INTERNATIONAL MONETARY FUND

Macroeconomic Exposure to the EU's Carbon Border Adjustment Mechanism

The Case of the Middle East and Central Asia

Mariz Abdou, Hasan Dudu, Kerstin Gerling, and Dalia Kadissi

WP/25/182

2025
SEP

WORKING PAPER

 WP/25/182

IMF Working Paper
Middle East and Central Asia Department

Macroeconomic Exposure to the EU's Carbon Border Adjustment Mechanism: The Case of the Middle East and Central Asia

Prepared by Mariz Abdou, Hasan Dudu, Kerstin Gerling, and Dalia Kadissi*

Authorized for distribution by Alexander Tieman
August 2025

ABSTRACT: Taking the European Union's Carbon Border Adjustment Mechanism (CBAM) as given, our paper evaluates the impact of this terms-of-trade shock on the Middle East and Central Asia (ME&CA). Using a novel methodology and fresh data applied to the latest CBAM legislation, we both quantify and decompose the financial burden countries face as their exports to the EU become subject to a greenhouse gas-based fee starting in January 2026. Our analysis reveals that while the average effects of CBAM in ME&CA are modest, the region will shoulder one of the highest burdens worldwide, totaling US$1.7 billion annually (equivalent to 0.03 percent of GDP and a 14 percent surcharge on CBAM exports to the EU). The Middle East, North Africa, Afghanistan, and Pakistan (MENAP) subregion will bear a greater share of this burden than the Caucasus and Central Asia (CCA) due to stronger trade ties with the EU and higher emission intensity. Substantial country- and sector-level differences in CBAM exposure emphasize the need for tailored policy responses to mitigate the broader macroeconomic effects.

RECOMMENDED CITATION: Abdou, M., Dudu, H., Gerling, K., Kadissi, D., 2025. Macroeconomic Exposure to the EU's Carbon Border Adjustment Mechanism: The Case of the Middle East and Central Asia, *IMF Working Paper* No: WP/25/182 Washington, DC

JEL Classification Numbers:	F14; F18; H23; Q54; Q56
Keywords:	Carbon Border Adjustment Measures; Carbon Leakage; Trade Policy; Middle East; Central Asia and Caucasus
Authors' E-Mail Addresses:	mariz.samy_sobhy_abdou@doctorant.uca.fr; hdudu@imf.org; kgerling@imf.org; and dkadissi@imf.org

* This project started when Mariz Abdou, who is currently at CERDI, Clermont Auvergne University, was an intern at the IMF. Hasan Dudu, Kerstin Gerling, and Dalia Kadissi are IMF staff members. The authors would like to thank Subir Lall, Alexander Tieman, Eliakim Kakpo, and seminar participants at the IMF for their insightful comments and suggestions; and Geoffroy Dolphin, Salem Nechi, and Zeina Hasna for valuable discussions on data and methodological approaches. The usual caveats apply.

Contents

Acronyms and Abbreviations **4**
Glossary **5**
1. Introduction **7**
2. Literature Review **10**
3. Methodology **12**
3.1 Analytical Framework 12
3.2 Data 15
3.3 Scope 16
4. Key Findings **17**
4.1 Sizing ME&CA's Overall CBAM Exposure: Emission Coverage and Burden 17
4.2 Unpacking ME&CA's CBAM Exposure: Key Drivers 18
4.2.1 MENAP 18
4.2.2 CCA 23
5. Conclusion **25**
Appendix I. Country Sample and Groupings **28**
Appendix II. CBAM Emission Coverage **29**
Appendix III. CBAM Commodity Coverage **30**
Appendix IV. Relative Price Bias **31**
Appendix V. GLORIA and BACI Transformations **32**
Appendix VI. Employed Carbon Prices **33**
Appendix VII. Country-by-Country CBAM Results **34**
References **35**

BOXES

Box 1. The EU's Carbon Adjustment Mechanism (CBAM) 1/ 9

FIGURES

Figure 1. ME&CA and Peer Regions: Power Mix and EU Trade 1/ 7
Figure 2. CBAM Burden: Methodological Decomposition 14
Figure 3. ME&CA and Peer Regions: Overall CBAM Exposure 18
Figure 4. MENAP Countries: Overall CBAM Exposure 19
Figure 5. MENAP Countries: Sectoral CBAM Burdens 20
Figure 6. MENAP Countries: Contribution of 21
Figure 7. MENAP Countries: Disaggregation of Selected CBAM Burden Drivers 22
Figure 8. CCA Countries: Overall CBAM Exposure 23
Figure 9. CCA Countries: Sectoral CBAM Burdens 24
Figure 10. CCA Countries: Contribution of 24
Figure 11. CCA Countries: Disaggregation of Selected CBAM Burden Drivers 25

Acronyms and Abbreviations

ºC	Degree Celsius
AE	Advanced Economy
APAC	Asia and Pacific
AMER	Americas
BAU	Business-As-Usual
CBAM	Carbon Adjustment Mechanism
CCA	Caucasus and Central Asia
CFC	Chlorofluorocarbon
CGE	Computable General Equilibrium
CH_4	Methane
CO_2	Carbon Dioxide
EC	European Commission
EDGAR	Electronic Data Gathering, Analysis, and Retrieval
EEA	European Economic Area
EITE	Emission-Intensive and Trade-exposed
EM	Emerging Market
EMDE	Emerging Market and Developing Economy
ETS	Emission Trading System
EU	European Union
EUA	EU Emission Allowance
EUR	Europe
FCS	Fragile and Conflict-Affected State
GCC	Gulf Cooperation Council
GHG	Greenhouse Gas Emissions
GLORIA	Global Resource Input-Output Assessment
GTAP-E	Global Trade Analysis Project-Energy
IMF	International Monetary Fund
IO	Input-Output
IPPU	Industrial Processes and Product Use
K-tonne	Kilo Tonne
LIDC	Low-Income and Developing Country
ME&CA	Middle East and Central Asia
MENA	Middle East and North Africa
MENAP	Middle East and North Africa, Afghanistan, and Pakistan
MRIO	Multi-Region Input-Output
$mtCO_2e$	Million tons of CO_2-equivalent
N_2O	Nitrous Oxide
OE	Oil Exporter[1]
OECD	Organization for Economic Co-operation and Development
OI	Oil Importer[1]
p.c.	Per Capita
pct.	Percent
PFC	Perfluorocarbon
ROW	Rest of the World
SSA	Sub-Saharan Africa
TOPSIS	Technique for Order Preference by Similarity to Ideal Solution
WEO	World Economic Outlook
WTO	World Trade Organization

[1] The term oil exporter (resp. importer) refers to both an oil and gas exporter (resp. importer). 13 of the world's 25 EMDE oil exporters (OEs) are in ME&CA: ten in MENAP—six GCC members (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates) and four others (Algeria, Iran, Iraq, and Libya)—and three in the CCA (Azerbaijan, Kazakhstan, and Turkmenistan).

Glossary[1]

Carbon Border Adjustment Mechanism (CBAM)	Tool designed by the EU to combat carbon leakage by levying a fee on GHG emissions produced during the manufacturing of carbon-intensive goods upon their entry into the EU. This fee is collected from importing companies.
CBAM burden	A country's static incidence across all its CBAM-covered export products, i.e., the additional cost from CBAM (as a share of GDP).
CBAM's importance in EU trade	Share of CBAM commodities as a percentage of total exports to the EU.
CBAM's importance in total trade	Share of CBAM commodities as a percentage of total exports to all countries, including the EU.
CBAM net fee	Difference between the EU's CBAM fee and the carbon fee paid in the exporting country per unit of emission (measured in US$ per mtCO2e).
CBAM obligation	A country's static incidence across all its CBAM-covered export products, i.e., the additional cost from CBAM (measured in US$).
Electricity intensity	Total value of electricity used per unit of output (measured in US$).
Emissions	Releases of gases into the atmosphere (e.g., the release of carbon dioxide during fuel combustion). Emissions can be either intended or unintended releases.
Emission intensity	Total amount of GHG emissions released per unit of output or total production (measured in tons of CO_2 equivalent (mtCO_2e)).
Emission intensity of electricity	Total amount of GHG emissions released per unit of electricity generated (measured in tons of CO_2 equivalent (mtCO_2e)).
Emission intensity of energy	GHG emissions per unit of non-electric energy used as an input in the production of CBAM commodities.
Emission intensity of process	Industrial process and product use (IPPU) emissions per unit of output quantity (measured in million tons of CO_2-equivalent (mtCO_2e)).
Energy	Capacity for doing work as measured by the capability of doing work (potential energy) or the conversion of this capability to motion (kinetic energy). Energy has several forms, some of which are easily convertible and can be changed to another form for useful work.
Energy efficiency	Ratio of output or useful energy or energy services or other useful physical outputs obtained from a system, conversion process, transmission or storage activity to the input of energy. Energy efficiency is often described by energy intensity.
Energy intensity	Ratio of economic output to energy input.

[1] See EU (2024a, b), UNFCCC (2025), and IPCC (2025).

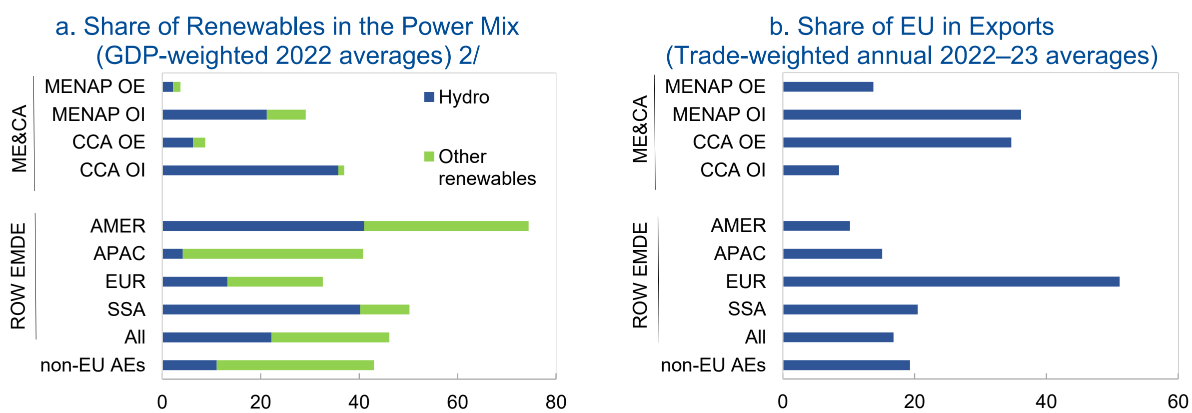
Emissions Trading System (ETS)	Market-based approach to reducing GHG emissions by setting a limit on total emissions and allowing firms to trade emission permits. Also known as a "cap-and-trade" system.
EU's importance in CBAM trade	Share of CBAM commodities exported to the EU as a percentage of total exports to all countries, including the EU.
EU's importance in total trade	Share of total exports to the EU as a percentage of total exports to all countries, including the EU.
Export importance in economy	Share of total exports as a percentage of GDP.
Fossil fuel	General term for buried combustible geologic deposits of organic materials, formed from decayed plants and animals that have been converted to crude oil, coal, natural gas, or heavy oils by exposure to heat and pressure in the earth's crust over hundreds of millions of years.
Greenhouse gases (GHG)	Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, but are not limited to, water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).
Industrial Processes and Product Use (IPPU)	GHG emissions resulting from various industrial activities that produce emissions not directly the result of energy consumed during the process and the use of man-made greenhouse gases in products. Examples include the release of CO2 as a by-product of cement production and the use of fossil fuel (primarily natural gas) as a feedstock in ammonia production.
Renewable energy	Energy obtained from sources that are essentially inexhaustible, unlike, for example, fossil fuels, of which there is a finite supply. Renewable sources of energy include wood, waste, geothermal, wind, photovoltaic, and solar thermal energy.
Scope 1, 2, and 3 emissions	Scope 1 are "direct" emissions from sources owned or controlled by a firm; scope 2 "indirect" emissions from the firm's purchased electricity, steam, heat, and cooling; and scope 3 include all other emissions associated with a firm's activities.
Trade exposure	Share of CBAM commodities exported to the EU as a percentage of GDP.

1. Introduction

Beginning in January 2026, the European Union (EU) will fully implement its new climate-policy trade instrument: the Carbon Border Adjustment Mechanism (CBAM). This mechanism imposes a fee on greenhouse gas (GHG) intensive goods imported by the EU (Box 1), mirroring the EU's carbon taxation on domestically produced goods. CBAM aims to prevent carbon leakage,[2] encourage global partners to adopt greener practices, and ensure fair competition between EU and foreign producers. Several other advanced economies (AEs) are considering similar measures.

While the average effects of CBAM are modest, its introduction poses challenges in some key economic sectors for EU trading partners in the Middle East and Central Asia region (ME&CA).[3] Many countries in this region face several issues: (i) heavy reliance on fossil fuels, which make up over 90 percent of the power mix in more than two-thirds of the countries in the Middle East, Afghanistan, and Pakistan (MENAP), and nearly half in the Caucasus and Central Asia (CCA) (Figure 1.a); (ii) the prevalence of energy-intensive industries with limited progress toward GHG emissions reductions; and (iii) strong trade ties with the EU (Figure 1.b). Further, CBAM exports are largely produced by state-owned or -backed companies in several countries, presenting direct risks to fiscal revenues. ME&CA policymakers must thus carefully consider CBAM's impact on their trade and overall economy, considering sectoral heterogeneity and the potential for the CBAM burden to rise in the future as both its scope and carbon prices may increase.

Figure 1. ME&CA and Peer Regions: Power Mix and EU Trade 1/
(Percent)



Sources: IRENA, Comtrade, IMF WEO, and authors' calculations.
Note: 1/ Rest of the world (ROW) EMDE includes all but ME&CA and EU EMDEs. See Appendix I for the composition of country groups, categorized by oil exporters (OE) and importers (OI), income levels (including advanced economies (AEs)), and regions (including the Americas (AMER), Asia and Pacific (APAC), Europe (EUR), and Sub-Saharan Africa (SSA)). 2/ Electricity only.

Research on CBAM is still evolving and lacks sufficient analysis for policymakers. Comprehensive studies are needed to evaluate a country's exposure for designing informed macroeconomic policy responses.

[2] Carbon leakage occurs when EU companies relocate carbon-intensive production to countries with weaker climate policies or when EU products are replaced by more carbon-intensive imports. This risk is particularly high in sectors with high emissions that produce globally traded goods (see e.g., Nielsen et al., 2021), undermining the global benefits of domestic policies (Fontagné and Schubert, 2023) and discouraging unilateral policy action (Barrett, 2003). Note that empirical evidence indicates that leakage rates are quite low (see e.g., Dechezleprêtre et al., 2022 or Verde, 2020).

[3] See Appendix I for country sample, group compositions, and abbreviations.

Existing research shows substantial macroeconomic effects on EU trading partners, particularly emerging and developing economies (EMDEs). These effects may include changes in welfare, job reallocation, and shifts in inequality within and across countries.[4] Since CBAM applies broadly to all EU trading partners, those with lower emission intensities fare better than those with higher ones. Therefore, policymakers need to understand the emission intensity of their country's CBAM exports both in detail and relative to their peers.

This paper aims to fill this gap by estimating the CBAM burden for each EU trading partner and its key drivers down to the sectoral level, using a new approach and data applied to current CBAM provisions. We quantify and break down the total CBAM burden into three primary drivers: (i) trade exposure to the EU in relevant sectors; (ii) emission intensity of production; and (iii) carbon fee difference with the EU. Our approach is calibrated to the EU's 2026 CBAM provisions for all IMF member countries. We compile data from over 15 billion multi-region input-output (MRIO) observations from the University of Sydney's GLORIA Database and four additional sources (Comtrade, IMF WEO, BACI, and the World Bank Carbon Pricing Dashboard). As our static approach uses 2022–23 average trade dependencies, it represents an upper bound of the potential CBAM burden if implemented then, without accounting for endogenous adjustments in trade flows, emission intensities, and carbon taxation since. A summary of country scores is available online.[5]

We find the ME&CA region substantially exposed to CBAM, with the MENAP and CCA subregions facing some of the highest global burdens, concentrated in specific countries and sectors. This reflects the CCA's high emission intensity of CBAM-eligible products, and MENAP's both substantial EU export share and emission intensity of CBAM-eligible EU exports (particularly in the aluminum, iron, and steel sectors). In many countries, emission intensity is the main driver of the CBAM burden, rather than trade exposure or net carbon fees. Neither subregion has domestic carbon taxes, except Kazakhstan (since 2021) and Mauritania (planned for 2025). The estimated annual CBAM burden for the ME&CA region stands at US$1.7 billion (0.03 percent of GDP or 14 percent of CBAM exports) per year, though considerable disparities exist between countries. Lebanon and Tunisia each bear the highest burdens at 0.3 percent of GDP, followed by Algeria and Libya at 0.2 percent of GDP. This corresponds to 30 to 45 percent of these countries' CBAM exports. By contrast, most low-income, fragile, and conflict-affected states (FCSs) expect minimal burdens. Our analysis shows that CBAM exposure varies widely by country and sector, emphasizing the need for tailored policy responses. Looking ahead, ME&CA's exposure is expected to persist in the short run, given slow progress in economic diversification and energy transition. Our findings also offer insights into the potential impacts of future scenarios—such as CBAM expansion or higher carbon prices—and suggest tailored policy directions like redirecting trade, reducing emissions, and implementing carbon taxation.

