ASSESSMENT OF THE ECONOMIC AND ENVIRONMENTAL IMPLICATIONS OF THE CARBON BORDER ADJUSTMENT MECHANISM (CBAM) FOR UZBEKISTAN

By

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Abstract

The European Union's shift to climate neutrality via its Green Deal has introduced new trade policies, the Carbon Border Adjustment Mechanism (CBAM) among them. The mechanism will impose a carbon price on certain imports into the EU, focusing on high-emitting-producing countries. This paper examines how Uzbekistan can theoretically be impacted by CBAM, a country with increasing trade relationships with the EU and massive dependence on carbon-emitting industries such as cement, steel, aluminum, and fertilizers.

From a combination of quantitative data analysis and qualitative stakeholder interviews from government agencies to business analysts, the research examines the prospective risks along with the game-changing opportunities of CBAM. In the short term, the Uzbek exporters may feel increases in costs and competitiveness issues. But the system can also be an inducer of industrial modernization, carbon reduction, and development of environmental reforms.

Research places emphasis on global cooperation and technical assistance. Helpful data of GIZ and Green Economy Projects in the Ministry of Economy and Finance shows how policy support, finance tools, and institutional capacity building can position Uzbekistan in a position to better prepare to respond appropriately to CBAM.

As a whole, the findings show that not only is CBAM challenging to Uzbekistan but also an opportunity to become part of the world's sustainability agenda and build a more climate-resilient economy. Provided with a proper strategy, investment, and cooperation, Uzbekistan can potentially turn this policy shift into a development opportunity.

Keywords: CBAM, Uzbekistan, EU Green Deal, decarbonization, sustainable development

INTRODUCTION

General information:

Over the last few decades, climate change has been one of the most controversial global issues and an international priority to the global community. Carbon dioxide (CO_2), the leading driver of global warming, is at the heart of the problem and is in dire need of reduction. In this effort, the European Union (EU) has led the way in the world on climate policy with its enactment of diverse policies aimed at making the EU carbon neutral by 2050.

One of the EU's most powerful tools against climate change—and to make the shift to a low-carbon economy—is the Carbon Border Adjustment Mechanism (CBAM) (European Commission, 2021).

Signed into law under EU Regulation 2023/956 and officially launched on October 1, 2023 (EU Regulation), CBAM is the EU's answer to the issue of carbon leakage—when companies relocate carbon-emitting manufacturing to nations with weaker climate laws. It supplements the EU Emissions Trading System (EU ETS), which adds a cost for carbon emissions within the EU (European Commission. (2023).

One element of the entire European Green Deal, the CBAM has as its intention to have the price of certain imported goods pay for their hidden-in-them carbon emissions. The policy will be used to level the playing field for European producers, who are subject to extra costs due to stricter climate policy, and drive businesses in other countries to adopt more ambitious climate policies (European Union Regulation, 2023).

The EU ETS is EU’s flagship market-based policy to reduce the emissions from producers in certain high-emitting industries (European Commission, 2025). It covers heat and power generation, energy-intensive industries, (domestic) aviation and maritime transport, which together account for around 40% of total EU emissions. It is set up as a cap-and-trade system of emission allowances,

where one allowance allows a producer to emit one metric tonne of carbon dioxide (CO_2) or its equivalent in other greenhouse gases (GHGs). A cap is set on the total number of emission allowances in circulation, thereby limiting the total amount of emissions from producers covered by the EU ETS. This gap will be gradually reduced in line with the EU's decarbonisation targets. In addition, any allowances not used in a given year are cancelled, ensuring a steady reduction in the supply of allowances.

However, in certain industries open to trade, the increase in production costs associated with the need to purchase ETS allowances could lead companies to relocate production to other countries with less stringent climate policies – a phenomenon known as carbon leakage. Currently, to prevent carbon leakage, a limited number of ETS allowances are distributed to all producers in the industries with a high risk of carbon leakage free of charge. The number of allowances each producer receives is based on product benchmarks, which are calculated as the average emissions of the 10% most efficient producers of that product (European Commission, 2025). There are 54 product benchmarks in total. Beyond the reduction in free allowances due to efficiency gains by ETS producers, the number of free allowances is reduced by a linear reduction factor, set at 2.2% per year for the current ETS phase (2021 to 2030). If a producer needs more allowances than it has received for free, it must buy additional allowances either through auctions on the European Energy Exchange (EEX) or on the secondary market. The price of ETS allowances is therefore determined by the supply of allowances (limited by the cap) and the market demand.

However, the disadvantage of free allocation is that it weakens the price signals of the EU ETS and thus the incentives for producers to invest in decarbonisation, thereby limiting the effectiveness of the system. As an alternative option, CBAM has been introduced as an anti-carbon leakage mechanism that will allow free allocation in the EU ETS to be phased out. By applying the same carbon price to all EU supplies of certain goods, whether domestically produced or imported, it

tackles the incentive for EU producers to set up production in third countries with the aim of re-importing these goods into the EU while avoiding the carbon price. As a by-product, the EU also hopes to encourage decarbonisation efforts in third countries.

In its current form, the CBAM only covers a subset of products that receive free allocation in the EU ETS. These include cement, nitrogenous fertilisers, iron and steel, aluminium, and hydrogen, as listed in Annex I of the CBAM Regulation. In addition, electricity is also included in the CBAM, for which there is already no free allocation under the EU ETS. The inclusion of electricity is particularly important for developing countries.

CBAM covers both direct emissions from the production of CBAM goods (scope 1) and indirect emissions from the use of electricity for their production (scope 2) for cement and fertilisers, but currently only scope 1 emissions for iron and steel, aluminium, and hydrogen. In addition to CO_2, CBAM also covers nitrous oxide (N_2O) from fertiliser production and perfluorocarbons (PFCs) from aluminium production.

