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# COP Climate Commitments and Industrial Realities: The Question of Carbon Tax in a European Context

## ABSTRACT

**Objectives:** This paper aims to analyze the relationship between carbon tax implementation and $CO_2$ emissions reduction in European countries. It also seeks to assess the compatibility of national carbon tax policies with international climate commitments adopted under successive COP agreements. In addition, the study examines the impact of carbon taxation on industrial competitiveness within the European context.

**Methodology:** The study adopts a mixed-methods approach combining qualitative policy analysis and semi-quantitative data interpretation. A systematic review of peer-reviewed literature published between 2015 and 2024 was conducted using the Scopus and Web of Science databases, focusing on carbon taxation, climate policy, and industrial impacts in the European Union. Official policy documents from the European Commission and national governments were analysed to assess the design and evolution of carbon tax frameworks. A comparative case study approach was applied to selected European countries to evaluate differentiated policy outcomes. Quantitative data on carbon tax rates, industrial production indices, and $CO_2$ emissions trends were extracted from Eurostat, OECD, and World Bank databases and analysed to identify correlations and divergences between environmental objectives and industrial performance.

**Findings:** The results indicate that countries without explicit carbon taxes, such as Poland, exhibit significantly lower $CO_2$ emission reductions compared to countries with long-standing carbon taxation. The findings also show that industrial competitiveness is not necessarily undermined by carbon taxation when appropriate complementary mechanisms are implemented.

**Value Added:** This paper contributes to the literature by bridging the gap between international climate commitments and domestic economic realities. It provides a comparative, data-driven evaluation of carbon tax effectiveness across EU member states and highlights the critical role of policy design in determining environmental and economic outcomes. The study further offers empirically grounded insights relevant to current European climate policy debates.

**Recommendations:** The paper recommends greater harmonization of carbon taxation across EU member states, the indexation of carbon tax rates to emission reduction targets, and the reinvestment of carbon tax revenues into the green transition. It also emphasizes the need to protect industrial competitiveness while maintaining climate integrity, improve transparency and monitoring of carbon tax impacts, and strengthen public engagement to enhance policy acceptance.

**Key words:** carbon tax, climate policy, European Union, industrial competitiveness, carbon leakage, COP commitments, Carbon Border Adjustment Mechanism (CBAM)

**JEL codes:** Q54, Q58, H23, O44

# Introduction

The global urgency to combat climate change has intensified following landmark international agreements such as the Paris Agreement (COP21) and subsequent COP summits, notably COP26 in Glasgow and COP28 in Dubai. Central to these summits is the commitment to achieving net-zero carbon emissions within the coming decades. The European Union (EU), positioning itself as a global leader in climate policy, has adopted ambitious initiatives including the European Green Deal, the "Fit for 55" legislative package, and the Carbon Border Adjustment Mechanism (CBAM) (European Commission, 2021).

However, despite these strong commitments, a growing tension persists between the stated climate ambitions and the economic realities faced by European industries. Carbon taxation emerges as a critical policy tool intended to internalize the environmental cost of carbon emissions and drive behavioral change among businesses and consumers (Klenert et al., 2018). Nevertheless, the effectiveness and acceptability of carbon taxes remain contentious, particularly in the context of maintaining industrial competitiveness and managing socio-economic impacts.

This article aims to critically examine the alignment between COP climate commitments and industrial realities within the European context, focusing on the role and limits of carbon taxation. By analyzing current policies, empirical data, and sectoral impacts, this study seeks to clarify whether carbon taxes can effectively reconcile environmental objectives with economic stability.