The paper is structured as follows. Section 2 reviews the existing literature on the projected impact of CBAM on EU trading partners. Section 3 outlines the methodology, data sources, and calibration applied in this study. Section 4 presents key findings, while Section 5 concludes by highlighting the main policy implications.

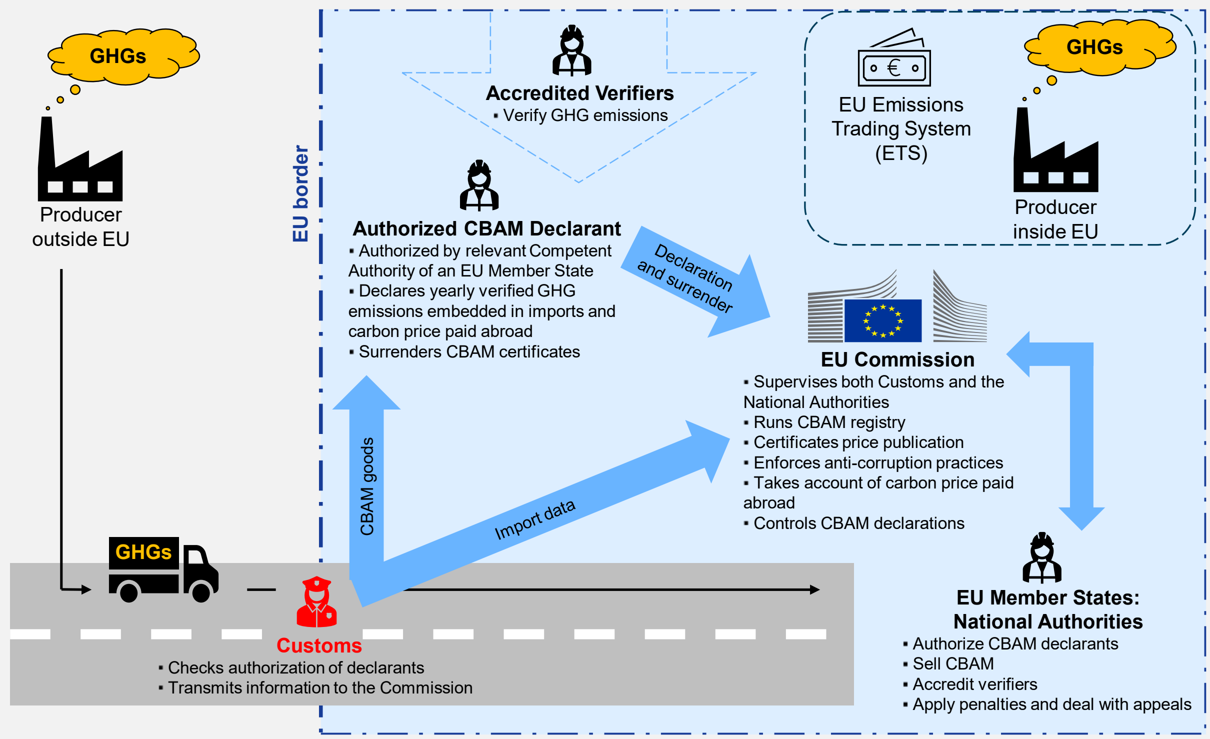
[4] See e.g., Eicke et al. (2021), Perdana and Vielle (2022), Amendola (2025), and He et al. (2025).

[5] See https://www.imf.org/-/media/Files/Publications/WP/2025/Datasets/wp25182.ashx.

Box 1. The EU's Carbon Adjustment Mechanism (CBAM) [1/]

Legislated as part of the European Green Deal in May 2023, CBAM is a new EU climate policy tool that complements the EU's Emissions Trading System (ETS). CBAM imposes a price on the GHGs emitted during the production of certain GHG-intensive goods when they enter the EU, in order to equate the price of carbon emissions associated with the production of imported goods with those produced inside the EU.[2] It targets companies based on the actual carbon content of imported goods, particularly in carbon-intensive sectors, while—where applicable—accounting for the emission price already paid in the exporting country (Box Figure 1).

Box Figure 1. EU CBAM: Functioning and Administration



Source: Authors' compilation, based on EU (2023a, b, c).

CBAM is part of the EU's climate strategy to achieve a 55-percent net reduction in GHG emissions by 2030 compared to 1990 levels. It aims to prevent carbon leakage, to incentivize decarbonization efforts in non-EU countries, and to level the playing field with EU firms subject to the EU's carbon pricing. CBAM is designed to align with the EU's international policies and legal commitments, including World Trade Organization (WTO) regulations. Its implementation proceeds in three phases:

- ***Transition phase*** (from October 2023). EU importers are required to report (but not yet pay): (i) embedded emissions in their imported products from six GHG-intensive sectors at high risk of carbon leakage: aluminum, iron and steel, cement, fertilizer, hydrogen, and electricity; and (ii) carbon fees paid in the exporting country. CBAM covers scope 1 emissions (i.e., direct GHG emissions from production) and scope 2 emissions (i.e., indirect GHG emissions from electricity, steam, and heat used in production). It captures carbon (CO_2), nitrous oxide (N_2O) for certain fertilizers, and perfluorocarbons (PFCs) for certain aluminum goods (Appendix II).
- ***Definitive regime*** (from January 2026). CBAM payment obligations will begin. EU importers must purchase CBAM certificates equivalent to the carbon price that would have applied if the goods were produced under the EU's carbon pricing rules. The price of CBAM certificates will be based on the weekly average auction price of EU ETS allowances. Any carbon price already paid during production abroad can be deducted. In addition, free

EU emission allowances (EUAs) for emission-intensive and trade-exposed (EITE) sectors covered by the ETS will gradually phase out by 2034.[3]

- ***Possible expansion*** (by 2030). The EU will review the functioning and scope of CBAM—alongside its experience with the extension of EU ETS to ETS 2 (planned for 2027)—to assess the feasibility of including: (i) additional sectors (such as coking coal, chemicals, non-ferrous metals, petroleum products, glass and ceramics, and asphalt bitumen); and (2) scope 3 emissions (i.e., indirect GHG emissions from the production of non-electricity inputs used in CBAM commodities).

CBAM exempts third countries participating in the EU ETS (or linked systems) to avoid double carbon pricing on the same product, including members of the European Economic Area (EEA: Iceland, Liechtenstein, and Norway) and Switzerland.

CBAM has encountered significant global resistance, particularly from the EU's EMDE trading partners. Critics emphasize potential emission fairness issues, trade distortions, risks of retaliatory measures, especially for countries with high CBAM-exposed exports, high carbon intensity, low technological innovation capacity, and low public support for climate policies.[4]

______

1/ See e.g., EU (2023a, b, c) and EU (2024a, b, c) for CBAM's provisions and operationalization; and e.g., Pan and Liu (2024) or Espa et al. (2022) for a review of CBAM's historical evolution and institutional aspects.

2/ CBAM does not offer export rebates to compensate EU firms for the carbon price they paid.

3/ While criticized for their climate, economic, and fiscal impacts, such carbon credits have mainly aimed to support industrial transition by providing EU firms with a temporary cushion to prevent carbon leakage by disincentivizing production relocation.

4/ Summarizing these frictions, Overland and Sabyrbekov's (2022) index identifies countries most likely to resist: several ME&CA countries (e.g., Iran, United Arab Emirates, Egypt, and Kazakhstan) and others (e.g., Ukraine, the US, China, India, and Russia).

2. Literature Review

Emerging research suggests that CBAM, though intended to promote environmental sustainability,[6] could unintentionally widen disparities between developed and developing countries. However, most studies employ broad methodologies and datasets with limited sectoral coverage, applied to various CBAM design scenarios without adequately accounting for actual CBAM provisions and all GHG emissions.

Evidence suggests CBAM could worsen economic inequalities, with EMDEs disproportionately affected compared to AEs. CBAM affects countries' competitiveness, influencing their terms of trade and relative prices based on their export exposure to the EU and the GHG emission intensity of their production (e.g., Makarov et al., 2021; Ma and Xu, 2024). The resulting costs and shifts in trade patterns can generate macroeconomic and redistributive effects both within the EU (Amendola, 2025) and globally, especially among EMDEs (Eicke et al., 2021; Perdana and Vielle, 2022). Using a recursive dynamic computable general equilibrium (CGE) model for broad CBAM implementation, He et al. (2025) forecast an annual welfare gain of US$141 billion in developed countries (mainly in the EU), and a loss of US$106 billion in developing countries by 2030. The relative impact per country would be negligible for AEs (less than 0.01 percent annual GDP gain on average) but significant for some others (e.g., Egypt with a 0.3 percent annual GDP loss).

[6] The EU CBAM's effectiveness in curbing carbon leakage and promoting cleaner production is likely limited due to its modest emission coverage relative to total emissions from all EU imports. However, CBAM may help accelerate the global adoption of carbon pricing (Mehling et al., 2024; Beaufils et al., 2023) and preserve the EU's global competitiveness (Ambec et al., 2024).

While studies concur that CBAM burdens will differ for each EU trade partner, their estimated levels vary by assumptions about CBAM provisions, applied methods, and covered sectors and emissions.[7]

- ***Some studies are closer to our paper's approach.*** Using numerical simulations within a simple analytical framework, Dolphin and Ferrucci (2025) find the direct CBAM impact on EU trade to be minimal. They project that CBAM payment obligations by the EU's trade partners would be 0.1 percent of the EU's total imports and 0.3 percent of the trade partners' exports to the EU (ranging from 1.2 percent of exports for Bosnia and Herzegovina (driven by electricity) to 0.1 percent for Iran). The World Bank's Relative CBAM exposure index (2023c) even offers a broad decomposition for a selected country sample with limited commodity detail. It identifies countries that are significantly exposed to the EU CBAM by examining carbon emissions intensity and exports of CBAM products to the EU. It utilizes environmentally extended MRIOs from the GTAP database and Comtrade data to calculate exposure based on trade exposure, emission intensity, and EU ETS price.
- ***Other studies follow more fundamentally different approaches.*** Employing MRIO analysis, Magacho et al. (2024) also reveal varying degrees of CBAM exposure among countries, with many EMDEs experiencing around 2 percent of their exports and 1 percent of their production being affected. They expect external pressures (measured by net generation of foreign exchange by CBAM exports) to intensify in Africa (notably Mozambique, Zimbabwe, and Cameroon) and socio-economic pressures (measured as the share of employment and wages in sunset industries) to rise in ME&CA (notably Morocco and Tajikistan). Similarly, Sun et al. (2024) predict declining exports from major EU trade partners (particularly India, Russia, Ukraine, South Africa, and Saudi Arabia), alongside increased intra-EU trade. Beaufils et al. (2023) use an Eora MRIO table to demonstrate the disproportionate CBAM impact on EMDEs, even under conservative implementation for 26 sectors. Assuming an expanded CBAM coverage beyond the EU's current provisions, their results for ME&CA indicate a higher annual per-capita welfare loss for MENAP (EUR 12.3 billion) than for the CCA (EUR 3.2 billion). Losses could be substantial, ranging from EUR 40 million in Jordan to EUR 2.9 billion in Algeria in MENA and from EUR 6 million in the Kyrgyz Republic to EUR 2.2 billion in Kazakhstan in the CCA. Finally, Dechezleprêtre et al. (2025) also employ a MRIO model to examine the effects of CBAM and other related EU reforms. They find a 0.03 percent reduction in the EU's trading partners' total value added. They also observe that CBAM could help prevent carbon leakage and result in a moderate decrease in global emissions by 0.5 percent.

Studies examining trade in specific products reveal similar insights. Ren et al. (2023) highlight CBAM's potential to exacerbate global economic-carbon inequality (measured as the ratio of the increase in emissions to the increase in value added due to exports). Their MRIO analysis finds sizable welfare losses for EMDEs reliant on plastic exports (including Russia, China, and the Asia Pacific region). Shuai et al. (2024) show that CBAM could lead to large GDP and social welfare losses among iron and steel exporters (notably China and India), while benefitting the EU, US, Japan, and Russia. Their model[8] predicts declining production in non-EU countries (excluding Japan), thereby reducing CO_2 emissions and mitigating carbon leakage. Qi et al. (2022) and Zhao et al. (2024) corroborate these findings for China. Sun et al. (2024) find that high carbon intensity exposes Ukraine's ferrous metal industry and Malaysia's chemical industry. Pauw et al. (2022) estimate that CBAM will decrease Mozambique's GDP by 1.6 percent as over half of its aluminum exports go to the EU.

[7] Typically, studies employ broad methodologies (often matrix algebra) and datasets with limited sectoral coverage (such as the EORA global supply chain database with 26 sectors), applied to various potential CBAM design scenarios (regarding products and emission types) and a diverse group of target countries.

[8] Includes a global trade analysis project (GTAP-E 11.0) and technique for order preference by similarity to ideal solution (TOPSIS).

Other studies show that CBAM's expected impact extends beyond GHG-intensive sectors.[9] Carbon tariffs can indirectly affect non-carbon-intensive industries linked to carbon-intensive sectors, affecting upstream industries and low-carbon alternatives (Tang et al., 2015; Li et al., 2016; Chen and Guo, 2017). Sectors closely linked to carbon-intensive industries (particularly upstream), are likely to experience negative effects due to lower demand for inputs related to carbon-intensive production. For instance, studies suggest CBAM effects on non-energy-intensive and non-trade-exposed sectors in China's landlocked regions, as they supply inputs to energy-intensive industries in coastal areas (Huang et al., 2022; Zhong and Pei, 2022).

3. Methodology

To provide more robust input for macroeconomic policymaking, this paper advances prior research by: (i) introducing a novel analytical decomposition of the CBAM burden; (ii) leveraging a new dataset; and (iii) reflecting more precisely CBAM's definitive regime, both as set to take effect in 2026 and in potential future expansions, including the possible integration of scope 3 emissions (Box 1).

3.1 Analytical Framework

Our approach involves three steps, starting with quantifying a country's expected CBAM burden.[10] This burden δ_r represents the static incidence for country r across all its CBAM-covered export products, i.e., the additional cost from CBAM (as a share of GDP). To this end, we first calculate the CBAM obligation $\phi_{i,r}$ (measured in US$) for each commodity i that country r exports to the EU as the product of r's respective: (i) export quantity $X_{i,r,eu}$ (measured in physical quantities);[11] (ii) emission intensity, i.e., total emissions $E_{i,r}$ relative to total production $Y_{i,r}$ (measured in tons of CO_2 equivalent ($mtCO_2e$) emissions per physical unit of output);[12] and (iii) net carbon fee per unit of emission, i.e., the incurred difference between the EU's CBAM fee τ_{eu} and the carbon fee paid in the exporting country τ_r per unit of emission (measured in US$ per $mtCO_2e$):

$$\phi_{i,r} = \underbrace{\underbrace{X_{i,r,eu}\frac{E_{i,r}}{Y_{i,r}}}_{\substack{Emission\\coverage}} \times \underbrace{(\tau_{eu} - \tau_r)}_{\substack{Net\ carbon\ fee\ per\\unit\ emission}}}_{CBAM\ obligation} \tag{1}$$

where $E_{i,r}$ captures scope 1 and 2 emissions (i.e., $E_{i,r} = E^1_{i,r} + E^2_{i,r}$).[13] Multiplying exports by emission intensity gives the CBAM emission coverage, or the "tax base," which captures the total volume of CBAM-covered GHG emissions (measured in $mtCO_2e$). The net carbon fee represents the "unit tax." Defining the set $cbam$ to only consist of all CBAM-eligible commodities and the set eu to only include the EU countries among r's trading partners d, we can express country r's total CBAM obligation ϕ_r as:

[9] See Tang et al. (2015), Dai et al. (2020), Chepeliev (2021), Acar et al. (2022), Qi et al. (2022), Gu et al. (2023), Li et al. (2023), Lin and Zhao (2023), Ren et al. (2023), Zhang et al. (2023), Deng et al. (2024), Shuai et al. (2024), and Zhu et al. (2024).

