Center for Energy Efficiency – XXI (CENEf – XXI)

Sanctions and CBAM: Implications for the Russian industry

Slow carbon Low carbon No carbon

Moscow, December 2022

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INTRODUCTION

In 2021, CENEf-XXI released a robust study on the potential implications on the Russian economy of the CBAM mechanism announced by the EU (CENEf-XXI, 2021. *CBAM: Impact on the Russian economy*. Moscow). The intention for 2022 was to trace the evolution of CBAM regulations and CBAM-like regulations and to assess the impacts of the final CBAM design on the Russian economy. The final CBAM regulation was released by the EU only in mid-December 2022. On February 24, the Russian military operation started and was followed by multiple sanctions which ultimately closed the EU market for some of the Russian CBAM goods, and this had much more severe effects on the Russian industry, than what had been expected from CBAM alone. Until the sanctions are lifted, they will be coupling with the CBAM effects for those CBAM goods, which are still allowed to the EU market.

The key results of this research are presented in Section 1 as 11 takeaways. Section 2 briefly describes global trends, drivers and mitigation challenges for industrial GHG emissions. Section 3 discusses carbon leakage evidence and expectations. Section 4 presents the new EU ETS reform and the final CBAM regulation features as released late December 2022. Section 5 covers the global reaction to the CBAM proposal. Sections 6 and 7 address alternatives to CBAM, including provisions of IRA adopted in the U.S., which imply a mechanism very different from that adopted in the EU to support deep decarbonization of industry. Section 8 describes the Carbon Clubs concept – a forum to coordinate the implications of a large variety of tools used to decarbonize industry on the international trade and international relations. Sections 9 and 10 cover recent implications of the energy crisis and the military operation for the EU and for Russia. The effects of the sanctions and final CBAM regulation on the Russian exports are addressed in Section 11. The last section briefly answers the question – what needs to be done?

The analysis was accomplished by CENEf-XXI under the *“Climate change: Russia’s action and the global science”* project, which is implemented in cooperation with the European Climate Foundation and 2050 Pathways Platform. Under this project, on December 29, 2022, CENEf-XXI in cooperation with the Institute of World Economy and International Relations of the Russian Academy of Science held a workshop *“Global and Russian Industry Decarbonization Perspectives”*.

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1. Takeaways

Net zero CO_2 emissions from the industrial sector are possible but challenging as we need to shift focus from the incremental improvements to transformational changes. Industrial sector decarbonization management is more complex, than in the other sectors.

Mushroomed empirical studies testing carbon leakage failed to find convincing evidence. A failure to reveal the 'carbon leakage' phenomenon in the past does not mean that it will not be revealed in the future. With USD 100/tCO_2 carbon price, basic materials manufactured in the EU will become 25-100% more expensive, so their competitiveness is at a high risk.

CBAM is based on the EU belief, that coupling the EU ETS reform with a removal of free allowances and CBAM opens a unique 'window of opportunity' to timely attain the EU Green Deal goals, and that CBAM is the most effective mitigation tool.

This vision was challenged by the US Inflation Reduction Act (IRA), a powerful non-price-based mitigation mechanism. This US approach works to bring down the US producers' costs, whereas the approach used by the EU escalates them. IRA provides $391 billion to support energy security and climate mitigation via a variety of tax incentives, grants and concessionary loans, which are expected to leverage $1.7 trillion in financing.

In 2022, the EU industry began to feel the negative impacts of the Russian military operation in Ukraine, which reversed the industrial production trends to a decline and accelerated the EU deindustrialization and carbon leakage. These, in turn, highlighted the impacts of other factors, such as energy costs and power pricing schemes, on carbon leakage.

After the EU imposed sanctions on Russia, iron and steel exports from Russia to the EU dropped substantially, and almost ceased for some product groups. The sanctions had a smaller impact on fertilizers exports and nearly no impact on aluminium.

After years of growth, or relatively stable production of basic materials in Russia, February 2022 marked the beginning of a production decline era for many of them. Growing materials use by a militarized economy and the announced "turn to the East" failed to block the negative effects of the sanctions.

The Russian military operation and the subsequent sanctions closed the EU markets for some CBAM goods (mostly iron and steel products) for the years to come. Sanctions-driven loss in Russian export revenues for CBAM goods can be estimated at $4.1-5.4 billion. This loss exceeds half of pre-2022 CBAM export revenues from Russia to the EU and goes far beyond any loss that had been expected from CBAM.

With the most likely combination of various conditions, CBAM-associated losses of the Russian companies will not exceed $1-1.5 billion by 2050. Exports from low carbon plants and installations will help bring net export revenue losses down to nearly zero. Fiscal-neutral carbon pricing in Russia can deliver $2 billion in additional export revenues by limiting the Russian exporters' price increments for CBAM-products.

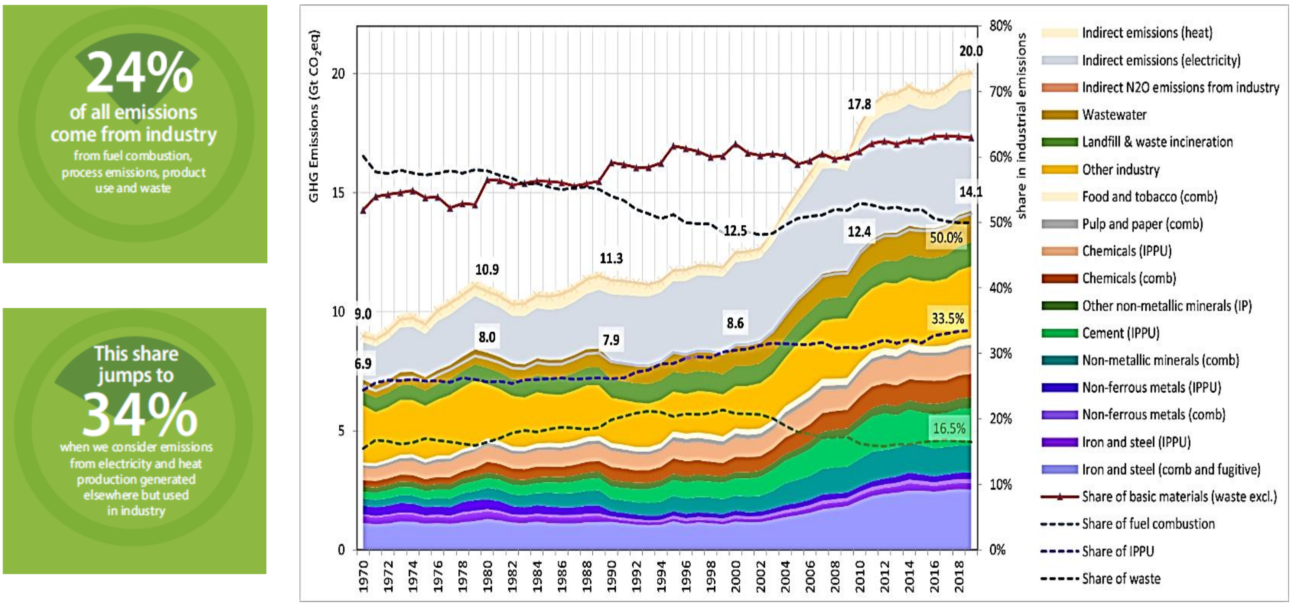
If Russia is much behind the EU in decarbonizing CBAM industries because it takes no action and conserves the current carbon intensity levels for decades to come, then by 2050 CBAM export revenue loss may be up to $5 billion and will become equal to the effect of the sanctions. On the contrary, Russia's leap to carbon neutrality coupled with the EU's passivity may deliver more than $8 billion in additional export revenues by 2050.

If Russia and the EU race in parallel, apply effective industrial GHG mitigation policies and technologies, Russia's export revenue loss may peak at $1 billion in the mid-2030s and halve towards 2050. Only proactive reduction in carbon intensity of Russian CBAM-products and (or) the introduction of fiscal-neutral carbon payments will help reduce the losses or even end up with additional export revenues.

2. GHG emissions from industry: global trends, drivers and mitigation challenges

Global industry is the sector with the fastest emission growth since 2000 and with expected slowest emission decline by 2050. In 2019, industry accounted for 14.1 GtCO2eq, or 24% of direct emissions, and together with indirect emissions the amount reached 20 GtCO2eq, or 34%. **Industry is the largest global anthropogenic GHG emission source** (Figure 1). The share of fossil fuel emissions is only 50%, while the rest are emissions from production processes and waste. Basic materials contribute 2/3 to the industrial emissions.

Figure 1. GHG emissions from global industry



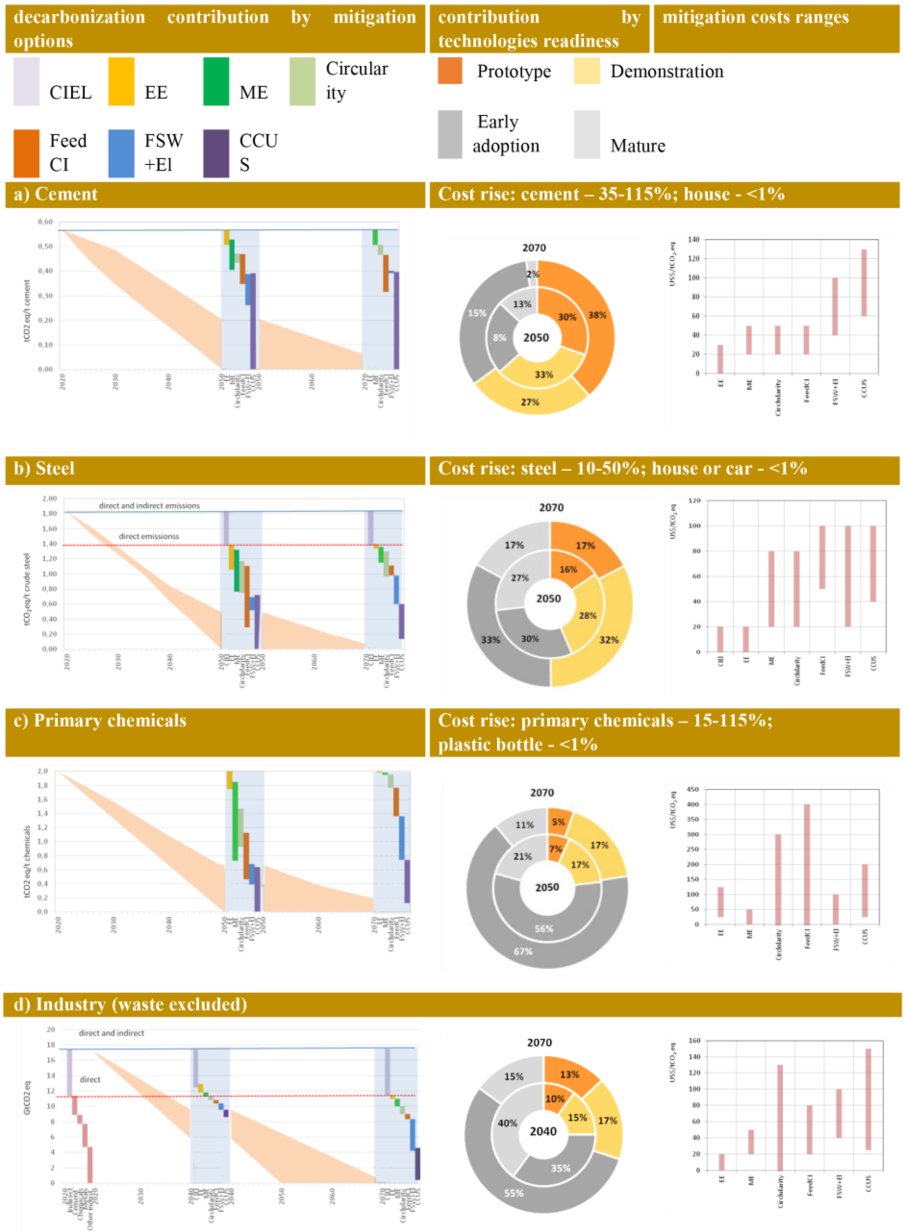
Source: Bashmakov et al. 2022. Industry. In: Climate Change 2022. Mitigation of Climate Change. Contribution of Working Group III to the IPCC Sixth Assessment Report (AR6) [Skea, J. et al., (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

For a long-time, energy efficiency was the only factor driving industrial emissions down, but much of the energy efficiency potential in industry is already tapped out. This makes a strong contrast to global material efficiency, which has demonstrated no progress. There is certain, albeit not very impressive, progress in circularity – only 10% of total materials inputs are recycled materials. As to carbon intensity, for some basic materials it has been practically stagnating over the last three decades.

