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EU CBAM EXPOSURE OF UZBEKISTAN'S EXPORTS AND ECONOMIC SECURITY MANAGEMENT

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Annotatsiya. 2026-yil 1-yanvardan boşlangan Yevropa Ittifoqining Uglerod chegarasi böyiça tuzatiş mexanizmi (CBAM) uglerod narxlaş tizimi mavjud bölmagan mamlakatlardan mahsulot eksport qiluvçilar uçun yangi taşqi xavfni yuzaga keltiradi. Uşbu hujjatda Özbekiston eksportining CBAM ta'siriga qay darajada duçor bölişi hamda buning iqtisodiy xavfsizlikni boşqarişga ta'siri baholanadi. Eurostat va BMTning Comtrade statistik ma'lumotlarini taqqoslaş orqali tekşirilgan (farq 0,3 foizdan kam) 2025-yilgi savdo ma'lumotlari şuni körsatadiki, Yevropa Ittifoqining Özbekistondan importida CBAM qamrab oladigan tovarlar 21,6 foizni taşkil etadi; bunda azotli va murakkab öğitlar uşbu hajmning 90,4 foiziga töğri keladi. Har bir tonna mahsulot uçun CBAM sertifikati böyiça tölovlar Yevropa Komissiyasining standart emissiya körsatkiçlari, bepul kvotalarni bosqiçma-bosqiç bekor qiliş jadvali hamda Yevropa Ittifoqi emissiya savdosi tizimi (EU ETS) narxlariga asoslangan uç xil ssenariy (uglerod narxi böyiça) asosida hisoblab çiqildi. Örtaça ssenariyga köra, ammoniy nitrat uçun tölov miqdori 2026-yilda bir tonna uçun 5,0 yevroni taşkil etsa, 2034-yilga kelib 199,8 yevrogaça kötapiladi; moçevina (karbamid) uçun esa bu tölov uning narxiga nisbatan 40,8 foizga teng böladi. Yevropa Markaziy banki, Jahon banki va Osiyo taraqqiyot banki modellari bilan taqqoslaş uşbu xavf-xatar tuzilmasini tasdiqlaydi hamda yukning bir qismini tasdiqlangan emissiya ma'lumotlari orqali kamaytiriş mumkinligini körsatadi. Boşqaruv mexanizmini takomillaştiriş böyiça çoralar taklif etiladi.

Kalit sözlar: CBAM, iqtisodiy xavfsizlik, tarkibiy emissiyalar, öğitlar, boşqaruv mexanizmi.

Аннотация. Механизм корректировки углеродных выбросов на границе Европейского союза (CBAM), вступивший в окончательную фазу с 1 января 2026 года, создаёт новый внешний риск для экспортёров из стран, в которых отсутствуют системы ценообразования на углерод. В данной работе оценивается степень подверженности экспорта Узбекистана воздействию CBAM, а также его влияние на управление экономической безопасностью. Данные о торговле за 2025 год, проверенные путём сопоставления статистики Eurostat и UN Comtrade (расхождение менее 0,3%), показывают, что товары, охватываемые CBAM, составляют 21,6% импорта Европейского союза из Узбекистана; при этом азотные и комплексные удобрения занимают 90,4% данного объёма. Платежи за сертификаты CBAM на тонну продукции рассчитаны по трём сценариям цен на углерод на основе стандартных значений выбросов Европейской комиссии, графика постепенной отмены бесплатных квот и цен Системы торговли выбросами Европейского союза (EU ETS). Согласно умеренному сценарию, платежи за аммиачную селитру составляют 5,0 евро за тонну в 2026 году и увеличиваются до 199,8 евро за тонну к 2034 году; для мочевины (карбамида) данный платёж составляет 40,8% её цены. Сопоставление с моделями Европейского центрального банка, Всемирного банка и Азиатского банка развития подтверждает данную структуру рисков и показывает, что часть нагрузки может быть снижена посредством подтверждённых данных о выбросах. Предложены меры по совершенствованию механизма управления.

Ключевые слова: CBAM, экономическая безопасность, встроенные выбросы, удобрения, механизм управления.