[10] Note that the CBAM burden is not necessarily borne entirely by the exporting country. It may be shared between exporters and EU consumers, depending on the degree of price pass-through, which depends on various factors (such as market structure).

[11] Average export quantity is calculated by dividing the export value by the average prices from the Comtrade database for GLORIA commodity groups. Since HS12 commodities are aggregated into GLORIA's broader groups, the resulting quantities are weighted averages based on the share of each HS12 commodity within the aggregate group.

[12] Average output quantity is determined by dividing the output value reported in GLORIA by the average price of the commodity group in Comtrade, adjusted for the trade share of HS12 commodities within GLORIA groups.

[13] This formulation can easily be extended to include scope 3 emissions.

$$\phi_r = \sum_{i \in cbam} \phi_{i,r} \tag{2}$$

For better cross-country comparability, we normalize the CBAM obligation by dividing it by the origin country's GDP to derive the CBAM burden δ_r, and by the total export value to obtain the ad-valorem tariff equivalent t_r:

$$\delta_r = \frac{\phi_r}{GDP_r} \tag{3}$$

$$t_r = \frac{\phi_r}{X_r} \tag{4}$$

In the second step, we decompose the country's CBAM burden into three key drivers: trade exposure, emission intensity, and net carbon fee. By reformulating each component of equation (3) in accordance with equation (1), we express country r's CBAM burden δ_r as the product of its: (i) CBAM emission coverage per unit of GDP (measured in $mtCO_2e$ per US$) and (ii) net carbon fee (measured in US$ per $mtCO_2e$). We derive the CBAM emission coverage by multiplying trade exposure and emission intensity. If a country's carbon price exceeds the EU's, the burden becomes zero as negative burdens (implying EU subsidies) are not allowed.[14]

$$\delta_r = \max\,(0, \underbrace{\underbrace{X_{cbam,r,eu}/GDP_r}_{\substack{Trade\\ exposure}} \times \underbrace{E_{cbam,r}/Y_{cbam,r}}_{\substack{Emission\\ intensity}}}_{CBAM\ emission\ coverage\ per\ GDP} \times \underbrace{(\tau_{eu} - \tau_r)}_{\substack{Net\ carbon\\ fee\ per\ unit}}) \tag{5}$$

where:[15]

$$X_{cbam,r,eu} = \sum_{i \in cbam} \sum_{d \in eu} X_{i,r,d} \tag{6}$$

$$E_{cbam,r} = \sum_{i \in cbam} E_{i,r} \tag{7}$$

$$Y_{cbam,r} = \sum_{i \in cbam} Y_{i,r} \tag{8}$$

Finally, we further decompose each driver of the country's CBAM emission coverage to reveal the granular heterogeneity of countries' CBAM exposure profiles (Figure 2). This shows that country r's:

(i) ***Trade exposure*** depends on five factors: (i) the EU's role as a destination for country r's commodity i exports; (ii) the significance of commodity i in country r's total trade; (iii) the importance of commodity i in country r's exports to the EU; (iv) the importance of the EU in country r's total exports; and (v) the overall importance of exports to country r's economy. Formally:

$$\underbrace{\frac{X_{cbam,r,eu}}{GDP}}_{\substack{\text{Trade}\\ \text{exposure}}} = \underbrace{\sqrt{\frac{X_{cbam,r,eu}}{X_{cbam,r,wrld}}}}_{\substack{\text{EU's}\\ \text{importance}\\ \text{in CBAM trade}}} \underbrace{\sqrt{\frac{X_{cbam,r,wrld}}{X_{tot,r,wrld}}}}_{\substack{\text{CBAM's}\\ \text{importance}\\ \text{in total trade}}} \underbrace{\sqrt{\frac{X_{cbam,r,eu}}{X_{tot,r,eu}}}}_{\substack{\text{CBAM's}\\ \text{importance}\\ \text{in EU trade}}} \underbrace{\sqrt{\frac{X_{tot,r,eu}}{X_{tot,r,wrld}}}}_{\substack{\text{EU's}\\ \text{importance}\\ \text{in total trade}}} \underbrace{\frac{X_{tot,r,wrld}}{GDP_r}}_{\substack{\text{Export}\\ \text{importance}\\ \text{in economy}}} \tag{9}$$

with:

$$X_{tot,r,eu} = \sum_i \sum_{d \in eu} X_{i,r,d} \tag{10}$$

[14] In our data, only Uruguay has a carbon price higher than the EU.

[15] CBAM burdens (and other indicators defined below and used in our analysis) are not additive across commodities or countries. Therefore, equations (5) to (8) effectively define an aggregate CBAM commodity as a weighted average of all CBAM commodities. However, the weighting becomes complex as we approximate the sum of ratios with a ratio of sums.

$$X_{cbam,r,wrld} = \sum_{i \in cbam} \sum_{d} X_{i,r,d} \tag{11}$$

$$X_{tot,r,wrld} = \sum_{i} \sum_{d} X_{i,r,d} \tag{12}$$

where the subscript $wrld$ refers to the aggregate of all trading partners of a country, including the EU.

(ii) ***Emission intensity*** depends on the use of relevant energy sources. Separately for scope 1 (from non-electric energy use and industrial processes and product use (IPPU))[16] and scope 2 (from electric energy use), the two drivers of emission intensity are: (i) the emission intensity of the energy used to produce commodity i; and (ii) the energy intensity of production. Hence:

$$\frac{E_{cbam,r}}{Y_{cbam,r}} = \left(\overbrace{\overbrace{\underbrace{\frac{E^1_{cbam,r}}{NELY_{cbam,r}}}_{\substack{\text{Emission}\\ \text{intensity}\\ \text{of energy}}} \times \underbrace{\frac{NELY_{cbam,r}}{Y_{cbam,r}}}_{\substack{\text{Energy}\\ \text{intensity}}}}^{\text{non-electric energy}} + \overbrace{\underbrace{\frac{E^3_{cbam,r}}{Y_{cbam,r}}}_{\substack{\text{Emission}\\ \text{intensity}\\ \text{of process}}}}^{\text{IPPU}}}^{\text{Scope 1 emissions}} + \overbrace{\underbrace{\frac{E^2_{cbam,r}}{ELY_{cbam,r}}}_{\substack{\text{Emission}\\ \text{intensity of}\\ \text{electricity}}} \times \underbrace{\frac{ELY_{cbam,r}}{Y_{cbam,r}}}_{\substack{\text{Electricity}\\ \text{intensity}}}}^{\substack{\text{Scope 2 emissions:}\\ \text{electricity}}} \right) \tag{13}$$

where $NELY_{i,r}$ is the non-electric energy and $ELY_{i,r}$ the electricity used to produce commodity i, and:

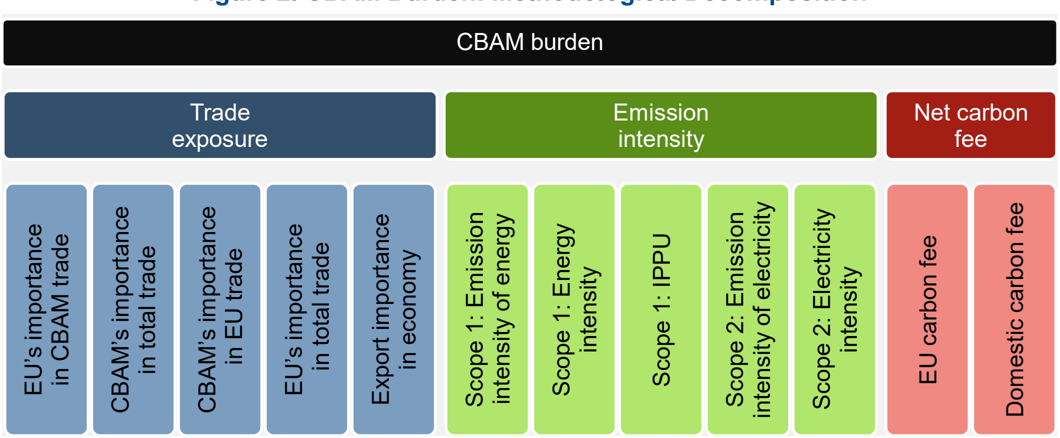
$$ELY_{cbam,r} = \sum_{i \in cbam} ELY_{i,r} \tag{14}$$

$$NELY_{cbam,r} = \sum_{i \in cbam} NELY_{i,r} \tag{15}$$

$$Y_{cbam,r} = \sum_{i \in cbam} Y_{i,r} \tag{16}$$

$$E_{cbam,r} = \sum_{i \in cbam} E_{i,r} \tag{17}$$

Figure 2. CBAM Burden: Methodological Decomposition



Source: Authors' methodology.

Overall, our approach provides detailed decomposition while minimizing biases. Unlike most other studies, our CBAM burden calculation uses trade volumes instead of values to avoid distortions from difference

[16] We divide scope 1 emissions into non-electric energy (e.g., coal used in aluminum furnaces) and IPPU (e.g., chemical reactions in cement production), as the former is related to energy intensity, but the latter is not.

between domestic prices and export prices (see Appendix IV). Some limitations remain. We can analyze the initial CBAM exposure of sectors in a country and across regions, which is valuable for identifying key areas of concern for climate and trade policies. However, we cannot account for behavioral changes in response to CBAM, such as firms shifting markets or adopting greener, more energy-efficient technologies to lower their emission intensities. Capturing these dynamics would require periodic re- analysis. Moreover, incorporating firm-level data could further improve our analysis' accuracy by accounting for country- and sector-specific factors (such as market structure and concentration).[17] Also, anticipated shifts towards greener exports post-CBAM would likely lower this burden. Finally, our analysis does not account for the implicit costs associated with CBAM reporting requirements, which might be prohibitive for some firms with weak institutional capacity.

3.2 Data

In essence, we utilize the new GLORIA dataset and integrate it with three additional sources. Handling the complexity, incompatible formats, and volume of the various datasets requires extensive data transformations and significant computational power (Appendix V).

- ***University of Sydney's GLORIA for production and GHG emission data*.** GLORIA is a high-resolution, multi-region input-output database that integrates diverse sources to track global bilateral resource flows like goods, materials, and energy. First released in 2017, GLORIA contains about 60 billion records at the activity-industry level for 158 countries, 4 regions,[18] and 120 sectors from 1990 to 2027.[19] Additionally, we incorporate several non-economic environmental indicators from satellite databases, including GHG emissions (from EDGAR and the OECD), covering carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), and chlorofluorocarbons (CFCs).[20] While GLORIA offers unprecedented potential for analysis, it has some—for our purposes manageable—limitations, including potential discrepancies from original source data,[21] missing byproducts,[22] and an enormous data volume in an unusual format.[23]
- ***BACI for bilateral trade data*** (Gaulier and Zignago, 2010). We aggregate the 2017 revision for 2017–22 at the HS6 product group level to match GLORIA's commodities and regions. We compute the terms of trade for transactions between the EU and the rest of the world (ROW), using available value and quantity data.
- ***IMF WEO for output data.*** We utilize this source for nominal GDP.
- ***World Bank's carbon pricing dashboard for carbon fees*.**[24] Due to limited sector-specific data, we use the industry carbon price for scope 1 emissions and power generation carbon prices for scope 2 emissions

[17] Based on a firm-level analysis, Clausing et al. (2025) conclude that "CBAMs can effectively boost competitiveness, curb leakage, and encourage regulation, while also avoiding disproportionate impacts on lower-income countries."

[18] Regions consist of countries not individually included in the database, such as small island states.

[19] Gloria uses GDP growth projections from the IMF and the World Bank to project the full global MRIO until 2027.

[20] These CFCs comprise C4F8, C2F6, C3F8, C4F10, C5F12, C6F14, and CF4.

[21] GLORIA ensures several specific equalities, such as supply-demand balance for each commodity in each country. However, varied data sources necessitate algorithms and assumptions, potentially causing deviations from original sources, especially in bilateral trade. Therefore, we use BACI for bilateral trade data.

[22] GLORIA's diagonal supply matrix attributes all sector output to its main product. With 120 industries and commodities, the impact of missing byproducts or industries producing multiple commodities should be minimal in our analysis. Moreover, the output of CBAM-covered industries primarily consists of their main product.

[23] For our purpose, one year of data is about 7 GB, consisting of a 39,360x39,360 input-output (IO) matrix and a 3x39,360 satellite submatrix. This requires converting the GLORIA matrices into a long format, enabling the analysis of unique source country-destination country-product combinations and the calculation of intermediate input and emission intensities (Appendix V).

[24] While only 23 non-EU countries impose carbon pricing (primarily AEs, but also some EMDEs such as China, Uruguay, and South Africa), we find that not accounting for AEs' own carbon pricing alone can overestimate their CBAM burden by about 60 percent.

(Appendix VI). For countries with regional pricing (e.g., the US, China, Canada, Mexico, and Japan), we adjust national carbon prices using sub-national data. Weights are based on the emission shares of jurisdictions with carbon pricing within each sub-region.

3.3 Scope

Our coverage encompasses the widest possible scope. This enables CBAM burden estimates that facilitate comprehensive global comparisons.

- ***Sample.*** Data is available for 156 of the 191 IMF members, covering five regions and three income groups (Appendix I), and encompassing 120 economic sectors. Our analysis spans the years 2015 to 2023, with a focus on average data from 2022–23 to align with the latest trade data and to minimize the trade impact of the COVID-19 pandemic and other anomalies specific to individual years.
- ***CBAM calibration*.** We align closely with the EU's scheduled 2026 CBAM rollout (Box 1; EU 2023a, 2024b, 2024c, 2024a, 2024b, and 2024c) and trading partners' domestic carbon taxation regimes. Specifically:
  - ***CBAM-eligible commodities*.** We include aluminum products, iron and steel products, fertilizers, cement, and electricity, but exclude brown and blue hydrogen due to its minimal trade volume and absence in GLORIA. Appendix III presents the full list of commodities.
  - ***CBAM-affected countries*.** We include imports from all EU trading partners, except for exempted countries (i.e., EEA members and Switzerland).
  - ***GHG emissions.*** We include CO_2 for iron and steel products, cement, and electricity; CO_2 and N_2O for fertilizers, along with CO_2 and PFCs for aluminum products. We account for scope 1 and 2 emissions for cement, fertilizers, iron and steel, and aluminum,[25] while only considering scope 1 emissions for all other CBAM commodities, as scope 2 emissions for these are not subject to CBAM.
  - ***Electricity imports.*** We follow the CBAM regulation's simplification in calculating the scope 2 emissions of imported electricity using domestic grid coefficients.[26]
  - ***Carbon prices.*** For the EU, we use US$103 per tCO_2e following BloombergNEF (2024) projections, deducting the CBAM fees paid in the country of origin.[27]
  - ***Free allowances and recent changes in legislation.*** We do not adjust to the phasing-out of free allowances as they only affect the carbon price incurred by some firms producing in the EU, not those exporting to the EU. We also do not account for recent CBAM developments, such as the Omnibus Package (EC, 2025). However, these updates are expected to have a minimal impact on our results, as they mostly pertain to small importers and affect only 1 percent of emissions included in CBAM exports.

[25] The CBAM legislation includes scope 2 emissions for the aluminum, and iron and steel sectors during the transition period but excludes them in the definitive phase, noting that this is subject to revision. We included scope 2 emissions from these sectors to highlight the risks for some ME&CA countries, where grid emission intensity is relatively high. The possible inclusion of scope 2 emissions for these sectors would exacerbate the burden for these countries.

[26] Unlike the EU, we cannot use IEA emission coefficients for power generation, as these are in gCO2e/kwh whereas our electricity use and exports from GLORIA and BACI are in US$. Our results are minimally affected, as our sources use IEA energy balances data.

[27] Since the CBAM burden is linear in the CBAM fee, any change in EU ETS prices would shift our findings for all sectors and countries equi-proportionately.