Chapter 11 of WG III Sixth Assessment Report concludes:[1] **net zero CO2 emissions from the industrial sector are possible, but challenging, as we need to shift focus from the incremental improvements to transformational changes.** A mitigation challenge is to shift from three decades of stagnating specific emissions to net zero in the coming 3 to 4 decades. Production costs for low to zero emission materials may be high, but the additional costs for end-users will be low (Figure 2).

[1] Bashmakov et al. 2022. Industry. In: *Climate Change 2022. Mitigation of Climate Change. Contribution of Working Group III to the IPCC Sixth Assessment Report (AR6)* [Skea, J. et al., (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Figure 2. **Potentials and costs for zero-carbon mitigation options for industry and basic materials**



CIEl is carbon intensity of electricity for indirect emissions; EE is energy efficiency; ME is material efficiency; Circularity is material flows (clinker substituted by coal fly ash, blast furnace slag or other by-products and waste, steel scrap, plastic recycling, etc.); FeedCI is feedstock carbon intensity (hydrogen, biomass, novel cement, natural clinker substitutes); FSW+El is fuel switch and processes electrification with low carbon electricity. Ranges for mitigation options are shown based on bottom-up studies for grouped technology packages, not for individual technologies. In circles contribution to mitigation from technologies based on their readiness are shown for 2050 (2040) and 2070. Direct emissions include fuel combustion and process emissions. Indirect emissions include emissions attributed to consumed electricity and purchased heat. For basic chemicals only methanol, ammonia and high-value chemicals are considered. Total for industry doesn't include emissions from waste. Base values for 2020 for direct and indirect emissions were calculated using 2019 GHG emission data and data for materials production. Negative mitigation costs for come options like Circularity are not captured.

Source: Bashmakov et al. 2022. Industry. In: Climate Change 2022. Mitigation of Climate Change. Contribution of Working Group III to the IPCC Sixth Assessment Report (AR6) [Skea, J. et al., (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Key mitigation options include:

- Demand reduction, i.e. less product per service (unlike sufficiency, which is about less service);
- Material efficiency, i.e. less material per product;
- Circularity, i.e. less virgin material per input;
- Only a limited potential is left for energy efficiency (and will shrink further through some mitigation options – CCUS);
- Fuel switch and low carbon feedstocks towards biomass (limited resource) and hydrogen;
- Low carbon electrification – starting with, but not limited to, not carbon intensive industries;
- CCS and CCU are expected to be key mitigation options in some industries by 2050.

Regarding the technological options, the key findings in Chapter 11 are as follows:[2]

- There are multiple current and near horizon options to greatly reduce basic materials emissions intensity;
- Industry is getting ready for near-zero, excluding the petrochemical industry (so recycling is important there);
- Technologies are available to bring all industry sectors to very low or zero emissions, but… they require 5 to 15 years of intensive commercialization and policies to ensure large-scale uptake;
- Mitigation costs vary between 50 and 150 $/tCO2eq, with a large fluctuation within and beyond this band;
- All this affects the competitiveness of low carbon products and requires supporting policies.

Decarbonization management in industry is more complex than in other sectors. The policy challenge is to shift away from shielding industries and supporting only EE and R&D to deep decarbonization strategies. This transition requires clear policy targeting towards net zero through:

- Fostering market demand for less primary materials via demand management, improving material efficiency and circularity policies;
- Fostering market demand for low-carbon materials and products;
- Learning and governance capacity at all levels (from international to local);
- Socially inclusive phase-out plans and burden equality;
- Encouraging international cooperation and coordination of climate and trade policies;
- Comprehensive and sequential policies leading to immediate actions;
- Integration with other policy domains and across sectors.

Industry should no longer be like a child left in the store by climate policy-making parents.

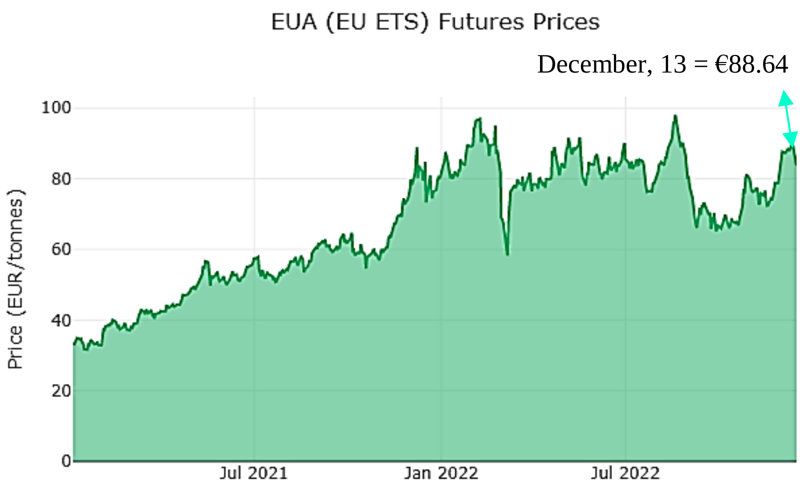
[2] Bashmakov et al. 2022. Industry. In: *Climate Change 2022. Mitigation of Climate Change. Contribution of Working Group III to the IPCC Sixth Assessment Report (AR6)* [Skea, J. et al., (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

3. Carbon leakage: evidence and expectations

The EU Parliament claims, that **about 27% of global CO_2 emissions from fuel combustion originate from internationally traded goods.** While the EU has managed to reduce its production-based (domestic) GHG emissions, the GHG emissions embedded in the EU imports have been constantly increasing, undermining the EU's efforts to reduce its global GHG footprint.[3] 50% of product-related emissions arise from products manufactured outside of the EU.[4]

Announced elimination of free emission allowances in the EU ETS, which has a high carbon price (Figure 3), **may lead to much higher prices of basic materials in the EU markets. This provokes concerns about 'carbon leakage'**. 'Carbon leakage' is a term used to describe carbon pricing-driven transfer of production to countries with no or lax carbon regulation, or the substitution of domestic products (manufactured with lower GHG emissions) with imports from such countries. Grubb et al. (2022) define climate policy-induced carbon leakage as a "subset of all embodied emissions in trade that is specifically driven by international differences in climate policies".[5]

Figure 3. EU ETS allowances prices: 2021-2022



Sources: EU Carbon Price Tracker | Ember (ember-climate.org)

The 'carbon leakage' risk:

- is estimated based on the carbon intensity of products and the intensity of international trade;

[3] P9_TA(2022)0248. Carbon border adjustment mechanism ***. Committee on the Environment, Public Health and Food Safety. PE697.670. Amendments adopted by the European Parliament on 22 June 2022 on the proposal for a regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism (COM(2021)0564 – C9-0328/2021 – 2021/0214(COD.

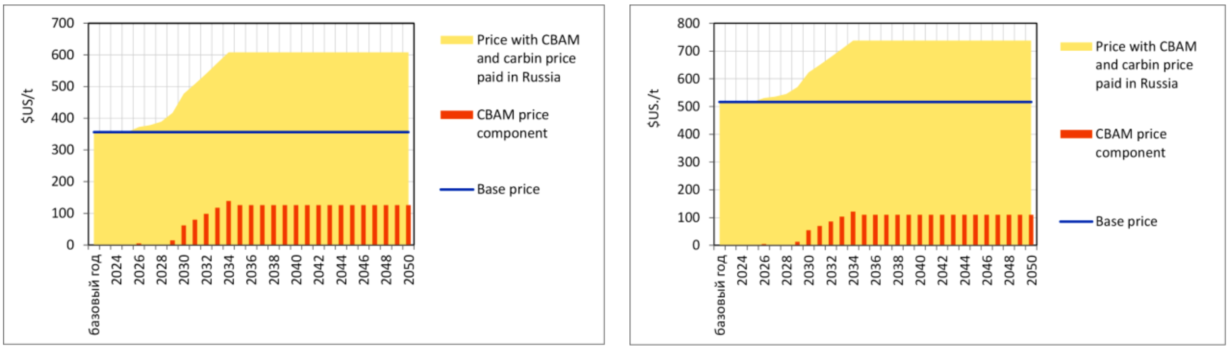
[4] Grubb M., N.D. Jordan, E. Hertwich, K. Neuhoff, K. Das, K.R. Bandyopadhyay, H. van Asselt, M. Sato, R. Wang, W.A. Pizer. Carbon Leakage, Consumption, and Trade. Vol. 47:753-795 (Volume publication data October 2022). First published as a Review in Advance on September 14, 2022. https://doi.org/10.1146/annurev-environ-120820-053625.

[5] Grubb M., N.D. Jordan, E. Hertwich, K. Neuhoff, K. Das, K.R. Bandyopadhyay, H. van Asselt, M. Sato, R. Wang, W.A. Pizer. Carbon Leakage, Consumption, and Trade. Vol. 47:753-795 (Volume publication data October 2022). First published as a Review in Advance on September 14, 2022. https://doi.org/10.1146/annurev-environ-120820-053625.

- is the highest for carbon-intense basic materials, with a potential for more than 20% carbon cost in the product price;
- declines as these materials move up the value chain: the share of carbon cost goes down to less than 1% of the ultimate product price.

With \$100/tCO_2 carbon price basic materials manufactured in the EU become 25-100% more expensive (Figure 4) and so much less competitive.

Figure 4. Basic materials price growth with carbon price equal to 100 \$US/t CO2



ammonia pig iron

Source: Authors.

The issue of whether or not the very phenomenon of carbon leakage exists, has not been theoretically proved, and a literature review does not provide an unambiguous answer.[6]

Mushroomed empirical studies that were looking for carbon leakage evidence failed to find convincing evidence.[7] According to (Grubb et al., 2022),[8] the historical increase in emission transfers from the developing to developed countries peaked around 2006 and declined since that time, and there is no evidence that climate policies lead to carbon leakage. The carbon leakage problem was overestimated in the past, as large amounts of free GHG allowances in the EU ETS shielded heavy industry from carbon regulation; the carbon price component in the ETS was below 1% of the materials costs for 95% of European industries.[9] For a number of CBAM-products, EU ETS allocated more than 100% of allowances in 2020 for free, i.e. the free allowances exceeded the amounts of verified emissions. Empirical tests of the 'carbon leakage' hypothesis using the econometric analysis methods did not reveal any statistically significant impact of carbon prices on the competitiveness parameters, such as net imports, direct foreign investments, output, value added, rate of employment, profits, productivity, and innovations in the industrial sector.

The failure to reveal the 'carbon leakage' phenomenon in the past does not mean that it will not be revealed in the future. The reduction in the share of free allowances coupled with high EU ETS carbon prices requires protection for EU businesses. EU selected the CBAM mechanism to perform this function. The EU believes that the 'carbon leakage' risk is highest for petroleum products, chemistry, iron and steel, non-ferrous metals, and pulp and paper. The risks are highest for 'carbon leakage' from the EU to Russia, China, USA, and Turkey.

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[6] Bashmakov I.A. CBAM and Russian export. *Voprosy Ekonomiki*. 2022;(1):90-109. (In Russ.) https://doi.org/10.32609/0042-8736-2022-1-90-109$; CENEf-XXI (2021). CBAM. Impact on the Russian economy. Moscow: Center for Energy Efficiency-XXI. (In Russian).

[7] See overviews in CENEf (2021). CBAM. Impact on the Russian economy. Moscow: Center for Energy Efficiency-XXI (in Russian) and Grubb M., N.D. Jordan, E. Hertwich, K. Neuhoff, K. Das, K.R. Bandyopadhyay, H. van Asselt, M. Sato, R. Wang, W.A. Pizer. Carbon Leakage, Consumption, and Trade. Vol. 47:753-795 (Volume publication data October 2022). First published as a Review in Advance on September 14, 2022. https://doi.org/10.1146/annurev-environ-120820-053625.

[8] Ibid.

[9] CENEf-XXI (2021). CBAM. Impact on the Russian economy. Moscow: Center for Energy Efficiency-XXI.

4. ETS reform and CBAM regulation

The authors have thoroughly considered the CBAM proposal issued by the European Commission on July 14, 2021, and its implications for the Russian exports to the EU.[10] On June 22, 2022, the European Parliament (EP) adopted a 165 pages-long document with 223 amendments on the ETS proposal[11] and another 91 pages-long document with 184 amendments on the CBAM proposal.[12] In the very beginning, the EP stressed that it "*should be done in a manner that is equitable and respects the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances*". Then a trialogue between the Council, Commission and Parliament was launched and ended up on December 13, 2022, with a provisional agreement on CBAM and on December 16, 2022, with a final regulation. As a result, another 201 pages-long document was produced which reflects the trialogue outcome.[13] The EP defines CBAM as follows:

> "*The Carbon Border Adjustment Mechanism (CBAM) is a mechanism that addresses the risk of carbon leakage through the application of a uniform price on emissions embedded in goods imported into the customs territory of the Union*".[14]

In the final document this definition was modified:

> *"The CBAM is a climate measure which should support the reduction of global emissions and prevent the risk of carbon leakage, while ensuring compatibility with WTO rules".*

For the EU, preventing carbon leakage means avoiding an escape of EU businesses to other countries. Preventing global carbon leakage may mean a transfer of EU businesses to jurisdictions with lower carbon intensities, so the two goals are different. The EU wants to kill two birds.