Sector	GHG scope	GHGs covered	Emission calculation
Iron & steel 	Scope 1	CO_2	1. Actual reported emissions 2. Country-product specific defaults 3. Product-specific EU defaults*
Aluminum 	Scope 1	CO_2, PCFs	
Nitrous fertilizers 	Scope 1&2	CO_2, N_20	
Cement 	Scope 1&2	CO_2, N_20	
Hydrogen 	Scope 1	CO_2	
Electricity 	Scope 1	CO_2	Country-specific defaults Actual reported emissions possible if a set of criteria is met

Source: DIW Econ consulting company

Since its introduction, CBAM has been raising the alarm—particularly among developing countries with carbon-based economies. Early estimates were sounding warning bells on negative impacts on exports, economic performance, and employment (Skalamera, 2024; World Bank, 2022). However, current research, including a report by the Asian Development Bank (ADB, 2023) which

suggests that any cumulative economic impact will be limited to a few sectors in some nations.

However, most research focuses too narrowly, with much of the attention going to the percentage of CBAM-covered products in GDP or exports to the EU, with little regard for how emissions embedded within them are priced, nor the shape of impacted industries.

This paper presents a more holistic approach. It presents a model for assessing how CBAM might impact Uzbekistan—examining the state of preparedness of the country, its requirement level, and potential channels for support. The model will be applied specifically to the Uzbekistan case. It is against this background that the following research questions are raised:

i. Which industry of Uzbek economy is / are affected by CBAM and to what extent are they affected?
ii. What is the effect of CBAM implementation on profit-oriented production process and environmentally friendly manufacturing in Uzbekistan?
iii. What are challenges and opportunities in implementing CBAM?

Aim and Objectives:

The aim of the research is to assess the Economic and Environmental Implications of the Carbon Border Adjustment Mechanism (CBAM) for Uzbekistan. The specific objectives are to:

i. Identify industries of Uzbekistan economy that are affected by CBAM
ii. Evaluate contribution of CBAM to identified industries.
iii. Analyze the effects of CBAM implementation on profit-oriented process and environmentally friendly manufacturing.
iv. Identify the challenges and opportunities of implementing CBAM.

Justification for the study:

This paper decided to explore issues around CBAM because of how Uzbekistan is changing. The country’s economy is still growing, and a big part of its industry

relies on processes that release a lot of carbon. But there's a growing awareness here—people are starting to realize that climate issues can't be ignored. At the same time, industries are trying to modernize, and this shift presents both challenges and opportunity to improve. One of the reasons this transition matters is Uzbekistan's relationship with the European Union. Businesses here are increasingly looking toward the EU as a market, especially with all the recent global changes affecting trade. Sectors like chemicals, metals, and textiles see Europe as a promising destination for exports.

The EU isn't just any market—it's one of Uzbekistan's biggest trading partners. In 2024, trade between the two reached over $6 billion (European Commission, 2025). What is more interesting is that exports from Uzbekistan to the EU went up sharply, while imports stayed about the same level. This shift shows how local industries are beginning to depend more on Europe, particularly in areas like fertilizer, copper, and fabrics. But at the same time, there's a move away from relying on EU imports, as companies turn to Asian suppliers instead. This growing trade with the EU is important for a few reasons. It helps keep people employed in factories, brings in foreign income, and pushes companies to produce better-quality goods. Plus, Uzbekistan has access to tariff benefits under an agreement called the GSP+ program. These benefits could be even more useful if industries go greener and meet higher environmental standards.

But here's where it gets tricky. The EU is introducing stricter climate-related rules—one of the most important is the Carbon Border Adjustment Mechanism, or CBAM. If Uzbek companies want to keep exporting to Europe, they will need to adjust how they operate. That means cleaner production, better energy use, and less pollution. It's a huge shift, especially for industries that were built in the Soviet era and still rely on outdated, energy-intensive equipment.

Uzbekistan has committed to several international climate agreements, including the Paris Agreement. There are plans to cut emissions and invest in greener production. But actually, making that happen across the country's industries will

not be easy. There are real economic risks involved, especially for companies that might struggle to keep up.

The goal of this paper, therefore, is to understand how CBAM might affect Uzbekistan—economically and environmentally. This paper explores not just the potential impacts, but also what steps the country could take in response. Finally, the paper also looks at different future scenarios to see how Uzbekistan might overcome the toughest parts of this transition.

MATERIAL AND METHODS:

Research Design

In this paper, the formulas introduced by the European Union for calculating CO_2 emissions are presented. To calculate CBAM-related costs, the amount of CO_2 calculated by the enterprise is multiplied by the proportion corresponding to exports. This is done through a simple arithmetic calculation, which helps determine the level of economic impact.

To assess the environmental impact, the effect of measures against CBAM that can be implemented by enterprises and the government is evaluated. In addition, interviews with enterprise representatives and relevant government officials also help determine the quality and reliability of the assessment.

In assessing the macroeconomic impact, the total export volume is analyzed along with the share of the European Union within it, as well as the volume of products subject to CBAM. This provides a basis for decision-making at the national level.

In the process of microeconomic analysis, the ratio of each enterprise’s total production volume to its exports to the European Union is examined. The results of the micro-level analysis highlight the importance of enterprise-level modernization, the installation of energy-efficient equipment, and the adoption of green production principles.

The mixed-methods approach is suitable for integrating numerical data and contextual understanding, enabling triangulation and strengthening the validity of findings (Creswell and Plano Clark, 2018).

Data Collection Methods

Primary Data*:*

- Interviews with experts of Uzkimyosanoat, Navoiyazot JSC, GIZ, Ministry of Economy and Finance.

Secondary Data*:*

- Statistical data from Uzkimyosanoat JSC
- State Committee of the Republic of Uzbekistan on Statistics
- Ministry of Economy and Finance of Uzbekistan
- Trade statistics, emissions data
- EU CBAM documentation
- Reports from international organizations and consulting companies (ADB, World Bank, GIZ, KPMG, etc.)

Methods for calculating embedded emissions as per Regulation (EU) 2023/956

Officially, importers in the EU will be required to submit emissions declarations and purchase CBAM certificates. However, CBAM-covered goods are relatively standardized, which means there will be limited room to raise prices for consumers. As a result, importers are likely to pass on CBAM-related costs partially—or even entirely—to their suppliers.

Additionally, importers must report the actual emissions associated with imported goods, and they will request this information from their suppliers. The European Commission has published a supporting template that contains all the information importers need to complete the emissions declaration.