4. Key Findings

Despite its ambition (Box 1), the EU's current CBAM configuration covers a limited portion of global emissions. Nevertheless, it will impose non-negligible burdens on various regions, likely more so on certain countries and sectors. [28] *On average, ME&CA will encounter one of the highest burdens, even as MENAP has the second highest global CBAM emission coverage and the CCA the lowest. In MENAP, this is primarily due to high trade exposure, highlighting the importance of CBAM products in its exports to the EU. In the CCA, the burden arises from both high trade exposure (due to the EU's large share in CBAM exports) and the emission intensity of CBAM commodities (which is influenced more by the emissions from energy sources used than by the energy consumed during their production). The impact of net carbon fees is relatively minor.*

4.1 Sizing ME&CA's Overall CBAM Exposure: Emission Coverage and Burden

The EU's CBAM will affect trading partners worldwide, notwithstanding its modest emission coverage. On average, in 2022–23, CBAM-eligible products accounted for 35 percent of global GHG emissions (12,747 mtCO_2e), while representing only 8.5 percent of global output, 3.28 percent of global trade, and 1.6 percent of global exports to the EU. However, since the CBAM solely applies to the EU's imports, it is set to cover only about 68 mtCO_2e of emissions. This amounts to roughly 0.2 percent of global emissions and 0.5 percent of emissions from CBAM sectors.[29] Of the emissions covered, 60 percent originated from EMDEs compared to AEs,[30] with four-fifth classified as scope 1 emissions. If applied to 2022–23 trade volumes, CBAM will impose a considerable financial impact on the EU's trade partners, translating to a CBAM obligation of around US$6.3 billion, equivalent to an average 6 percent fee on CBAM imports.

However, regional CBAM exposure differs widely. The ME&CA region is expected to emit 16.3 mtCO_2e, leading to a yearly CBAM obligation of US$1.7 billion, representing 24 percent of global coverage and 27 percent of global obligations. This gap mainly reflects broader carbon pricing schemes elsewhere. On average:

- ***Emission coverage—MENAP rank second globally, and CCA lowest*** (Figure 3.a). This reflects countries' distinct trade exposures and emission intensities of CBAM-eligible commodities across sectors (Section 4.2). MENAP's average emission coverage is 16.3 mtCO2e, lower than Asia and the Pacific (APAC) EMDEs, but slightly higher than non-EU EMDE peers in Europe (EUR). In contrast, CCA is lowest at just 1 mtCO_2e, ahead of EMDEs in the Americas (AMER) and Sub-Saharan Africa (SSA). Scope 1 emissions make up 90 percent of MENAP's and 85 percent of CCA's total CBAM-covered emissions. IPPU emissions account for 22 percent in MENAP and 26 percent in CCA, both close to the EMDE average of 24 percent. The main emitting sectors are iron and steel, and aluminum for both regions, with cement significant in MENAP and fertilizer in CCA.
- ***Burden—MENAP and CCA face some of the highest burdens globally*** (Figure 3.b). Beyond differences in emission coverage, this reflects disparities in economic size (and trade volume), and, to a lesser degree, carbon tax schemes (Section 4.2).[31] On average, ME&CA countries bear a burden about three times greater than other EMDEs, about 0.04 percent of GDP and a 14-percent tariff on CBAM exports. The average

[28] For convenience, an online database—see https://www.imf.org/-/media/Files/Publications/WP/2025/Datasets/wp25182.ashx--shares the scores for each country's exposure, i.e. the burden and its breakdown into the main drivers.

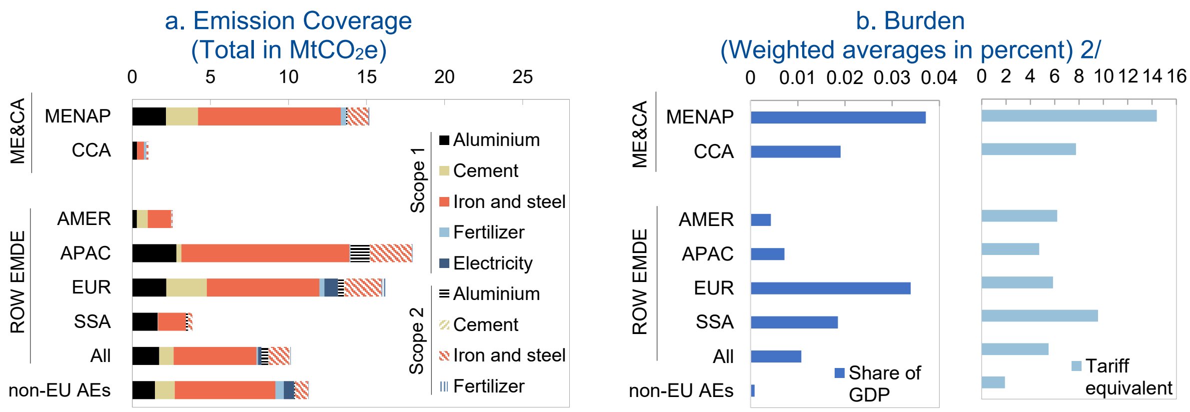
[29] On top, the EU's ETS covered an average of 1,500 mtCO_2e from the production of CBAM products within the EU in 2022–23.

[30] AEs will account for the remaining 12 percent of total CBAM-covered emissions, with nearly half from the UK alone.

[31] Consequently, high emission coverage, particularly among the region's oil exporters, does not always correlate with high burden.

MENAP country will be particularly hit with a burden of 0.037 percent of GDP (equivalent to a 14.4 percent tariff), followed by European peers at 0.034 percent of GDP and Sub-Saharan African peers with an 9.6 percent equivalent tariff. The average CCA country ranks third, with a burden of 0.019 percent of GDP (equivalent to a 7.7 percent tariff).

Figure 3. ME&CA and Peer Regions: Overall CBAM Exposure
(Annual 2022–23 averages) 1/



Source: Authors' calculations.
Note: 1/ Excludes Syria due to data availability issues. 2/ GDP shares are weighted by GDP, and tariff equivalents by trade.

4.2 Unpacking ME&CA's CBAM Exposure: Key Drivers

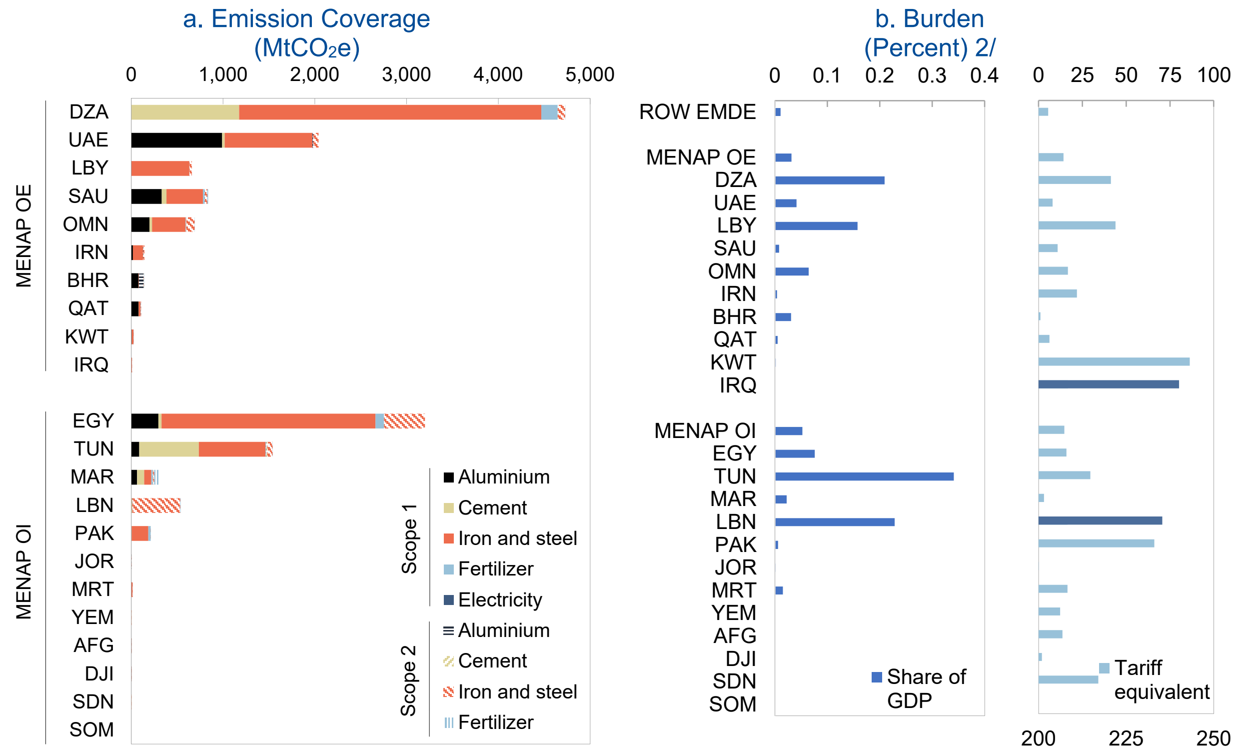
4.2.1 MENAP

4.2.1.A CBAM Exposure by Country and Sector

In the MENAP subregion, CBAM exposure will primarily affect a small number of countries, leading to differences in emission coverage and burden (Figure 4 and Appendix VII). On average, the subregion's oil exporters will see nearly twice the emission coverage of importers, while both groups will have similar overall burdens. However, two countries in each group dominate, accounting for over two-thirds of their groups' coverage, with emissions ranging from 4.7 $mtCO_2e$ to 1.5 $mtCO_2e$ (Algeria and the UAE for oil exporters; and Egypt and Tunisia for oil importers). Most emissions come from scope 1, which constitute 96 percent of total emissions in oil exporters and 80 percent in importers (primarily from the iron and steel, aluminum, and cement industries). Notably, the cement sector makes up 57 percent of IPPU emissions, while iron and steel, and aluminum account for 25 and 14 percent, respectively. In relative terms, this emission coverage translates into a more mixed picture regarding burden. Lebanon, Tunisia, Algeria, and Libya exhibit a burden ranging from 0.3 to 0.2 percent of GDP, while Lebanon and Pakistan face equivalent tariffs between 235 and 66 percent. Consequently, a country's disproportionately lower burden compared to its equivalent tariff suggests lower export dependence on CBAM commodities relative to peers, as seen in Iraq, Pakistan, and Kuwait. In contrast, the opposite emerges for Tunisia, Algeria, and Libya (see more detail below).

At the country level, the brunt of the CBAM burden will typically originate from a few sectors (Figure 4). For instance, among MENAP oil exporters, Libya's CBAM burden will be primarily concentrated in its iron and steel sectors, amounting to 26 percent of the sector's production value, which corresponds to sectoral tariffs of 59 percent. Algeria's CBAM burden will mainly impact its cement and iron and steel sectors, with burdens of 15 percent and 60 percent of their respective production values, equivalent to tariffs of approximately 95 percent for both sectors.[32] Tunisia will face the greatest impact in its aluminum, cement, and iron and steel sectors, with burdens equivalent to 19 percent, 38 percent, and 28 percent of productive value, translating to sectoral tariffs of 14 percent, 104 percent, and 25 percent, respectively. Morocco's aluminum sector will bear the highest burden, with 5 percent of production subjected to a 23 percent tariff equivalent. In Egypt, iron and steel exports will be most affected, with 7 percent of production subjected to a 27 percent tariff equivalent.

Figure 4. MENAP Countries: Overall CBAM Exposure
(Annual 2022–23 averages) 1/

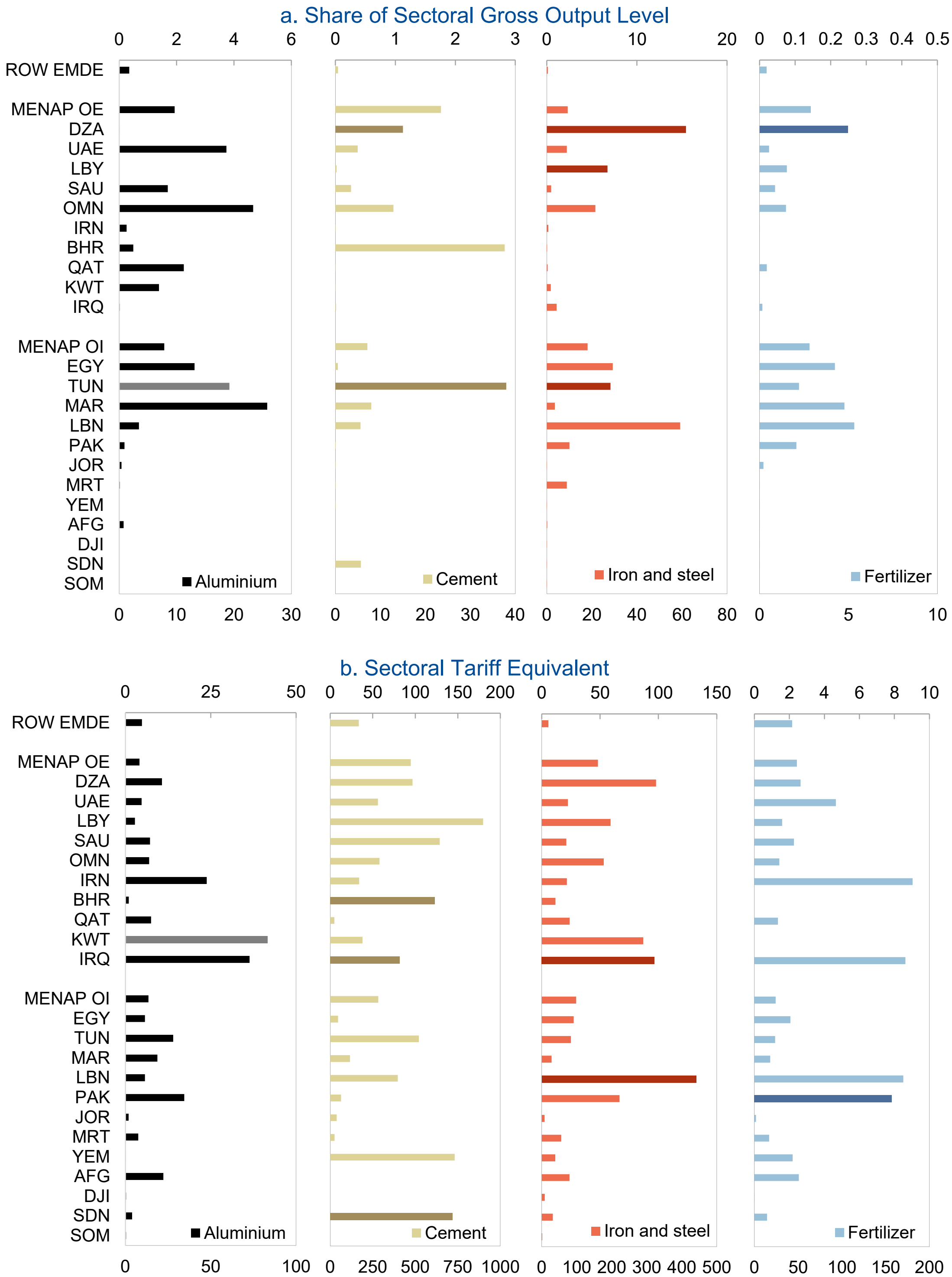


Source: Authors' calculations.
Note: 1/ Excludes Syria due to data availability issues. 2/ Country group averages of GDP shares are weighted by GDP, and tariff equivalents by trade. 2/ Darker shades for burden correspond to lower axis.

Export companies are mainly affected, limiting sectoral effects in many countries (Figure 5). The relative sectoral burden (as a share of production value) is lower than the equivalent tariff (in percent) in the cases of Kuwaiti aluminum; Iraqi fertilizer and aluminum; and Afghan iron and steel where only a small portion of domestic production is exported to the EU. Conversely, high relative sectoral export dependence is noticeable for Algerian cement; Lebanese iron and steel; and Tunisian aluminum and cement, as a larger share of their more emission-intensive domestic production is exported to the EU.

[32] Country studies lend support. For instance, Egypt could face the second largest CBAM impact (after South Africa), with 6 percent of exports affected, including three-quarters of iron and steel, 70 percent of aluminum, and half of fertilizer exports (Baker et al., 2022). By 2030, CBAM could reduce real income by 0.6 percent and output by 2.6 percent, mainly from fossil fuels, power transmission, and chemicals (World Bank, 2022b). In contrast, Tunisia could see less than 2 percent of its EU exports subjected to CBAM, mainly cement (World Bank, 2023b), and face a cost of 0.1 percent of GDP (Dolphin and Ferrucci, 2025). Similarly, Morocco could experience a CBAM impact below 0.2 and percent of GDP (Morchid et al., 2024; World Bank, 2022d), concentrated on fertilizers. Jordan could only see a moderate near-term impact, mainly from chemicals (World Bank, 2022c).