The list of CBAM goods. The list of CBAM goods initially developed by the Commission included iron and steel, cement, aluminium, fertilizers, and electricity. The EP added:

- Chemicals:
  - 29 – Organic Chemicals (42 four-digit positions);
  - 2804 10 000 – Hydrogen;
  - 2814 10 000 – Anhydrous ammonia;
  - 2814 20 00 – Ammonia in aqueous solution;
- Polymers – 39 – Plastics and articles thereof.

Ammonia (wider four-digit code 2814) was already covered under fertilizers. It is not clear, why ammonia is duplicated by EP under chemicals. The 29 group (Organic Chemicals) includes 42

[10] Bashmakov I.A. CBAM and Russian export. *Voprosy Ekonomiki*. 2022;(1):90-109. (In Russian) https://doi.org/10.32609/0042-8736-2022-1-90-109$; CENEf (2021). CBAM. Impact on the Russian economy. Moscow: Center for Energy Efficiency-XXI. (In Russian).

[11] P9_TA(2022)0246 Revision of the EU Emissions Trading System. Amendments adopted by the European Parliament on 22 June 2022 on the proposal for a directive of the European Parliament and of the Council amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757 (COM(2021)0551 – C9-0318/2021 – 2021/0211(COD).

[12] P9_TA(2022)0248. Carbon border adjustment mechanism ***. Committee on the Environment, Public Health and Food Safety. PE697.670. Amendments adopted by the European Parliament on 22 June 2022 on the proposal for a regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism (COM(2021)0564 – C9-0328/2021 – 2021/0214(COD).

[13] CBAM - CION PROPOSAL – COUNCIL GA – EP POSITION - version of 14 DECEMBER 2022.

[14] P9_TA(2022)0248. Carbon border adjustment mechanism ***. Committee on the Environment, Public Health and Food Safety. PE697.670. Amendments adopted by the European Parliament on 22 June 2022 on the proposal for a regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism (COM(2021)0564 – C9-0328/2021 – 2021/0214(COD).

four-digit positions of different organic chemical products groups and hundreds of six-digit positions.[15] It is going to be a huge challenge to set emission benchmarks for those. A correct statement by the Commission – *organic chemicals are not included in the scope of this Regulation due to technical limitations that do not allow to clearly define the embedded emissions of imported goods* – was removed by the EP. It is hard to expect a timely solution for the specific emission estimation problem for these multiple complex goods. For importers and exporters, it will be a huge administrative challenge to trace specific emissions for each product in 29 CN Code group.[16] A similar problem was recognized by the Commission for petroleum products. A decision was made to develop a fair methodology for calculating embedded emissions from refinery products before the end of the transition phase.

The final CBAM proposal captures the expected complexity of carbon footprint evaluation for chemicals and refinery products. Therefore, they were not included.

Some more 4–8-digit code items, in addition to the list initially proposed by the Commission,[17] were included in the final regulation:[18]

CN code and products list	Volume of exports from Russia to EU in 2021 ($1000)
• 2523 30 00 – Aluminous cement	1
• 7326 – Other articles of iron or steel	0
• 7610 – Aluminium 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); aluminium plates, rods, profiles, tubes and the like, prepared for use in structures	0
• 7611 00 00 – Aluminium 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	1.4
• 7612 – Aluminium 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	0
• 7613 00 00 – Aluminium containers for compressed or liquefied gas	302.1
• 7614 – Stranded wire, cables, plaited bands and the like, of aluminium, not electrically insulated	0
• 7616 – Other articles of aluminium	0
• 2804 10 000 – Hydrogen	0

All these additional items sum up to much below $1 million in the Russian exports to the EU, so they were not taken into account while studying the CBAM effects on the Russian exports.

[15] 0629erev_2007e.pdf (wcoomd.org).
[16] Harmonized Commodity Description and Coding System is a list of numbers used by customs to classify a product.
[17] See CENEf (2021). CBAM. Impact on the Russian economy. Moscow: Center for Energy Efficiency-XXI. (In Russian).
[18] CBAM - CION PROPOSAL – COUNCIL GA – EP POSITION - version of 14 DECEMBER, 2022.

Reporting requirements will come into effect in October 2023 as part of a gradual phase-in. The EP considered a 2030 timeline for gradually expanding the CBAM scheme across all goods covered by ETS.[19] Moreover, EP requests that in three years the Commission expand the CBAM scope to include downstream products containing a significant share of CBAM goods. Such provision, if accepted, would boost estimation of carbon intensity benchmarks and footprints.[20]

GHGs and emission scopes covered. The EP's proposal includes: carbon dioxide (CO_2); where relevant, nitrous oxide (N_2O); and perfluorocarbons ('PFCs'). Initially, the Commission's proposal had a provision to include only direct GHG emissions, and at a later stage (after the end of the transition period and upon further assessment) to add indirect emissions too, mirroring the scope of the EU ETS. ETS mostly covers direct emissions from installations, which is different from product emissions, because some installations produce several products, and methodologies for emissions allocation by products are not sophisticated enough. The EP claimed that CBAM should apply to both direct and indirect emissions and added that "coherence between the CBAM and the EU ETS is essential to respect the principles of the WTO". For aluminium it stated, that the scope of CBAM covers indirect emissions. The EP also revised the definition of direct emissions by adding "including emissions from the production of heating and cooling consumed during the production processes". The wording in the final regulation is as follows: "from the production of heating and cooling consumed during the production processes, regardless of the location of the production of the heating and cooling". The goal is to cover the emissions associated with the use of district heating, because in the final document 'indirect emissions' mean emissions from the generation of electricity, which is consumed for the production of goods.[21]

Emission estimates are to be actual ***verified*** emissions; default values can only be used, if data on actual emissions is unavailable. Therefore, the administrative workload to estimate and verify emissions will be significant. The EP requires that verified embedded emissions be publicly accessible via the CBAM registry. Some exporters may thus face certain confidentiality problems.

According to the final document, CBAM should initially apply to direct GHG emissions from the production of goods and to indirect emissions, mirroring the scope of the EU ETS to ensure coherence. In line with this principle, subsequent revisions of the EU ETS should be appropriately captured in CBAM. The EU ETS accounts for indirect emissions from EAF steel and aluminium. All goods are split into simple ones and others. The simple goods are primary materials "produced in a production process requiring exclusively input materials and fuels, having zero embedded emissions". In reality, such goods do not exist, as even in primary production inputs, such as mining and transportation of natural materials and industrial gases used – all have some embedded emissions. For other ('complex') products, scope 1 and 3 emissions should be included, whereas scope 2 emissions are only to be reported.[22]

More strict methodologies are needed to report emissions. Some EU industrial associations (EUROFER, CEMBEREAU, European Aluminium, Fertilizers Europe) already have benchmarking systems and emissions calculators, which are based on the EU standards. They can be used to estimate carbon footprints – embedded emissions.[23] Marku et al. are also stressing the

[19] P9_TA(2022)0248. Carbon border adjustment mechanism ***. Committee on the Environment, Public Health and Food Safety. PE697.670. Amendments adopted by the European Parliament on 22 June 2022 on the proposal for a regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism (COM(2021)0564 – C9-0328/2021 – 2021/0214(COD).

[20] CENEf-XXI and Environmental Industrial Policy Center (EIPC) in 2021-2022 developed three benchmarking systems for iron and steel products, cement products and ammonia production compatible with those used by EU professional associations and consistent with EU standards.

[21] The issue of indirect emissions in the CBAM scheme is explored in: Marcu A., M. Mehling, A. Cosbey. Border Carbon Adjustment in the EU: Indirect Emissions in the CBAM. ERCST. 5 July, 2022.

[22] CBAM - CION PROPOSAL – COUNCIL GA – EP POSITION - version of 14 DECEMBER, 2022.

[23] Bashmakov I.A, D.O. Skobelev, K.B. Borisov, T.V. Guseva. 2021. GHG benchmarking system in the iron and steel industry // Chernaya Metallurgia. 2021. Vol.77, No. 9. (In Russian); CENEf – XXI. 2021. Report. Carbon intensity benchmarking for iron and steel in the Russian Federation. Description of the BenCHerMetarking system for iron and

need for convergence methodologies to account for embedded carbon emissions of different countries in a collaborative effort aiming to accommodate national approaches.[24]

Benchmarking. CBAM largely relies on benchmarking. The EP highlights the need to consult with relevant stakeholders in the covered sectors, with representatives of the civil society, and with the European Scientific Advisory Board on Climate Change, when outlining the principles for setting ex-ante benchmarks in individual sectors and subsectors. The benchmarks are moving targets. In order to capture the technological progress, the benchmarks are to be revised downward for the period of free allocation –by 2.5% per year. In 2026-2030, the benchmarks should be adjusted for 8 to 50% compared to the value used in the ETS during 2013-2020. If non-price-based policies applied in other countries are effective in reducing GHG intensity of a CBAM product, then the CBAM charge is either zero or low.[25]

CBAM factor is the share of free allowances. The EC proposal was to eliminate free allocation by 2035 via deducing 10% per year from 2026 onwards. The EP came up with a more ambitious schedule:

- 100% during the transition period (2023-2026);
- 93% in 2027;
- 84% in 2028;
- 69% in 2029;
- 50% in 2030;
- 25% in 2031;
- 0% from 2033 onwards.

The EP proposal makes the launching period a bit softer, but speeds up the process thereafter and ends it up by 2033.

According to the final regulation, the timeline for the elimination of free carbon allowances under the EU ETS is as follows:

- 97.5% in 2026;
- 95% in 2027;
- 90% in 2028;
- 77.5% in 2029;
- 51.5% in 2030;
- 39% in 2031;
- 26.5% in 2032;
- 14% in 2033;
- 0% from 2034 onwards.

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steel products in Russia. Moscow, 2021; CENEf – XXI. 2022. Carbon intensity benchmarking for mineral non-metal materials (cement, glass) in the Russian Federation. Analysis of international methodologies and development of Russian approaches to estimating specific GHG emissions and setting sectorial benchmarks for glass and cement products in Russia. Moscow, 2022.

[24] Marcu A., M. Mehling, A. Cosbey, P. Nouallet. International Cooperation on BCAs: Issues and Options. ERCST. 28 September, 2022.

[25] Marcu A., M. Mehling, A. Cosbey. CBAM: Aligning the Design with Evolving Circumstances. ERCST. 27 October, 2022.

A compromise was reached between the Commission and EP, and since 2034 the EU's CBAM is expected to be fully operational. EU decision-makers introduced the option of "emergency brake", which would slow down the elimination of free allowances, should there be any problems.

Protecting the EU exporters. There have been many comments that CBAM, in the format proposed by the Commission, will undermine the competitiveness of EU CBAM goods in the international markets.[26] To mitigate this risk, the EP proposed keeping the free allocations for products exported to the third countries, which have no carbon pricing mechanisms similar to the EU ETS. This provision is introduced to protect the EU businesses in CBAM export markets. It does not specify the details for markets with existing, but low, carbon price. The EP requests the "Commission to submit a proposal for any appropriate and WTO-compliant legislation and measures that equalize the costs of CO_2 with the different pricing schemes of those third countries". When the carbon intensity of CBAM goods is lower, than that in a third country, the risk of carbon leakage is increased, rather than prevented, by CBAM. This provision will defend EU CBAM goods producers, while downstream exports will be more expensive, as prices for basic materials grow. When "carbon costs were reimbursed for exports, this would mute the incentives for export-oriented producers to pursue climate neutral production processes, material efficiency and substitution".[27] The EP's proposals on defending the EU exporters were not included in the final CBAM regulation.[28] But responding to the challenge set but the U.S. IRA (see below) the EU lawmakers agreed to release additional funding for EU countries to provide support to industries whose exports have become uncompetitive on the global markets as a result of the EU's climate measures. €3.5 billion were allocated for EU member states to support their industry's decarbonisation. Plus, some funding will be available from the EU's innovation support for the steel and fertilisers decarbonisation.[29]

Indirect costs. The EU's practice to compensate for the indirect costs associated with the carbon costs passed on electricity prices is considered as causing a risk of carbon leakage. To mitigate this risk, member states should adopt financial measures for the compensation of the indirect costs. This provision in the ETS regulation was not removed, despite the EP says in CBAM regulation: "compensation for indirect emission costs weakens the price signal",[30] and CBAM regulation considers providing *favorable tax arrangements* in third countries as circumvention practices (see below).