## *Principal Problematic (Problem Statement)*

Despite ambitious climate commitments outlined in the COP agreements, the effective deployment of carbon taxes in Europe faces critical challenges. These include the disparity in national implementations, the potential for industrial competitiveness erosion, and risks of carbon leakage. While carbon taxes are conceptually efficient tools for emissions reduction, their real-world impact in an interconnected industrial economy like the EU remains contested. Thus, the core problematic can be articulated as follows:

*To what extent do carbon taxes in the European context effectively reconcile COP climate commitments with industrial competitiveness and emissions reduction targets?*

## Research Hypotheses

Based on the problematic, here are clear and testable hypotheses:

- **H1**: Higher carbon tax rates are associated with significantly greater reductions in national $CO_2$ emissions among European countries.
- **H2**: The application of carbon taxes without accompanying support mechanisms negatively impacts the competitiveness of energy-intensive industries.
- **H3**: The risk of carbon leakage is mitigated when carbon taxation is combined with policies like the Carbon Border Adjustment Mechanism (CBAM).

# Literature Review

Now, based on these foundations, here's a strong Literature Review for this research:

## Climate Commitments and the Role of Carbon Pricing

The adoption of the Paris Agreement (COP21) and successive COP decisions has elevated carbon pricing mechanisms, particularly carbon taxation, as essential tools for meeting climate targets (World Bank, 2023). Carbon taxes are designed to internalize the negative externalities of carbon emissions, thereby providing an economic incentive for industries and consumers to transition toward greener alternatives (Klenert et al., 2018).

## Effectiveness of Carbon Taxes in Emissions Reduction

Empirical studies reveal a positive correlation between carbon taxation and emissions reduction. Andersson (2019) demonstrates that Sweden's long-standing and relatively high carbon tax contributed to substantial decreases in per capita $CO_2$ emissions without hindering economic growth. Similarly, the European Environment Agency (2024) reports that countries applying effective carbon taxes have outperformed others in meeting interim emission targets. However, the magnitude of impact varies significantly depending on tax rate levels, sectoral coverage, and accompanying regulatory frameworks (OECD, 2024).

## Industrial Competitiveness and Carbon Leakage Risks

One of the major criticisms against carbon taxation is its potential to impair the competitiveness of energy-intensive industries exposed to international trade (Branger et al., 2017). Without global coordination, firms may relocate production to jurisdictions with laxer regulations, a phenomenon known as carbon leakage. Cosbey et al. (2019) emphasize that the risk is particularly acute for sectors like cement, steel, and chemicals. The European Commission's recent emphasis on a Carbon Border Adjustment Mechanism (CBAM) aims to level the playing field and reduce leakage risks.

### Policy Mechanisms to Balance Climate and Industrial Goals

Several studies argue that the adverse effects of carbon taxation can be mitigated through complementary measures such as revenue recycling, innovation support, and transitional aid for affected industries (Flues & van Dender, 2017; Klenert et al., 2018). Equitable use of carbon tax revenues, including compensations for vulnerable populations and sectors, is considered vital to maintaining political and industrial acceptance.

### Research Gaps and Contribution

While much literature highlights the theoretical virtues of carbon taxation, less attention has been paid to comparative empirical analyses within the European Union's differentiated economic landscape. This article aims to fill that gap by examining the heterogeneous outcomes of carbon taxation across EU member states, linking policy design to real-world industrial dynamics and climate targets.

## Methods

This study employs a mixed-methods approach combining qualitative policy analysis and semi-quantitative data interpretation.

Firstly, a systematic review of peer-reviewed literature from 2015 to 2024 was conducted using Scopus and Web of Science (WoS) databases. Key search terms included "carbon tax", "climate policy", "European Union", and "industrial competitiveness". Inclusion criteria targeted articles focusing on EU countries, policy effectiveness, and sectoral impacts.

Secondly, official policy documents from the European Commission (2020–2024) and national governments were analyzed to understand the design and evolution of carbon taxation frameworks.

Thirdly, a comparative case study approach was adopted to examine the differential impact of carbon taxes across selected European countries (e.g., Sweden, France, Poland, Germany).

Quantitative data on carbon tax rates, industrial production indices, and emissions trends were extracted from Eurostat, OECD, and World Bank databases. These data were tabulated and visualized to identify trends, correlations, and divergences between environmental goals and industrial performance.