Abstract. The European Union's Carbon Border Adjustment Mechanism (CBAM), which entered into its definitive phase on January 1, 2026, creates a new external risk for exporters from countries without carbon pricing systems. This paper assesses the extent to which Uzbekistan's exports are exposed to CBAM and its implications for economic security management. Trade data for 2025, cross-validated through a comparison of Eurostat and UN Comtrade statistics (with a discrepancy of less than 0.3%), indicate that CBAM-covered goods account for 21.6% of the European Union's imports from Uzbekistan, with nitrogenous and compound fertilizers representing 90.4% of this volume. CBAM certificate payments

per tonne of product were calculated under three carbon price scenarios based on the European Commission's default emission values, the schedule for the gradual phase-out of free allowances, and EU Emissions Trading System (EU ETS) prices. Under the moderate scenario, the payment for ammonium nitrate amounts to EUR 5.0 per tonne in 2026 and rises to EUR 199.8 per tonne by 2034; for urea, the payment is equivalent to 40.8% of its price. Comparison with models developed by the European Central Bank, the World Bank, and the Asian Development Bank confirms this risk structure and indicates that part of the burden can be reduced through verified emissions data. Measures to improve the management mechanism are proposed.

Keywords: CBAM, economic security, embedded emissions, fertilizers, management mechanism.

INTRODUCTION

On 1 January 2026 the European Union started the definitive period of the Carbon Border Adjustment Mechanism (CBAM), under which importers of iron and steel, aluminium, cement, fertilisers, hydrogen and electricity must purchase certificates corresponding to the greenhouse gas emissions embedded in the imported goods (European Parliament & Council of the European Union, 2023a). At the same time the free allocation of allowances to EU producers of these goods is being phased out, so that the share of embedded emissions for which certificates are paid rises from 2.5 % in 2026 to 100 % in 2034 (European Parliament & Council of the European Union, 2023b), which turns CBAM from a reporting instrument into a steadily growing burden on exporters from third countries.

LITERATURE REVIEW

For the Republic of Uzbekistan this mechanism is particularly important, because after the country joined the EU special incentive arrangement GSP+ in 2021 (European Commission, 2021), EU imports from Uzbekistan increased from EUR 200 million in 2020 to EUR 477 million in 2021 and EUR 1,012 million in 2025, while products of the chemical industry accounted for 42.7 % of these imports in 2025 (European Commission, 2026) (Figure 1).

GSP+ preferences concern customs duties and do not exempt exporters from CBAM, whose exemptions for third countries apply only to Iceland, Liechtenstein, Norway and Switzerland (European Parliament & Council of the European Union, 2023a), and therefore part of the benefits obtained under GSP+ may be lost as CBAM payments increase.

In the theory of economic security, the stability of foreign economic activity and export earnings is regarded as one of its components, whose level is assessed by a system of indicators compared with threshold values (Senchagov, 2014). For Uzbekistan, the assessment of energy security as a component of economic security has been addressed by Avezova and Dalmuradova (2023) and Allayev et al. (2024), while the links of the shadow economy and the innovation mechanism with economic security have been examined by Yakubov (2021a, 2021b). The impact of CBAM on third countries has been estimated by the Asian Development Bank, which found the overall effect on Asian economies to be limited but significant for particular countries and sectors, including fertilisers and aluminium in Central Asia (Park et al., 2023), and by the European Central Bank, according to which full implementation of the mechanism raises the cost of exports to the EU by 0.04 % on average and by 1.2 % for the most affected country, with much larger effects for individual products (Dolphin & Ferrucci, 2026).