Figure 5. MENAP Countries: Sectoral CBAM Burdens
(Annual 2022–23 averages in percent) 1/, 2/, 3/

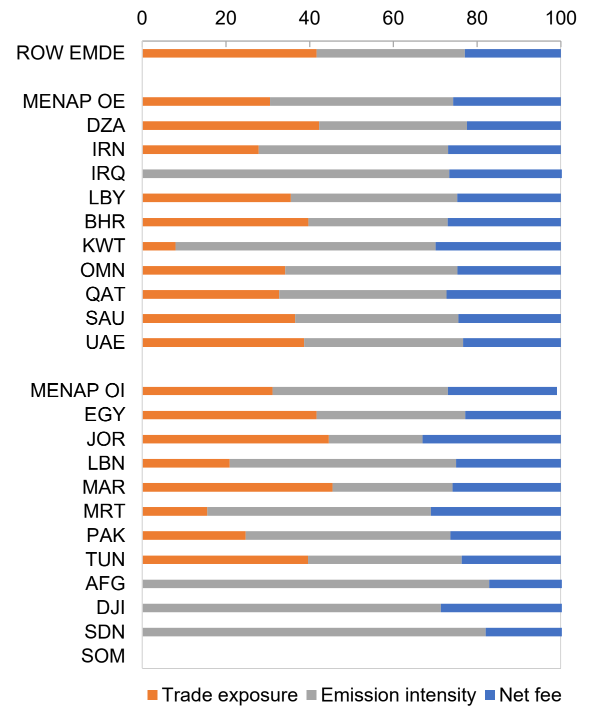


Source: Authors' calculations.
Note: 1/ Excludes Syria due to data availability issues. 2/ Country group averages of sectoral gross output values are weighted by countries' sectoral gross output values, and tariff equivalents by sectoral export volumes. 3/ Gray for aluminum and darker shades for cement, iron and steel, and fertilizer correspond to lower axis.

4.2.1.B CBAM Burden by Driver

Unlike the average peer EMDE, a smaller share of the MENAP region's CBAM burden arises from trade exposure, while emission intensity dominates in several countries (Figure 6). Among *MENAP oil exporters*, trade exposure is the prime driver in Algeria, Bahrain, and the UAE; but it is emission intensity in Kuwait, Qatar, and Iran. In Oman, Libya, and Saudi Arabia, both drivers are of roughly equal importance, with the net carbon fee most notably impacting Kuwait and Qatar.[33] For the average *MENAP oil importer*, trade exposure is slightly more critical than for its oil-exporting peers, especially in Jordan, Morocco, and Egypt. In contrast, high emission intensity matters most in Mauritania, Yemen, and Pakistan. In MENAP FCS, emission intensity dominates (notably Yemen, Sudan, and Afghanistan) due to minimal CBAM EU exports.

Figure 6. MENAP Countries: Contribution of CBAM Burden Drivers
(Annual 2022–23 average percentages of total) 1/, 2/, 3



Sources: Authors' calculations.
Note: 1/ Excludes Syria due to data availability issues and Somalia due to a zero CBAM burden. 2/ Based on the sum of all drivers' logarithms. 3/ Country group averages are weighted by GDP.

MENAP's trade exposure is mainly due to CBAM products dominating EU exports, while energy emission intensity (both electric and non-electric) and process emissions drive emission intensity. Country-level variations are significant (Figure 7).

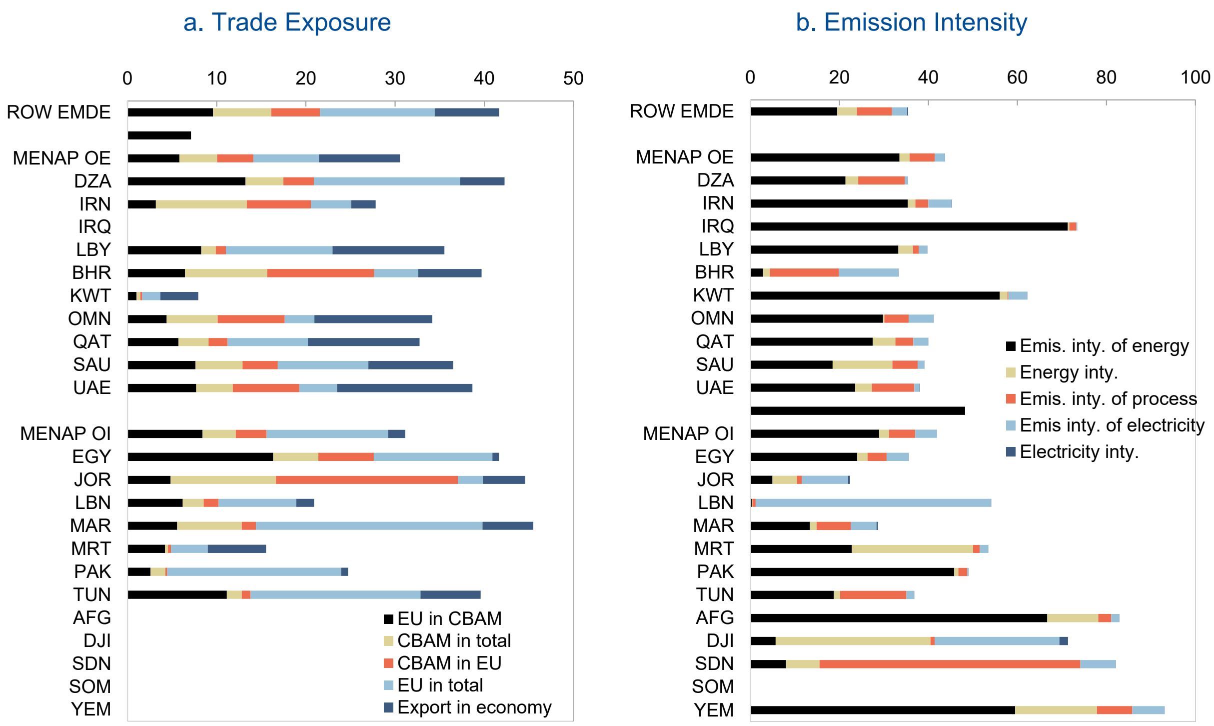
- ***Trade exposure.***
  - *MENAP oil importers*. Their average trade exposure is nearly three times that of peer EMDEs, mainly due to the EU's dominant role as a trade partner. Egypt has high shares of both EU-bound CBAM exports and CBAM's portion in overall exports. For Morocco and Lebanon, CBAM commodities matter similarly or more for total exports, but the EU's share in their CBAM exports is much lower. In Jordan, although the EU is slightly less vital as a trade partner, CBAM's importance for total and EU exports is higher. Tunisia depends heavily on EU exports and has a large share of CBAM exports to the EU; but since CBAM commodities are a small part of total exports, short-term effects are likely limited.
  - *MENAP oil exporters.* Their trade exposure is, on average, 25 percent higher than other EMDEs. In Algeria, the EU's share in CBAM exports drives trade exposure, with CBAM commodities playing a significant role. Conversely, in Libya, the contribution of CBAM commodities to trade is smaller despite the high EU share in its CBAM exports. Similarly, the impact on Iran is minimal, due to the low EU share in CBAM exports, regardless of the high proportion of CBAM commodities in total trade. GCC countries generally show higher trade exposure—except Kuwait—with Bahrain and Oman exposed across all subcomponents, the UAE showing a smaller CBAM share in total exports, and Saudi Arabia sending

[33] Figure 6 illustrates the breakdown of the CBAM burden among the three main drivers. Although the net fee is same in US$-terms for all countries, its contribution to the burden may vary depending on the relative size of the other two drivers.

fewer CBAM commodities to the EU. Finally, Qatar has lower exposure since the EU is minor trade partner and CBAM commodities form a small export share.

- ***Emission intensity.*** CBAM commodity emission intensity in MENAP countries mainly reflects energy sources. Oil exporters and importers have non-electric energy emission intensities 380 percent and 183 percent above the EMDE average, and electricity emission intensities are 217 percent and 550 percent higher. Iraq and Kuwait lead in non-electric emission intensity due to heavy oil reliance (rather than natural gas or renewables) and high energy subsidies (hindering adoption of energy-efficient technologies), while Bahrain even outperforms the EMDE average. Bahrain, Tunisia, Morocco, and Algeria show high IPPU emission intensities from large cement and fertilizer exports. Lebanon and Djibouti rank highest in scope 2 emission intensities, while several others (Bahrain, Oman, Morocco, Jordan, Iran, and Egypt) exceed the EMDE average because of hydrocarbon-based power generation. Overall, MENAP's energy intensity is lower than the EMDE average, except for low-income, conflict-affected countries and Saudi Arabia.
- ***Net fee.*** Since none of the MENAP countries currently price carbon, their net carbon fee remains uniform. The planned introduction of carbon pricing in Mauritania would proportionally decrease its CBAM obligation.

Figure 7. MENAP Countries: Disaggregation of Selected CBAM Burden Drivers
(Annual 2022–23 average percentage contribution to the total) 1/, 2/, 3/



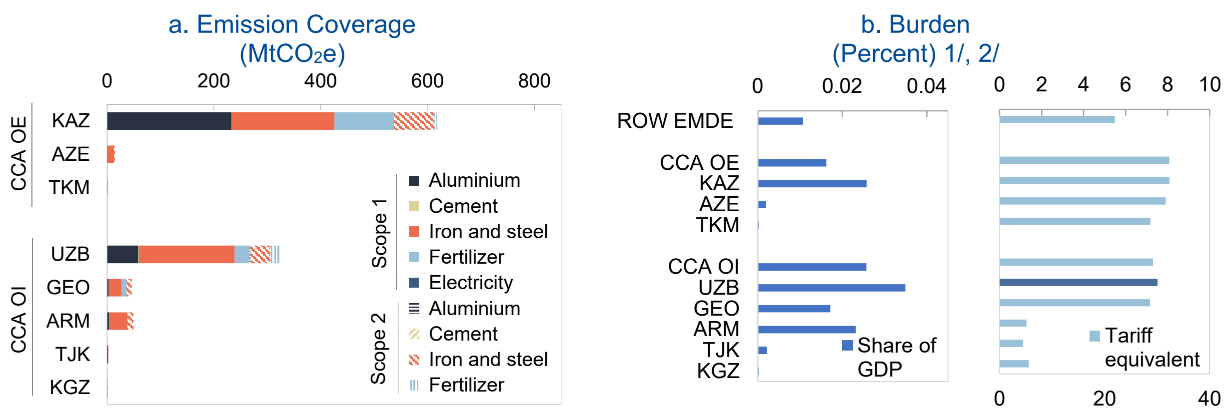
Source: Authors' calculations.
Note: 1/ Excludes Syria due to data availability issues. 2/ Based on the sum of all drivers' logarithms. 3/ Country group averages are weighted by GDP.

4.2.2 CCA

4.2.2.A CBAM Exposure by Country and Sector

Like in MENAP, CBAM exposure in the CCA will be focused in a few countries, but with roughly comparable emission coverage and burdens (Figure 8 and Appendix VII). Of the CCA's 1 mtCO_2e CBAM emissions, some 90 percent originate in two countries alone: Kazakhstan (60 percent) and Uzbekistan (30 percent), mainly from scope 1 emissions (84 percent of the total) in iron and steel, aluminum, and fertilizer production. This results in both Kazakhstan and Uzbekistan facing a burden of 0.03 percent of GDP, with tariff equivalents of 8 and 30 percent, respectively. Armenia and Georgia, despite low emissions, will bear a burden of 0.02 percent of GDP as their trade exposure is high relative to their GDP. In contrast, Azerbaijan and Turkmenistan will face small burdens because of a relatively higher GDP, and the Kyrgyz Republic and Tajikistan because of minimal emission coverage.[34]

Figure 8. CCA Countries: Overall CBAM Exposure
(Annual 2022–23 averages)

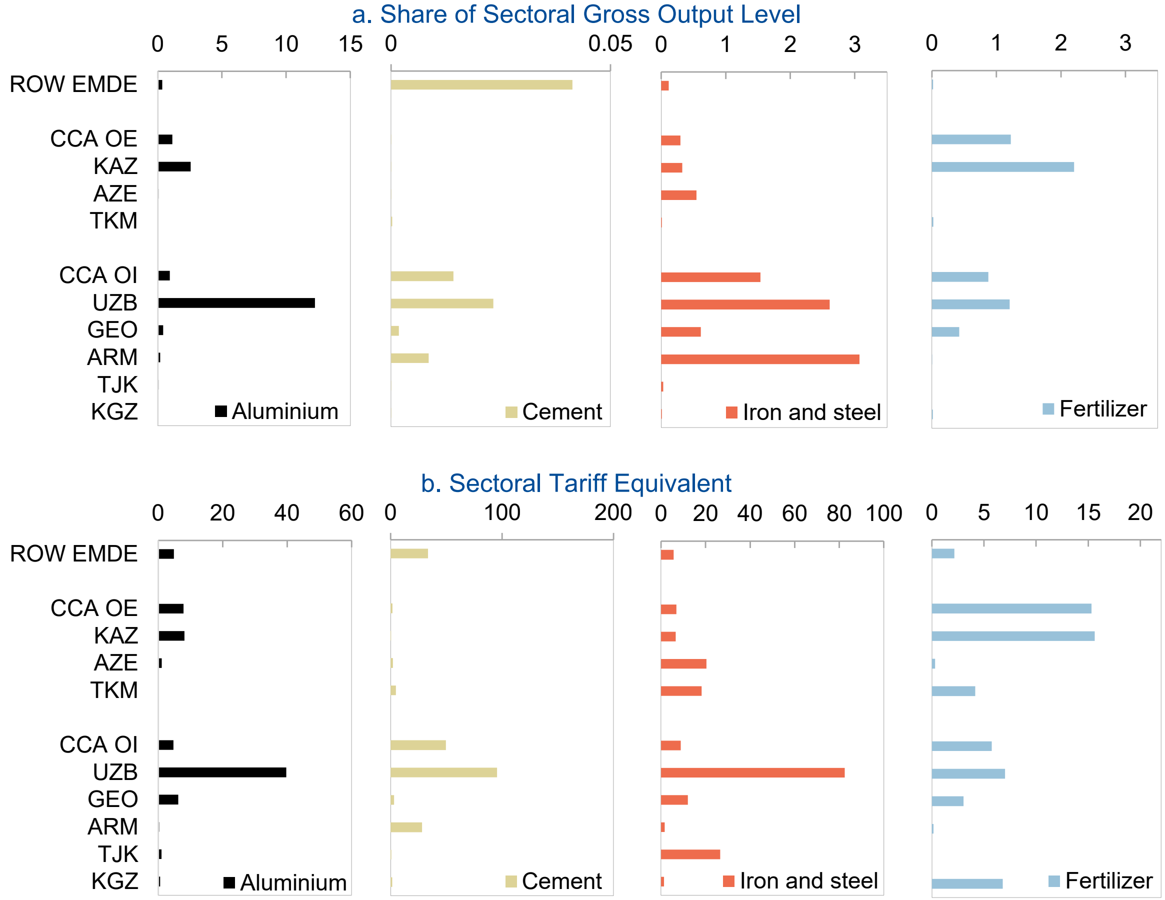


Source: Authors' calculations.
Note: 1/ Country group averages of GDP shares are weighted by GDP, and tariff equivalents by trade. 2/ Darker shades for burden correspond to lower axis.

Also like in MENAP, CCA countries' CBAM burden will be driven by a limited number of sectors (Figure 9). In Uzbekistan, all CBAM sectors will face substantial tariff and output burdens. In Kazakhstan, the aluminum and fertilizer sectors will be most affected, but the iron and steel sector less so. Georgia's iron and steel sector will bear the highest burden, and its aluminum sector will also be notably affected. Armenia's greatest impact, as a share of output, will be in the iron and steel sector.

[34] Country studies lend some support. Azerbaijan's real GDP could decline by 1 percent below its NDCs- business-as-usual (BAU) scenario due to competitiveness losses given its high carbon intensity and despite its strengths in chemical and petrochemical sectors (World Bank, 2023a). Kazakhstan could see 2.5 percent of its exports subject to CBAM, characterized by high emission intensity (World Bank, 2022a; Issayeva et al., 2023). It could lose over US$250 million in annual export revenue to the EU, with potential future losses reaching US$1.5 billion if CBAM expands, particularly impacting the iron and steel sector.

Figure 9. CCA Countries: Sectoral CBAM Burdens
(Annual 2022–23 averages in percent) 1/



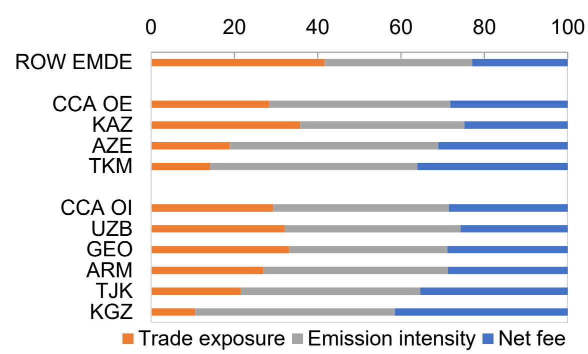
Source: Authors' calculations.
Note: 1/ Country group averages of sectoral gross output values are weighted by countries' sectoral gross output values, and tariff equivalents by sectoral export volumes.