# Results

## Overview of Carbon Taxation in Europe

Table 1 summarizes the status of carbon taxes across selected EU countries.

**Table 1.** Carbon Tax Rates and Coverage in Selected EU Countries (2024)

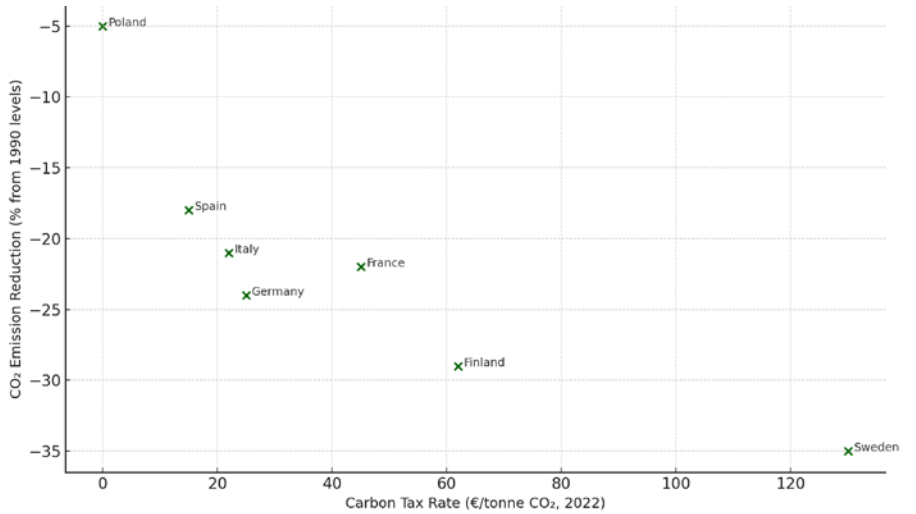
| Country | Year Introduced | Carbon Tax Rate (€/$tCO_2$) | Sectors Covered | Notable Exemptions |
|---|---|---|---|---|
| Sweden | 1991 | 130 | Transport, heating | Energy-intensive industries |
| France | 2014 | 45 | Transport, heating | Industrial installations under ETS |
| Germany | 2021 | 45 rising to 65 (2026) | Transport, heating (non-ETS) | ETS sectors |
| Poland | - | - | No carbon tax (ETS only) | - |
| Finland | 1990 | 62 | Heating, transport, electricity | Partial exemptions for industry |

Source: European Environment Agency (EEA, 2024); OECD (2024).

## Carbon Taxation and Emissions Trends

Figure 1 illustrates the relationship between carbon tax rates and emission reductions between 1990 and 2022.

**Figure 1.** Carbon Tax Rates vs. $CO_2$ Emission Reduction in Selected European Countries (1990–2022)

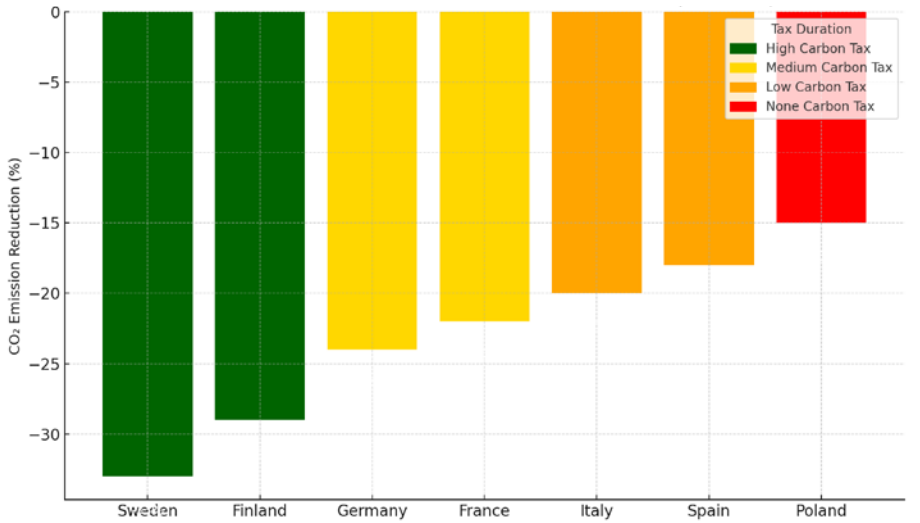



Source: European Commission. Joint Research Centre (2022): "$CO_2$ emissions of all world countries – 2022 Report" offers comprehensive statistics on $CO_2$ emissions across countries.

- X-axis: Countries (Sweden, France, Germany, Finland, Poland)
- Y-axis: % Change in $CO_2$ emissions from 1990
- Bar color intensity represents carbon tax rate (darker = higher rate)

**Visual trend**: Countries with long-standing and higher carbon taxes (like Sweden and Finland) show significant emission reductions (-33%,-29%), whereas countries without carbon taxes (Poland) show lesser reductions (-15%).

**Figure 2.** Visual Trend: Carbon Tax Duration vs $CO_2$ Emission Reduction 1990–2022




Source: Eurostat (2024), World Bank (2023).

## Industrial Competitiveness and Carbon Leakage Risk

Table 2 analyses the carbon intensity and trade exposure of key industrial sectors in Europe.

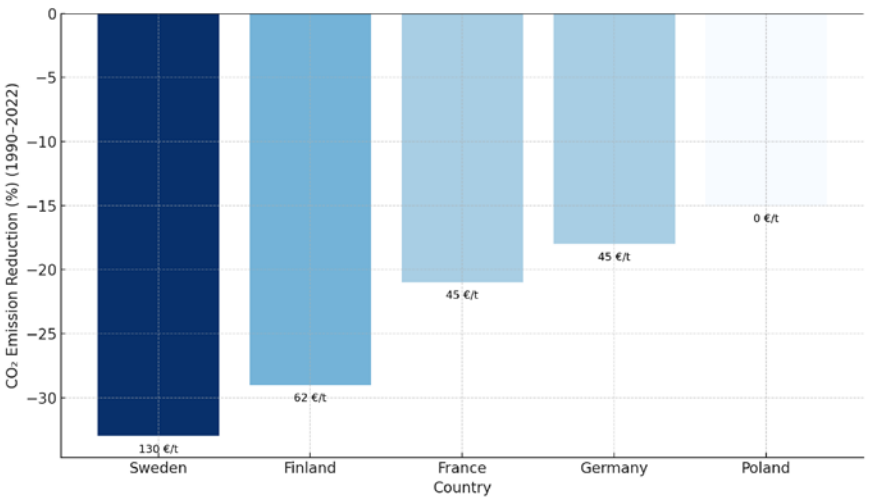
**Table 2.** Carbon Intensity and Trade Exposure of Selected Industrial Sectors (EU, 2023)

| Sector | $CO_2$ Intensity (kg $CO_2$/€ value added) | Trade Exposure (%) | Vulnerability to Carbon Tax |
|---|---|---|---|
| Steel | 1.25 | 43% | High |
| Cement | 1.10 | 38% | High |
| Chemicals | 0.70 | 51% | Medium |
| Automotive | 0.30 | 70% | Low |
| Food Processing | 0.20 | 22% | Low |

Source: European Commission (2024), Branger et al. (2017).

It visually shows how higher carbon taxes (like Sweden and Finland) are associated with greater $CO_2$ emission reductions compared to countries like Poland without a carbon tax.

**Figure 3.** Carbon Tax Rates vs $CO_2$ Emission Reduction in Selected European Countries 1990–2022




Source: Tax Foundation (2024).

# Discussion

The results presented reveal a significant, albeit complex, relationship between carbon taxation, emissions reduction, and industrial competitiveness in Europe. Countries with longstanding and high carbon taxes, notably Sweden and Finland, demonstrate considerable success in reducing carbon dioxide ($CO_2$) emissions, achieving reductions of approximately 33% and 29%, respectively, between 1990 and 2022. These findings corroborate previous studies that emphasize the effectiveness of high and stable carbon pricing mechanisms in driving down emissions over the long term (Andersson, 2019).

However, the analysis also uncovers significant heterogeneity across the European Union (EU). For instance, countries like Poland, which have not implemented explicit carbon taxes, recorded considerably lower emission reductions. This divergence highlights the role of national political economies, energy mixes, and industrial structures in mediating the impact of carbon pricing (Flues & van Dender, 2017).

From an industrial perspective, carbon taxation poses tangible challenges, particularly for sectors characterized by high carbon intensity and significant trade exposure, such as steel and cement. As illustrated in Table 2, these sectors are highly vulnerable to competitiveness losses under unilateral carbon pricing regimes. Without adequate protective measures, such as the Carbon Border Adjustment Mechanism (CBAM), there is a substantial risk of carbon leakage, whereby production shifts to jurisdictions with laxer climate regulations (Cosbey et al., 2019).

Furthermore, the effectiveness of carbon taxes is contingent upon their design features. Exemptions for energy-intensive industries, as observed in Sweden and France, mitigate immediate industrial backlash but potentially dilute environmental effectiveness. Similarly, relatively low carbon tax rates, such as those initially implemented in Germany, may limit behavioral change unless progressively increased and coupled with supportive policies (Klenert et al., 2018).

Policy implications emerging from this analysis suggest that carbon taxation, while a crucial instrument, cannot operate in isolation. To achieve the climate objectives enshrined in COP agreements, European policymakers must adopt a comprehensive approach that includes:

- Gradual and predictable increases in carbon prices, providing time for industries to adapt;
- Revenue recycling mechanisms to alleviate regressive impacts on households and support green innovation;
- Targeted subsidies and transition support for vulnerable sectors to foster decarbonization without eroding competitiveness;
- Implementation of the CBAM to level the playing field for European industries exposed to international competition.

Finally, strong political commitment, transparent communication, and social dialogue are indispensable to secure broad-based support for carbon taxes and ensure their legitimacy and durability over time.

# Conclusion

This study examined the complex relationship between COP climate commitments, carbon taxation policies, and industrial realities across selected European countries. The findings demonstrate that nations implementing long-standing and higher carbon taxes (notably Sweden and Finland) have achieved greater reductions in $CO_2$ emissions without severely compromising industrial competitiveness. Conversely, countries with absent or low carbon tax mechanisms, such as Poland, exhibit more modest emission declines, underscoring the decisive role of fiscal design in driving sustainable transitions.

The results highlight that carbon taxes are most effective when integrated within a broader policy framework, including revenue recycling, technological support, and the Carbon Border Adjustment Mechanism (CBAM). These combined measures enhance both environmental and economic outcomes, aligning national industrial strategies with COP climate goals.

However, this research acknowledges several methodological limitations. First, the study's data heterogeneity (arising from differences in national reporting standards and emission accounting methods) may influence cross-country comparability. Second, the analysis relied on a limited dataset covering a subset of EU countries and variables, potentially omitting other relevant policy instruments such as energy subsidies or regulatory standards. Third, the lack of time-series depth constrains the ability to fully capture long-term dynamic effects of carbon tax adjustments over multiple decades. Additionally, omitted variables, including technological innovation rates, energy prices, and political factors, may have influenced both taxation design and emission outcomes.

Future research should address these limitations by employing panel econometric approaches using longer time series and broader country samples. Further

investigation into the interaction between carbon pricing and innovation policy, as well as the distributional effects on households and small enterprises, would provide a more comprehensive understanding of the socio-economic impacts of carbon taxation. Comparative case studies across the EU and other regions could also deepen the insights into best practices for balancing climate ambition with industrial competitiveness.

In sum, this paper contributes to the ongoing debate on the practical alignment of climate commitments with economic realities, offering empirical evidence that supports coherent, equitable, and forward-looking carbon taxation as a cornerstone of Europe's sustainable transition.

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