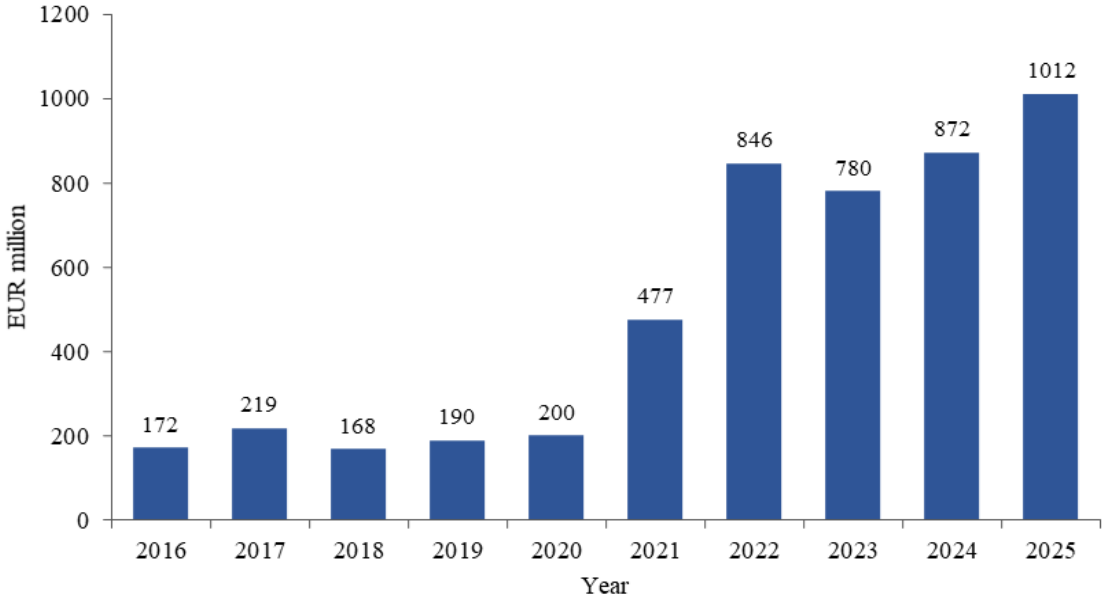


Figure 1. EU imports from Uzbekistan, 2016–2025, EUR million[1]

A World Bank study has shown that Uzbek aluminium producers have a lower carbon intensity than the average EU producer (Maliszewska et al., 2025); however, an assessment of the exposure of Uzbekistan's exports across the whole set of CBAM goods, and of how this exposure should be reflected in the management of economic security, is not available in the literature.

Based on the above, and taking into account that EU imports of chemical products from Uzbekistan increased from EUR 312 million in 2024 to EUR 432 million in 2025 (European Commission, 2026), this paper attempts to assess the exposure of Uzbekistan's exports to CBAM and, on this basis, to substantiate directions for improving the mechanism for managing economic security.

RESEARCH METHODOLOGY

The study is based on data of the European Commission on EU trade with Uzbekistan (European Commission, 2026), UN Comtrade data on EU imports from Uzbekistan by HS chapter for 2025 (United Nations Statistics Division, 2026), default embedded emission values published by the European Commission (European Commission, 2023), EU ETS allowance prices (Nissen et al., 2025), the euro reference exchange rate of the European Central Bank (Bank of Finland, 2026) and the urea price published by the World Bank (World Bank, 2025). The set of covered goods was determined according to Annex I to Regulation (EU) 2023/956, which includes nitrogenous fertilisers of heading 3102 and compound fertilisers of heading 3105 except phosphorus-potassium fertilisers, while potassic fertilisers are not covered (European Parliament & Council of the European Union, 2023a).

Export exposure was measured by two indicators. The first is the share of CBAM goods in EU imports from Uzbekistan:

CBAM goods in EU imports from Uzbekistan:

$$S_{CBAM} = \frac{\sum_{i \in CBAM} X_i}{X_{EU}} \cdot 100 \quad (1)$$

where X_i is EU imports from Uzbekistan of CBAM product group i, USD million, and X_{EU} is total EU imports from Uzbekistan, USD million. The second indicator is the CBAM certificate payment per tonne of product:

$$C_{it} = E_i \cdot P_s \cdot \varphi_t \quad (2)$$

where E_i is embedded emissions per tonne of product i, tCO_2e/t; P_s is the certificate price in scenario s, EUR/tCO_2e; φ_t is the share of embedded emissions paid for in year t according to the free allocation phase-out schedule (European Parliament & Council of the European Union, 2023b).