While the template is not mandatory, it is highly likely that importers will insist that their suppliers complete it.

Exporters are required to submit information separately for each production facility (if more than one exists) and for each CBAM product group sold to an EU importer:

1. General file/entry information – *not filled out by the exporter*
2. Company information, products/production processes, energy use, and greenhouse gas (GHG) emissions – *must be completed by the exporter*
3. Summary data – *calculated automatically, though some fields require input from the exporter*

To support both potential use by verifiers and to ensure transparency and consistency in internal processes, it is strongly recommended to develop methodological documentation that includes:

- A description of production processes and system boundaries (ideally with a diagram)
- An explanation of emission calculation methods used for each emission source
- The approach to data collection and processing
- Sampling methods for materials and fuels (if applicable)
- The other documentation: laboratory analyses, instrument calibration, calculation methods, standard values with sources, control procedures, and secure data archiving.
- Regular reviews to identify opportunities to improve the monitoring system

When selecting and documenting a monitoring methodology, it is important to focus on the following goals:

- The methodology should be as straightforward as possible, adapted to existing systems at the production site.
- It should be transparent and clear how the data is generated and compiled, particularly for verification purposes during the definitive phase of CBAM. This includes documenting all calculations and assumptions made, as well as control measures used to ensure data accuracy.

- Supplementary documentation should include detailed instructions for all activities covered by the methodology. These should clearly define staff roles and responsibilities and indicate where relevant data is stored.

Calculation-based approach: Emissions are determined for each source based on activity data (e.g., fuel consumption) and, if needed, additional parameters obtained through laboratory analyses or standard values.

The alternative methods can be considered valid if they are part of an established carbon pricing system, a legally required emissions monitoring program, or a verified monitoring framework implemented at the production level—such as those used in greenhouse gas reduction initiatives. To qualify, these methods must provide data that is comparable in scope and accuracy to EU standards. Examples include Predictive Emissions Monitoring Systems (PEMS).

Formula for calculating the specific actual embedded emissions:

$$SEEg = AttrEmg / ALg \quad \text{Equation 1}$$

Source: Regulation (EU) 2023/956

SEEg are the specific embedded emissions of goods g, in terms of CO2e per tonne;

AttrEmg are the attributed emissions of goods g, and

ALg is the activity level of the goods, being the quantity of the goods produced in the reporting period in that installation.

The attributed emissions shall be calculated using the following equation:

$$AttrEmg = DirEm + IndirEm \quad \text{Equation 2}$$

Source: Regulation (EU) 2023/956

DirEm are the direct emissions, resulting from the production process, expressed in tonnes of CO2e, within the system boundaries referred to in the implementing act, and

IndirEm are the indirect emissions resulting from the production of electricity consumed in the production processes of goods, expressed in tonnes of CO2e, within the system boundaries referred to in the implementing act.

For calculating the specific actual embedded emissions of complex goods produced:

$$\boldsymbol{SEEg = (AttrEmg + EEInpMat) / ALg}$$ ……Equation 3.

Source: Regulation (EU) 2023/956

AttrEmg are the attributed emissions of goods g;

EEInpMat are the embedded emissions of the input materials (precursors) consumed in the production process. Only input materials (precursors) listed as relevant to the system boundaries of the production process as specified in the implementing act adopted.

ALg is the activity level of the goods, being the quantity of goods produced in the reporting period in that installation,

The relevant EEInpMat are calculated as follows:

$$\boldsymbol{EEImpMat = \sum_{i=1}^{n} Mi * SEEi}\sum\mathbf{n}$$ ……Equation 4.

Source: Regulation (EU) 2023/956

Where:

Mi represents the mass of input material (precursor) i utilized in the production process, while **SEEi** refers to the specific embedded emissions associated with that input material. For **SEEi**, the operator must apply the emissions value originating from the facility where the input material was manufactured, provided that reliable measurement data from that facility is available

Default values must be established using the most reliable and publicly accessible data available. These values will be regularly updated through implementing acts, reflecting the latest trustworthy information, including data submitted by third countries or groups of countries. When an authorised CBAM declarant is unable to accurately determine actual emissions, default values will apply. These defaults correspond to the average emission intensity of the exporting country for each product listed in Annex I of the Regulation, excluding electricity, with an added mark-up. If reliable data from the exporting country is unavailable for a specific product, default values will be based on the average emission intensity of the X% worst-performing EU ETS installations for that product. The specific X% will be defined in implementing acts to uphold CBAM's environmental integrity, using the most current and credible data, including insights gathered during the transitional period.

List of goods and greenhouse gases

For the purpose of the identification of goods, this Regulation shall apply to goods falling under the Combined Nomenclature ('CN') codes set out in the following table. The CN codes shall be those under Regulation (EEC) No 2658/87.

Fertilisers

CN code	Greenhouse gas
2808, 2814, 2834 21 00 – Nitrates of potassium	Carbon dioxide and nitrous oxide
3102 – Mineral or chemical fertilisers, nitrogenous	Carbon dioxide and nitrous oxide
3105 – Mineral or chemical fertilisers containing two or three of the fertilising elements nitrogen, phosphorus and potassium	Carbon dioxide and nitrous oxide

Source: Regulation (EU) 2023/956

Aluminium

CN code	Greenhouse gas
7601 – Unwrought aluminium	Carbon dioxide and perfluorocarbons
7603 – Aluminium powders and flakes	Carbon dioxide and perfluorocarbons
7604 – Aluminium bars, rods and profiles	Carbon dioxide and perfluorocarbons
7605 – Aluminium wire	Carbon dioxide and perfluorocarbons
7606 – Aluminium plates, sheets and strip, of a thickness exceeding 0,2 mm	Carbon dioxide and perfluorocarbons
Other articles of aluminium 7607, 7608, 7609, 7610, 7611, 7612, 7613, 7614, 7616	Carbon dioxide and perfluorocarbons