Carbon price paid by the importers to the EU. The claim for a reduction in the number of CBAM certificates to be surrendered may correspond only to the '***explicit***' carbon price already paid for those emissions in other jurisdictions. The EP adds that such reduction may be up to 100%, if the carbon price paid in the country of origin is equivalent to, or higher than, the EU carbon price.[31] This provision discourages any trade partner to introduce a carbon price higher, than that in the EU ETS. The wording for the final regulation is: "An authorised CBAM declarant

[26] CENEf (2021). CBAM. Impact on the Russian economy. Moscow: Center for Energy Efficiency-XXI (In Russian); Grubb M., N.D. Jordan, E. Hertwich, K. Neuhoff, K. Das, K.R. Bandyopadhyay, H. van Asselt, M. Sato, R. Wang, W.A. Pizer. Carbon Leakage, Consumption, and Trade. Vol. 47:753-795 (Volume publication data October 2022). First published as a Review in Advance on September 14, 2022. https://doi.org/10.1146/annurev-environ-120820-053625.

[27] NEUHOFF K., O. CHIAPPINELLI, J. RICHSTEIN, H. DE CONINCK, P. LINARES, T. GERRES, G. KHANDEKAR, T. WYNS, L. ZETTERBERG, B. FELSMANN, A. ŚNIEGOCKI. 2022. Closing the Green Deal for Industry. What design of the carbon border adjustment mechanism ensures an inclusive transition to climate neutrality? The Climate Friendly Materials Platform.

[28] CBAM - CION PROPOSAL – COUNCIL GA – EP POSITION - version of 14 DECEMBER 2022.

[29] See more discussion on the export implications in Marcu A., M. Mehling, A. Cosbey, A. Maratou. Border Carbon Adjustment in the EU: Treatment of Exports in the CBAM. ERCST. March 2022.

[30] P9_TA(2022)0248. Carbon border adjustment mechanism ***. Committee on the Environment, Public Health and Food Safety. PE697.670. Amendments adopted by the European Parliament on 22 June 2022 on the proposal for a regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism (COM(2021)0564 – C9-0328/2021 – 2021/0214(COD).

[31] Ibid.

should be allowed to claim a reduction in the number of CBAM certificates to be surrendered corresponding to the carbon price already ***effectively*** paid for those emissions in other jurisdictions". The final document on CBAM defines the 'carbon price' as a monetary amount paid in a third country, under a carbon emissions reduction scheme, either in the form of a tax, levy, fee or emission allowances under a greenhouse gas emissions trading system, calculated on greenhouse gases covered by such a measure, and released during the production of goods.[32]

There are more items in the EP list of circumvention practices, and the most important one is: "*direct and indirect subsidies, such as favorable tax arrangements, energy pricing, export rebates or other forms of compensation on exportation, for goods covered by this Regulation in order to absorb parts or the entirety of the costs linked to a CO2 price paid in the third country"*. Many countries, including the U.S., consider subsidies to support low carbon production as the key policy instrument. The provision above potentially makes it a circumvention practice, along with any other LDCs' policies to promote export to the EU. It is in contrast with the provision on preserving free allocations for EU goods to support the competitiveness in international markets, which may be considered by them as subsidies.

Geographical coverage. In the Commission's proposal to address the problems of LDCs, which may be losing out EU CBAM product markets, there is only general wording about technical assistance to LDCs to facilitate their adaptation to the new obligations established by CBAM regulation. The EP made this support more concrete, specifying that the EU should finance LDCs' efforts towards the decarbonization of their industries with an annual amount corresponding at least to the level of revenues generated by the sale of CBAM certificates.[33] This approach has a few shortcomings. First, "corresponding" is not the same as "equal". Second, companies losing revenues from EU CBAM markets and those which may benefit from the EU assistance may not match. Third and most important: it is implicitly assumed, that $1 carbon price in LDCs can make as much in terms of mitigation as $1 carbon price in the EU. This assumption is wrong, as prices for all production factors (labor, energy, capital, materials) in LCDs are substantially different from those in the EU, and equal carbon prices can have up to an order of magnitude larger effects in LDCs, than in the EU. The final document keeps mentioning technical assistance and identifying the EU's budget as a source. In other words, the provisions on matching EU CBAM market losses and the amount of assistance were deleted, and LDCs face the risk of getting no compensation.[34]

5. Global reaction to the CBAM proposal

Initial reactions to the CBAM proposal were like "please take it back". There was a strong opposition from the BRICS, Australia, U.S., Turkey, and African low-income countries. As some assessments of the CBAM effects were published, the reaction became softer.[35] After the U.S. IRA was adopted (see below), the concerns began to emerge from the EU side. Climate mitigation ambitions and policies asymmetries, fundamental differences in the regulatory approaches – whether to impose the financial burden in the form of pricing or provide direct financial support

[32] CBAM - CION PROPOSAL – COUNCIL GA – EP POSITION - version of 14 DECEMBER 2022.
[33] P9_TA(2022)0248. Carbon border adjustment mechanism ***. Committee on the Environment, Public Health and Food Safety. PE697.670. Amendments adopted by the European Parliament on 22 June 2022 on the proposal for a regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism (COM(2021)0564 – C9-0328/2021 – 2021/0214(COD).
[34] CBAM - CION PROPOSAL – COUNCIL GA – EP POSITION - version of 14 DECEMBER 2022.
[35] Clingendael Institute 2022. The CBAM Effect: how the world is responding to the EU's new climate stick. May 2022.

(selected by the largest global economy) – all these call for convergence between the approaches selected in different jurisdictions and may lead to a revision in CBAM provisions.[36]

The EU is recognizing only explicit or effective carbon pricing, which may only level the playing field for the EU domestically consumed goods and may be not sufficient in avoiding EU deindustrialization. The EP directly says: “For that reason the CBAM could be an effective measure to lower emissions in third countries while ensuring a level playing field for Union industry”.[37] To support this, the EP’s CBAM text version included the provision that ‘***explicit***’ carbon price in country-exporter over the longer term should not be applicable only to the exports to the EU. It probably needs to be accepted that the CBAM remains an imperfect tool to address persistent climate policy heterogeneity in an imperfect world.

CBAM, in fact, disagrees with the well-recognized statement that “a global agreement on common carbon pricing is not possible, and even “dual track” approaches proposed for carbon pricing and convergence seem “doomed to fail”.[38] UNFCCC claims, that all Parties should have common, but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances. CBAM assumes equal burdens. But in reality, the infrastructure built in LDCs with 5 $/t$CO_2$ imposed on materials may deliver as much mitigation as 100 $/t$CO_2$ in an OECD country.[39] What really matters is not carbon price *per se*, but the share of energy or materials costs in incomes. When these are equal, there are equal incentives to use resources more efficiently.[40] A carbon price in LDCs, if equal to that in the EU ETS (Figure 1), would destroy economic growth and put an end to building infrastructure in LDCs. Mozambique’s GDP, for example, would drop by about 1.5% due to the tariffs on aluminium exports alone. Mauritania and Senegal would also be affected.[41]

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[36] Marcu A., M. Mehling, A. Cosbey. CBAM: Aligning the Design with Evolving Circumstances. ERCST. 27 October, 2022.

[37] P9_TA(2022)0248. Carbon border adjustment mechanism ***. Committee on the Environment, Public Health and Food Safety. PE697.670. Amendments adopted by the European Parliament on 22 June 2022 on the proposal for a regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism (COM(2021)0564 – C9-0328/2021 – 2021/0214(COD).

[38] Grubb M., N.D. Jordan, E. Hertwich, K. Neuhoff, K. Das, K.R. Bandyopadhyay, H. van Asselt, M. Sato, R. Wang, W.A. Pizer. Carbon Leakage, Consumption, and Trade. Vol. 47:753-795 (Volume publication data October 2022). First published as a Review in Advance on September 14, 2022. https://doi.org/10.1146/annurev-environ-120820-053625; van den Bergh JCJM, Angelsen A, Baranzini A, Botzen WJW, Carattini S, et al. 2020. A dual-track transition to global carbon pricing. *Clim. Policy* 20(9):1057–69; Haites E. 2020. A dual-track transition to global carbon pricing: nice idea, but doomed to fail. *Clim. Policy* 20(10):1344–48.

[39] Bashmakov I. and L. Nilson What are (radical) changes in industry across different industrial sectors and their physical processes? COP-27. 11 November, 2022. https://www.google.com/search?sxsrf=ALiCzsauwve5jYZmhO8nBiT-J79kyE6-fA:1671005189480&source=univ&tbm=isch&q=What+are+(radical)+changes+in+industry+across+different+industrial+sectors+and+their+physical+processes?&fir=2gGc4hUcJHR2iM%252Cv9Team-8t7K4sM%252C_%253BttA6rTDKNaOIFM%252Cv9Team-8t7K4sM%252C_%253B5konmG61JTKLVM%252Cv9Team-8t7K4sM%252C_%253BR7L2G2smaHez-M%252CaCmjEqDw2Sez7M%252C_%253B5lE_oTs5WIW7TM%252CzgGY_i9hmgLinM%252C_%253BdaMxaEPgyd7P9M%252Cv9Team-8t7K4sM%252C_%253BHXl9yvkR--NjQM%252CCuRe6yiMiXL08M%252C_%253BmB8YAQxLal3nCM%252CaCmjEqDw2Sez7M%252C_%253BGvN5257prllSmM%252Czd9yPwuW9FRBIM%252C_%253BIXheVz_3jYLMWM%252CssekAzDCVaRyoM%252C_&usg=AI4_-kRG0k_CoJJtKK0pBoju5WsEJXfA4w&sa=X&ved=2ahUKEwiU-fG10_j7AhVihosKHdOoAEkQjJkEegQIHBAC&biw=891&bih=456&dpr=2.05

[40] Bashmakov I. A., 2016. “Economics of the constants” and long cycles of energy prices dynamics. Voprosy Economiki. No. 7, 2016. Pp. 36-63. (In Russian); Bashmakov I. A., 2017. “The first law of energy transition and carbon pricing. International Journal of Energy, Environment and Economics Volume 25, Number 1; Bashmakov I.A. and A. Myshak, 2018. “Minus 1” and Energy Costs Constants: Sectorial Implications. Journal of Energy. Volume 2018, Article ID 8962437, 24 pages. https://doi.org/10.1155/2018/8962437; Bashmakov I. 2019. Energy efficiency and economic growth. *Voprosy Ekonomiki*, No. 8. (In Russian).

[41] Center for Global Development.

Equal carbon cost burden – a level playing field – emerges with the following carbon price adjustment:

$$Cprice_i^t = Cprice_{ETS}^t * GDPcap_i^t / GDPcap_{EU}^t \qquad (1)$$

where $Cprice_i^t$ is carbon price in country *i* in year *t*, and $Cprice_{ETS}^t$ is ETS carbon price;

$GDPcap_i^t$ and $GDPcap_{EU}^t$ are GDP per capita in country *i* and in the EU in year *t*.

Such approach would set a much less discriminatory mechanism for CBAM imports from LCDs. It will result in "*an equivalent carbon pricing for imports and domestic products and a level playing field",* as EP says, ensuring equal carbon pricing, which is genuinely a level playing field.[42] The EU should require that carbon price in other countries be put only on the exports to the EU, rather than on the whole domestic CBAM goods production or exports. But the EP's proposal does not allow it, considering as circumvention the case when a "CO_2 price paid in a third country is placed only on goods to be exported to the Union". It is quite unclear, why. Such provision does not create *a level playing field* for the exporting country, if the carbon price is expanded to other export markets and also to domestic markets. This EP's proposal was not taken on board in the final regulation.[43]

One of the EU ETS and CBAM goals for the EU is to promote material efficiency and recycling via higher basic material costs and prices.[44] If '*explicit*' carbon price covers more than the EU market, it means that materials in other markets will become more expensive. Therefore, in addition to losing the EU market niche, the exporters will also lose the market niches in other jurisdictions. This logic has generated additional resistance to the proposed CBAM scheme. Excise adjustment mechanisms would perform this function better, as they apply only to materials imported by the EU.

[42] P9_TA(2022)0248. Carbon border adjustment mechanism ***. Committee on the Environment, Public Health and Food Safety. PE697.670. Amendments adopted by the European Parliament on 22 June 2022 on the proposal for a regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism (COM(2021)0564 – C9-0328/2021 – 2021/0214(COD).

[43] CBAM - CION PROPOSAL – COUNCIL GA – EP POSITION - version of 14 DECEMBER, 2022.