To compare the results with models that express the CBAM burden as a percentage of export value, the payment was converted into an ad valorem equivalent:

$$AVE = \frac{C_{it} \cdot e}{p_i} \cdot 100 \quad (3)$$

1 Source: compiled by the authors from European Commission (2026).

where e is the exchange rate, USD/EUR, and p_i is the product price, USD/t. The calculation was made for urea, for which an official World Bank price series is available (USD 440/t in 2025; World Bank, 2025), at an exchange rate of 1.13 USD/EUR (Bank of Finland, 2026); the price and exchange rate were held constant to isolate the effect of the mechanism itself. Since the actual emissions of Uzbek producers are not published, the sensitivity of the payment to their level was assessed through the ratio of actual to default emissions:

$$C_{it}(k) = k \cdot E_i \cdot P_s \cdot \varphi_t \quad (4)$$

where k ranges from 0.5 to 1.2.

As Uzbekistan has no carbon price, the deduction for carbon prices paid in the country of origin provided by Regulation (EU) 2023/956 was not applied. For fertilisers both direct and indirect emissions were taken into account, whereas for iron, steel and aluminium only direct emissions were used, because Annex II to the Regulation lists these goods among those for which only direct emissions are counted (European Parliament & Council of the European Union, 2023a). Emission values were taken from the default values of the European Commission (European Commission, 2023), which are world averages and allow the order of magnitude of payments to be estimated before verified data of Uzbek producers become available. The certificate price was set by three scenarios based on observed EU ETS prices: the low scenario corresponds to the 2024 average (EUR 64.76/t), the medium scenario to the 2023 average (EUR 83.60/t) and the high scenario to the 2022 maximum (EUR 97.51/t) (Nissen et al., 2025). The reliability of the trade data was checked by comparing two independent sources, Eurostat data in euro by SITC (European Commission, 2026) and UN Comtrade data in US dollars by HS chapter (United Nations Statistics Division, 2026), converted to one currency. All calculations were performed in spreadsheets with formulas linking the input data and results, which ensures their reproducibility.

ANALYSIS AND RESULTS

The results of the data verification are given in Table 1.

The discrepancy between the sources does not exceed 0.3 % for total imports and 0.03 % for chemical products, which confirms that the UN Comtrade data used below to estimate the product structure are consistent with the official EU statistics.The structure of EU imports from Uzbekistan by CBAM goods is shown in Table 2 and Figure 2.

According to formula (1), CBAM goods account for 21.6 % of EU imports from Uzbekistan, and 90.4 % of this amount consists of nitrogen and compound fertilisers, whereas aluminium and iron and steel account for less than 10 %.

Table 1.
Comparison of Eurostat and UN Comtrade data on EU imports from Uzbekistan, 2025[2]

Indicator	Eurostat, EUR million	Eurostat, USD million (1.13 USD/EUR)	UN Comtrade, USD million	Discrepancy, %
Total imports	1,012	1,143.6	1,140.0	−0.3
Chemical products (SITC 5; HS chapters 28, 31, 34, 39)	432	488.2	488.0	−0.03

Table 2.
EU imports from Uzbekistan of goods covered by CBAM, 2025[3]

Product group	Imports, USD million	Share of total EU imports from Uzbekistan, %	Share of CBAM goods, %
Nitrogenous fertilisers (3102)	190.43	16.7	77.5
Compound and other fertilisers (3105)*	31.77	2.8	12.9
Aluminium and articles thereof (76)	15.15	1.3	6.2
Iron and steel (72)	8.35	0.7	3.4
Total CBAM goods	245.70	21.6	100.0
Total EU imports from Uzbekistan	1,140.0	100.0	–

2 Source: calculated by the authors from European Commission (2026), United Nations Statistics Division (2026) and Bank of Finland (2026).

3 Source: calculated by the authors from United Nations Statistics Division (2026). * Heading 3105 is included in full, although phosphorus–potassium fertilisers (3105 60) are not covered; potassic fertilisers (3104) are excluded.

Consequently, the CBAM exposure of Uzbekistan's exports is almost entirely concentrated in one industry, the production of nitrogen fertilisers from natural gas, which distinguishes Uzbekistan from Kazakhstan, where aluminium is the main CBAM product (Park et al., 2023). The estimate is a lower bound, since inorganic chemicals (HS 28), of which USD 200.6 million were imported in 2025 (United Nations Statistics Division, 2026), may contain ammonia and nitric acid, which are also covered by CBAM, but their separation requires data at the eight-digit level of the Combined Nomenclature.