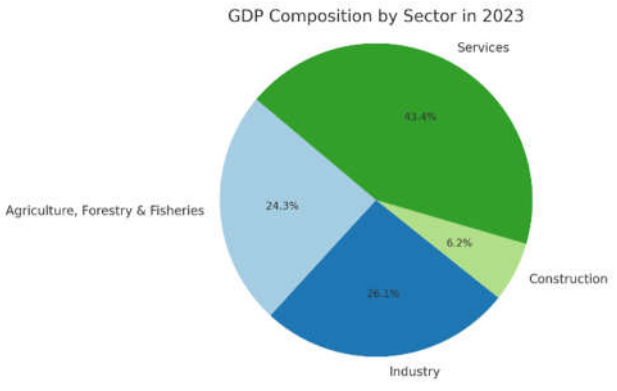
Source: Regulation (EU) 2023/956

RESULTS OF DATA ANALYSIS

Macroeconomic and Microeconomic Analysis and Environmental Impact

Macroeconomic Analysis

In terms of GDP structure for 2023, agriculture, forestry, and fisheries made up 24.3 percent, industry 26.1 percent, construction 6.2 percent, and the services sector 43.4 percent. The growth in GDP was driven primarily by services (2.6 percentage points), followed by industry (1.5 percentage points), agriculture, forestry, and fisheries (1 percentage point), and construction (0.4 percentage points)

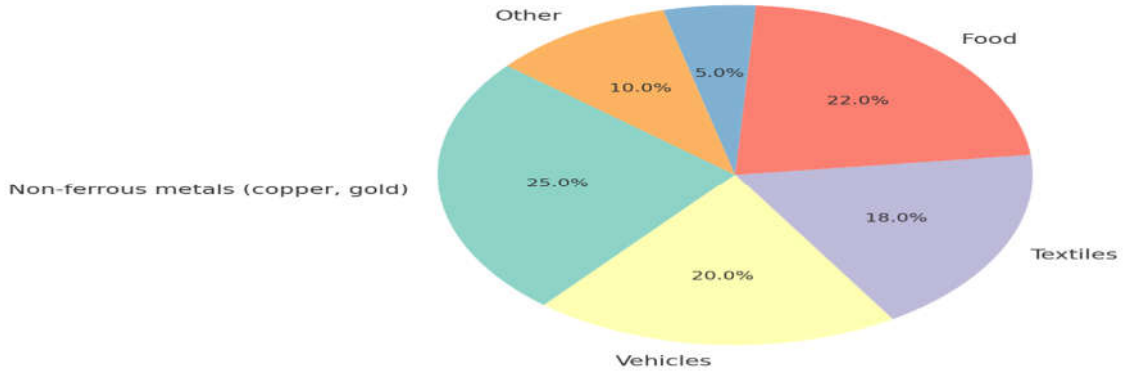


Sectoral Contributions to GDP Growth (2023)	**Contribution (%)**
Services	2.6
Industry	1.5
Agriculture, Forestry & Fisheries	1.0
Construction	0.4

Source: stat.uz

Preliminary data for 2023 show that over 69.4 thousand industrial enterprises produced goods worth 655.8 trillion UZS, representing a 6% increase in volume

compared to the same period of the previous year. The processing industry accounted for the highest share at 84.4 percent.



Source: tradingeconomics.com

Main Manufacturing Outputs

The pie chart highlights Uzbekistan's key industrial products. The dominant outputs are:

- Non-ferrous metals (copper, gold): 25%
- Food products: 22%
- Vehicles: 20%
- Textiles: 18%
- Fertilizers & Iron/Steel: 5%

Manufacturing is one of the fastest-growing sectors in Uzbekistan. From 2014 to 2020, industry's share of GDP grew from 14% to 20%, stabilizing at 20–21% through 2023. However, compared internationally, the share remains slightly below average.

The main manufacturing outputs: non-ferrous metals (copper, gold), vehicles, textiles, food.

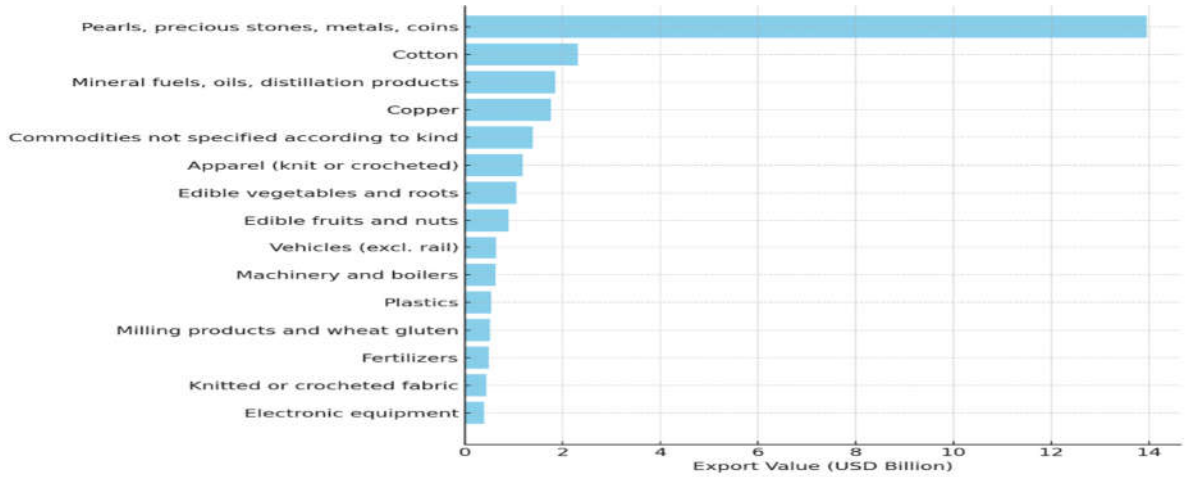
Uzbekistan exported in the amount of US$31.86 billion last year, according to data from the United Nations COMTRADE database. Our main trading partners were Russia, China, and neighboring countries such as Kazakhstan, highlighting the country's strong economic ties within the region and with major global players.

Based on this, it has been identified that Uzbekistan's most CBAM-sensitive economic sector is the chemical industry. Greenhouse Gas Emissions from Chemical Industry Enterprises under the CBAM Mechanism.