[44] Grubb M., N.D. Jordan, E. Hertwich, K. Neuhoff, K. Das, K.R. Bandyopadhyay, H. van Asselt, M. Sato, R. Wang, W.A. Pizer. Carbon Leakage, Consumption, and Trade. Vol. 47:753-795 (Volume publication data October 2022). First published as a Review in Advance on September 14, 2022. https://doi.org/10.1146/annurev-environ-120820-053625; NEUHOFF K., O. CHIAPPINELLI, J. RICHSTEIN, H. DE CONINCK, P. LINARES, T. GERRES, G. KHANDEKAR, T. WYNS, L. ZETTERBERG, B. FELSMANN, A. ŚNIEGOCKI. 2022. Closing the Green Deal for Industry. What design of the carbon border adjustment mechanism ensures an inclusive transition to climate neutrality? The Climate Friendly Materials Platform.

Paris Agreement (PA) is based on NDCs, where the ambition level and regulatory tools are selected individually by each country. The final document on CBAM says: "CBAM is expected to effectively support reduction of emissions in third countries". Therefore, the EU's CBAM encourages growth in the level of ambition in other jurisdictions. According to Art. 3.5 of the UNFCCC, "Measures taken to combat climate change, including unilateral ones, should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade." Some countries have declared that CBAM is challenging the spirit and the letter of the PA, as it is penalizing countries with lower ambition in their NCDs, uses non-price instruments, and is not compatible with WTO.[45]

6. Alternatives to CBAM

There is much enthusiasm about coupling the ETS reform to eliminate free allowances with CBAM, which is believed to produce a unique 'window of opportunity' to implement the EU Green Deal reform. This may work out, if CBAM proves to be effective, but many experts recognize the shortcoming of the proposed CBAM scheme and offer alternatives.[46] One includes the combination of three elements:[47]

- excise charges on carbon intensive products;
- carbon contracts for difference (CCfD)[48] to support low carbon materials lead markets;
- free allowances for conventional basic materials producers to avoid double charging from climate contribution and EU ETS.

Excise charges do not require administratively intensive carbon footprint assessment. They allow it that carbon costs be reflected in material prices in the EU market. Contracts for difference (CCfDs) are proposed to support low carbon product manufacturing.[49] They have demonstrated their efficiency as a mechanism to support renewables penetration. A strike price for renewables is set, and when the wholesale market price gets above this price, the producer gets the gap, and vice versa. This works well for a homogenous product (electricity) with costs dominated by levelized CAPEXes. For CBAM products, this mechanism cannot be that simple, because there are many other important violative cost factors, and product qualities may differ within one code group. The authors argue, that such combination minimizes the cost to the society. For example, liabilities for importers can be calculated and verified easily, as it is based on the weight of the

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[45] Marcu A., M. Mehling, A. Cosbey. CBAM: Aligning the Design with Evolving Circumstances. ERCST. 27 October, 2022.
[46] CENEf (2021). CBAM. Impact on the Russian economy. Moscow: Center for Energy Efficiency-XXI. (In Russian).
[47] Grubb M., N.D. Jordan, E. Hertwich, K. Neuhoff, K. Das, K.R. Bandyopadhyay, H. van Asselt, M. Sato, R. Wang, W.A. Pizer. Carbon Leakage, Consumption, and Trade. Vol. 47:753-795 (Volume publication data October 2022). First published as a Review in Advance on September 14, 2022. https://doi.org/10.1146/annurev-environ-120820-053625; NEUHOFF K., O. CHIAPPINELLI, J. RICHSTEIN, H. DE CONINCK, P. LINARES, T. GERRES, G. KHANDEKAR, T. WYNS, L. ZETTERBERG, B. FELSMANN, A. ŚNIEGOCKI. 2022. Closing the Green Deal for Industry. What design of the carbon border adjustment mechanism ensures an inclusive transition to climate neutrality? The Climate Friendly Materials Platform.
[48] See CENEf-XXI for Rosatom. Comparative analysis (benchmarking) of globally existing mechanisms of support for the development of RE-based generation. Moscow. 2019.
[49] Grubb M., N.D. Jordan, E. Hertwich, K. Neuhoff, K. Das, K.R. Bandyopadhyay, H. van Asselt, M. Sato, R. Wang, W.A. Pizer. Carbon Leakage, Consumption, and Trade. Vol. 47:753-795 (Volume publication data October 2022). First published as a Review in Advance on September 14, 2022. https://doi.org/10.1146/annurev-environ-120820-053625; NEUHOFF K., O. CHIAPPINELLI, J. RICHSTEIN, H. DE CONINCK, P. LINARES, T. GERRES, G. KHANDEKAR, T. WYNS, L. ZETTERBERG, B. FELSMANN, A. ŚNIEGOCKI. 2022. Closing the Green Deal for Industry. What design of the carbon border adjustment mechanism ensures an inclusive transition to climate neutrality? The Climate Friendly Materials Platform.

materials covered, international trade conflicts are mostly avoided, as the mechanism builds on well-established WTO principles for excise charges.

The IRA (see below) challenges the strong EU's believe that carbon price is the most cost-effective mitigation instrument by providing huge subsidies. Therefore, the score in the battle between EU companies dead-weighted with large carbon costs and the US companies alleviated with subsidies is yet to be seen.

7. The U.S. Inflation Reduction Act

The US Inflation Reduction Act (IRA, August 16, 2022) is an example of non-price-based mitigation market mechanism. IRA incorporates multiple provisions to support GHG emission reduction through tax credits, which are the key instrument. This approach is different from the one used by the EU. The U.S. provides government funding to support low carbon technologies penetration and to improve the competitiveness of locally produced goods (supported by the localization requirement); it is expected to generate more budget revenues in the coming decades, while the EU collects ETS and CBAM revenues. In other words, **the US approach brings down the costs of producers, while the approach used by the EU works to increase them.**

CBAM regulation for the U.S.-manufactured goods with no effective carbon price will thus use the EU ETS price. But the way this regulation is written, subsidies will not be accounted for. Therefore, the competitive advantage of the US goods will be a balance of levelized costs: $a * Sub_i^t + Cprice_i^t$:

$$LCOP_i^t = (a * (I_i^t - Sub_i^t) + OC_i^t + Cprice_i^t)/P_i^t \tag{2}$$

where $Cprice_i^t$ is carbon price for product *i* in year *t*;

OC_i^t is operational costs for product *i* in year *t*;

P_i^t is production level for product *i* in year *t*.

The effects of the subsidies are not well-studied compared to the price effects. In many models, logit functions are used to determine the share of energy efficient technologies in the newly commissioned facilities:[50]

$$Share_i^t = \frac{a_i * LCOP_{it}^{-2}}{\sum_i a_i * LCOP_{it}^{-2}} \tag{3}$$

Policies can affect the a_i parameter, capturing the priority of a particular technology, and the *LCOP* parameter. It get s up with carbo price, or down if there are subsidies. Based on equation (3), for the conditional example,[51] the dependence of the low carbon technology market share on the share of subsidies is estimated for three options of parameter a_i for the fourth technology (Figure 5). It

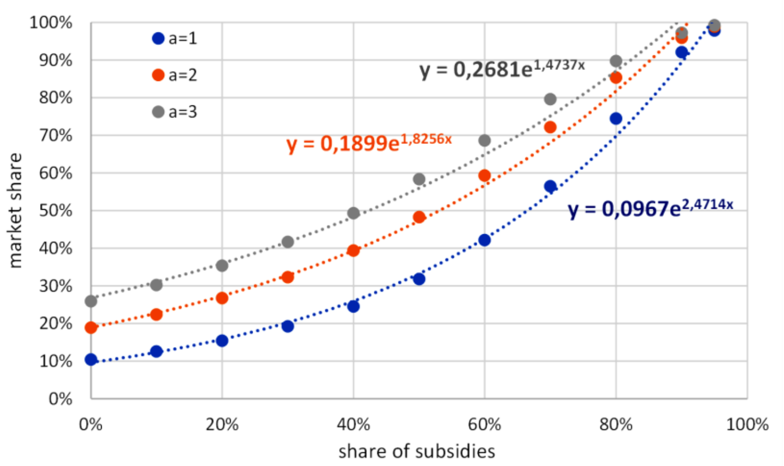
[50] These functions are widely used in modelling: Despres, J., Keramidas, K., Schmitz, A., Kitous, A., Schade, B. POLES-JRC model documentation – 2018 update, EUR 29454 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-97300-0, doi:10.2760/814959, JRC113757; EIA. 2020. Model Documentation Report: Industrial Demand Module of the National Energy Modeling System. December 2020. US DOE. IEA uses the same logic, but a more complex set of functions: IEA. 2021. World Energy Model Documentation. October 2021; Bashmakov I., V. Bashmakov, K. Borisov. M. Dzedzichek, A. Lunin, I. Govor (2022). Russia's carbon neutrality: pathways to 2060. CENEf-XXI. https://cenef-xxi.ru/articles/russia's-carbon-neutrality:-pathways-to-2060.

[51]

technology	LCOP	incremental LCOP	*a*	market share	carbon intensity
1	10	0	1	37.9%	1.0
2	12	2	1	26.3%	0.9
3	15	5	1	16.8%	0.8
4	20	10	2	18.9%	0.7

is clear that substantial subsidies and strong supporting policies may substantially escalate low carbon technologies penetration.

Figure 5. Market share of low carbon technology as the share of subsidies



Source: Authors.

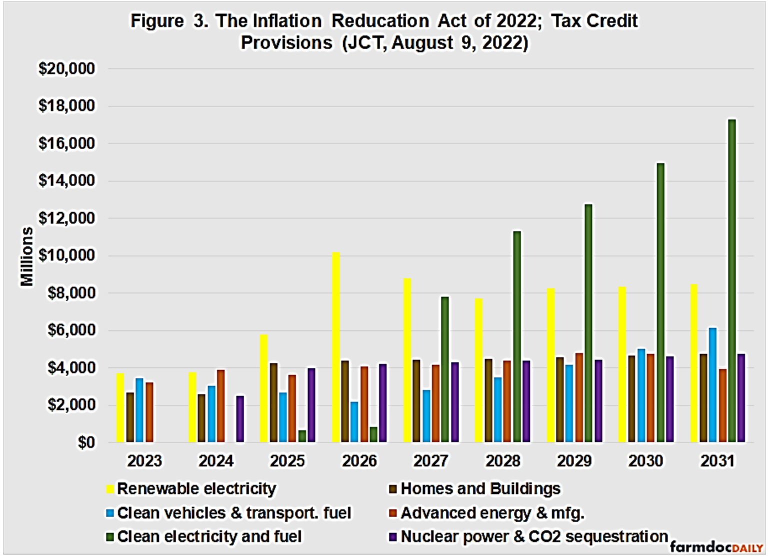
IRA provides \$391 billion in support to energy security and climate mitigation via a large variety of tax incentives, grants and concessionary loans, which are expected to leverage \$1.7 trillion in financing.[52] The main allocation areas are (Figure 6) as follows:[53]

- \$128 billion for renewable energy and grid energy storage;
- \$37 billion for advanced manufacturing;
- \$30 billion for nuclear power;
- \$22 billion for home energy supply improvements;
- \$14 billion for home energy efficiency upgrades;
- \$13 billion for electric vehicle incentives;
- \$9 billion in home energy rebate programs that focus on improving access to energy efficient technologies, and 10 years of consumer tax credits for the use of heat pumps, rooftop solar, and high-efficiency electric heating, ventilation, air conditioning and water heating;
- \$3 billion in tax incentives for installing carbon capture and storage at existing power plants;
- \$3 billion to electrify the USPS fleet.

This large-scale support may generate larger carbon leakage from the EU to the U.S., than to any other jurisdiction.[54] It differs from free allocation support in the EU and is going to scale up, while free allocations are expected to scale down.

[52] American Public Power Association, *Ultimate Public Climate Spending Spurred by Inflation Reduction Act Could be Over \$800 Billion: Credit Suisse*, 19 October 2022, https://www.publicpower.org/periodical/article/ultimate-public-climate-spending-spurred-inflation-reduction-act-could-be-over-800-billion-credit.
[53] https://en.wikipedia.org/wiki/Inflation_Reduction_Act_of_2022#Provisions.
[54] Marcu A., M. Mehling, A. Cosbey. CBAM: Aligning the Design with Evolving Circumstances. ERCST. 27 October, 2022.