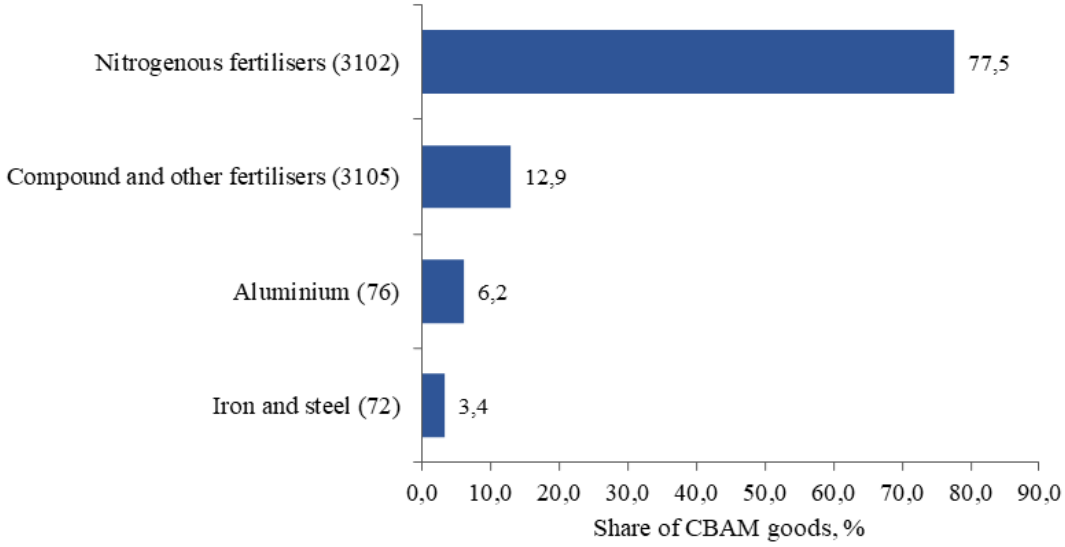


Figure 2. Structure of EU imports from Uzbekistan of goods covered by CBAM, 2025, %[4]

The default emission values used and the payments calculated by formula (2) are given in Table 3, and the trajectory of the payment for ammonium nitrate is shown in Figure 3.

Table 3.
CBAM certificate payment per ton of product, EUR/t[5]

Product (CN code)	Emissions, tCO_2e/t	2026 (φ = 2.5 %)			2030 (φ = 48.5 %)			2034 (φ = 100 %)		
		Low	Med.	High	Low	Med.	High	Low	Med.	High
Ammonium nitrate (3102 30)	2.39	3.9	5.0	5.8	75.1	96.9	113.0	154.8	199.8	233.0
Urea (3102 10)	1.90	3.1	4.0	4.6	59.7	77.0	89.9	123.0	158.8	185.3
NPK fertilisers (3105 20)	1.35	2.2	2.8	3.3	42.4	54.7	63.8	87.4	112.9	131.6
Unwrought aluminium (7601)	2.36*	3.8	4.9	5.8	74.1	95.7	111.6	152.8	197.3	230.1
Steel bars (7214 20)	1.89*	3.1	4.0	4.6	59.4	76.6	89.4	122.4	158.0	184.3

4 Source: compiled by the authors from United Nations Statistics Division (2026).
5 Source: calculated by the authors by formula (2); default values from European Commission (2023), direct and indirect for fertilisers, direct only (*) for aluminium and steel; prices: low 64.76, medium 83.60, high 97.51 EUR/tCO□e (Nissen et al., 2025).