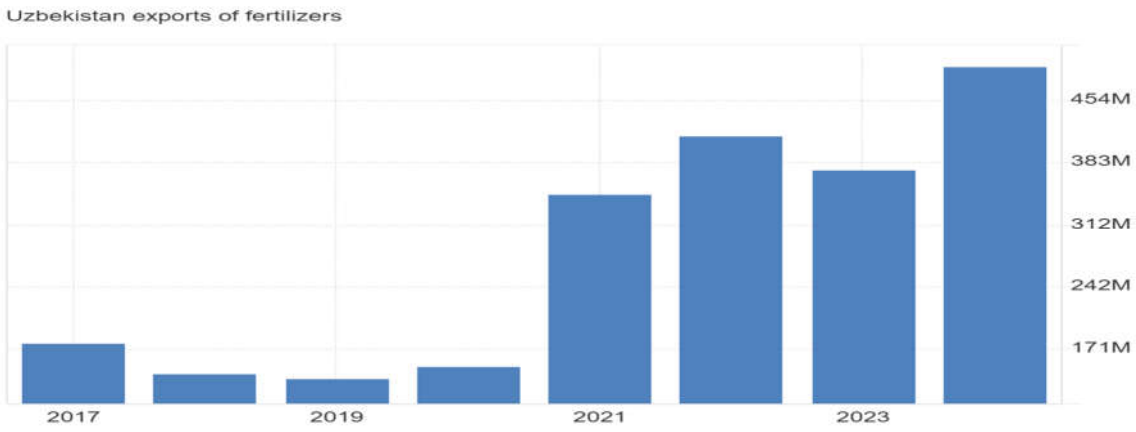
According to the analysis results, the volume of goods exported to the European Union fell under the scope of the CBAM mechanism amounted to **101.967 million USD** in 2024.

Source: Green Economy Projects Center

Top 15 export categories of Uzbekistan in 2024



Source: tradingeconomics.com



Source: tradingeconomics.com

According to the data provided by the Ministry of Economy and Finance of Uzbekistan, the total value of goods exported to the European Union that fall

under the scope of the CBAM mechanism amounted to **101.967 million USD** in 2024. Of this:

- 94% was Fertilizers
- 4% was Iron and Steel
- 2% was Aluminum
- 0% Cement, Electricity and Hydrogen

The share of CBAM products in export value is calculated as: (CBAM products value / Total exports) × 100% = (US$101.967 million / US$31.86 billion) × 100% = 0.32%

As seen from the above calculation, CBAM-covered goods account for **0.32% of total exports**.

Now, let's calculate the CBAM cost based on this value. Considering that companies have not yet submitted CBAM reports, we will use the default value in accordance with the CBAM regulation.

Fertilizers

Based on the above, the *Green Economy Projects Center* (hereinafter referred to as the Center) and *Uzkimyosanoat JSC* (hereinafter referred to as the Company) jointly carried out research on the status of chemical industry enterprises.

According to the export data provided by the Company, in 2024, Uzbekistan's exports to the European Union consisted solely of products classified under HS codes 3102 (Mineral or chemical fertilizers, nitrogenous) and 3105 (Mineral or chemical fertilizers containing two or three of the fertilizing elements nitrogen, phosphorus, and potassium; other fertilizers).

In accordance with Clause 9, Appendix 4 of the Presidential Decree of the Republic of Uzbekistan No. PF-16 dated January 30, 2025, it is mandated to conduct an inventory of greenhouse gas emissions from chemical industry enterprises and to assess the impact of carbon regulation mechanisms.

To ensure the implementation of this directive, the following measures have been approved:

1. Conduct a pilot inventory of greenhouse gas emissions at two domestic chemical industry enterprises that produce chemical products.
2. Based on the results of the inventory, develop proposals to improve readiness for compliance with international standards and submit them to the Cabinet of Ministers.

EU CBAM default emission values for fertilizers, applicable during the transitional period (1 October 2023 – 31 December 2025):

- For most fertilizer products (aggregated CN code category), the default embedded emissions are:
  - Direct emissions: 1.29 t CO_2e per tonne of fertilizer
  - Indirect emissions: 0.11 t CO_2e per tonne
  - Total: 1.40 t CO_2e per tonne taxation-customs.ec.europa.eu+12taxation-customs.ec.europa.eu+12taxation-customs.ec.europa.eu+12
- There's a specific sub-category (CN 3105 90 "Other" fertilizers) with slightly lower defaults:
  - Direct: 0.94 t CO_2e/t
  - Indirect: 0.08 t CO_2e/t
  - Total: 1.02 t CO_2e/t taxation-customs.ec.europa.eu

Fertilizer Category	Direct (t CO_2e/t)	Indirect (t CO_2e/t)	Total (t CO_2e/t)
General fertilizers (CN)	2.32	0.07	**2.39**
"Other" fertilizers (CN 3105 90)	1.23	0.11	**1.35**

Source: Regulation (EU) 2023/956

Additionally, according to current CBAM procedures, both direct and indirect emissions generated during the production process must be calculated. The European Parliament has approved emission coefficients for each product group in accordance with their respective HS codes.