Figure 6. Tax credits under the IRA



Source: Reviewing the Inflation Reduction Act of 2022, Part 3: The Bigger Picture – farmdoc daily (illinois.edu)

CCUS. Inflation Reduction Act (IRA) provides tax credits for the carbon capture industry—increasing the government subsidy for capturing CO_2 from facilities put in service after 2022 up to \$85/tCO_2 and simplifies the tax credits receiving process. It also opens the subsidy to smaller carbon capture projects. Up to \$85/tCO_2 incentive (tax credit) is sufficient to motivate CCUS projects at facilities with low CO_2 concentration. IRA makes CCUS tax credits eligible for a structure called direct pay, which simplifies project financing and opens the tax credits to smaller players that lack substantial tax bills to offset.[55] The tax credits for direct air capture are much higher –\$36-180 tCO_2 for storage and \$26-130 tCO_2 for utilization. Such incentives are critical for the technology development.[56] IRA extends tax credits for industrial applications of CCS and leverages Bipartisan Infrastructure Law investments in CCS demonstrations and CO_2 transportation infrastructure to abate emissions in ethanol, cement, and refining. This builds on \$1 billion in R&D funding for carbon removal provided by the recently passed CHIPS Act. For DAC facilities, the capacity threshold is reduced from 100,000 to 1,000 t; for power-generating facilities, from 500,000 to 18,750 t; and for other facilities, from 100,000 to 12,500 t.[57] IRA builds upon last 2021 infrastructure law, which provides \$100 million for the DOE to design CO_2 pipelines to underground storage sites, \$2.1 billion in loans and grants for the private sector to build the CO_2 pipelines, and \$3.5 billion to construct four "hub" facilities to remove CO_2 from the atmosphere. Together these facilities will be able to sequester less than 0.1% of the CO_2 the U.S. emits each year.

Heavy industry decarbonization and green material markets. Some \$6 billion in grants and tax credits are made available to support companies in decarbonizing heavy industries — chemicals, cement and steel. IRA creates a market for tax credits, as it allows tax-exempt entities, including state and local governments, to claim credits as cash refunds (rather than offsets against taxes otherwise payable). The election is also available to other taxpayers, but only for a maximum of five years. The act allows taxpayers to sell credits tax-free by transferring the credits to other taxpayers in exchange for cash.[58]

[55] https://www.jonesday.com/en/insights/2022/08/inflation-reduction-act-expands-carbon-capture-and-sequestration-tax-credit; https://time.com/6205570/inflation-reduction-act-carbon-capture/
[56] https://cen.acs.org/policy/legislation-/Inflation-Reduction-Act-chemistry/100/web/2022/08
[57] https://www.jonesday.com/en/insights/2022/08/inflation-reduction-act-expands-carbon-capture-and-sequestration-tax-credit
[58] https://cen.acs.org/policy/legislation-/Inflation-Reduction-Act-chemistry/100/web/2022/08

The IRA launches a $5.8 billion-worth Advanced Industrial Facilities Deployment Program which is designed to provide financial support for the application of advanced industrial low carbon technologies, including electrification, application of low-carbon fuels, CCUS. This will promote emission reductions in emission-intensive industrial sectors. The IRA provides over $60 billion in subsidies for carbon-free power generation, split evenly between domestic capacity building for renewables and production tax credits for existing nuclear plants.

The IRA leverages the purchasing power of the federal government to support demand for low-carbon construction materials through procurement provisions. It also supports standardizing Environmental Product Declarations to make it easier for the federal government and other customers to purchase low carbon materials.[59]

Hydrogen. The hydrogen production tax credit will leverage the hydrogen hub and demonstration investments from the Bipartisan Infrastructure Law to drive up hydrogen production and use in production of ammonia, petroleum products, steel, biofuels, and heavy-duty transportation.[60]

Methane emissions. The IRA also provides $1.55 billion to the US EPA for loans, grants, rebates, and contracts to support oil and gas industry in reducing methane emissions. It authorizes the EPA to charge a per-ton fee on methane emissions above project- and site-specific thresholds. Many of the capture and emission reduction incentives in the IRA also apply to methane, as well as nitrous oxide, fluorocarbons, and other greenhouse gases.[61]

Localization provisions. Many IRA tax incentives have localization provisions. They are conditional to domestic-production or domestic-procurement requirements. For example, scaling up percentage of critical minerals in the battery to be recycled, extracted or processed in the U.S. or in a country which has a free-trade agreement with the U.S., and the battery must also be manufactured or assembled in North America.

A specific feature of the IRA is the linkage of the amount of the tax deduction with the degree of localization in the purchased equipment. Depending on the equipment, the required share of localization grows from 20-40% in 2025 to 55% in 2028.[62] This is a reasonable schedule for increasing the localization requirement, which does not require a transition to 100%, as it would either increase the cost of products or reduce the qualities. Both subsidies and localization provisions provide competitive advantages to US products and undermine the competitiveness of the EU and other low carbon suppliers. The issue of equal footing of price-based and non-price-based policies cannot be ignored by the EU anymore.[63]

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[59] https://www.energy.gov/sites/default/files/2022-08/8.18%20InflationReductionAct_Factsheet_Final.pdf

[60] https://www.energy.gov/sites/default/files/2022-08/8.18%20InflationReductionAct_Factsheet_Final.pdf

[61] https://cen.acs.org/policy/legislation-/Inflation-Reduction-Act-chemistry/100/web/2022/08

[62] Inflation Reduction Act Offers Significant Tax Incentives Targeting Energy Transition and Renewables | White & Case LLP (whitecase.com)

[63] Strictly price-based policies run counter to the spirit of the Paris Agreement. Marcu A., M. Mehling, A. Cosbey. CBAM: Aligning the Design with Evolving Circumstances. ERCST. 27 October, 2022.

8. Carbon clubs

One problem with CBAM is the recognition of carbon pricing as the most effective mitigation instrument. The US administration uses a very different approach in the IRA concentrating on subsidies. Therefore, the gap with carbon prices and so the need for importers to pay the CBAM price is fully applied to US products and even aggravated by subsidies, which are not welcomed by the EU. Another G7 member –Japan –has no national carbon pricing system either.[64] It has become clear, that conflicts and trade frictions associated with the different visions of effective climate regulation may be substantial and it is important to have some kind of institution to handle such conflicts. To address these problems, the European Parliament for the first-time formulated amendments as the carbon club provisions to the Commission's CBAM proposal.[65] They were then reflected in the final CBAM document. The final regulation says: "The establishment of the CBAM calls for the development of bilateral, multilateral and international cooperation with third countries. For this purpose, a forum of countries with carbon pricing instruments or other comparable instruments ('Climate Club') should be set up, in order to promote the implementation of ambitious climate policies in all countries and pave the way for global carbon pricing framework".[66]

The Carbon club objective is to allow for the comparison and coordination of carbon pricing measures, as well as non-carbon pricing measures with an impact on emission reduction. According to the EP and the final regulation, the Carbon club should:

- ensure continuous exchange in good faith with the Union's trade partners;
- be voluntary and open non-exclusive international forum, aiming for high climate ambition in line with the Paris Agreement which could be located under an appropriate multilateral organization (WTO or the OECD);
- support the comparability of climate measures by ensuring the quality of climate monitoring, reporting and verification among its members. Membership of the club should be informal, open and on a voluntary basis for countries aiming at high climate ambition in line with the Paris Agreement.

On December 12, German Chancellor O. Scholz presented the 'climate club' as a platform for countries wishing to protect the climate with club's four-page "terms of reference" text approved by G7 members. It describes climate club as a high-ambition intergovernmental forum for discussion to facilitate transition to a near zero industrial production emissions.[67] In parallel, the Biden Administration suggested the creation of a consortium to boost trade in low carbon metals with creating tariffs on less "green" metals. To join, countries would have to ensure that their steel and aluminium industries meet certain emissions standards. But the 'climate club' is not yet global and doesn't eliminate problems with paying CBAM fees for exports to the EU.

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[64] Grubb M., N.D. Jordan, E. Hertwich, K. Neuhoff, K. Das, K.R. Bandyopadhyay, H. van Asselt, M. Sato, R. Wang, W.A. Pizer. Carbon Leakage, Consumption, and Trade. Vol. 47:753-795 (Volume publication data October 2022). First published as a Review in Advance on September 14, 2022. https://doi.org/10.1146/annurev-environ-120820-053625.

[65] P9_TA(2022)0246 Revision of the EU Emissions Trading System. Amendments adopted by the European Parliament on 22 June 2022 on the proposal for a directive of the European Parliament and of the Council amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757 (COM(2021)0551 – C9-0318/2021 – 2021/0211(COD).

[66] CBAM - CION PROPOSAL – COUNCIL GA – EP POSITION - version of 14 DECEMBER, 2022.

[67] Green industry: G7 sets out terms for global 'climate club' – EURACTIV.com

In his presentation at COP-27 IPCC session on industry, Chris Bataille broke down the concepts of carbon clubs into negative and positive.[68] The original conception of negative, exclusionary climate clubs was introduced by Nordhaus as a group of nations with strong climate policy setting a collective border carbon tariff to protect their industries. Bataille pointed out that this conception dominates trade thinking. He opposes this concept with positive, inclusionary climate clubs to be formed to work together on a shared GHG accounting and MRV systems; technology development costs and risk sharing, pooling and sharing lead market costs. In this concept, non-participants are welcome to export ultra-clean products and even capture lead market subsidies on parity with domestic producers with funding (increased for developing country applicants) provided on a first-come–first-served basis for early retirement of high-emitting facilities, replaced with ultra-low emitting facilities. Grubb et al.[69] echo this, pointing out that the approach on cooperation emphasizes the potential for positive gains from membership, benefits of internal cooperation, from harmonizing rules, from a focus on coordinated measures to accelerate innovations, and build markets for them.

9. Recent implications of energy crisis and military operation for EU. EU CBAM materials production and import

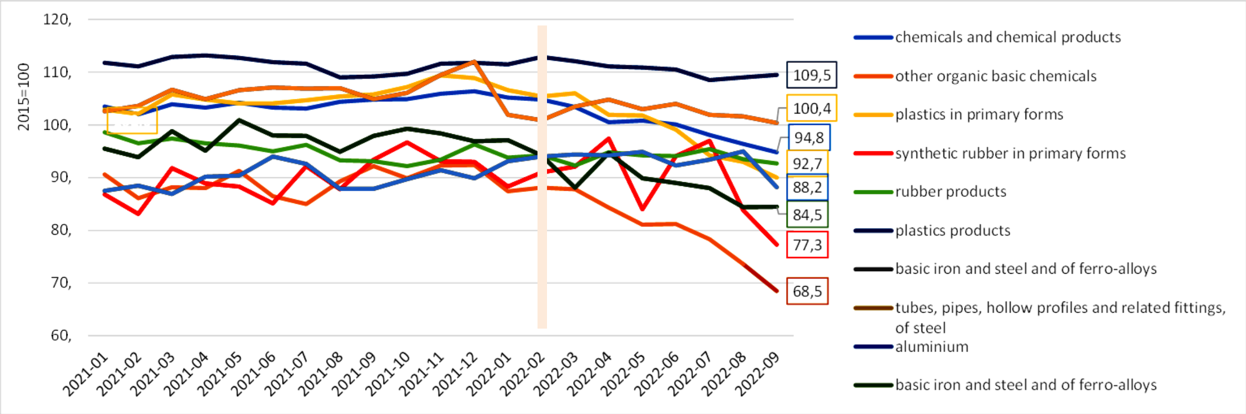
2021 EU industry revival after the 2020 COVID crisis was suddenly interrupted by the negative impacts of the Russian military operation. “European industry now finds itself subject to a host of unforeseen negative forces”:[70] the energy price shocks, uprise of basic materials prices and general inflation, supply chains interruptions and other effects led to reversing industrial production trends to decline, accelerating the EU deindustrialization and corresponding carbon leakage. Only plastics and other organic basic chemicals production in September 2022 stood above the 2015 level (Figure 7). Particularly abrupt production reductions since February 2022 were registered for other organic basic chemicals (-22%); plastics in primary forms (-15,1%); synthetic rubber in primary forms (-16,1%); chemicals and chemical products (-8,3%); tubes, pipes, hollow profiles and related fittings, of steel (-6,6%); basic iron and steel and of ferro-alloys (-4,1%); aluminium (-3%); plastics products (-2,3%), and only rubber products demonstrated a small growth (0,4%).

[68] Bataille C., 2022. Deep mitigation in industrial sectors exposed to international competition How can we trigger investment in clean technologies and processes in a world moving at different climate policy speeds? COP-27 IPCC session on industry. November 11, 2022.

[69] Grubb M., N.D. Jordan, E. Hertwich, K. Neuhoff, K. Das, K.R. Bandyopadhyay, H. van Asselt, M. Sato, R. Wang, W.A. Pizer. Carbon Leakage, Consumption, and Trade. Vol. 47:753-795 (Volume publication data October 2022). First published as a Review in Advance on September 14, 2022. https://doi.org/10.1146/annurev-environ-120820-053625.