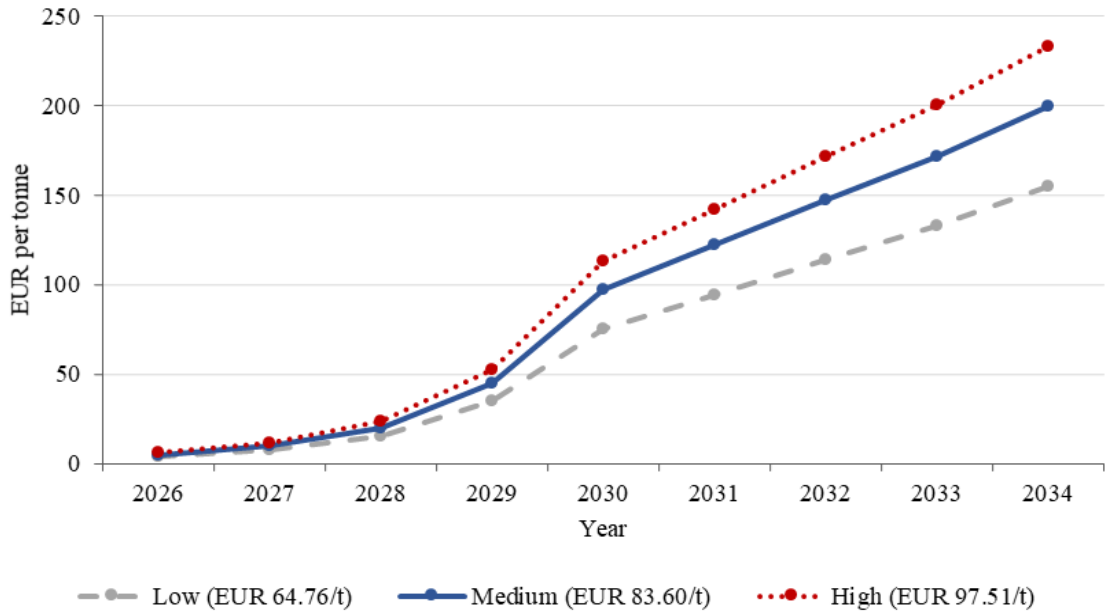


Figure 3. CBAM payment per tonne of ammonium nitrate, 2026–2034, under three price scenarios, EUR/t[6]

In 2026 the payments are small and amount to EUR 3.9 – 5.8 per tonne of ammonium nitrate, but as free allocation is phased out, they increase almost fortyfold and reach EUR 154.8 – 233.0 per tonne in 2034, and EUR 123.0 – 185.3 per tonne for urea. Since the payment is directly proportional to embedded emissions, the burden grows fastest for the most carbon-intensive goods, and this is why nitrogen fertilisers, the main CBAM export of Uzbekistan, are also the most exposed, because nitrous oxide emissions, which are counted for headings 2808 and 3102, are added to their CO_2 emissions (European Parliament & Council of the European Union, 2023a).

The scale of this burden becomes clear when it is related to the product price. The ad valorem equivalent of the payment for urea, calculated by formula (3) under the medium price scenario, amounts to 1.0 % of the price in 2026, 19.8 % in 2030 and 40.8 % in 2034 (Figure 4), and therefore by the end of the phase-out schedule the certificate payment becomes comparable with half of the product price, which, at the current carbon intensity, would practically eliminate the competitiveness of Uzbek nitrogen fertilisers on the EU market.

