operate. Because of these rules, businesses need to adjust routines inside their organizations. Meeting fresh demands means tracking pollution more closely, sharing accurate reports, and confirming data through checks. One way forward is building tools that measure hidden emissions tied to products. Gathering better details through suppliers has become necessary too. Another shift includes adding carbon numbers directly into paperwork sent to buyers. Falling short might bring fines, harm public image, or block entry to certain markets. That risk keeps pushing firms toward different ways of working.

Growing societal expectations regarding corporate environmental responsibility increasingly influence organizational behavior. Institutional theory literature by Greenwood et al. (2017) and Scott (2014) explains that stakeholders such as consumers, investors, and regulators place greater emphasis on environmental performance, encouraging firms to adopt practices that extend beyond minimum legal requirements. Institutional theory explains these changes by emphasizing how organizations respond to regulatory frameworks, social norms, and expectations in their institutional environment.

Within this perspective, policy instruments such as the Carbon Border Adjustment Mechanism (CBAM) may influence not only trade compliance but also organizational practices. Firms operating in Finland's metal sector may gradually integrate emission monitoring, reporting systems, and climate-related considerations into their operational routines and strategic decision-making to maintain legitimacy and competitiveness in European markets.

Some perspectives suggest that stricter environmental regulations may weaken industrial competitiveness by increasing production costs and compliance burdens for firms operating in international markets. Economic analysis by Copeland and Taylor (2004) shows that higher environmental standards can impose additional financial and technological requirements, particularly for emission-intensive industries competing globally.

The Porter Hypothesis presents an alternative perspective on the relationship between environmental regulation and competitiveness. According to this view, well-designed environmental regulations can stimulate innovation, improve resource efficiency, and encourage firms to develop cleaner production technologies. Porter and van der Linde (1995) argue that these innovation effects may offset compliance costs and, in some cases, strengthen long-term competitiveness.

Empirical research provides mixed evidence regarding the impact of environmental regulation on firm performance and international competitiveness. Studies by Ambec et al. (2013) indicate that outcomes often vary depending on industry characteristics, regulatory design, and firms' capacity for technological adaptation. Sectors with high emissions, such as steel or aluminum production, may initially face higher adjustment costs, while firms capable of innovation and efficiency improvements may gain advantages in emerging low-carbon markets.

The implementation of the Carbon Border Adjustment Mechanism (CBAM) raises practical implications for Finnish metal exporters. The mechanism introduces additional reporting obligations and potential carbon-related costs, which may create adjustment pressures for firms that are slower to adopt low-emission production processes. At the same time, firms that previously invested in cleaner technologies and transparent emission-tracking systems

may benefit from improved competitiveness in the European market, particularly as competitors from jurisdictions with weaker environmental regulations face similar carbon-related obligations (European Commission, 2023; Mehling et al., 2019).

## 2.5 Integrated framework - Conceptual model

Integrating the theoretical perspectives discussed above provides a clearer understanding of how CBAM may influence Finland's metal export sector. Beyond functioning as a trade policy instrument, CBAM introduces regulatory pressures that may shape firms' operational decisions and compliance strategies.

Theoretical perspectives discussed by Scott (2014) and Porter and van der Linde (1995) suggest that organizations often adopt their practices in response to regulatory and normative pressures, while the Porter Hypothesis highlights the potential for environmental regulation to stimulate innovation and efficiency improvements. Consequently, policies such as CBAM may encourage firms to improve emission monitoring, adopt cleaner technologies, and adjust their production practices in response to evolving environmental and market expectations.

### 3 Methodology

This chapter describes the methodological choices made in this thesis. It explains the re-search design, research strategy, and research approach used to examine how the EU's Carbon Border Adjustment Mechanism affects Finnish metal exports to the European Union.

A fresh look at the data begins by tying regulation effects to real world results through a connected model. Instead of just listing outcomes, it links changes in trade patterns with likely carbon pricing risks ahead. This shapes how measurements are picked for tracking rule-related pressures on businesses. Not only that, but it also feeds into understanding what adjustments companies might need. Rather than ending there, it opens how Finnish metal exporters could face new competition dynamics under CBAM inside Europe.

#### 3.1 Research Design

The study applies a descriptive analytical approach combined with quantitative methods based on secondary data. Given that the Carbon Border Adjustment Mechanism (CBAM) is a relatively new and evolving policy instrument, the analysis does not aim to establish strict causal relationships. Instead, the study focuses on identifying observable patterns related to institutional developments, regulatory requirements, and broader policy dynamics associated with CBAM. Attention is given to the regulatory framework of the mechanism, including the obligations it creates for exporting firms and their potential implications for cross-border trade during the early stages of implementation.

Empirical analysis relies primarily on secondary data sources. Policy-related information is derived from European Union legislation, implementing regulations, official guidance documents, and related policy reports. These materials provide the institutional and regulatory context necessary for understanding CBAM's structure and operational requirements. In addition, descriptive statistical analysis of trade data is used to examine recent patterns in Finnish metal exports to the European Union. The combination of policy document analysis and trade statistics allows the study to explore the relationship between regulatory developments and observable trade patterns within the limits of available data.

#### 3.2 Research Approach

The study follows an inductive research approach. From close analysis of individual cases or records, patterns emerge that lead to broader insights. Since findings grow out of observation, this method fits well when exploring new terrain. The CBAM system is still unfolding in practice.

Evidence about its influence on commerce and company choices remains limited. Generalizations form only after examining concrete examples. Early-stage policies often lack clear outcomes. One works outward from specifics instead of applying preset theories.

Starting from observations, the research collects Finnish trade data alongside policy texts about CBAM, along with scholarly work tied to the topic. Next, common features begin to surface examples include consistent compliance demands, growing hurdles in implementation, shifts seen in exports of metal-sector goods. Interpretation follows, guided by ideas introduced earlier: concepts around trade rules and hidden barriers blend here with views on institutions, plus insights into how green policies shape market strength. The method builds understanding step by step, rooted in real-world material before linking back to established thinking.

Because CBAM remains a developing policy framework, the study adopts an exploratory analytical approach. The limited availability of consistent quantitative data restricts the possibility of establishing clear causal relationships. Instead, the analysis draws on existing records, policy documents, and available observations to examine the implications of CBAM for Finland's metal trade within its specific regulatory context.

Putting these elements side by side the numbers-based setup, layered investigation plan, while building understanding step by step shapes how the study looks at CBAM's rules, management, financial sides when Finland sends metal goods into EU markets.

### 3.3 Research Strategy

The research strategy consists of three complementary components. Putting together these three parts builds a full picture of what CBAM means. From document study, rules and duties become clear. Export patterns show real-world background instead. A look at different scenarios brings likely economic outcomes ahead.