[70] Marcu A., M. Mehling, A. Cosbey. CBAM: Aligning the Design with Evolving Circumstances. ERCST. 27 October, 2022.

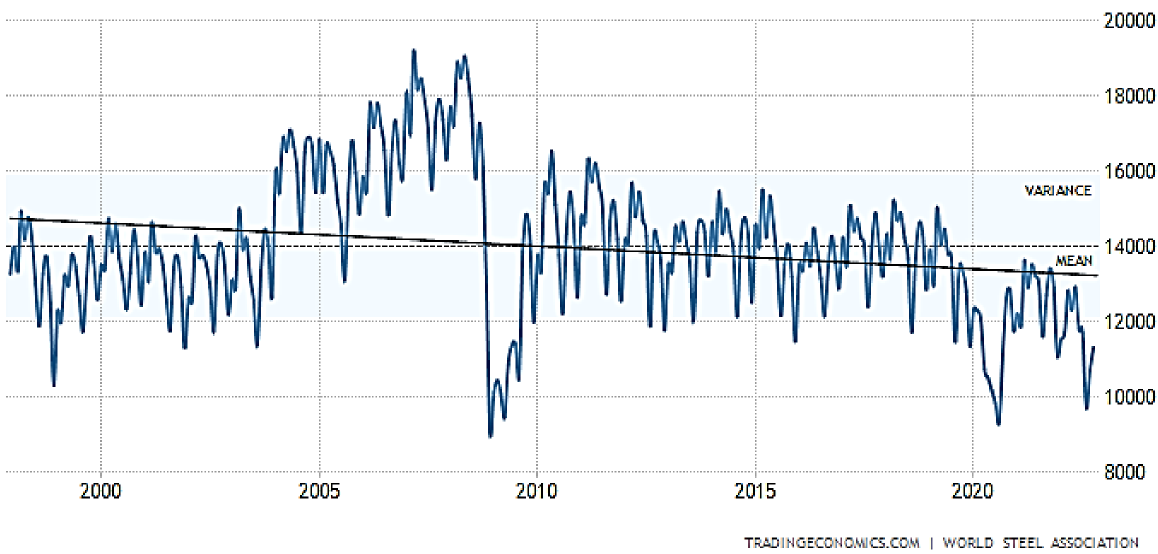
Figure 7. Monthly EU basic materials production indexes. 2021-2022



Sources: Eurostat, December 2022.

Iron and steel. After some recovery from the 2020 COVID crisis in 2021, EU steel production is on decline in 2022 comparable with the 2020 decline (Figure 8). Steel production peaked in 2009 and then was quite stable in 2010-2019 oscillating around 14 thou. tons per month. Therefore, no carbon leakage was observed in that period. In January-October 2022, EU monthly steel production was on average 11,630 tons per month, or over 10% below the 2021 level. In 2020-2022 the trendline was obviously declining.

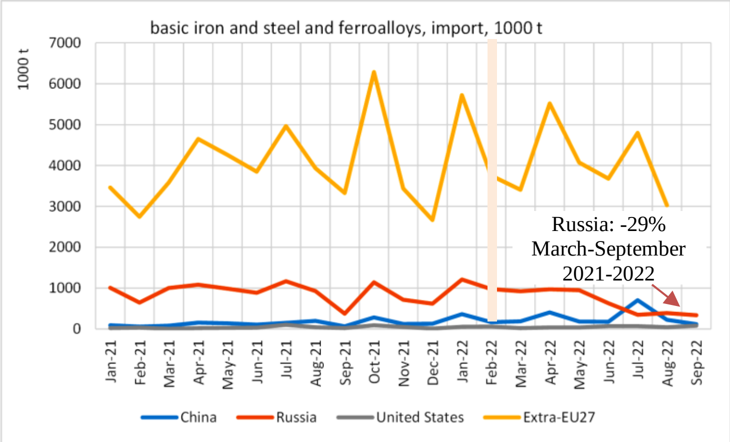
Figure 8. Monthly EU steel production. 2000-2022

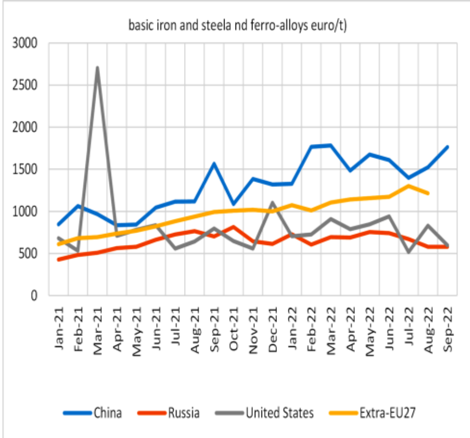


Source: European Union Steel Production - November 2022 Data - 1990-2021 Historical (tradingeconomics.com)

Three positions on iron and steel are reported by Eurostat EU import statistics: basic iron and steel and ferro-alloys; tubes, pipes, hollow profiles and related fittings; and other products of the first processing of steel. The evolution of import to the EU is shown in Figure 9.

Figure 9. Monthly EU iron and steel products import and import prices. 2021-2022

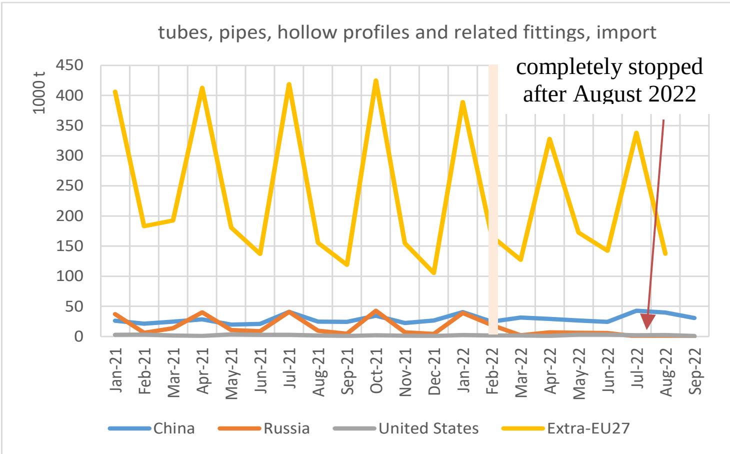


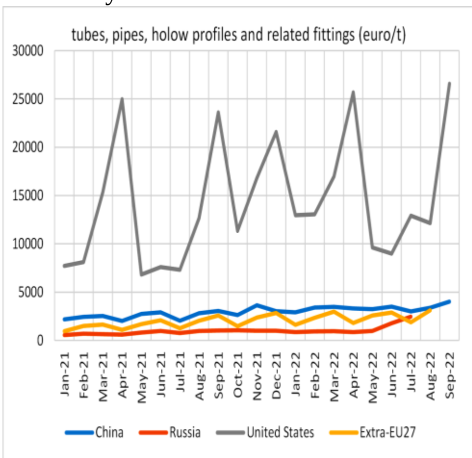


import volumes

import prices

basic iron and steel and ferro-alloys

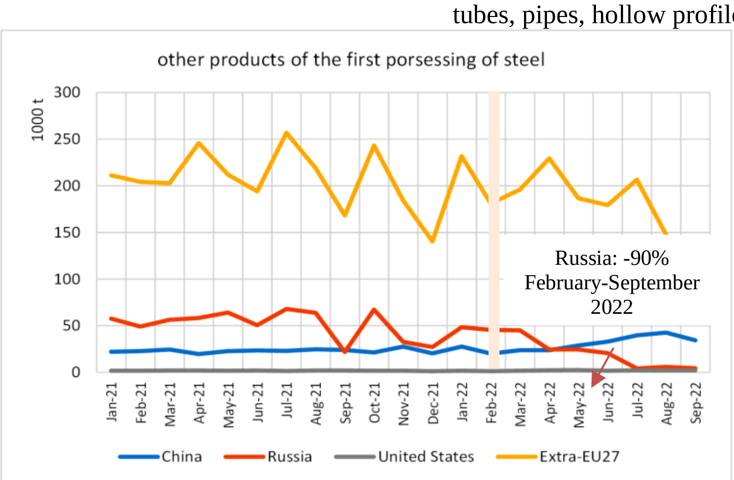


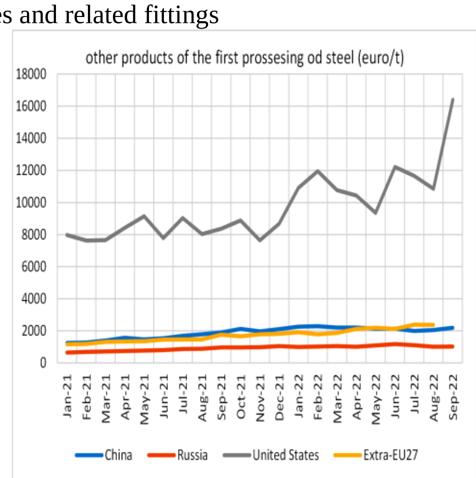


import volumes

import prices

tubes, pipes, hollow profiles and related fittings





import volumes

import prices

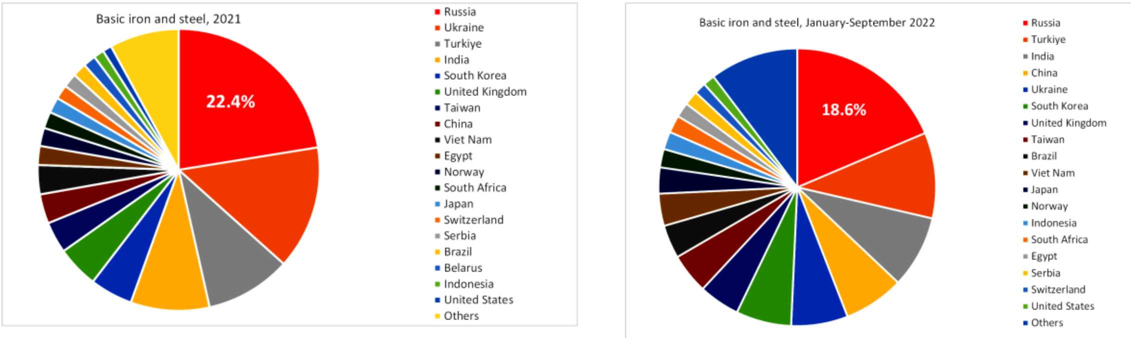
other products of the first processing of steel

Source: CENEf-XXI based on Eurostat, 2022. Database DS-057009 "EU trade 1988-2022 by CPA 2008" http://epp.eurostat.ec.europa.eu/newxtweb/mainxtnet.do

After the sanctions were imposed, basic iron and steel and ferro-alloys exports from Russia dropped by 29% in March-September 2022 versus the same period in 2021 and by 65% in September 2022 comparing with February 2022. The imports of tubes, pipes, hollow profiles and related fittings from Russia practically stopped in July 2022. For other products of the first processing of steel, the import in September 2022 was only 10% of that in February 2022. For all the three items, there was a decline in total imports to the EU, and so the EU lost the least expensive Russian steel supply.

For tubes, pipes, hollow profiles and related fittings and for other products of the first processing of steel, the loss in Russian exports was offset by the growing exports from China. In all, Russia lost 3.8% of the EU basic iron and steel and ferro-alloys import market share (Figure 10). China was the beneficiary. The EU and Russian steel production carbon intensity is lower, than in China. Against the background of steel production reduction in the EU, this manifests carbon leakage in 2022 which is not related to the carbon price gap. The takeaway here is as follows: unless the current sanctions are lifted, CBAM risks for iron and steel exports from Russia are low. They are totally eclipsed by the risks of the sanctions.

Figure 10. Geographical structure of EU basic iron and steel and ferro-alloys imports. 2021-2022

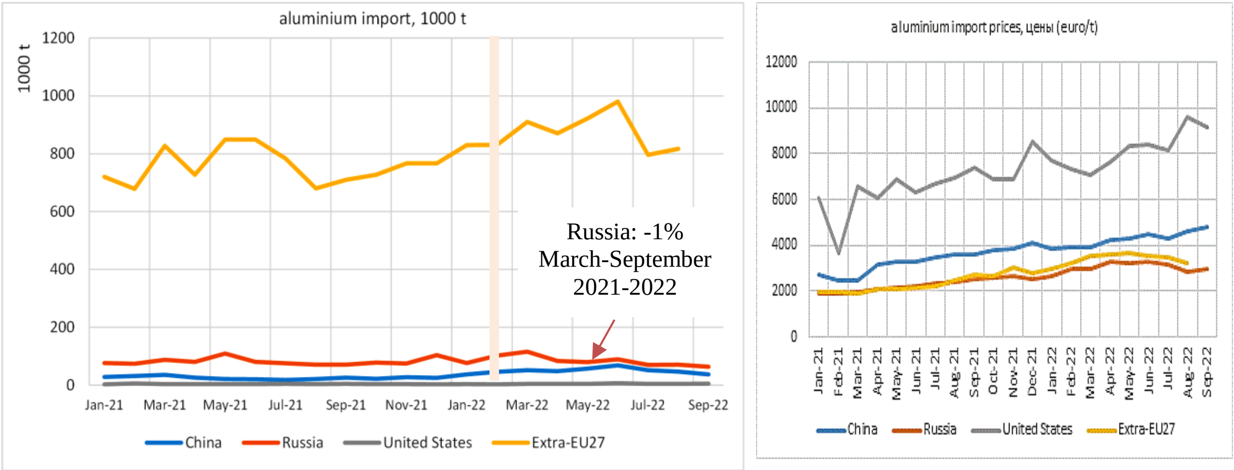


Sources: Eurostat, December 2022.