6 Source: calculated by the authors by formula (2).

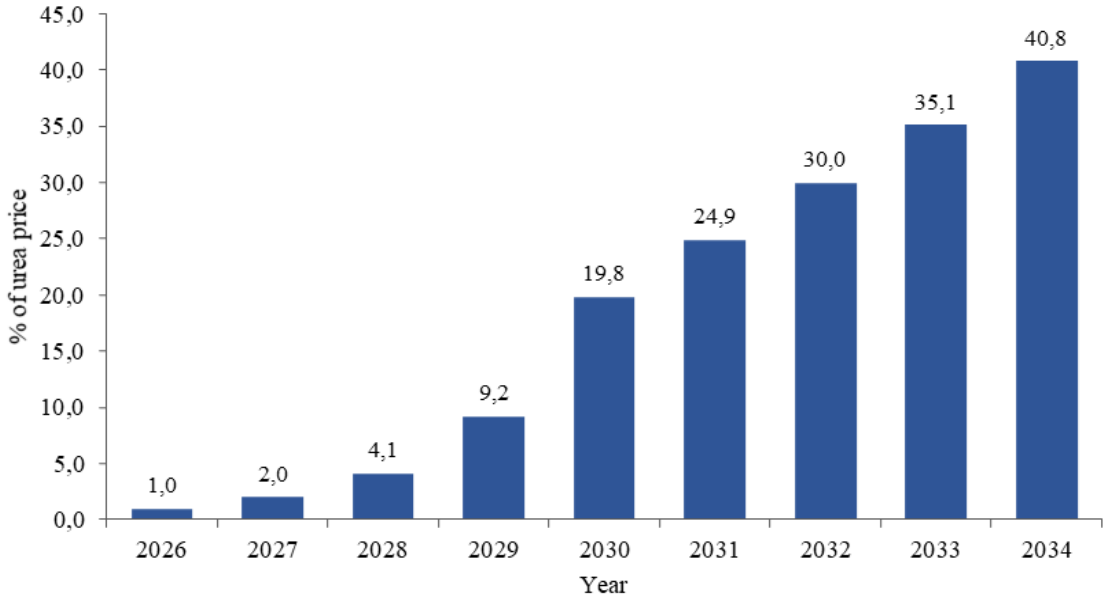


Figure 4. Ad valorem equivalent of the CBAM payment for urea under the medium price scenario, % of price.[7]

To verify the results, they were compared with the estimates of known models (Table 4).

Table 4.
Comparison of the results with estimates of known models[8]

Study and approach	Result of the study	Result of this paper under comparable assumptions
Dolphin and Ferrucci (2026), European Central Bank: ad valorem equivalent of CBAM based on 2021 trade, full implementation, USD 90/tCO_2	On average 0.04 % of export value to the EU, 1.2 % for the most affected country, up to 21.8 % for nitrogenous fertilisers (Moldova)	Under the same assumptions (φ = 100 %, USD 90/tCO_2) the ad valorem equivalent for urea is 38.9 %, higher than the ECB estimate, because default values include indirect and nitrous oxide emissions, and the ECB authors themselves note that the burden on fertilisers may be understated
Maliszewska et al. (2025), World Bank: excess carbon intensity over the EU average, USD 100/tCO_2	The index for Uzbek aluminium is negative (−0.1 to −0.3 %), i.e. its carbon intensity is below the EU average	The calculation with default values gives EUR 197.3/t for aluminium in 2034 and is therefore an upper bound; with verified emissions the burden would be substantially lower
Park et al. (2023), Asian Development Bank: sectoral impact of CBAM on Asian economies	The main exposures of Central Asia relate to aluminium and fertilisers	For Uzbekistan the exposure is concentrated in fertilisers (90.4 % of CBAM goods), while aluminium accounts for 6.2 %

The comparison shows that the results of this paper are consistent with known models in terms of the direction and structure of exposure, while the differences in quantitative estimates are explained by the emission data used: the models of the European Central Bank and the World Bank rely on estimates of actual carbon intensity, whereas this paper uses the default values that will apply to Uzbek exporters in the absence of verified data. The gap between the two types of estimates therefore characterises the part of the burden that can be removed by management measures rather than by technological modernisation.

This conclusion is supported by the sensitivity analysis carried out by formula (4) (Figure 5). For every 10 % reduction of actual emissions relative to the default value, the 2030 payment for ammonium nitrate under the medium price scenario decreases by EUR 9.7 per tonne, and with emissions 30 % below the default it amounts to EUR 67.8 per tonne instead of EUR 96.9, whereas emissions 20 % above the default raise the payment to EUR 116.3

7 Source: calculated by the authors by formula (3) from European Commission (2023), Nissen et al. (2025), Bank of Finland (2026) and World Bank (2025).
8 Source: compiled by the authors.

per tonne.