#### 3.3.1 Document based policy and regulatory analysis

One step begins by reviewing key European Union and Finland-specific materials about CBAM alongside details on Finnish trade and manufacturing patterns. Instead of simply listing sources, it looks at laws guiding CBAM, official guidance, policy papers from the EU on climate and commerce, along with Finland's own analyses on cutting emissions in industry and how carbon rules affect exports. Attention is focused on what goals CBAM aims to meet, which sectors fall under their reach, what data must be reported, how compliance is checked, and where overlaps may occur with current regulations shaping metal production. Through this lens, the study tackles aspects of the main inquiry focused on what new duties or procedures might face Finnish firms shipping metals abroad.

### 3.3.2 Descriptive export trend analysis

Another part involves looking at Finland's export data for metal goods. During the time around CBAM's trial stage, attention turns to shifts in both worth and amount shipped to European Union countries. Instead of proving cause and effect, the goal becomes spotting clear movements or repeated behaviors. These observations might matter later when weighing what CBAM could eventually do. Attention stays fixed on types of products either inside or near the areas regulated by CBAM.

### 3.3.3 Scenario based consideration of potential carbon cost exposure

A look at Finland's metal exports reveals early numbers on what carbon costs could emerge when CBAM operates fully. Understanding how prices form under the mechanism, which sectors it covers, also its overlap with existing EU climate rules helps shape this picture. While precise figures remain out of reach here, likely patterns of financial pressure come into view. Shifts in market position may follow, yet firms' long-term decisions could shift too. Exposure levels depend heavily on how much CO<sub>2</sub> their processes release during manufacturing. One thing stands clear emission heavy methods face greater strain once payments start.

## 3.4 Data Collection

This study relies exclusively on secondary data obtained from official institutions and scientific publications. Secondary data are widely used in environmental trade policy re-search because regulatory frameworks such as CBAM are primarily documented through legislation, policy reports, and official statistics. Using secondary sources is appropriate here, as CBAM is a new and evolving mechanism and firm level primary data are limited.

### 3.4.1 Secondary Data Sources

- The main data sources used in this thesis are:
- European Commission CBAM regulations, implementing acts, and guidance documents
- European Commission – DG TAXUD CBAM guidance and default values for embedded emissions
- Eurostat international trade statistics
- Finnish Customs and Statistics Finland export statistics
- OECD and other international policy reports and trade studies
- European Environment Agency analyses EU ETS auctioning revenues

Policy and regulatory documents are essential for analyzing compliance requirements and institutional impacts of CBAM. Official EU CBAM texts and guidance describe monitoring, reporting, and verification (MRV) requirements as well as methodological rules and default values for the transitional period, which form the basis for evaluating administrative and compliance burdens introduced by the regulation (European Commission 2023; European Commission – DG TAXUD 2023). DG TAXUD guidance on default values and reporting templates is particularly important for understanding how importers and, indirectly, exporters must calculate and report embedded emissions during the transitional phase (European Commission – DG TAXUD 2023).

Trade statistics from Eurostat and Finnish Customs provide the quantitative data required for analyzing export trends, market structure, and sector level trade performance. Euro-stat's dataset "International trade of EU and non-EU countries since 2002 by SITC" (dataset code ds 059331\_\_custom\_19997071) offers export values in euros and quantities in kilograms for detailed product groups, including iron and steel, bars and rods, and related metal manufactures, disaggregated by intra EU and extra EU trade flows (Eurostat 2026). Finnish Customs and Statistics Finland data are used to place metal exports in the context of Finland's overall export structure and to confirm the importance of EU markets for Finnish industry.

Information provided by the European Environment Agency (2024) explains how revenues from auctioning EU ETS allowances are used to finance climate and energy measures, which help situate CBAM and carbon pricing within the broader EU climate finance context. Peer reviewed academic literature and international policy studies supply theoretical perspectives and empirical findings on CBAM, carbon leakage, border carbon adjustments, and the competitiveness of emission intensive industries.

### 3.4.2 Measurement of CBAM Impact

The impact of CBAM is evaluated along three analytical dimensions that are commonly used in recent climate policy research:

- Regulatory and administrative impact
- Export performance and trend developments
- Potential future CBAM related carbon cost exposure

These dimensions provide a structured way to assess how CBAM may affect regulatory conditions, trade patterns, and cost structures that are relevant for Finnish metal exporters. They do not allow precise causal estimation, but they enable a systematic examination of the main channels through which CBAM can influence the Finnish metal industry.

### 3.4.3 Regulatory and Administrative Impact Analysis

The first analytical dimension evaluates the regulatory and administrative burden introduced by CBAM. Environmental trade policies often influence trade through compliance requirements rather than through direct tariffs, so measuring administrative obligations provides a direct indicator of regulatory impact.

In this thesis, the regulatory and administrative burden is examined qualitatively using indicators such as:

- The number and type of reporting obligations introduced by CBAM
- The frequency and content of CBAM reporting requirements
- The complexity of MRV procedures and the availability of default values
- The need for emissions data, documentation, and verification along supply chains
- Indicative estimates of compliance effort at firm level based on existing studies

Recent CBAM research highlights that MRV requirements represent one of the most significant compliance challenges for exporters. Research by Malik et al. (2025) and Mehling et al. (2019) indicates that firms lacking reliable emissions measurement and reporting systems may face competitive disadvantages in regulated markets, especially when default emissions values are higher than their actual performance. Guidance published by DG TAXUD on CBAM default values and reporting obligations illustrates the administrative complexity of the mechanism and underscores the need for robust data systems and coordination between importers and foreign producers (European Commission – DG TAXUD 2023).

### 3.4.4 Descriptive Export Trend Analysis

The second analytical dimension evaluates export performance using descriptive statistical analysis. Descriptive trend analysis is widely applied in trade policy research when regulatory changes may influence export values, volumes, and market shares, but where data limitations make robust causal identification difficult.

In this thesis, the descriptive export trend analysis focuses on:

- Export value of Finnish metal industry products to EU member states
- Export volume of metal industry products, where quantity data are available
- The share of metal exports in Finland's total goods exports and in exports to the EU

Trade data are drawn primarily from Eurostat's SITC trade dataset (ds 059331\_\_custom\_19997071) and from Finnish Customs and Statistics Finland (Euro-stat 2026; Finnish Customs 2024; Statistics Finland 2025). The analysis compares export performance in the period preceding the CBAM transitional phase with developments during and after the start of that phase, subject to data availability. Research by Dobranschi (2024) shows that similar descriptive statistical approaches are frequently applied in CBAM research when assessing trade performance and policy impact under regulatory uncertainty.