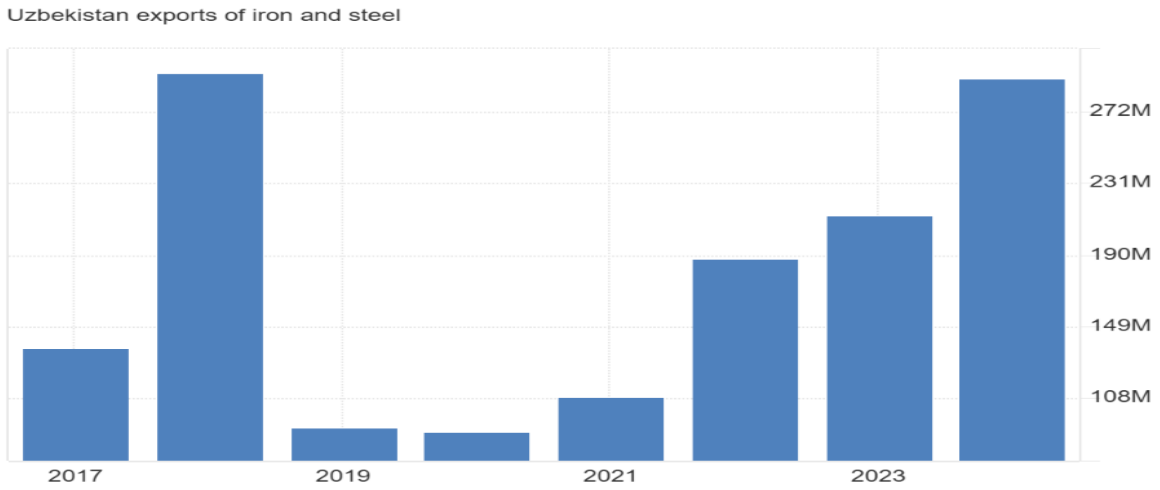
Product	Export value in $	Volume in tn	Total (t CO_2e/t) for category 310230 2.39	CBAM Cost average USD 74	Cost of CBAM to product price
Ammonium nitrate, whether or not in aqueous solution (3102 30)	$ 71,189,000.00	129,997.58	310,694.22	$ 22,991,372.60	32%
Mineral or chemical fertilisers containing the three fertilising elements nitrogen, phosphorus and potassium (3105 20)	$ 17,070,800.00	39,737.89	53,646.15	$ 3,969,815.14	23%
Total	**$ 88,259,800.00**	**169,735.47**	**364,340.37**	**$ 26,961,187.75**	**31%**

Source: author's calculations

From the above analysis and calculations, it is clear that the impact of CBAM is significant under this methodology. In other words, importers will be required to pay an additional USD 27 million. It will have a noticeable financial impact on Uzbekistan's fertilizer exports. Together, exports of ammonium nitrate and NPK fertilizers total around $88.26 million. However, when the carbon cost is factored in—based on an average CBAM price of $74 per ton of CO_2 emitted—the additional cost amounts to about $26.96 million. That's nearly one-third (31%) of the total export value. Ammonium nitrate (HS code 310230) is hit the hardest, with a CBAM cost of roughly $22.99 million—about 32% of its value. For NPK fertilizers (HS code 310520), the cost is lower in both absolute and relative terms—around $3.97 million, or 23% of the product's value.

Steel Sector

Steel Exports to the EU emerged around 2022–2023 due to EU sanctions on Russian steel. EU share peaked at 10–12%, declined in 2024. Prices in EU dropped, suggesting a shift in the composition of exported goods.



Source: tradingeconomics.com

Carbon Intensity of Steel Sector depend on energy use, type of energy, and process emissions. Data on sectoral emissions is limited. However, energy mix suggests carbon intensity is comparable to average EU exporters.

Screws Category	Direct (t CO_2e/t)	Indirect (t CO_2e/t)	Total (t CO_2e/t)
Actual calculation 73181100	2.135	0.724	2.858
Default value for 73181100	1,89	0,32	2,21

Source: Regulation (EU) 2023/956

Based on the above information, if we estimate the export value of CBAM-covered products at around $4 million, we can arrive at the following approximate calculation. Assuming an average import price of $2,154 per ton based on 2023 EU import data, this would correspond to an export volume of approximately 1,850 tons. It is important to note that this is a rough estimate.

Product	Export value in $	Volume in tn	Total (t CO_2e/t) for category 73181100	CBAM Cost average USD 74	Cost of CBAM to product price
Screws (Default value for 2.21)	$ 4,000,000.00	1,850.00	4,088.50	$ 302,549.00	8%
Screws (Actual value for 2.858)	$ 4,000,000.00	1,850.00	5,287.30	$ 391,260.20	10%

Source: author's calculations

The export of screws (HS code 73181100) with a total value of $4 million and a volume of 1,850 tons results in a notable CBAM-related cost. Based on two different carbon intensity values:

- Using the default emissions factor (2.21 tCO_2e/t):

  The CBAM cost is approximately $302,549, accounting for 8% of the product's export value.

- Using the actual emissions factor (2.858 tCO_2e/t):

The CBAM cost rises to about $391,260, making up 10% of the export value.

This shows that more accurate emissions data can significantly increase the financial burden under CBAM, emphasizing the importance of emission reduction and accurate reporting.

Microeconomic Analysis and the Process of Implementing CBAM for Uzbek Exporters

A micro-level analysis of the CBAM effect has been conducted for Ammonium nitrate, whether or not in aqueous solution (HS code 3102.30), given the importance of this product.

This product accounts for more than 70% of CBAM-covered exports. Most of it is exported by JSC Navoiyazot and JSC Maxam Chirchiq. Macroanalysis of CBAM effect helps to learn possible challenges and opportunities for companies in introducing a new mechanism. However, due to data limitations, it was not possible to analyze each company separately.

Profitability Analysis

Parameter	Value
Export volume	129,997.08 tons
Export value	$71,189,000
Export price without CBAM	$547.62/ton
CO_2 intensity	2.39 tCO_2e/ton
CBAM price ($74/$tCO_2e$)	$176.86/ton
EU import price with CBAM	$724.48/ton
Local price	$190.00/ton
Delivery cost	$220.00/ton

Source: author's calculations

Where:

Export value – according to the materials The Center of Green Economy Projects under Ministry of Economy and Finance.

Export price without CBAM – source: Web site: (https://wits.worldbank.org/trade/comtrade/en/country/ALL/year/2023/tradeflow/Exports/partner/WLD/product/310230)

CO_2 intensity 2.39 tCO_2e/ton – source: European Commission Directorate-General Taxation and Customs Union.