Aluminium. Growing electricity prices in the EU have driven up primary aluminium manufacturing costs and metal price and reduced both domestic competitiveness and demand. According to International Aluminium Institute Western & Central Europe, primary aluminium production was 12% down in March-October 2022 compared to March-October 2021[71] and the drop was deeper in the EU alone. This initially generated a higher demand for imports (Figure 1) by June 2022, but then the recession pushed it down. Imports from Russia in March-September 2022 was only 1% below the same period in 2021. Five European industry associations urged European authorities from sanctions, tariffs or boycotts against Russian aluminium that they said could put thousands of companies out of business.[72] This is due to a decline in primary aluminium production in the EU, as energy and power prices skyrocketed there in 2022. Due to aluminium price growth Russia earned 39% more on aluminium exports to the EU in March-September 2022 compared with the same period in 2021. Nevertheless, aluminium imports from Russia to the EU were among the least expensive (Figure 11).

[71] Primary Aluminium Production - International Aluminium Institute (international-aluminium.org)
[72] Business groups say bans on Russian aluminium will decimate European industry | Reuters

Figure 11. Monthly EU aluminium imports and import prices. 2021-2022



import volumes import prices

Source: CENEf-XXI based on Eurostat, 2022. Database DS-057009 "EU trade 1988-2022 by CPA 2008" http://epp.eurostat.ec.europa.eu/newxtweb/mainxtnet.do

Additional aluminium demand for import was partly met by China (plus 217 thousand tons in January-September 2022) against the background of reduced domestic production in the EU. Therefore, the 2022 energy crisis generated some carbon leakage, as Chinese primary aluminium production is considered much more carbon intensive, than the EU or Russian production.[73] This makes clear that energy price shocks and the market situation can generate much higher leakage compared with that originating from carbon price gaps alone. In February-October 2022, the EU aluminium import price from China went up by 910 $/t. With 15 000 kWh per ton of primary aluminium and 0.25-0.3 kg CO_2/kWh it makes 202-240 $/t$CO_2$ carbon price gap. Even this high additional carbon price in China will not prevent carbon leakage.

Fertilizers. Europe produced 18.3 million tons of nitrogen fertilizers and consumed 17 million tons in 2021.[74] Eurostat reports an 8% decline in EU fertilizers production in 3Q2022 (Figure 12). According to some estimates, after natural gas prices peaked, the industry shut down 70% of its ammonia production,[75] and fertilizers production is running at only 50% capacity.[76]

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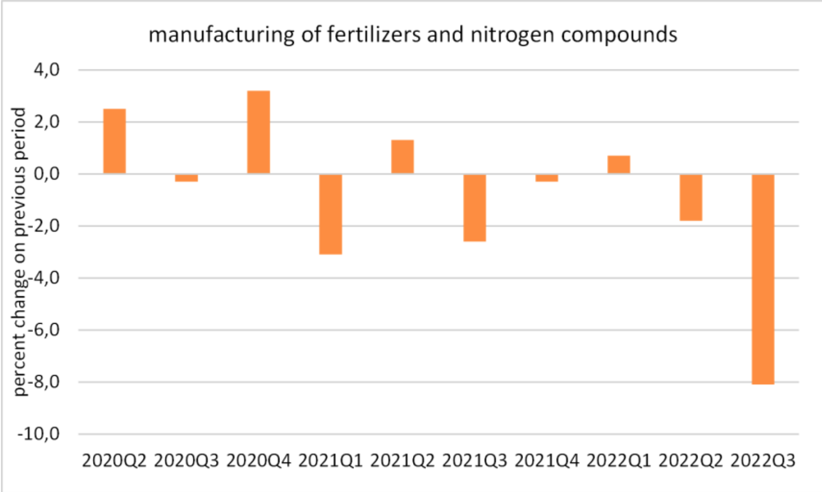
[73] Bashmakov I.A. CBAM and Russian export. *Voprosy Ekonomiki*. 2022;(1):90-109. (In Russ.) https://doi.org/10.32609/0042-8736-2022-1-90-109$; CENEf (2021). CBAM. Impact on the Russian economy. Moscow: Center for Energy Efficiency-XXI. (In Russian).

[74] Fertilizers Europe. Fertilizer Industry Facts & Figures 2022.

[75] E.U. Announces Measures to Ensure Fertilizer Supply, Lower Costs - Olive Oil Times

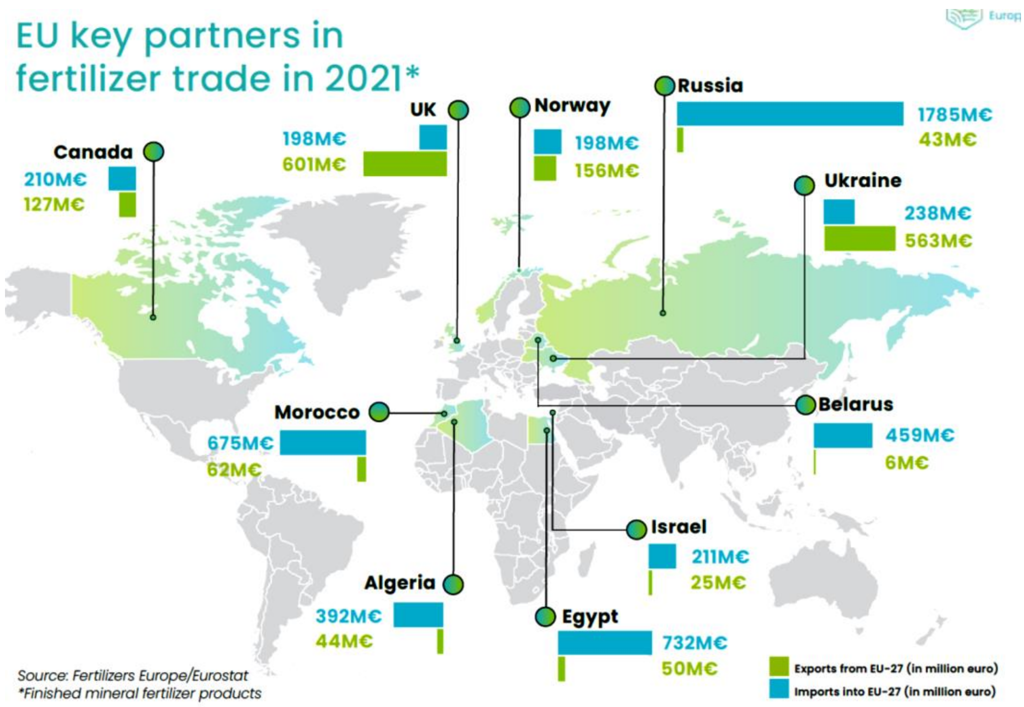
[76] Energy crisis in Europe hits fertilizer production (aa.com.tr)

Figure 12. **Quarterly indexes of EU fertilizers production. 2020-2022**



Source: Eurostat, December 2022.

Figure 13. **EU key partners in fertilizer trade in 2021**

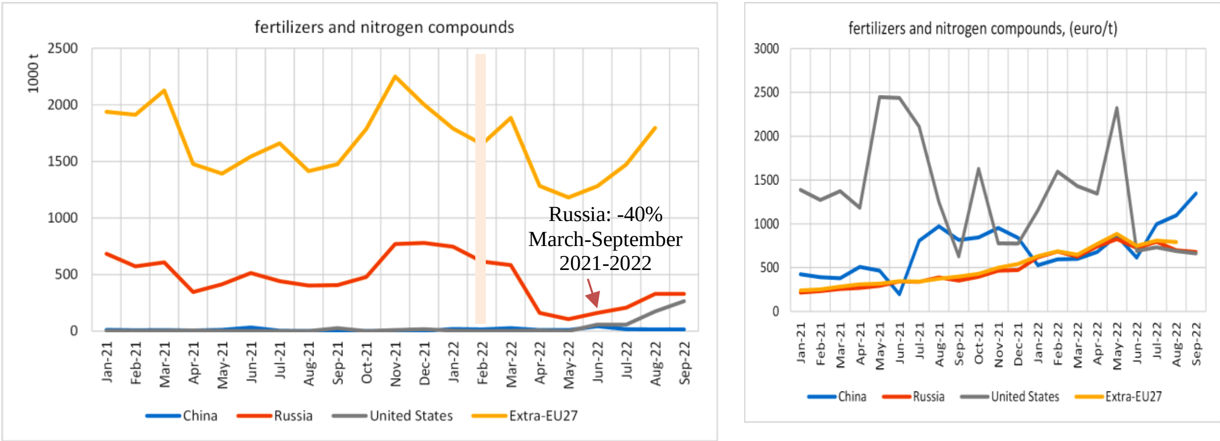


Source: Fertilizers Europe. Fertilizer Industry Facts & Figures 2022.

Russia and Belarus provided about 60% of the EU's fertilizer supply in 2021 (Figure 13). EU sanctions do not severely affect fertilizers imports from Russia. About 80% of nitrogen and phosphorous fertilizers can be imported from Russia without constraints. The rest of the imports, including potash and mixtures containing potash, are allowed with a limit corresponding to the volumes of historical trade.[77] However, sanctions imposed in other areas, such as banking, transportation and insurance, negatively affect the imports, and so does domestic EU demand reduction driven by low affordability because of the high fertilizer prices (Figure 14). All these factors have led to 40% year-to-year reduction in the EU imports from Russia in March-September 2022. This was followed by some rebound since August after a deep fall in February-May. The CBAM risks for Russian fertilizers exports to the EU remain high.

[77] EU fertilizer sector at a crossroads amid world's multiple crises – EURACTIV.com

Figure 14. Monthly EU fertilizers imports and import prices. 2021-2022

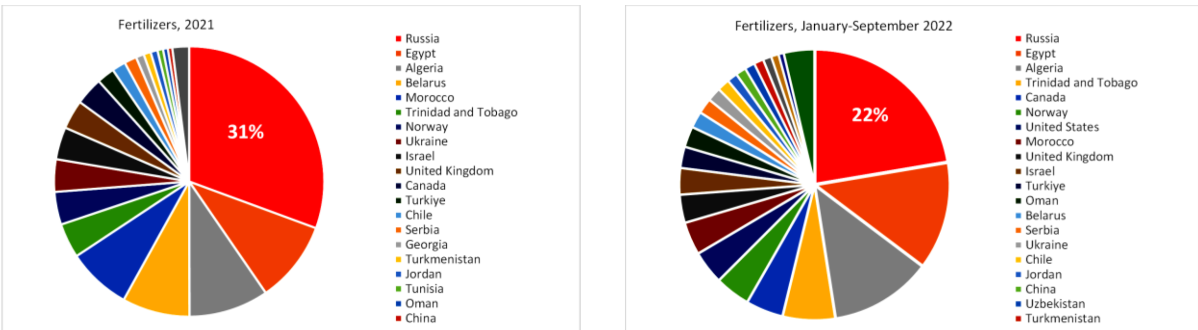


import volumes import prices

Source: CENEf-XXI based on Eurostat, 2022. Database DS-057009 "EU trade 1988-2022 by CPA 2008" http://epp.eurostat.ec.europa.eu/newxtweb/mainxtnet.do

Russia has lost 8.3% of the EU fertilizers imports market share. After May 2022, growing EU fertilizers import demand was met mostly by the U.S., Egypt, Algeria, Trinidad and Tobago, and Canada (Figure 15). So, since May onwards, carbon was mostly leaking from the EU to the U.S. and Africa. Our analysis shows, that carbon intensity of ammonia in the EU does not differ much from that in other countries, so there are no grounds to judge whether carbon leakage resulting from a large-scale relocation of fertilizers production from the EU to other jurisdictions has generated any net global GHG emissions increment.

Figure 15. