



1. Title: Optimizing Carbon Border Adjustments: A microsimulation approach to Regulatory Compliance and Global Decarbonization

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3. Societal case

The European Union's Carbon Border Adjustment Mechanism (CBAM) aims to prevent carbon leakage by imposing a carbon charge on imports from countries without, or with less stringent carbon pricing (CP) mechanisms [1, 3]. While this policy seeks to level the playing field for EU industries, it has raised concerns about potential negative impacts on developing countries [2-3]. These nations may face economic challenges due to increased costs associated with the CBAM, potentially affecting their competitiveness and overall welfare [2-5]. This raises questions about climate justice, as countries with historically lower emissions and limited resources are disproportionately affected [3-5]. Further, CBAM could destabilize supply chains and introduce significant regulatory challenges including compliance complexity [2-6]. Climate TRACE, a coalition leveraging AI and remote sensing to track emissions, provides critical data to address these challenges [7]. The data combined with a microeconomic model [8] will identify vulnerabilities and emission hotspots in value chains, informing internal CP strategies. This could enable dynamic revisions instead of current annual pricing mechanism [1]. Finally, the data-model framework can significantly alleviate several regulatory challenges posed by the CBAM, particularly in data accuracy, supply chain transparency, and compliance efficiency- providing insights into SDGs 7, 8, 9, 13 and 17.

4. Scientific case

This proposed research seeks to understand the tension between regulatory compliance, socioeconomic efficacy, and fairness—central themes in CBAM. We developed a microsimulation model to demonstrate that CP triggers non-linear economic transitions to low-carbon technologies [9]. Integrating TRACE's data with the model would enhance its ability to compute country- and sector-specific tipping points. TRACE's facility-level data can refine the model's inputs and outputs in three ways: a) Sector-Specific Tipping Point Identification: TRACE provides real-time emissions for sectors like steel or aviation [7], enabling calibration of CP thresholds for each industry. The model could calculate the CP required to shift producers to carbon capture or alternative fuels. b) The model can adjust CP thresholds based on regional renewable energy potential. Flag countries lacking renewable resources, where CP alone may fail impacting compliance and stability of the supply chain. The integration of CP models with TRACE's emissions data creates a powerful nexus to inform compliance risk mapping and dynamic regulatory adjustments by simulating scenarios and optimizing decarbonization pathways. The framework enables customized CBAM rates by sector/country to maximize compliance while minimizing trade friction. Future work can explore quantifying risks like carbon leakage or legal challenges under WTO rules, considering human rights obligations [10-12].

5. Contribution to the aims and success indicators of ENLENS

A. How will your project evolve after the proposed research/activity. What is the long-term goal?

The project aims to evolve from an initial analytical tool into a comprehensive global platform for climate policy optimization. This includes expanding the analytical framework, engaging private sector to refine and validate the model. To achieve this the team will explore future NWO grants such as VIDI and M grant. We further aim to participate in any potential consortium for EU funding mechanisms.

B. Why and how does your project contribute to the UvA-community of interdisciplinary research, and ENLENS more specifically?

The project integrates climate science, economics, law, and technology by combining carbon pricing models with Climate TRACE data. This aligns with UvA's emphasis on interdisciplinary research across faculties, as seen in initiatives like SEVEN and ENLENS. The project directly addresses ENLENS' mission of mapping energy transitions

in Europe while considering their broader socio-economic impacts on SDGs like equity and sustainable consumption. By serving as a pilot study, the project lays the groundwork for future interdisciplinary research proposals on climate policy optimization and compliance mechanisms. This aligns with ENLENS’ goal of providing seed money to initiate long-term projects. More specifically, the project will have potentially strong synergies with DigiChain (a RDT seed project_ and the Responsible Business Conduct Lab .

C. ENLENS aims at broadening the community beyond the group of project PIs. Describe how your project will contribute to this goal.

The project integrates expertise from multiple disciplines—economics, environmental science, law, and technology – enabling broader stakeholder network. By focusing on CBAM’s international implications, the project can connect UvA researchers with global collaborators, expanding the ENLENS network beyond Dutch and European borders. The project’s focus on actionable insights ensures that its findings resonate with non-academic audiences, fostering trust and engagement with external communities.

6. Budget

Faculty: Faculteit der Natuurwetenschappen, Wiskunde en Informatica	
Description: A researcher integrating the model with TRACE data	€15000
Faculty: Faculteit der Rechtsgeleerdheid	
Description: A researcher generating compliance and regulatory scenarios	€15000
Extra	
Description: Survey of specific firms across four diverse countries to understand the operational and mechanistic impact of CBAM. Specifically, it will assess if CBAM levies drive decarbonization in non-EU suppliers. The survey will be designed to capture why firms delay green transitions, refining carbon pricing models to account for real-world inertia. It will bridge the gap between macro-level models and micro-level behavior, addressing assumptions about rational actor responses in economic models. The survey will include compliance challenges, economic impact, effectiveness in emission reduction and supply chain adaptation. The budget is based on quotations from Market research company. The dataset will be unique and has a wide potential for reuse well beyond the duration of the project.	€15000
Total budget:	€45000

7. References

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