4.2.2.B CBAM Burden by Driver

Unlike other EMDEs, emission intensity is central to the CCA's CBAM burden, with variations primarily among oil importers (Figure 10). Low trade in CBAM commodities with the EU makes emission intensity the predominant driver, even though the contribution of trade exposure is slightly higher in Kazakhstan, Uzbekistan, Georgia and Armenia.

Emission intensities are more consistent across CCA countries than in MENAP, notably between oil exporters and importers (Figure 11).

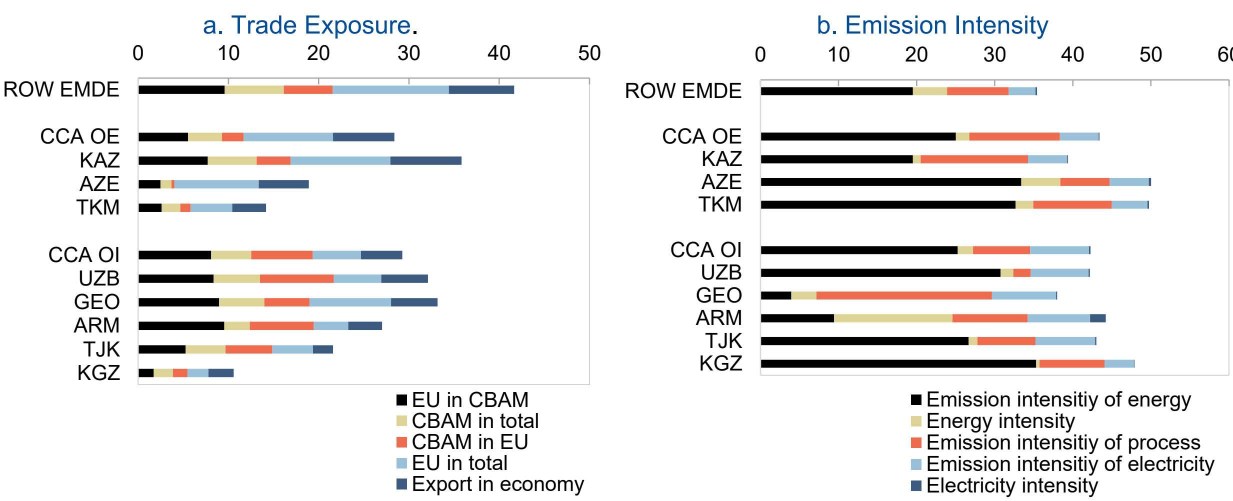
Figure 10. CCA Countries: Contribution of CBAM Burden Drivers
(Annual 2022–23 average percentages of total) 1/, /2



Sources: Authors' calculations.
Note: 1/ Based on the sum of all drivers' logarithms. 2/ Country group averages are weighted by GDP.

- ***Trade exposure.*** Among countries with higher trade exposure, the main driver is the EU's share in CBAM exports. The share of CBAM commodities in exports to the EU is also significant in Armenia and Uzbekistan. CBAM exports constitute a low share of total exports throughout the region, especially for Armenia among the highly trade-exposed countries.
- ***Emission intensity.*** Compared to other EMDEs, CCA countries exhibit high emission intensity primarily due to non-electric energy, but in Kazakhstan, Georgia, and, to some extent, Armenia. In these countries, as well as in Kazakhstan, IPPU emission intensity contributes more significantly. Additionally, the power grid's contribution to emission intensity is notable in Kazakhstan, Uzbekistan, Armenia, and Tajikistan. In terms of overall energy intensity, the region performs relatively well in non-electric energy except for Armenia, and relatively poor in electric energy, with almost all countries higher than the EMDE average.
- ***Net fee.*** This is uniform across CCA countries, except for Kazakhstan, where the low carbon price does not significantly affect CBAM obligations.

Figure 11. CCA Countries: Disaggregation of Selected CBAM Burden Drivers
(Annual 2022–23 average percentage contribution to the total) 1/, 2/, 3/



Source: Authors' calculations.
Note: 1/ Syria is not included due to data availability issues. 2/ Based on the sum of all drivers' logarithms. 3/ Country group averages are weighted by GDP.

5. Conclusion

The EU's CBAM will initially place a modest burden on its trading partners because of its limited emission coverage, but the ME&CA region will face one of the highest burdens globally—with significant variations across countries and sectors mirroring differences in trade exposure, emission intensity, and net fees. Using a novel decomposition methodology, new datasets, and realistic calibration for 2022–23 data, this paper estimates that ME&CA will face an annual burden of US$1.7 billion, averaging 0.03 percent of GDP per country (equivalent to a 12 percent tariff), ranging from 0.3 percent of GDP in Tunisia to near-zero in most LICs and FCSs. Within ME&CA, the burden will be greater in MENAP than in the CCA due to stronger trade links with the EU and higher emission intensity of CBAM-eligible exports, reflecting greater reliance on fossil fuels and energy-intensive industries (particularly in the aluminum, and iron and steel sectors). ME&CA's exposure is expected to persist, especially as long as progress in economic diversification and energy transition remains slow and carbon taxation widely absent (except in Kazakhstan and, more recently, Mauritania). Under the current setup, CBAM's macroeconomic impact is generally expected to be modest,[35] yet it might increase if CBAM's scope expands or EU carbon prices rise to meet emission goals (e.g., under ETS1 and ETS2). It will, in any case, disproportionally affect a few key sectors in specific countries.

Various policy measures can help reduce the CBAM burden. In the near term, implementing a carbon tax equivalent or exceeding EU standards can lower or eliminate net fees, while generating domestic revenue that would otherwise be collected by the EU. In addition, such a tax would curb GHG emissions by incentivizing investments in greener technologies. Over the medium term, eliminating energy subsidies and prioritizing reductions in scope 2 emissions (e.g., through investments in clean energy infrastructure) can lower emission intensities.[36] Furthermore, trade polies (such as re-orienting CBAM-affected exports to non-EU countries and eliminating trade barriers) can reduce trade exposure.[37] Including policies that reduce emissions in CBAM sectors within future updates of Nationally Determined Contributions (NDCs) and national action plans can further support greener practices in these sectors and also help achieve overall mitigation goals.

While ME&CA countries share the policy priority of reducing the emission intensity of their CBAM products to lower their CBAM burden and its macroeconomic impact, tailored policies are essential. Although carbon taxation represents the most efficient measure to reduce emission intensities, this paper offers guidance for ME&CA policymakers on complementary sector-specific policies, which consider both the size and the drivers influencing their projected CBAM burden. For instance:

- ***Countries with high CBAM burdens primarily from trade exposure.*** Where high trade exposure stems from a significant EU share in CBAM exports and a large share of CBAM goods in total exports (e.g., Algeria, Bahrain, Egypt, Tunisia, Morocco, Jordan, Armenia), diversifying away from CBAM goods or redirecting exports to other destinations can offer short-term relief. However, reducing the EU market's importance may not be sustainable over time, requiring a reduction in the emission intensity of production, particularly in the aluminum and iron and steel sectors. Conversely, for countries where CBAM commodities make up a large part of exports to the EU (e.g., Bahrain, Egypt, Jordan, Armenia), trade diversion may have more immediate impacts until adjustments are made.[38]
- ***Countries with high CBAM burdens primarily from emission intensity.*** Where high emission intensity results from the high emission intensity of energy production (e.g., Uzbekistan, Kazakhstan, Lebanon, and Libya), increasing mitigation efforts is important for reducing the CBAM burden. High combustion and IPPU emission intensity indicate a need to green the production of CBAM commodities by transitioning to greener production technologies (e.g., green steel and aluminum). However, these technologies will be ineffective without reducing scope 2 emission intensity by adopting cleaner power generation technologies

[35] Most importantly, CBAM will affect countries' balances of payments through reduced exports and international competitiveness, growth and unemployment through decreased external demand, and fiscal balances through lower tax revenues, especially for countries relying heavily on CBAM exports.

[36] Renewable energy has emerged as a highly competitive sector, with regional leaders such as Pakistan, Morocco, and Jordan rapidly increasing their share of renewable energy in total electricity production. This shift presents a cost-effective method for reducing scope 2 emissions, given that renewable energy sources are now more economical than fossil fuels.

[37] Several other studies emphasize the need for additional economic and trade policies, particularly ambitious CO2 abatement through carbon pricing (Dai et al., 2020; Acar et al., 2022; Huang et al., 2022; Qi et al., 2022; Deng et al., 2024; Shuai et al., 2024; Zhu et al., 2024) or trade diversification and export subsidies (Zhang et al., 2019; Ren et al., 2023).

[38] A good example of such policies are Bahrain's efforts to leverage its strategic location and Free Trade Agreements (FTAs) to access diverse markets are a good example.

for sectors that rely on electrification.[39] In contrast, where the EU is less critical for CBAM trades (e.g., Azerbaijan, Turkmenistan, Kyrgyz Republic, Libya), diverting exports may be more feasible.

- ***Countries with low CBAM burdens primarily from low trade exposure but with a high emission intensity.*** These countries, including those in the GCC (except Bahrain and Oman), Pakistan, and many LIC FCS, should prioritize reducing their emission intensity to improve competitiveness if they aim to increase their currently small share of CBAM exports to EU markets in the future. They should also closely monitor potential changes in competition within non-EU markets as other countries may adjust their presence in EU markets.[40]

Alongside unique exposure profiles, policy decisions should consider available fiscal and policy space, structural context, and technical capacity. Lowering emission intensity is helpful but not enough. A targeted, multi-sector approach is needed, often down to the firm level. Transitioning to a low-carbon economy requires complementary measures that focus on climate transformation pathways. Like many peer EMDEs, ME&CA countries need external support, especially financing, knowledge transfer, capacity building, and favorable trade policies. The EU could help by recycling CBAM revenues and sharing low-carbon technologies with its trading partners to support their decarbonization and diversification efforts.[41]

Looking ahead, ME&CA's exposure will shift as the EU expands CBAM and trading partners adapt. Higher CBAM fees would proportionally increase ME&CA's CBAM burden, while newly added commodities would affect countries differently. For example, we estimate that including chemicals could nearly double ME&CA's covered emissions to 28 mtCO_2e and add US$2.4 billion in obligations, increasing its burden to 0.06 percent and raising the tariff equivalent from 13 to 15 percent.[42] However, these estimates reflect an upper-bound, first-order static effect. A more precise medium-term outlook requires general equilibrium analysis that incorporates changes in macroeconomic policies, trade patterns, and production technologies.

[39] See e.g., Egypt's efforts to build renewable capacity for its aluminum sector as an example of such policies.

[40] Green hydrogen investments in Oman are a good example of policies aimed at creating trade in greener products.

[41] The effectiveness of CBAM recycling mainly depends on the design of allocation criteria (Perdana and Vielle, 2022; Beaufils et al., 2023; Ren et al., 2023; Hong et al., 2023; Sun et al., 2024).

[42] We designed our methodology to accommodate such changes and plan to publish updates of our results for all IMF member countries in response to major developments on https://www.imf.org/en/Publications/WP/Issues/2025/09/12/Macroeconomic-Exposure-to-the-EUs-Carbon-Border-Adjustment-Mechanism-The-Case-of-the-Middle-570332.

Appendix I. Country Sample and Groupings

191 **IMF Members**		156 **Included in GLORIA**			35 **Not Included in GLORIA**
		120 **Emerging Market and Developing Economies** (EMDEs)		36 **Advanced Economies** (AEs)	(26 EMs, 7 LICs, 2 AEs)
		68 **Emerging Markets** (EMs)	52 **Low-Income Countries** (LICs)		
31 **Middle East and Central Asia** (ME&CA)	21 **Middle East and North Africa** (MENA); 23 **MENA, AFG, and PAK** (MENAP)	15 **MENA**: Algeria (DZA)°, Egypt (EGY), Iran (IRN)°, Iraq (IRQ)°*, Jordan (JOR), Lebanon (LBN)*, Libya (LBY)°*, Morocco (MAR), Tunisia (TUN), and 6 Gulf Corporation Council members (**GCC**)°: Bahrain (BHR)°, Kuwait (KWT)°, Oman (OMN)°, Qatar (QAT)°, Saudi Arabia (SAU)°, and United Arab Emirates (UAE)° 1: Pakistan (PAK)	6 **MENA**: Djibouti (DJI), Mauritania (MRT), Somalia (SOM)*, Sudan (SDN)*, Syria (SYR)*, Yemen (YEM)* 1: Afghanistan (AFG)*		
	8 **Caucasus and Central Asia** (CCA)	5: Armenia (ARM), Azerbaijan (AZE)° , Georgia (GEO), Kazakhstan (KAZ)° , Turkmenistan (TKM)°	3: Kyrgyz Republic (KGZ), Tajikistan (TJK), Uzbekistan (UZB)		
160 **Rest of the world** (RoW)	45 **Sub-Saharan Africa** (SSA)	6: Angola (AGO)°, Botswana (BWA), Equatorial Guinea (GNQ)°, Gabon (GAB)°, Namibia (NAM), South Africa (ZAF)	31: Benin (BEN), Burkina Faso (BFA)*, Burundi (BDI)*, Cameroon (CMR)*, Central African Republic (CAF)*, Chad (TCD)°*, Rep. of Congo (COG)°*, Côte d'Ivoire (CIV), Dem. Rep. of the Congo (COD)*, Eritrea (ERI)*, Ethiopia (ETH)*, The Gambia (GMB), Ghana (GHA), Guinea (GIN), Kenya (KEN), Liberia (LBR), Madagascar (MDG), Malawi (MWI), Mali (MLI)*, Mozambique (MOZ)*, Niger (NER)*, Nigeria (NGA)°*, Rwanda (RWA), Senegal (SEN), Sierra Leone (SLE), South Sudan (SSD)°*, Tanzania (TZA), Togo (TGO), Uganda (UGA), Zambia (ZMB), Zimbabwe (ZWE)*		4 **EMs**: Cabo Verde (CPV), Eswatini (SWZ), Mauritius (MUS), Seychelles (SYC) 4 **LICs**: Comoros (COM)*, Guinea-Bissau (GNB)*, Lesotho (LSO), São Tomé and Príncipe (STP)*
	35 **Asia and Pacific** (APAC)	10: Brunei Darussalam (BRN)°, China (CHN),India (IND), Indonesia (IDN), Malaysia (MYS), Mongolia (MNG), Philippines (PHL), Sri Lanka (LKA), Thailand (THA), Vietnam (VNM)	7: Bangladesh (BGD), Bhutan (BTN), Cambodia (KHM), Lao P.D.R. (LAO), Myanmar (MMR)*, Nepal (NPL), Papua New Guinea (PNG)*	5: Australia (AUS), Japan (JPN), Korea (KOR), New Zealand (NZL), Singapore (SGP)	10 **EMs**: Fiji (FJI), Maldives (MDV), Marshall Islands (MHL)*, Fed. States of Micronesia (FSM)*, Nauru (NRU), Palau (PLW), Samoa (WSM), Tonga (TON), Tuvalu (TUV)*, Vanuatu (VUT) 3 **LICs**: Kiribati (KIR)*, Solomon Islands (SLB)*, Dem. Rep. of Timor-Leste (TLS)*
	34 **Americas** (AMER)	19: Argentina (ARG), Bahamas (BHS), Belize (BLZ), Bolivia (BOL), Brazil (BRA), Chile (CHL), Colombia (COL), Costa Rica (CRI), Dominican Republic (DOM), Ecuador (ECU)°, El Salvador (SLV), Guatemala (GTM), Jamaica (JAM), Mexico (MEX), Panama (PAN), Paraguay (PRY), Peru (PER), Uruguay (URY), Venezuela (VEN)°*	3: Haiti (HTI)*, Honduras (HND), Nicaragua (NIC)	2: Canada (CAN), United States (USA)	10 **EMs**: Antigua and Barbuda (ATG), Barbados (BRB), Dominica (DMA), Grenada (GRD), Guyana (GUY)°, St. Kitts and Nevis (KNA), St. Lucia (LCA), St. Vincent and the Grenadines (VCT), Suriname (SUR), Trinidad and Tobago (TTO)
	46 **Europe** (EUR)	4 **EU**: Bulgaria (BGR), Hungary (HUN), Poland (POL), Romanian (ROU), 8 **Non-EU**: Albania (ALB), Belarus (BLR), Bosnia and Herzegovina (BIH), North Macedonia (MKD), Russia Federation (RUS), Serbia (SRB), Türkiye (TUR), Ukraine (UKR)*	1 **Non-EU**: Moldova (MDA)	23 **EU**: Austria (AUT), Belgium (BEL), Croatia (HRV), Cyprus (CYP), Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Ireland (IRL), Italy (ITA), Latvia (LVA), Lithuania (LTU), Luxembourg (LUX), Malta (MLT), Netherlands (NLD), Portugal (PRT), Slovak Republic (SVK), Slovenia (SVN), Spain (ESP), Sweden (SWE) 6 **Non-EU**: Iceland (ISL), Israel (ISR), Liechtenstein (LIE), Norway (NOR), Switzerland (CHE), United Kingdom (GBR)	2 **EMs** (non-EU): Kosovo (KOS)*, Montenegro, Rep. of (MNE) 2 **AEs (non-EU)**: Andorra (AND), San Marino (SMR)

Note: Country income groups as per the IMF's WEO classification. * denotes fragile and conflict-affected states (FCS) and ° EMDE oil and gas exporters (OE).

Appendix II. CBAM Emission Coverage

Appendix Table II.1. CBAM Emission Coverage

Reporting metrics	Cement (Per tonne of good)	Fertilizer (Per tonne of good)	Iron & Steel (Per tonne of good)	Aluminium (Per tonne of good)	Hydrogen (Per tonne of good)	Electricity (Per MWh)
GHGs covered	Only CO_2	CO_2 (plus nitrous oxide for some fertilizer goods)	Only CO_2	CO_2 (plus perfluorocarbons (PFCs) for some aluminium goods)	Only CO_2	Only CO_2
Emission coverage during transitional period	Direct and indirect					Only direct
Emission coverage during definitive period	Direct and indirect		Only direct, subject to review			Only direct
Determination of direct embedded emissions	Based on actual emissions, but estimations (including default values) can be used for up to 100% of the specific direct embedded emissions for imports until 30 June 2024 (i.e., CBAM reports due until 31 July 2024) and for up to 20% of the total specific embedded emissions for imports until 31 December 2025					Based on default values, unless several cumulative conditions are met
Determination of indirect embedded emissions	Based on actual electricity consumption and default emission factors for electricity, unless conditions are met (i.e., direct technical connection or power purchase agreement). Estimations (including default values) can be used for up to 100% of the specific indirect embedded emissions for imports until 30 June 2024					Not applicable

Source: European Commission (2024b).

Appendix III. CBAM Commodity Coverage

Appendix Table III.1. CBAM Commodity Coverage

Gloria	HS6
Aluminum Products	7601 – Unwrought Aluminum
	7603 – Aluminum powders and flakes
	7604 – Aluminum bars, rods and profiles
	7605 – Aluminum wire
	7606 – Aluminum plates, sheets and strip, of a thickness exceeding 0,2 mm
	7607 – Aluminum foil (whether or not printed or backed with paper, paper-board, plastics or similar backing materials) of a thickness (excluding any backing) not exceeding 0,2 mm
	7608 – Aluminum tubes and pipes
	7609 00 00 – Aluminum tube or pipe fittings (for example, couplings, elbows, sleeves)
	7610 – Aluminum structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, balustrades, pillars and columns); Aluminum plates, rods, profiles, tubes and the like, prepared for use in structures
	7611 00 00 – Aluminum reservoirs, tanks, vats and similar containers, for any material (other than compressed or liquefied gas), of a capacity exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
	7612 – Aluminum casks, drums, cans, boxes and similar containers (including rigid or collapsible tubular containers), for any material (other than compressed or liquefied gas), of a capacity not exceeding 300 litres, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
	7613 00 00 – Aluminum containers for compressed or liquefied gas
	7614 – Stranded wire, cables, plaited bands and the like, of Aluminum, not electrically insulated
	7616 – Other articles of Aluminum
Iron and Steel Products	2601 12 00 – Agglomerated iron ores and concentrates, other than roasted iron pyrites
	7201 – Pig iron and spiegeleisen in pigs, blocks, or other primary forms. Some products under 7205 (Granules and powders, of pig iron, spiegeleisen, iron, or steel) may be covered here.
	7202 1 – Ferro-manganese
	7202 4 – Ferro-chromium
	7202 6 – Ferro-nickel
	7203 – Ferrous products obtained by direct reduction of iron ore and other spongy ferrous products
	7205 – Granules and powders, of pig iron, spiegeleisen, iron or steel (if not covered under category pig iron)
	7206 – Iron and non-alloy steel in ingots or other primary forms (excluding iron of heading 7203)
	7207 – Semi-finished products of iron or non-alloy steel
	7208 – Flat-rolled products of iron or non-alloy steel, of a width of 600 mm or more, hot-rolled, not clad, plated or coated
	7209 – Flat-rolled products of iron or non-alloy steel, of a width of 600 mm or more, cold-rolled (cold-reduced), not clad, plated or coated
	7210 – Flat-rolled products of iron or non-alloy steel, of a width of 600 mm or more, clad, plated or coated
	7211 – Flat-rolled products of iron or non-alloy steel, of a width of less than 600 mm, not clad, plated or coated
	7212 – Flat-rolled products of iron or non-alloy steel, of a width of less than 600 mm, clad, plated or coated
	7213 – Bars and rods, hot-rolled, in irregularly wound coils, of iron or non-alloy steel
	7214 – Other bars and rods of iron or non-alloy steel, not further worked than forged, hot-rolled, hot-drawn or hot-extruded, but including those twisted after rolling
	7215 – Other bars and rods of iron or non-alloy steel
	7216 – Angles, shapes and sections of iron or non-alloy steel
	7217 – Wire of iron or non-alloy steel
	7218 – Stainless steel in ingots or other primary forms; semi-finished products of stainless steel
	7219 – Flat-rolled products of stainless steel, of a width of 600 mm or more
	7220 – Flat-rolled products of stainless steel, of a width of less than 600 mm
	7221 – Bars and rods, hot-rolled, in irregularly wound coils, of stainless steel
	7222 – Other bars and rods of stainless steel; angles, shapes and sections of stainless steel
	7223 – Wire of stainless steel
	7224 – Other alloy steel in ingots or other primary forms; semi-finished products of other alloy steel
	7225 – Flat-rolled products of other alloy steel, of a width of 600 mm or more
	7226 – Flat-rolled products of other alloy steel, of a width of less than 600 mm
	7227 – Bars and rods, hot-rolled, in irregularly wound coils, of other alloy steel
	7228 – Other bars and rods of other alloy steel; angles, shapes and sections, of other alloy steel; hollow drill bars and rods, of alloy or non-alloy steel
	7229 – Wire of other alloy steel
	7301 – Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel
	7302 – Railway or tramway track construction material of iron or steel, the following: rails, check-rails and rack rails, switch blades, crossing frogs, point rods and other crossing pieces, sleepers (cross-ties), fish-plates, chairs, chair wedges, sole plates (base plates), rail clips, bedplates, ties and other material specialised for jointing or fixing rails
	7303 – Tubes, pipes and hollow profiles, of cast iron
	7304 – Tubes, pipes and hollow profiles, seamless, of iron (other than cast iron) or steel
	7305 – Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406,4 mm, of iron or steel
	7306 – Other tubes, pipes and hollow profiles (for example, open seam or welded, riveted or similarly closed), of iron or steel
	7307 – Tube or pipe fittings (for example, couplings, elbows, sleeves), of iron or steel
	7308 – Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, lock- gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balustrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel
	7309 – Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
	7310 – Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment
	7311 – Containers for compressed or liquefied gas, of iron or steel
	7318 – Screws, bolts, nuts, coach screws, screw hooks, rivets, cotters, cotter pins, washers (including spring washers) and similar articles, of iron or steel
	7326 – Other articles of iron or steel
Nitrogeous Fertilizers	2808 00 00 – Nitric acid; sulphonitric acids
	2814 – Ammonia, anhydrous or in aqueous solution
	2834 21 00 – Nitrates of potassium
	3102 – Mineral or chemical fertilisers, nitrogenous (except 3102 10 (Urea))
	3102 10 – Urea, whether or not in aqueous solution
	3105 – Mineral or chemical fertilisers containing two or three of the fertilising elements nitrogen, phosphorus, and potassium; other fertilisers (except: 3105 60 00 – Mineral or chemical fertilisers containing the two fertilising elements phosphorus and potassium)
Cement	2507 00 80 – Other kaolinic clays
	2523 10 00 – Cement clinkers
	2523 21 00 – White Portland cement, whether or not artificially coloured
	2523 29 00 – Other Portland cement
	2523 30 00 – Aluminous cement
	2523 90 00 – Other hydraulic cements
Electricity	2716 00 00 – Electrical energy

Source: Carbon Chain (2025)

Appendix IV. Relative Price Bias

Rewriting equation (1) in value terms allows to reveal the relative price bias from using trade values instead of volumes:

$$\theta_{i,r} = P^X_{i,r,eu} X_{i,r,eu} \frac{E_{i,r}}{P^Y_{i,r} Y_{i,r}} (\tau_{eu} - \tau_r) \tag{A.1}$$

where $P^X_{i,r,eu}$ represents the price of exports to the EU and $P^Y_{i,r}$ the domestic price. For individual commodities, it is straightforward to show that:

$$\theta_{cbam,r} = \underbrace{X_{cbam,r,eu}}_{\substack{\text{Trade}\\\text{volume}}} \underbrace{E_{cbam,r}/Y_{cbam,r}}_{\substack{\text{Emission}\\\text{intensity}}} \underbrace{(\tau_{eu} - \tau_r)}_{\substack{\text{Net}\\\text{fee}}} \underbrace{P^X_{cbam,r,eu}/P^Y_{cbam,r}}_{\substack{\text{Relative}\\\text{price}}} = \delta_{cbam,r} P^X_{cbam,r,eu}/P^Y_{cbam,r} \tag{A.2}$$

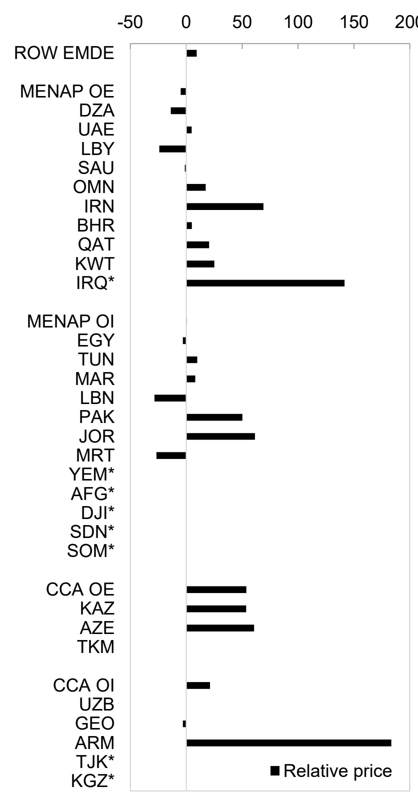
Thus, using trade and production values, as in other studies, adds the export-to-domestic price ratio, termed the 'relative price'. This can introduce a bias that increases with the price difference.[43] The price component can be either less than or greater than one, depending on trade policies and other factors. If it exceeds one, using trade and production values overestimates the CBAM burden (and vice versa).[44] We derive the relative price component as the ratio of the burden calculated using quantities and values at more aggregate levels:

$$P^X_{cbam,r,eu}/P^Y_{i,r} = \theta_r/\delta_r \tag{A.3}$$

Our findings show that the relative price effect can be significant. Globally, EMDE export prices to the EU are 8 percent higher than to the rest of the world, used as a proxy for domestic prices. MENAP oil exporters match the global average at 9 percent, while MENAP oil importers see EU export prices 2 percent lower than the rest of the world. In the CCA region, the difference is substantial: EU export prices are 52 percent and 21 percent higher for oil exporters and importers, respectively.

Figure IV.1. ME&CA and Peers: Relative Price Bias of EU Export Prices

(Percentage difference from domestic price, simple annual 2022–23 averages) 1/



Source: Authors' calculations.
Note: 1/ Excludes Syria due to data availability issues and countries marked with an asterisk due to a CBAM obligation of less than US$1 million.

[43] Using average physical quantities mitigates this bias, as demonstrated in this paper.

[44] For example, if a country subsidizes exports at the expense of domestic supply, the price component can be less than one. Conversely, if exports are higher in quality or must meet strict specifications, it can be greater than one.

Appendix V. GLORIA and BACI Transformations

GLORIA contains a vast amount of data organized in a specific annual format. Each year consists of a 39,360 x 39,360 IO matrix in basic prices and a 39,360 x 984 final demand matrix, also in basic prices.[45] The satellite database consists of a 5,982 x 39,360 matrix with several indicators, of which this paper primarily focuses on main emissions (CO_2, N_2O, CH_4 and CFCs)[46] from EDGAR to form a 3 x 39,360 submatrix for each year. GLORIA follows conventions in the literature, where the flow of commodities moves from rows to columns. The rows represent "sources" and "products," while the columns indicate "destinations" and "industries" in IO tables. In the final demand matrix, rows correspond to source countries and products, and columns consist of six final demand agents (household, non-profit organizations, government, gross fixed capital formation, inventory changes, and acquisition of valuables) for each destination country. In the emission data, rows represent GHG types, and columns correspond to emitting countries and industries. One year of data is approximately 7 GP in size.

Using matrix algebra over the entire dataset is impractical and demands massive computational power. Therefore, the matrices are pivoted into a long format, where each row represents a unique observation of an annual source country-destination country-product combination, and zero entries are removed. Further calculations involve matching GHG data from the satellite database by country and product, determining bilateral trade flows, and assessing exposure and burden. This process includes the following steps:

Step 1: Transform all three raw data matrices to long format	Step 2: Make long format suitable for analysis	Step 3: Aggregate bilateral trade flows
• Read data, row names, and column names from raw .csv files. • Add row names and column names. • Pivot matrix to long format. • Drop zero entries (which account for 80 percent of all data points). • Parse row and column names to separate countries (i.e. iso3 codes), sectors (sector codes), and indicator type (i.e. product or industry).	IO data enables the calculation of exports, imports and domestic use of intermediate inputs, leveraging about 380 million data points. • Intermediate input exports are calculated by aggregating the database over destination sectors, resulting in a source-sector-destination dimension. • Intermediate input use is calculated by aggregating the data on source countries, yielding a product-industry-destination dimension. • Supply is directly reported in GLORIA as a flow from industries to products along the diagonal of the IO matrix, which is isolated by retaining the diagonal elements.	The 2017 HS6 revision of the BACI database for 2017–22 comprises around 10 million annual bilateral commodity flows at HS6 level (5,381 commodity types) for 238 countries and regions. • Map 5,381 HS6-level commodities to 120 GLORIA commodities and aggregate BACI to include around 3.8 million records, which can be merged with the emission intensity data for these commodities.

Lastly, missing BACI observations for country-product pairs of trade quantities and values require estimation. To this end, we use the existing data to calculate the average price for each HS6 commodity for each country. After filling in the missing prices, we use the reported value and calculated price data to estimate the quantity data. We then recalculate the terms of trade for the EU and ROW for the aggregate commodities in the GLORIA database. The satellite data contains 100,000 non-zero entries and is the easiest to transform, retaining the main GHGs by emitting country and industry.

[45] Note that this paper does not utilize GLORIA's value-added database (a 984 x 39,360 matrix).

[46] The chlorofluorocarbons covered by GLORIA include C4F8, C2F6, C3F8, C4F10, C5F12, C6F14, and CF4.

Appendix VI. Employed Carbon Prices

Appendix Table VI.1. Carbon Prices Used for Calculations
(US$ per $mtCO_2e$)

Country	Scope1				Scope 2		
	2022	2023	2024	2026	2022	2023	2024
Albania			13				
Argentina	6	5	3				
Australia			22				
Canada	39	46	57				
Chile	5	5	5				
China	8	8	8		9	8	12
Colombia	5	5	7				
European Union	87	96	61	103			
Iceland	24	24	24				
Indonesia			0				1
Japan	2	3	2				
Kazakhstan	1	1	1				
Mexico	2	3	3				
Montenegro			26				
New Zealand	53	34	35				
Singapore	4	4	18				
Slovenia	0	0	0				
South Africa	10	9	10				
South Korea	19	11	6				
Switzerland	98	112	96				
Ukraine	1	1	1				
United Kingdom	99	88	45		61	55	34
United States	31	29	36		27	26	33
Uruguay	137	156	167				

Source: World Bank (2024).