CBAM price (\$74/tCO_2e) – website: statista.com

Delivery cost \$220.00/ton – this in an approximate calculation considering local price plus logistics

Profitability Per Ton

Metric	Formula	Value
Profit without CBAM	\$547.62 – \$220.00	\$327.62/ton
Profit with CBAM	\$724.48 – \$220 – \$176.86	\$327.62 – \$176.86 = \$150.76/ton
CBAM-induced margin loss	\$327.62 – \$150.76	\$176.86/ton (–54%)

Source: author's calculations

Total Profit Scenarios

A. Without CBAM

$$129{,}997.08 \times 327.62 = \$42{,}603{,}176.67$$

B. With CBAM (if it is compensated by exporters)

$$129{,}997.08 \times 150.76 = \$19{,}607{,}760.76$$

C. Total CBAM Loss

$$\$42{,}603{,}176.67 - \$19{,}607{,}760.76 = \$22{,}995{,}415.91$$

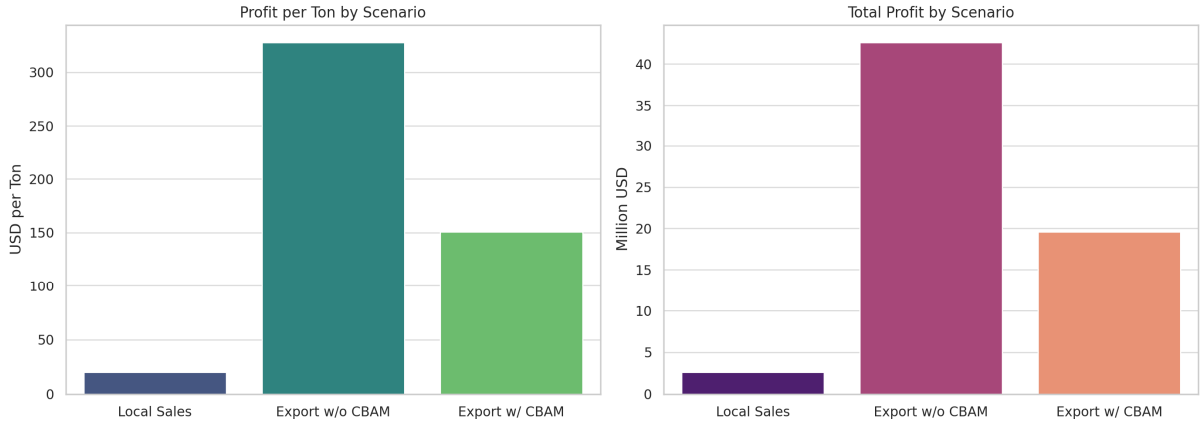
Source: author's calculations

Local Market Comparison

Scenario	Revenue/ton	Margin
Local price	\$190	\$190 – \$170 = \$20/ton

Exports with CBAM	$150.76 margin	7.5× more profitable than local sales
Export without CBAM	$327.62 margin	~16× more profitable than local sales

Source: author's calculations



Source: author's calculations

Substitution and Production Decisions

Firms may shift production to lower-emission methods or restructure supply chains to maintain market access. Investment in cleaner technology may become more attractive if it reduces CBAM costs and preserves long-term competitiveness.

Firms might start internal carbon accounting to optimize CBAM declarations. Some may delay or limit EU exports and look to alternative markets if costs outweigh benefits.

CBAM cuts profit per ton by 54%, costing nearly $23 million overall.

Exporting is still much more profitable than selling locally, even after CBAM.

However, the long-term sustainability of profit depends on:

- Reducing emissions (to cut CBAM cost),
- Passing CBAM to buyers,
- Or lobbying for a carbon pricing system in Uzbekistan to claim CBAM deductions.

Environmental Impact

The primary goal of establishing the CBAM mechanism is to reduce the environmental impact of production. It operates on the principle that the more harmful emissions a company produces, the more it has to pay. In the context of Uzbekistan, the scale of CBAM is relatively limited, accounting for only about 0.32% of the country's total exports. Moreover, the number of enterprises exporting CBAM-covered products is quite small.

Nevertheless, the implementation of CBAM compels producers to start thinking about their environmental impact. They are required to submit quarterly reports that quantify the extent of environmental harm caused by their operations. In this way, environmental damage becomes a measurable factor. As a result, companies are encouraged to become more efficient, focus on resource optimization, and adopt more sustainable practices.

One of the key environmental challenges Uzbekistan faces is the absence of a strong and reliable system for monitoring, reporting, and verifying (MRV) greenhouse gas emissions in line with EU standards. Without such a system, it becomes difficult to measure actual emissions accurately, which means companies often have to rely on default CBAM values—usually less favorable—and miss the opportunity to showcase real progress in reducing emissions.

The below table gives greenhouse gas (GHG) emissions for production of the chosen Uzbekistan exports to the European Union. They fall under the EU's Carbon Border Adjustment Mechanism (CBAM), which adds a carbon cost to imports based on their emissions footprint.

Product	Export Volume (tons)	Emission Factor (tCO_2e/ton)	Total Emissions (tCO_2e)
Ammonium Nitrate (HS 3102 30)	129,997.58	2.39	310,694.22
NPK Fertilizers (HS 3105 20)	39,737.89	1.35 *(estimated)*	53,646.15

Screws – Default EF (HS 7318 1100)	1,850.00	2.21	4,088.50
Screws – Actual EF (HS 7318 1100)	1,850.00	2.86	5,287.30

Total Estimated Emissions from Exported Goods: 373,716.17 tCO_2e

Source: author's calculations

Fertilizer products (especially ammonium nitrate) are the dominant contributors, accounting for over 83% of total emissions under CBAM-covered exports.

Industrial products like screws, though lower in total volume, carry high carbon intensity per ton, which makes them strategically important for decarbonization despite their smaller share in trade. Emission of 373,716 tCO_2e annually for the cargo to EU is equivalent to Greenhouse gas emissions from ~80,000 passenger gasoline vehicles burning over 160 million liters of gasoline.

As mentioned earlier, the data are calculated based on the default value data due to lack of information of CO2 calculation per product.

CBAM primarily assigns a monetary value to the CO2 emissions generated during production. Enterprises not only pay for electricity and other raw materials used in the manufacturing process, but the emissions resulting from their use also affect the final sale price of the product. This, in turn, encourages companies to adopt energy-efficient and efficient production technologies.

The application of the CBAM mechanism helps assess both the physical volume of environmental damage caused by production and its monetary value. Through this assessment, it creates a basis for improving the technical condition of enterprises and encourages them to adopt technologies that cause less harm to the environment.

In this regard, building up MRV capacity would not only help Uzbekistan provide more accurate data but also strengthen its ability to meet its climate goals under the Paris Agreement. Moreover, it would bring greater transparency and accountability to the country's overall approach to climate policy and environmental governance.

Starting from 2026, it is planned to implement similar measures—such as the greenhouse gas inventory conducted at Navoiyazot JSC and Maxam-Chirchiq JSC—across other enterprises in the sector.

DISCUSSION

The study focused on certain export products that fall within CBAM — mainly fertilizers like ammonium nitrate and NPK, as well as metal products like screws. The products are not just important to the Uzbek economy, but they're also relatively carbon-intensive, so they're more exposed under the new regime in the EU.

Fertilizers: With a combined export value of around $88.3 million, these products can have a CBAM-related cost of $27.6 million, or roughly 31% of their total worth.

Ammonium nitrate itself can have a 32% CBAM cost over its cost. The fertilizers are less affected, with an effect of 23%.

A moderate-sized but still important export. On a value of around $4 million, CBAM charges will be between $302,000 and $391,000 depending on the default or actual reporting of exporters. That's around 8–10% of the product value.

These are based on 2023 mean EU carbon price of $74 per ton CO_2 emitted. While estimates, these give a clear picture of the cost CBAM will be placing upon exporters.

Fertilizer Exporters: A Wake-Up Call

The fertilizer industry is clearly facing a major challenge. These products are emissions-heavy, and under CBAM, that translates directly into added costs. A third of their export value being eaten up by carbon charges is not sustainable in the long term. Unless companies invest in cleaner technologies or more efficient processes, they risk losing their foothold in the EU market.

Metal Product Exporters: Data Matters

For exporters of screws and similar products, the data shows that **actual emissions reporting** can make a difference. Using accurate data instead of default EU estimates can either increase or reduce CBAM payments. This means firms that measure and manage their emissions carefully could end up saving money — and gaining a reputation as responsible, modern suppliers.

Trade and Market Access

CBAM is more than just a climate policy — it's changing the rules of international trade. For Uzbek exporters, it means competing not just on quality or price, but also on carbon efficiency. If emissions stay high, products may become too expensive for EU buyers. Some exporters might even shift to markets where carbon isn't priced — but that limits growth potential in the long run.

A Readiness Gap

Right now, Uzbekistan doesn't have a carbon pricing system or a national platform to help companies track and report their emissions in a way that meets EU standards. This puts our businesses at a disadvantage. Without government support, training, and investment in monitoring systems, many exporters simply won't be able to keep up.

An Opportunity in Disguise

That said, CBAM could also be a chance to modernize. By upgrading technologies, improving efficiency, and becoming more climate-friendly, Uzbek firms could:

- Avoid CBAM costs,
- Access green financing,
- Build stronger relationships with EU partners, and
- Future-proof their businesses for a low-carbon economy.

Those who start adapting early could end up with a real competitive advantage. It's important to be clear about what this analysis can and can't tell us. These are approximate calculations based on available trade data, average carbon prices, and emissions estimates. Actual CBAM payments will depend on firm-level data,

which wasn't available. Prices could also rise or fall in the future, and the EU may change how CBAM works as it gets implemented fully after 2025.

Even so, the results highlight the very real financial risks ahead — and the urgent need for both policy and business responses.

CONCLUSIONS:

The research focused on some of the most important export products that come within CBAM - basically, fertilizers like ammonium nitrate and metal products like screws.

Not only are these products important to the Uzbek economy, but they also have quite high carbon intensities, so they're more vulnerable under the new EU regulation.

Fertilizers: With a collective value for export of nearly $88.3 million, the products can have a CBAM expense of $27.5 million, or some 31% of their collective value.

Ammonium nitrate alone can have a 34% CBAM cost compared to its price. The fertilizers are a bit less Based on this research, the policy of establishing the European Union's Carbon Border Adjustment Mechanism (CBAM) would be a significant shift in international trade and climate policy. This study analyzed how CBAM would economically and environmentally impact Uzbekistan as a country with limited but significant export connections to the EU in sectors such as fertilizers and metal products.

The quantitative assessment found that although aggregate exposure to CBAM is relatively low at the moment—approximately 0.32% of the nation's overall exports—the impact on specific goods and enterprises is significant. For example, fertilizer exports can be subject to a CBAM-related cost of up to 31% of export value, and even relatively smaller exports like screws can see their cost increase by 8–10%, depending on emissions reporting.

Environmentally, CBAM exerts pressure and also opportunity.

It sensitizes exporters to their carbon burden and compels industries to adopt cleaner technology and energy. One of the big issues, however, remains that there is no robust emissions Monitoring, Reporting, and Verification (MRV) mechanism. In the absence of these mechanisms, exporters are able to with default estimates of emissions and be at a cost disadvantage.

They are calculated from 2023's EU average carbon price of $74 per ton CO_2 emissions. They may be estimates, but they give us a fair estimate of the cost of burden that CBAM will impose on exporters.

RECOMMENDATIONS:

Establish a National MRV Framework

An entire MRV system being in place, aligned with EU level standards, is critical. This will allow Uzbekistan to provide verifiable emissions information, reduce the use of default values of CBAM, and allow exporters to highlight their actual environmental performance.

Promote Industry Transition towards Green Energy

Government incentives and public-private partnerships have to be created to incentivize large exporters to switch to green power. Pilot ventures with companies like Navoiyazot can serve as replicable models for solar and wind integration.

Raise Awareness and Build Capacity

A majority of companies are ignorant of the implications of CBAM. Capacity-building programs, technical workshops, and targeted outreach—especially for SMEs—will play a key role in enabling adaptation by industries.

Leverage CBAM as a Development Opportunity

As much as CBAM has compliance challenges, it also presents opportunities for modernization, investment, and innovation. Uzbekistan can leverage this opportunity to solidify its place within clean global value chains and mobilize green finance.

Coordination with National Climate Goals

CBAM compliance must be coordinated with overarching climate policies, including the Nationally Determined Contributions (NDCs) of Uzbekistan. This will help align trade, industry, and climate goals.

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