The analysis does not attempt to establish causal relationships between CBAM and export trends. Instead, it identifies observable changes in export values and volumes and discusses whether these developments are consistent with expectations about CBAM's potential influence, considering broader economic conditions.

### 3.4.5 Simulated Carbon Cost Estimation

The third analytical dimension evaluates potential future CBAM related cost exposure using a simplified, scenario-based approach. Economic modelling studies discussed by FIW Research Institute (2024) and Böhringer et al. (2017) show that CBAM research often applies general equilibrium models, input–output modelling, or other simulation tools to estimate policy impacts on trade competitiveness and emissions. However, such models require extensive data and are beyond the scope of this thesis. Instead, this thesis uses an indicative carbon cost estimation based on the basic CBAM pricing logic:

- Potential CBAM cost  $\approx$  Embedded CO<sub>2</sub> emissions  $\times$  EU ETS carbon price

This simplified calculation does not produce precise forecasts but provides an accessible and policy relevant indicator of possible financial impacts once CBAM becomes fully operational. In building scenarios, the thesis considers:

- Typical ranges of emissions intensity for metal industry products reported in the literature
- Illustrative levels of the EU ETS carbon price
- The potential recognition of foreign carbon pricing that could reduce CBAM obligations
- Possible pass through of CBAM costs along the supply chain between importers and exporters

The scenarios are used to discuss the order of magnitude and directional effects of CBAM related costs for Finnish metal exporters rather than to deliver point estimates.

### 3.5 Data Analysis Methods

The research applies qualitative content analysis combined with descriptive statistical analysis. Qualitative content analysis is used to examine CBAM legislation, policy documents, and regulatory guidance materials. This involves systematically reading and coding documents to identify regulatory objectives, sectoral scope, compliance obligations, MRV requirements, default value provisions, and institutional implications for exporters and importers. The categories used in the coding reflect the research questions and the theoretical framework.

Descriptive statistical analysis is used to evaluate export data trends. Trade data are presented through time series analysis, simple comparison tables, and, where appropriate, graphical visualization of export performance. The analysis focuses on changes in export value and volume for relevant metal industry product groups and on shifts in the share of metal exports in Finland's total goods exports and exports to the EU.

Recent CBAM research also uses simulation modelling and quasi experimental methods, such as difference in differences analysis, to examine policy impacts at firm or sector level (Liu 2025; FIW Research Institute 2024). Because CBAM is still in an early phase of implementation and firm level data are limited, this thesis does not apply advanced econometric methods. Instead, it emphasizes descriptive and policy-based analysis that is consistent with data availability and the exploratory nature of the research questions.

### 3.6 Reliability, validity and limitations

Ensuring reliability and validity is essential in policy-oriented research. This study enhances reliability by using multiple high quality data sources, including official EU legislation and guidance, international policy reports, and national and EU level trade statistics. Using several independent sources allows cross verification of regulatory content and statistical figures. Relying on official datasets such as Eurostat and Finnish Customs reduces the risk of measurement error in trade data.

Validity is supported through transparent research design, systematic data selection, and consistent analytical methods. Methodological literature by Wirdyansyah (2025) emphasizes that systematic data selection and clear documentation of procedures improve the credibility and reproducibility of literature-based climate policy research. The analytical framework is closely aligned with the research questions, and only data that are relevant to CBAM, the Finnish metal industry, and EU trade are included. This thesis follows such principles by clearly describing the sources used, the criteria for selecting product groups and time periods, and the limitations of the data and methods.

Despite these measures, the study has several limitations. First, it is based entirely on secondary data and does not include primary data such as firm level interviews or surveys. As a result, company specific strategies, internal decision making, and detailed cost structures are not directly captured. Second, the descriptive export trend analysis cannot isolate the impact of CBAM from other factors affecting trade, such as macroeconomic conditions, exchange rates, or geopolitical developments. The results should therefore be interpreted as indicative rather than causal.

Third, the scenario-based carbon cost estimation is necessarily simplified and relies on assumptions about emissions intensity, carbon prices, and cost pass through that may change over time. As CBAM is gradually implemented and more empirical data becomes available, future research will be able to refine these estimates using more sophisticated modelling approaches.

Nevertheless, the combination of qualitative document analysis, descriptive trade statistics, and scenario-based reasoning provides a coherent methodological framework for addressing the research questions and for exploring the regulatory, administrative, and economic implications of CBAM for Finnish metal exports to the European Union.

## 4 Results

This chapter presents the empirical and analytical results of the study in line with the three analytical dimensions defined in the methodology: regulatory and administrative impacts, descriptive export trend developments, and indicative carbon cost exposure. Together, these findings address the main research question and the sub-questions concerning regulatory obligations, export performance, and potential future CBAM-related cost exposure for Finnish metal exporters.

### 4.1 Regulatory and administration findings

The first analytical dimension concerns the regulatory and administrative compliance requirements introduced by CBAM. Prior to CBAM, Finnish metal exporters did not face carbon-related border adjustment reporting obligations linked specifically to embedded emissions. Carbon pricing and emissions reporting were confined to domestic EU ETS obligations for installations located within the EU. At the border, trade in metal products was not subject to specific climate-related declarations. Table 1 summarizes how CBAM changes this situation by comparing administrative and regulatory indicators before and after the mechanism's introduction.

Table 1: CBAM Administrative and Regulatory Requirements Before and After Implementation

Indicator	Before CBAM	After CBAM	Estimated Cost
<b>Reporting obligations</b>	No reporting obligations	Importers must report embedded emissions, production method, quantity of imported goods, and installation data	Included in administrative compliance cost
<b>Reports per year</b>	No reporting obligations	4 reports per year (Quarterly reporting)	Included in administrative compliance cost
<b>Administrative steps</b>	No formal CBAM administrative procedures	Data collection → Emissions verification → Report submission	Included in administrative compliance cost
<b>Compliance administrative cost</b>	0 €	Estimated €70,000 – €120,000 per firm per year	€70,000 – €120,000 per firm per year

Source: Author's compilation based on European Commission (2023) Impact Assessment accompanying Regulation (EU) 2023/956 (CBAM) and Commission Implementing Regulation (EU) 2023/1773 on CBAM reporting obligations.

Table 1 shows the main administrative and regulatory changes introduced by CBAM, comparing the situation before and after its implementation and indicating the potential compliance costs for firms involved in CBAM-related trade. The annual administrative compliance cost range (€70,000–€120,000 per firm) is an indicative estimate. It is benchmarked against the European Commission’s CBAM impact assessment, which reports recurring compliance costs for companies based on survey percentiles and reports one-off adjustment costs (e.g., legal/consulting and IT set-up) up to €129,000 at the 75th percentile. The range used in this thesis reflects (i) the higher end of the Commission’s reported recurring costs and (ii) potential additional firm-side MRV/data-management efforts required to provide verified embedded-emissions data to EU reporting declarants.