Appendix VII. Country-by-Country CBAM Results

Appendix Table VII.1. ME&CA: Key CBAM Results

Country		Emission Coverage	Burden	
		(thousand mtCO2e)	(Pct. of GDP)	(Pct. equivalent tariff)
MENAP				
Average	**MENAP**	**15,197.7**	**0.04**	**14.39**
Afghanistan, Islamic Rep.	AFG	0.4	0.00	13.61
Algeria	DZA	4,727.8	0.21	41.34
Bahrain	BHR	138.6	0.03	1.05
Djibouti	DJI	0.0	0.00	1.88
Egypt	EGY	3,201.3	0.08	15.89
Iran, Islamic Rep.	IRN	143.4	0.00	21.87
Iraq	IRQ	6.6	0.00	16.68
Jordan	JOR	6.0	0.00	0.15
Kuwait	KWT	26.2	0.00	86.29
Lebanon	LBN	537.7	0.23	16.48
Libya	LBY	662.5	0.16	43.93
Mauritania	MRT	15.0	0.02	16.48
Morocco	MAR	299.7	0.02	3.13
Oman	OMN	692.9	0.06	16.68
Pakistan	PAK	211.5	0.01	66.04
Qatar	QAT	106.7	0.01	6.17
Saudi Arabia	SAU	837.6	0.01	10.88
Somalia	SOM	0.0	0.00	0.00
Sudan	SDN	0.4	0.00	34.10
Syrian Arab Rep.	SYR	n.a.	n.a.	n.a.
Tunisia	TUN	1,542.1	0.34	29.51
United Arab Emirates	UAE	2,041.5	0.04	7.99
Yemen, Rep. of	YEM	0.1	0.00	12.29
CCA				
Average	**CCA**	**1,057.2**	**0.02**	**7.75**
Armenia	ARM	49.1	0.02	1.28
Azerbaijan	AZE	14.6	0.00	7.91
Georgia	GEO	46.3	0.02	7.16
Kazakhstan	KAZ	617.6	0.03	8.08
Kyrgyz Republic	KGZ	0.3	0.00	1.39
Tajikistan	TJK	2.4	0.00	1.12
Turkmenistan	TKM	1.8	0.00	7.17
Uzbekistan	UZB	325.0	0.03	0.00

Source: Authors' calculations.

References

Acar, S., A.A Asici, and A. Yeldan. 2022. "Potential effects of the EU's carbon border adjustment mechanism on the Turkish economy." *Environment, Development and Sustainability*, 24(6), 8162–94.

Ambec, S., F. Esposito, and A. Pacelli. 2024. "The Economics of Carbon Leakage Mitigation Policies." *Journal of Environmental Economics and Management*, 175: 102973.

Amendola, M. 2025. "Winners and losers of the EU carbon border adjustment mechanism. An intra-EU issue?" *Energy Economics*, *142*, p.108139.

Anderson, G, J. Ma, T. Mirzoev, L. Zhu, and K. Zhunussova. 2022. "A Low-Carbon Future for the Middle East and Central Asia: What are the Options?" IMF Departmental Paper No 2022/018.

Baker, P., T.Z.B. Beeharry, L. Le, R. Roy, and P. Quiles. 2022. Designing an African response to Carbon Border Adjustment Mechanisms. In African Economic Conference 2022: Supporting Climate Smart Development in Africa (Vol. 11, November).

Barrett, S. 2003. "Environmental and Statecraft: The Strategy of Environmental Treaty-Making." *Management of Environmental Quality*, 14(5), 622–23.

Beaufils, T., H. Ward, M. Jakob, and L. Wenz. 2023. Assessing different European Carbon Border Adjustment Mechanism implementations and their impact on trade partners. Communications Earth and Environment, 4, 131. Available at: https://ssrn.com/abstract=4739238.

BloombergNEF. 2024. EU ETS Market Outlook 1H 2024: Prices Valley Before Rally, available online: https://about.bnef.com/blog/eu-ets-market-outlook-1h-2024-prices-valley-before-rally/.

Carbon Chain, 2025, Quick guide to CN codes for EU CBAM goods: Summary List of CBAM CN Codes, https://www.carbonchain.com/cbam/eu-cbam-cn-codes#faq, accessed on 6/9/2025.

Chen, W. and Q. Guo. 2017. "Assessing the effect of carbon tariffs on international trade and emission reduction of China's industrial products under the background of global climate governance." *Sustainability*, 9(6), 1028.

Chepeliev, M. 2021. "Possible implications of the European carbon border adjustment mechanism for Ukraine and other EU trading partners." *Energy Research Letters*, 2(1).

Clausing, K., Colmer, J., Hisao, A., Wolfran, C., 2025, The Global Effects of Carbon Border Adjustment Mechanisms, NBER Working Paper No. w33723.

Dai, R., J. Zhang, and G. Liu. 2020. "Carbon tariff vs. emission cap of north–south countries in response to manufacturer's production." *Sustainability*, 12(4), 1443.

Dechezleprêtre, A., A. Haramboure, C. Kögel, G. Lalanne, and N. Yamano. 2025. "Carbon Border Adjustments: The potential effects of the EU CBAM along the supply chain." OECD Science, Technology and Industry Working Paper No. 2025/02.

Dechezleprêtre, A., C. Gennaioli, R. Martin, M. Muûls, and T. Stoerk. 2022. "Searching for carbon leaks in multinational companies," *Journal of Environmental Economics and Management*, vol. 112(C).

Deng, Y., M. Yin, X. Xu, L. Yu, G. Gao, and L. Ma. 2024. "How to develop global energy-intensive sectors in the presence of carbon tariffs?" *Journal of International Financial Markets*, Institutions and Money, 91, 101930.

Dolphin, G. and G. Ferruccii. 2025. "The EU's CBAM: Implications for Member States and Trading Partners." IMF Working Paper WP/25/125.

Eicke, L., S. Weko, M. Apergi, and A. Marian. 2021. "Pulling up the carbon ladder? Decarbonization, dependence, and third-country risks from the European carbon border adjustment mechanism." *Energy Research & Social Science*, 80, 102240.

Espa, I., J. Francois, and H. van Asselt. 2022. "The EU Proposal for a Carbon Border Adjustment Mechanism (CBAM): An Analysis under WTO and Climate Change Law." WTI Working Paper No. 06/2022.

European Union (EU). 2023a. "Regulation (EU) 2023/956." Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023R0956.

_____. 2023b. "Summary of EU Legislation: CBAM." Available at: https://eur-lex.europa.eu/EN/legal-content/summary/carbon-border-adjustment-mechanism.html.

_____. 2023c. "The Carbon Boarder Adjustment Mechanism." Available at: https://www.eeas.europa.eu/sites/default/files/documents/2023/CBAM%20general%20presentation_2023-11-16_EN.pdf.

_____. 2024a. "Carbon Border Adjustment Mechanism." Available at: https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en.

_____. 2024b. "Carbon Boarder Adjustment Mechanism (CBAM): Questions and Answers." Available at: https://taxation-customs.ec.europa.eu/document/download/013fa763-5dce-4726-a204-69fec04d5ce2_en?filename=CBAM_Questions%20and%20Answers.pdf.

_____. 2024c. "What is the EU ETS?" Available at: https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/what-eu-ets_en.L_2023228EN.01009401.xml.

Fontagné, L. and K. Schubert. 2023. "The Economics of Border Carbon Adjustment: Rationale and Impact of Compensating for Carbon at the Border," Annual Review of Economics, 15, 389–424.

Gaulier, G. and S. Zignago. 2010. "BACI: International Trade Database at the Product-Level. The 1994-2007 Version," Working Papers, CEPII research center, https://EconPapers.repec.org/RePEc:cii:cepidt:2010-23.

GLORIA Database Team. 2022. GLORIA multi-region input-output database. https://www.gloria-db.org.

Gritz, A. and G.B. Wolff. 2024. "CBAM, Hydrogen Partnerships and Egypt's Industry: Potential for Synergies." *Intereconomics*, 592, 92–97.

Gu, R., J. Guo, Y. Huang, and X. Wu. 2023. "Impact of the EU carbon border adjustment mechanism on economic growth and resources supply in the BASIC countries." *Resources Policy*, 85, 104034. Huang, T., Z. Liu, and T. Zhao. 2022. "Evolutionary game analysis of responding to the EU's carbon border adjustment mechanism." *Energies*, 152, 427.

He, X., F. Zhai, and J. Ma. 2025. "Global Impact of the Carbon Border Adjustment Mechanism–A Quantitative Assessment." *Journal of Globalization and Development*.

Hong, L., W. Huang, S. Anwar, and X. Lv. 2023. "North–South asymmetry, unilateral environmental policy and carbon tariffs." *Pacific Economic Review*, 282, 241–66.

Intergovernmental Panel on Climate Change (IPPC). 2025. "Glossary." Available online at: https://apps.ipcc.ch/glossary/.

Issayeva, G., I. Ihnatov, E. Zhussipova, and G. Pazilov. 2023. "Kazakhstan's carbon tax: economic foundations and European carbon border adjustment mechanism impact." *Journal of Economic Research: Business Administration*, 146(4), 51–63. https://doi.org/10.26577/BE.2023.V146.I4.05.

Kaya, Y. and K. Yokoburi. 1997. Environment, Energy, and Economy Strategies for Sustainability. United Nations University Press, Tokyo.

Li, W., X. Liu, and C. Lu. 2023. "Analysis of China's steel response ways to EU CBAM policy based on embodied carbon intensity prediction." *Energy*, 282, 128812.

Li, Y., M. Wang, Y. Sui, and Q. Huang. 2016. "Empirical analysis of carbon tariff's effect on the export structure of China's manufacturing industry and social welfare based on the GTAP model." *Chinese Journal of Population Resources and Environment*, 141, 1–10.

Lin, B. and H. Zhao. 2023. "Evaluating current effects of upcoming EU Carbon Border Adjustment Mechanism: Evidence from China's futures market." *Energy Policy*, 177, 113573.

Ma, J. and J. Xu. 2024. "Potential economic impacts of carbon tariffs on target countries: a systematic review." *Climate Policy*, 1-17, https://doi.org/10.1080/14693062.2024.2407830.

Magacho, G., E. Espagne, and A. Godin. 2024. "Impacts of the CBAM on EU trade partners: consequences for developing countries." *Climate Policy*, 24(2), 243–59.

Makarov, I., D. Besley, H. Dudu, J. Boratynski, M. Chepeliev, E. Golub, V. Nemova and I. Stepanov. 2021. "Russia and global green transition: risks and opportunities." World Bank, Washington, DC. http://hdl.handle.net/10986/36757.

Mehling, M.A., G. Dolphin, and R.A. Ritz. 2024. "The European Union's CBAM: Averting Emissions Leakage or Promoting the Diffusion of Carbon Pricing?" EPRG Working Paper No. 2416.

Morchid, W., E.A. Haddad, and L. Savard. 2024. "Measuring the Cost of the European Union's Carbon Border Adjustment Mechanism on Moroccan Exports." Sustainability 2024, 16, 4967. https://doi.org/10.3390/su16124967.

Nielsen T., N. Baumert, and A. Kander. 2021. "The Risk of Carbon Leakage in Global Climate Agreements." *International Environmental Agreements*, 21, 147–63.

Overland, I. and R. Sabyrbekov. 2022. "Know your opponent: Which countries might fight the European carbon border adjustment mechanism?" *Energy Policy*, 169, 113175.

Pan, X. and S. Liu. 2024. "The Development, Changes and Responses of the European Union Carbon Border Adjustment Mechanism in the Context of Global Energy Transition." *World Development Sustainability*, 4, 100148.

Pauw, P., L. van Schaik, and G. Cretti. 2022. "The CBAM Effect: how the world is responding to the EU's new climate stick." *Clingendael Alert*, 20225.

Perdana, S. and M. Vielle. 2022. "Making the EU Carbon Border Adjustment Mechanism acceptable and climate friendly for least developed countries." *Energy Policy*, 170, 113245.

Qi, S., Z. Xu, and Z. Yang. 2022. "China's carbon allowance allocation strategy under the EU carbon border adjustment mechanism: An integrated non-parametric cost frontier approach." *Science of the Total Environment*, 831, 154908.

Ren, Y., G. Liu, and L. Shi. 2023. „The EU Carbon Border Adjustment Mechanism will exacerbate the economic-carbon inequality in the plastic trade." *Journal of Environmental Management*, 332, 117302.

Shuai, J., W. Wang, H. Liu, C. Huang, T. Yi, Y. Zhao, and C. Shuai. 2024. "The impact of the EU's Carbon Border Adjustment Mechanism on the global iron and steel trade and emission reduction." *Environmental Science and Pollution Research*, 31(14), 21524–44.

Sun, X., Z. Mi, L. Cheng, D.M. Coffman, and Y. Liu. 2024. „The carbon border adjustment mechanism is inefficient in addressing carbon leakage and results in unfair welfare losses." *Fundamental Research*, 43, 660–70.

Tang, L., Q. Bao, and S. Wang. 2015. „Carbon-based border tax adjustments and China's international trade: analysis based on a dynamic computable general equilibrium model." *Environmental Economics and Policy Studies*, 17, 329–360.

United Nations Conference on Trade and Development (UNCTAD). 2021. "A European Union Carbon Border Adjustment Mechanism: Implications for Developing Countries." UNCTAD, OSG/INF/2021/2.

UN Framework Convention on Climate Change (UNFCC). 2025. "Glossary." Available online at https://unfccc.int/resource/cd_roms/na1/ghg_inventories/english/8_glossary/Glossary.htm.

United Nations Statistics Division (UNSD). 2025. UN COMTRADE. International Merchandise Trade Statistics, United Nations Statistics Division, New York, USA. Available online at http://comtrade.un.org/.

Verde, S.F. 2020. "The Impact Of The Eu Emissions Trading System On Competitiveness And Carbon Leakage: The Econometric Evidence," *Journal of Economic Surveys*, vol. 34(2), 320-343.

Wang, J., M. Hu, A. Tukker, and J.F.D. Rodrigues. 2019. "The impact of regional convergence in energy-intensive industries on China's CO2 emissions and emission goals." *Energy Economics*, 80(C), 512–23.

World Bank Group. 2022a. Kazakhstan Country Climate and Development Report. CCDR Series;. © World Bank, Washington, DC. http://hdl.handle.net/10986/38215 License: CC BY-NC-ND.

_____. 2022b. Egypt Country Climate and Development Report. CCDR Series;. © World Bank, Washington, DC. http://hdl.handle.net/10986/38245 License: CC BY-NC-ND.

_____. 2022c. Jordan Country Climate and Development Report. CCDR Series;. © World Bank, Washington, DC. http://hdl.handle.net/10986/38283 License: CC BY-NC-ND.

_____. 2022d. Morocco Country Climate and Development Report. CCDR Series;. © World Bank, Washington, DC. http://hdl.handle.net/10986/38240 License: CC BY-NC-ND.

_____. 2023a. Azerbaijan Country Climate and Development Report. CCDR Series. © Washington, DC: World Bank. http://hdl.handle.net/10986/40622 License: CC BY-NC-ND 3.0 IGO.

_____. 2023b. Tunisia Country Climate and Development Report. CCDR Series. © Washington, DC: World Bank. http://hdl.handle.net/10986/40658 License: CC BY-NC-ND 3.0 IGO.

_____. 2023c. Relative CBAM exposure index, online database available at https://www.worldbank.org/en/data/interactive/2023/06/15/relative-cbam-exposure-index, accessed on 6/26/2025.

_____. 2024. State and Trends of Carbon Pricing Dashboard, online database available at https://carbonpricingdashboard.worldbank.org/sites/default/files/data-latest.xlsx.

Zhang, J., K. Yang, and J. Qin. 2023. “Will the imposition of carbon tariffs enhance or worsen the carbon performance of China's export industries? A reality check based on 28 manufacturing industry segments.” *Environmental Science and Pollution Research*, 30(13), 36472–84.

Zhang, W., S. Xu, Z. He, B. Sharp, B. Zhao, and S. Wang. 2019. Impacts of US carbon tariffs on China’s foreign trade and social welfare. Sustainability, 1119, 5278.

Zhao, L.T., Z.Y. Chen, Y.X. Duan, and R.X. Qiu. 2024. How will CBAM affect the decarbonisation of steel industry in China? A system dynamics approach. International Journal of Production Research, 6218, 6859–80.

Zhong, J., and J. Pei. 2022. Beggar thy neighbor? On the competitiveness and welfare impacts of the EU's proposed carbon border adjustment mechanism. Energy Policy, 162, 112802.

Zhu, J., Y. Zhao, and L. Zheng. 2024. “The Impact of the EU Carbon Border Adjustment Mechanism on China’s Exports to the EU.” *Energies*, 17(2), 509.

PUBLICATIONS

Macroeconomic Exposure to the EU's CBAM: The Case of the Middle East and Central Asia

Working Paper No. WP/25/182