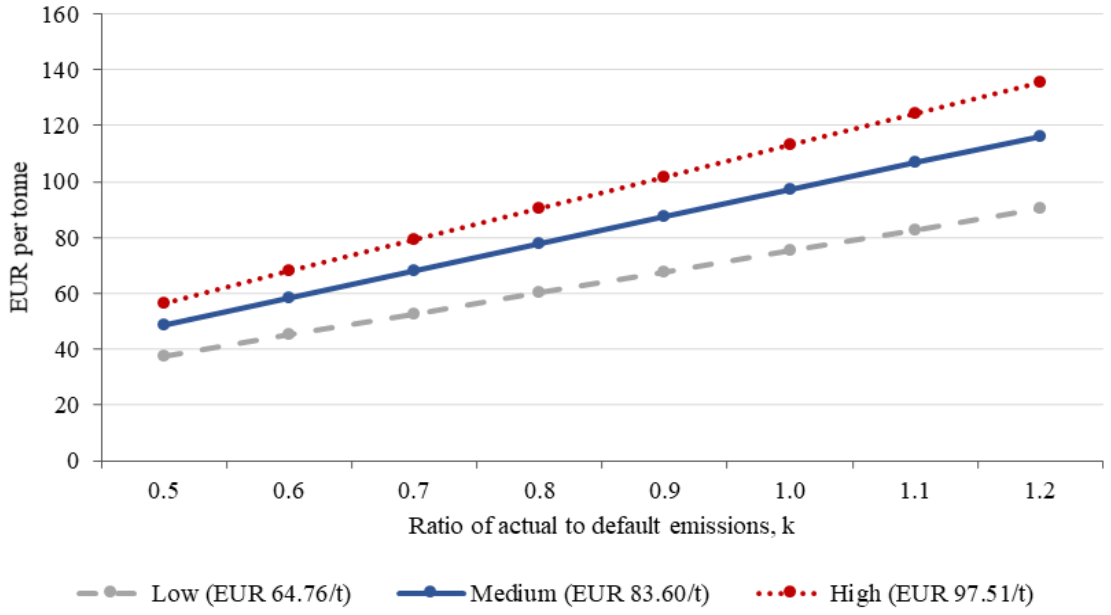


Figure 5. Sensitivity of the 2030 CBAM payment for ammonium nitrate to the ratio of actual to default emissions, EUR/t[9]

In the definitive period the importer may declare actual emissions verified by an accredited verifier (European Parliament & Council of the European Union, 2023a), so that a producer with emissions below the default values can reduce the payment, whereas a producer without verified data loses this opportunity. This makes the system of monitoring, reporting and verification of emissions at exporting enterprises not a technical but a management task, on which export earnings and, consequently, economic security depend. In addition, indirect emissions from consumed electricity are included for fertilisers, and therefore increasing the share of renewable energy in the power supply of chemical plants, envisaged by the green economy strategy (President of the Republic of Uzbekistan, 2019), directly reduces CBAM payments.

On this basis, the mechanism for managing economic security with respect to the external trade risks of the energy transition should be supplemented by three elements. The first is a national system of monitoring, reporting and verification of emissions at enterprises exporting CBAM goods, with accreditation of verifiers recognized in the EU, which will make it possible to replace default values with actual data. The second is targeted measures to reduce emissions in the production of nitrogen fertilisers, primarily nitrous oxide emissions in nitric acid production and indirect emissions through the transition of the power supply of these plants to renewable sources. The third is the inclusion of export exposure indicators in the economic security monitoring system, namely the share of CBAM goods in exports to the EU calculated by formula (1) and the expected CBAM payments calculated by formula (2) from actual export volumes, with responsibility assigned to the body coordinating foreign economic activity. These measures complement traditional risk mitigation instruments, including insurance of export operations (Yakubov, 2025), and make it possible to treat CBAM not only as a threat but also as an incentive to increase the competitiveness of Uzbek exporters.

CONCLUSIONS AND RECOMMENDATIONS

First, goods covered by CBAM account for 21.6 % of EU imports from Uzbekistan, and 90.4 % of this amount consists of nitrogen and compound fertilisers, which concentrates the exposure of exports in one industry. Second, the CBAM payment per tonne of ammonium nitrate under the medium price scenario will increase from EUR 5.0 in 2026 to EUR 96.9 in 2030 and EUR 199.8 in 2034, and the ad valorem equivalent for urea will reach 40.8 % of its price, which makes carbon intensity a determinant of competitiveness on the EU market. Third, the comparison with the models of the European Central Bank, the World Bank and the Asian Development Bank confirms the structure of exposure, and the difference between estimates based on default values and on actual carbon intensity characterises the part of the burden that can be removed by management measures. Fourth, the mechanism for

9 Source: calculated by the authors by formula (4).

managing economic security should be supplemented by a national system of monitoring, reporting and verification of emissions, measures to reduce nitrous oxide and indirect emissions in fertiliser production and indicators of export exposure to CBAM. Estimating total payments from actual export volumes in physical terms is a direction for further research.

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