#### 4.1.1 Reporting obligations:

Before CBAM, there were no border-related reporting obligations on embedded emissions. After CBAM’s introduction, importers of covered metal products must report embedded emissions, production methods, quantities, and installation-level information on a regular basis. Even though these obligations formally apply to EU-based importers, exporters in Finland are indirectly affected because importers need detailed emissions data from their suppliers to fulfil CBAM reports.

#### 4.1.2 Reporting frequency

CBAM requires quarterly reporting during the transitional phase. This represents a structural shift from a situation with no dedicated border-related climate reporting to one with four submissions per year. For firms, this means that emissions data must be collected, verified, and communicated in a continuous, cyclical process rather than on an ad hoc basis.

The quarterly frequency also requires firms to maintain more consistent internal monitoring of production and emissions data throughout the year, rather than compiling information only when required. As a result, companies may need to establish clearer internal routines for collecting and organizing emissions information and for communicating these data to EU importers responsible for submitting CBAM reports.

### 4.1.3 Administrative steps and processes

The CBAM reporting chain now includes at least three main steps: data collection on production and embedded emissions, emissions verification using accepted methodologies, and submission of reports in the required format. For Finnish metal exporters, this implies closer coordination between production, environmental management, and export/logistics functions, as well as increased interaction with EU importers regarding data quality and completeness.

In practice, these administrative steps require firms to organize internal workflows that ensure emissions information can be gathered from production processes, documented accurately, and transferred to importers within the required reporting timeline. This may involve assigning clear responsibilities for emissions data management and establishing procedures for checking the consistency and reliability of reported information before submission.

### 4.1.4 Compliance costs

The estimated annual administrative compliance cost per firm in the CBAM-exposed group is between €70,000 and €120,000. These costs include internal staff time, emissions accounting, verification services, and IT or data management adjustments needed to support MRV processes. Although these amounts are relatively small compared to aggregate export values, they represent fixed costs that all affected firms must bear regardless of export volume, and they may weigh more heavily on small and medium-sized enterprises.

Overall, the results show that CBAM operates as a non-tariff regulatory measure: it does not directly restrict trade through quotas or bans, but it increases the administrative burden on firms engaged in CBAM-covered trade. For Finnish metal exporters, the main short-term impact is therefore the need to develop or strengthen emissions data systems and reporting practices to support their EU customers' CBAM obligations. This finding directly addresses the first sub-research question concerning regulatory and administrative requirements.

## 4.2 Export Trend Developments for Finnish Metal Exports to the EU

The second analytical dimension focuses on descriptive changes in Finnish metal export performance during the period surrounding CBAM's introduction. Table 2 presents the quantity and value of Finnish metal exports to the EU between 2015 and 2024.

Table 2: Finnish Metal Exports to the EU: Quantity and Value 2015–2024

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Quantity (MT)	3.55	3.46	3.42	3.66	3.30	3.32	3.72	3.46	3.44	3.36
Value(B€)	5.50	5.10	5.98	6.30	5.78	5.52	7.36	9.08	8.43	8.12
Unit Price(€/ton)	1,547	1,474	1,752	1,719	1,752	1,666	1,980	2,627	2,449	2,419
Price change	--	-5%	19%	-2%	2%	-5%	19%	33%	-7%	-1%

Source: Author's calculations based on Eurostat (2026), International trade of EU and non-EU countries since 2002 by SITC [ds-059331], Data extracted on 05 February 2026.

Table 2 indicates that Finnish metal exports to the EU experienced fluctuations in both quantity and value during the period 2015–2024. Export values increased significantly between 2020 and 2022, partly reflecting higher global metal prices, while export volumes remained relatively stable. However, a decline in both export value and quantity can be observed in 2023 and 2024, suggesting a potential weakening in export performance during the period following the introduction of the CBAM transitional phase. For comparison, Table three presents the quantity and value of Finnish metal exports to markets outside the EU during the same period (2015–2024). Table 3 shows similar information outside of the EU.

Table 3: Finnish Metal Exports to outside of the EU: Quantity and Value 2015–2024

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Quantity (MT)	0.69	0.74	0.76	1.38	2.40	0.73	0.78	0.65	0.58	0.52
Value(B€)	1.73	1.62	1.97	2.64	3.12	1.90	2.39	2.95	2.04	1.71
Unit Price(€/ton)	2,499	2,198	2,586	1,910	1,300	2,597	3,054	4,550	3,533	3,313
Price change		-12%	18%	-26%	-32%	100%	18%	49%	-22%	-6%

Source: Author's calculations based on Eurostat (2026), International trade of EU and non-EU countries since 2002 by SITC [ds-059331], Data extracted on 05 February 2026.

Table 3 shows the development of Finnish metal exports to markets outside the EU between 2015 and 2024. The data indicate stronger fluctuations in both export quantities and values compared with intra-EU exports, with a notable increase in export quantities in 2019 followed by a decline in the following years. Unit prices also display considerable volatility, reflecting changing conditions in global metal markets.

#### 4.2.1 Pre-2019 growth phase

Between 2015 and 2018, Finnish metal exports to the EU showed a moderate upward trend in both quantity and value. Export quantities increased slightly from 3.55 million tons in 2015 to 3.66 million tons in 2018, while export values rose from €5.50 billion to €6.30 billion during the same period. This indicates relatively stable demand for Finnish metal products in EU markets.

However, in 2019, export quantities declined to 3.30 million tons, and export values decreased to €5.78 billion, suggesting the beginning of a temporary slowdown in export performance. Despite this short-term decline, the overall pattern before 2019 reflects relatively stable trade conditions and a balanced relationship between export volumes and values. Figures 1-2 visualize changes for better understanding of export trend.

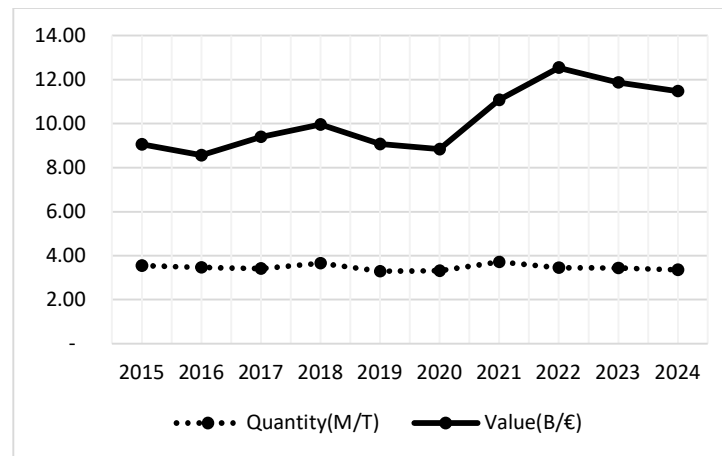


Figure 1: Finnish Metal Export Quantity and Value to the EU 2015–2024

Figure 1 illustrates the development of Finnish metal export quantities and values to the EU between 2015 and 2024. Export quantities remained relatively stable during the period, fluctuating around 3.3–3.7 million tons. In contrast, export values increased significantly between 2020 and 2022, reflecting rising global metal prices, before declining slightly in 2023 and 2024. This pattern suggests that changes in export value were driven more by price dynamics than by large changes in export volume.

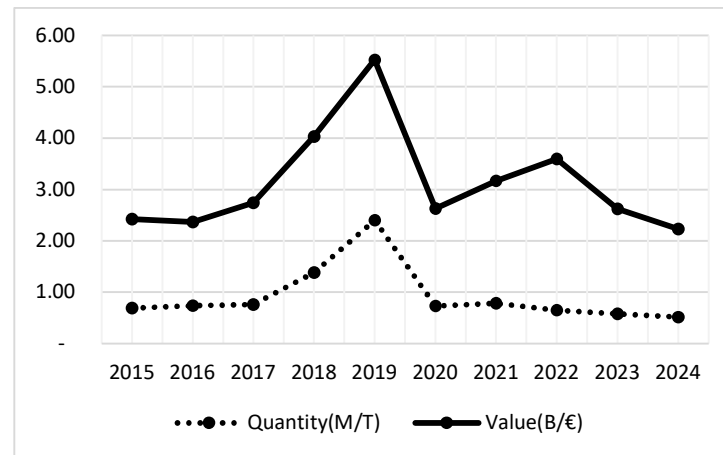


Figure 2: Finnish Metal Export Quantity and Value to outside of the EU 2015–2024

Figure 2 presents the development of Finnish metal export quantities and values to markets outside the EU during the same period. Compared with intra-EU exports, extra-EU exports show greater volatility in both quantity and value. Export quantities peaked in 2019 before declining sharply in 2020, while export values fluctuated considerably across the period. These variations reflect stronger exposure to global market conditions and demand changes in non-EU markets.

#### 4.2.2 Price dynamics and CBAM-related constraints

A comparison between global market price developments and intra-EU export prices suggests that Finnish exporters faced limited pricing power within the EU market. In global markets, unit prices increased sharply during 2020–2022, with annual changes of 100%, 18%, and 49%, respectively. In contrast, the corresponding price changes observed in Finnish exports to the EU were significantly lower, at –5%, 19%, and 33%.

This divergence indicates that Finnish exporters could not fully transmit global price increases to EU buyers. One possible explanation relates to the regulatory environment associated with the Carbon Border Adjustment Mechanism (CBAM). Even during its transitional phase, CBAM introduces additional reporting obligations and anticipated carbon-related costs for importers of emission-intensive goods. These implicit or expected compliance costs can reduce the willingness of EU importers to accept higher product prices.

As a result, part of the cost pressure generated by rising global metal prices may have been absorbed by exporters rather than passed on to EU buyers. This would limit the ability of Finnish producers to increase export prices in line with global market trends. Consequently, the price gap between global market developments and intra-EU export prices may reflect reduced pricing flexibility for Finnish exporters within the EU market, potentially compressing export margins.

### 4.2.3 CBAM-related decline in export performance

The comparison between intra-EU and extra-EU export trends suggests that the decline in export performance becomes more visible after the introduction of the CBAM transitional phase in 2023. While global metal prices increased strongly in 2021–2022, both export value and quantity began to decline afterwards.

In the case of Finnish exports to markets outside the EU, the decline in unit prices is more pronounced than in intra-EU trade. This suggests that exporters may have been forced to reduce prices more aggressively in external markets to remain competitive. One possible explanation is the regulatory pressure and increased administrative burden associated with the CBAM reporting framework, which may have increased transaction costs and uncertainty for emission-intensive exports.

As a result, Finnish exporters appear to have faced stronger competitive pressure in extra-EU markets after 2022. To maintain market access, producers may have lowered export prices, which is reflected in the sharper decline in unit price indicators compared with intra-EU trade.

At the same time, the data show a decline in export quantities and values in 2023–2024, indicating that the adjustment was not limited to prices but also affected the physical volume of exports. This pattern is consistent with the hypothesis that the introduction of CBAM-related regulatory requirements coincided with a period of reduced export performance for Finnish metal producers.

### 4.3 Indicative CBAM Carbon Cost Exposure and Cost Structure

The third analytical dimension examines potential CBAM-related cost exposure once the mechanism becomes fully operational. Table four provides an indicative estimate of the CBAM carbon cost per ton of exported metal. Table 4 describes how emission cost reveals regarding the CBAM implementation.

Table 4: Estimated CBAM Carbon Cost per Ton of Exported Metal

<b>Emissions intensity (tCO<sub>2</sub> / ton)</b>	<b>Carbon price (€ / tCO<sub>2</sub>)</b>	<b>CBAM cost (€ / ton)</b>
1.497	74.33	111.27

Source: Author's calculations based on European Commission CBAM documentation, European Environment Agency EU ETS carbon price statistics, and industry emission benchmarks reported by Steel Orbis (2024–2025).

As table 4 shows, the estimated CBAM cost per ton was calculated by combining the carbon intensity of metal production with the EU ETS carbon price. Emission intensities were assumed to be 1.53 tCO<sub>2</sub> per ton for steel and 1.464 tCO<sub>2</sub> per ton for aluminum, resulting in an average intensity of 1.497 tCO<sub>2</sub> per ton.

$$\text{CBAM cost per ton} = \text{Emission intensity} \times \text{Carbon price} \quad (1)$$

Using an EU ETS price of €74.33 per tCO<sub>2</sub>, the estimated carbon cost equals €111.27 per ton (1.497 × 74.33). This represents the implied carbon cost under EU ETS price conditions.

During the CBAM transitional phase (2023–2025), importers are required to report embedded emissions but are not yet required to purchase CBAM certificates. Administrative compliance costs arise from quarterly reporting obligations, including data collection, emissions verification, and report submission, with estimated costs ranging from €70,000 to €120,000 per firm per year as shown in table 5.

Table 5: Estimated Annual CBAM-Related Financial and Administrative Costs 2015–2024

<b>Cost</b>	<b>Year</b>	<b>2015-2022</b>	<b>2023</b>	<b>2024</b>
CBAM cost (m €)		Zero	383	374
Compliance administrative cost (m €)	Minimum	Zero	398	398
	Maximum	Zero	684	684

Source: Author's calculations based on European Commission CBAM transitional regulation, European Environment Agency EU ETS carbon price data, and Finnish metal industry structure statistics from Statistics Finland.

Table 5 summarizes the estimated CBAM-related financial and administrative costs for the Finnish metal sector. The results show that no CBAM-related costs existed before 2023, while both carbon-related costs and administrative compliance costs appear after the introduction of the CBAM transitional phase, indicating the potential financial burden associated with the mechanism.

#### 4.3.1 Carbon-related costs

There are no CBAM-related costs before 2023, reflecting the fact that CBAM had not yet been introduced. Simulated CBAM carbon costs appear in 2023 and 2024, at approximately €383 million and €374 million, respectively. These figures indicate the potential scale of aggregate carbon cost exposure once CBAM-related mechanisms begin to affect emission-

intensive trade. Even if actual future costs differ due to changes in emissions intensity, carbon prices, or recognition of foreign carbon pricing, the simulation suggests that CBAM could represent a notable additional cost component for the metal sector.

#### 4.3.2 Administrative compliance costs

Estimated minimum and maximum annual administrative compliance costs appear from 2023 onwards, corresponding to the range of €70,000–€120,000 per firm. Aggregated across the affected firm population, these costs amount to approximately €398 million (minimum) and €684 million (maximum) per year. Although these costs are lower than the estimated CBAM carbon costs, they represent persistent fixed expenses, as firms must maintain CBAM-compliant data collection, verification, and reporting systems regardless of changes in export volumes. This cost started from 2022 as shown in figure 3.

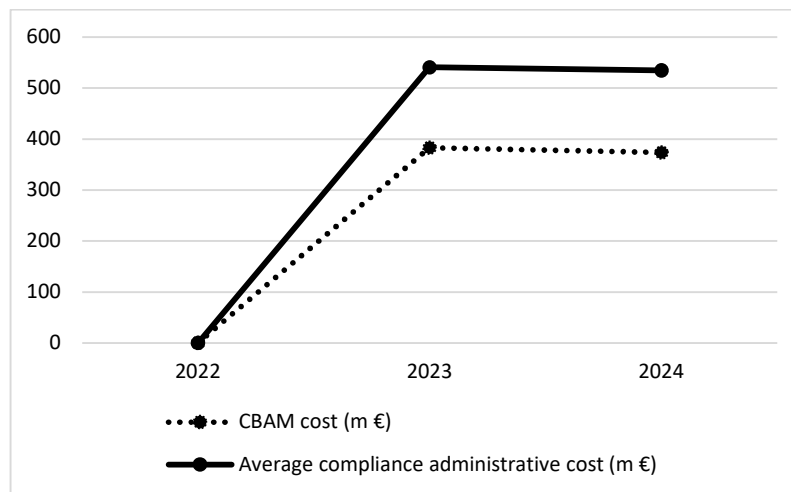


Figure 3: Estimated CBAM Carbon Cost and Administrative Compliance Costs 2022–2024

Figure 3 clearly shows that:

- CBAM-related carbon costs emerge sharply in 2023 and remain at a high level in 2024, illustrating a major potential financial shock once CBAM transitions from reporting-only to a full pricing mechanism.
- Administrative compliance costs are small in relative terms but constant, representing a fixed compliance burden that firms must absorb regardless of export volume.

Taken together, the results reveal a dual cost structure created by CBAM:

- Large variable carbon-related costs linked to emissions intensity and traded volume
- Smaller but persistent fixed administrative costs linked to reporting and verification obligations.

This dual cost structure is especially important when considering the heterogeneous structure of the Finnish metal industry. Table 6 highlights this structure.

Table 6: Structure of the Finnish Metal Industry by Number of Companies

<b>Industry Sector</b>	<b>Number of Companies</b>
Basic Metal Manufacturing	126
Fabricated Metal Manufacturing	5,577
Total Metal Industry (Approx.)	5,703+

Source: Statistics Finland. Structure of enterprises by industry (NACE C24 Basic metals and C25 Fabricated metal products), latest available data. Author's compilation.

As shown in table 6, basic metal manufacturing comprises 126 companies. This segment is typically capital-intensive and emission-intensive. These firms are likely to be most directly exposed to CBAM-related carbon costs because their products fall closer to CBAM's core scope and their production processes emit more CO<sub>2</sub> per unit of output.

Also fabricated metal manufacturing comprises approximately 5,577 companies. This segment is dominated by small and medium-sized enterprises that transform basic metals into components and finished products. These firms may be less exposed to direct CBAM carbon charges but more sensitive to administrative and compliance burdens passed along the value chain by larger suppliers and customers.

The sector structure therefore suggests that CBAM's financial and administrative impacts will not be evenly distributed. A small number of large, emission intensive basic metal producers are likely to bear the bulk of variable carbon costs, whereas many smaller fabricated metal manufacturers may be more affected by the fixed administrative and data-related obligations or by cost pass-through from their upstream suppliers.

From the perspective of the third sub-research question, these findings demonstrate that potential future CBAM cost exposure for Finnish metal exporters is substantial in aggregate and could materially influence competitiveness, especially in basic metals. At the same time, the burden of administrative compliance is likely to fall across a broader set of firms, including many smaller companies in the fabricated metal segment.

#### 4.4 CBAM as a Non-Tariff Regulatory Instrument

The results show that CBAM introduces new reporting obligations, monitoring requirements, and administrative procedures for firms involved in trade in emission-intensive metal products. Quarterly reporting of embedded emissions, the need to follow detailed calculation

methodologies, and the use of default values during the transitional period all point to a significant increase in regulatory complexity at the border level. This is consistent with the view of CBAM as a non-tariff regulatory instrument that affects trade primarily through compliance requirements rather than through traditional tariffs.

From the perspective of trade regulation and non-tariff barrier theory, these findings suggest that CBAM may influence export performance not only by changing relative prices via carbon costs but also by raising the fixed and variable costs of regulatory compliance. The introduction of MRV obligations effectively adds to a new layer of technical regulation that firms must navigate to maintain market access. In the case of Finnish metal exports, this is particularly relevant because a large share of exports is directed to EU markets where CBAM applies.

The descriptive export trends indicate that Finnish metal exports experienced robust volume and value growth up to 2019, followed by declining volumes and, more recently, declining values. Although multiple factors, such as the pandemic and energy price shocks, contributed to this development, the coincidence between the latest downturn and the CBAM transitional phase suggests that regulatory uncertainty and anticipated future costs may be part of the broader environment affecting export behavior. This aligns with literature that emphasizes the role of regulatory expectations and uncertainty in shaping trade and investment decisions in emission-intensive sectors.

#### 4.5 Institutional Adaptation in the Finnish Metal Industry

Institutional theory helps explain how Finnish metal companies may respond to the new CBAM regime. The results on administrative requirements and costs show strong coercive institutional pressure: firms and their EU customers must comply with new reporting rules, and failure to do so can result in penalties or loss of market access. This pressure encourages firms to adapt their internal processes, improve emissions data collection, and strengthen collaboration between production, environmental management, and export functions.

At the same time, normative pressures from customers, investors, and regulators increasingly favor transparent and reliable emissions information. Finnish metal exporters that can provide high-quality emissions data and comply efficiently with CBAM reporting may be perceived as more reliable partners, which could enhance their reputation and strengthen business relationships. This may lead to mimetic behavior, as other firms in the sector adopt similar practices to avoid being left behind.

The structure of the Finnish metal industry, with a small number of large, emission-intensive basic metal producers and many smaller fabricated metal manufacturers, implies differentiated adaptation paths. Basic metal producers face the strongest coercive pressures due

to direct CBAM exposure, but they also have more resources to invest in emissions monitoring technologies and data systems.

Smaller fabricated metal firms may be less exposed to direct carbon charges but more sensitive to fixed administrative costs and data requirements passed through supply chains. This heterogeneity supports the institutional theory view that adaptation to regulatory change is uneven and shaped by firm size, resource availability, and position in the value chain.

#### 4.6 Environmental Regulation, Cost Pressure, and Competitiveness

The simulated CBAM carbon cost of approximately €111 per ton for metal products with an emissions intensity of 1.497 tCO<sub>2</sub> per ton and an EU ETS price of €74.33 per tCO<sub>2</sub> highlights the potential magnitude of new variable costs. At aggregate level, simulated carbon costs in the range of roughly €9.8–10 billion per year represent a substantial potential burden for exporters once CBAM becomes fully operational. In addition, the estimated annual administrative compliance costs of €70,000–€120,000 per firm underline the presence of fixed costs, which may disproportionately affect smaller firms.

From the traditional perspective on environmental regulation, these findings can be interpreted as evidence of increased cost pressure that may weaken competitiveness in the absence of compensating factors. Higher carbon-related and administrative costs can reduce profit margins, constrain investment capacity, and potentially lead to lower export volumes if firms are unable to pass costs on to customers.

However, the Porter Hypothesis and related literature suggest a more nuanced interpretation. Environmental regulation can also act as a driver of innovation and efficiency improvements. For Finnish basic metal producers that already operate with relatively low emissions and have invested in advanced technologies, CBAM may level the playing field by imposing comparable carbon-related costs on competitors from jurisdictions with weaker regulation. In such cases, CBAM could strengthen the competitive position of Finnish producers in EU markets, if they can document and communicate their emissions performance effectively.

The dual cost structure identified in the results large variable carbon costs and smaller but persistent fixed administrative costs suggests that CBAM's competitiveness impacts will depend on firms' ability to reduce emissions intensity and to manage compliance efficiently. Firms that succeed in both dimensions may transform regulatory pressure into a strategic advantage; those that do not may experience a significant erosion of competitiveness.

## 4.7 Synthesis in Relation to Research Questions

This section synthesizes the empirical findings of the study by linking the results of the analysis to the three sub research questions. By integrating regulatory analysis, export performance trends, and simulated carbon cost estimations, the study provides a comprehensive understanding of how CBAM may influence the Finnish metal sector. The synthesis highlights the interaction between regulatory obligations, market performance, and potential future cost exposure, offering a structured interpretation of the results. In doing so, it clarifies how the observed developments in trade patterns and cost structures relate to the broader policy context of CBAM and its implications for emission-intensive exports to the European Union.

### 4.7.1 Regulatory and administrative requirements

CBAM introduces new quarterly reporting obligations, data collection and verification requirements, and fixed administrative costs. These changes confirm that CBAM functions as a non-tariff regulatory measure that increases compliance obligations for exporters and importers.

Firms involved in CBAM related trade must ensure the availability of reliable emissions data, maintain documentation on production processes, and cooperate closely with EU importers responsible for submitting CBAM reports. As a result, companies may need to strengthen internal monitoring systems and establish clearer procedures for collecting and communicating emissions information along the supply chain.

### 4.7.2 Export performance

Finnish metal export volumes and values to the EU show strong growth before 2019, followed by declining volumes and, recently, declining values. While causality cannot be established, the deterioration in performance during the CBAM transitional period consists of a context of heightened cost pressures and regulatory uncertainty for emission-intensive sectors.

These developments suggest that firms operating in the metal sector are facing a more complex trade environment in which regulatory compliance, production costs, and market conditions increasingly interact. As CBAM implementation progresses, exporters may need to adjust pricing strategies, cost management, and operational practices to remain competitive in EU markets.

### 4.7.3 Future cost exposure

Simulated CBAM carbon costs suggest substantial potential financial exposure at both unit and aggregate levels, especially for basic metals. Combined with fixed administrative costs,

this points to a dual cost structure that will influence the competitiveness of Finnish metal exports once CBAM becomes fully operational.

The magnitude of these potential costs indicates that firms with higher emissions intensity may face greater financial pressure in EU markets, particularly if they are unable to reduce emissions or pass additional costs on to buyers. Consequently, the ability to improve emissions efficiency and provide reliable emissions data may become an increasingly important factor shaping the future competitiveness of Finnish metal exporters.

## 5 Recommendations

### 5.1 Practical Implications for Finnish Metal Exporters

This section translates the empirical findings of the study into practical considerations for firms operating in the Finnish metal export sector. The results indicate that CBAM will not only introduce new administrative and reporting obligations but may also influence cost structures and competitive positioning in EU markets. As a result, exporters need to adapt their operational, managerial, and strategic practices to ensure compliance and maintain market access. The following recommendations focus on strengthening emissions data management, integrating compliance into internal processes, and developing longer-term strategies that address both regulatory requirements and emerging low-carbon market expectations.

#### 5.1.1 Strengthening emissions data and MRV systems

Firms need reliable processes for measuring embedded emissions at product level, applying EU-compatible methodologies, and providing verifiable data to their EU customers. Investments in data management, metering, and verification capacity will be essential, especially for basic metal producers directly covered by CBAM.

#### 5.1.2 Integrating CBAM compliance into business processes

CBAM-related data collection and reporting should be embedded in existing management systems rather than treated as an ad hoc task. Closer coordination between production, environmental management, finance, and export/logistics functions can reduce duplication and lower long-term compliance costs.

Integrating CBAM requirements into routine business processes may also improve the efficiency and reliability of emissions reporting. When data collection, documentation, and communication with EU importers become part of normal operational workflows, firms are better able to meet reporting deadlines and maintain consistent compliance with regulatory requirements.

#### 5.1.3 Strategic emissions reduction and product differentiation

Reducing emissions intensity can directly lower future CBAM-related costs and, at the same time, support market differentiation as a low-carbon supplier. Firms that can demonstrate superior emissions performance may leverage CBAM to strengthen their position in EU markets.

Investments in cleaner production technologies, energy efficiency, and low carbon energy sources can therefore play an important strategic role. By lowering embedded emissions

and improving transparency in emissions reporting, exporters may not only reduce potential CBAM costs but also respond to increasing demand from European buyers for environmentally sustainable products.

#### 5.1.4 Assessing impact along the value chain

Fabricated metal manufacturers, many of which are small and medium-sized enterprises, should assess how CBAM-related costs and data requirements propagate along supply chains. Even when not directly covered by CBAM, these firms may face indirect cost pressures and information demands from upstream producers and downstream customers.

Understanding how these requirements move through the value chain can help firms anticipate potential cost increases, adjust procurement strategies, and prepare the necessary emissions related documentation requested by business partners operating under CBAM obligations.

### 5.2 Policy Recommendations

In addition to firm-level implications, the findings highlight several areas where policy support may facilitate the adjustment of the Finnish metal sector to the CBAM framework. Because the mechanism introduces new regulatory, technical, and financial challenges, particularly for emission-intensive industries and smaller firms, public policy can play an important role in reducing transition barriers.

The recommendations in this section therefore focus on strengthening institutional guidance, supporting technological innovation and decarbonization, and ensuring that the implementation of CBAM remains balanced and transparent across different firm sizes and segments of the metal value chain.

#### 5.2.1 Support for MRV capacity and digital infrastructure

National authorities could facilitate CBAM compliance by providing guidance, training, and possibly financial support for investments in emissions monitoring and data systems, particularly for small and medium-sized enterprises in the metal value chain.

Improving MRV (monitoring, reporting, and verification) capacity through digital tools, standardized reporting platforms, and technical support programs can help firms manage emissions data more efficiently and reduce the administrative burden associated with CBAM compliance.

## 5.2.2 Targeted innovation and decarbonization support

Since basic metal producers face the greatest carbon cost exposure, targeted support for low-carbon process innovation such as hydrogen-based steelmaking, electrification, and increased recycling could help maintain their competitiveness under CBAM.

Public funding programs, research partnerships, and innovation incentives can support the development and adoption of these technologies, helping firms reduce emissions intensity while strengthening the long-term sustainability of the metal sector.

## 5.2.3 Coordination with EU-level CBAM design and default values

Finnish authorities and industry associations may engage with EU institutions to ensure that CBAM default values and methodologies reflect realistic emissions benchmarks. This can help avoid excessive penalties for firms whose actual emissions are lower than conservative default assumptions.

Active dialogue with EU level policymakers can also help communicate the specific characteristics of the Finnish metal industry, ensuring that reporting methodologies and calculation rules remain practical and proportionate for firms operating in different production contexts.

## 5.2.4 Monitoring distributional impacts across firm sizes

Policymakers should monitor how CBAM compliance costs affect firms of different sizes and consider complementary measures (e.g. advisory services, simplified reporting for small importers) to prevent disproportionate burdens on smaller enterprises.

Because the Finnish metal sector includes many small and medium sized firms, ongoing evaluation of CBAM's administrative and financial impacts can help identify where additional guidance or support mechanisms may be needed to ensure that smaller companies can adapt effectively to the new regulatory environment.

## 6 Conclusion

CBAM significantly increases regulatory and administrative obligations for firms involved in trade in emission-intensive metal products. Quarterly reporting of embedded emissions, the use of EU-specified calculation methodologies, and reliance on default values in the absence of verified data create a new regulatory layer at the border. Although these obligations apply formally to EU importers, Finnish metal exporters are indirectly affected because they must supply detailed production and emissions data to support compliance. Estimated administrative compliance costs of €70,000–€120,000 per firm per year indicate a non-negligible fixed cost burden, particularly for smaller companies.

Finnish metal export performance to the EU has weakened in recent years, with export volumes declining after 2019 and export values falling in 2023 and 2024. While these changes are influenced by multiple external factors, including macroeconomic conditions and energy price volatility, the timing suggests that the CBAM transitional phase occurs against a backdrop of heightened cost and regulatory pressures for emission-intensive industries. The descriptive evidence indicates that the export environment for Finnish metal products has become more challenging during this period.

Indicative simulations suggest that CBAM could result in substantial future carbon-related cost exposure for Finnish metal exporters once the mechanism becomes fully operational. An estimated CBAM cost of approximately €111 per ton for metal products with an emissions intensity of 1.497 tCO<sub>2</sub> per ton and an EU ETS price of €74.33 per tCO<sub>2</sub> illustrates the potential magnitude at the unit level. Aggregated simulated carbon costs of around €9.8–10 billion per year underline the scale of possible financial impacts. Combined with fixed administrative costs, CBAM introduces a dual cost structure that may significantly influence pricing, profitability, and investment decisions in the Finnish metal industry.

At the same time, the analysis suggests that CBAM may also create opportunities for firms with relatively low emissions intensity and strong data capabilities. For such firms, CBAM can level the playing field by raising the effective carbon cost of competitors from jurisdictions with weaker climate regulation, potentially enhancing the comparative advantage of low-carbon production.

The study has several limitations that point to avenues for future work. The analysis is based entirely on secondary data and simulated cost scenarios. Future research could incorporate firm-level interviews or surveys to gain deeper insights into how Finnish metal exporters perceive CBAM and how they are adapting operationally and strategically.

The descriptive export analysis cannot isolate CBAM's effects from other factors influencing trade. As more post-implementation data become available and CBAM moves from the transitional to the full financial phase, future studies could apply econometric methods or quasi-experimental designs to better identify the causal impact of CBAM on export performance.

The simplified carbon cost simulations assume constant emissions intensity and a single carbon price. Future research could integrate more detailed engineering data on process emissions, scenario ranges for EU ETS prices, and alternative CBAM design options. Linking such simulations to firm-level financial data would provide a richer picture of how CBAM affects profitability and investment decisions.

Finally, while this thesis focuses on Finnish metal exports to the EU, CBAM's effects extend beyond a single country and sector. Comparative studies across member states and industries could help identify which structural features such as energy mix, technological level, and firm size distribution are most important in shaping the balance between CBAM-induced cost pressures and competitiveness opportunities.

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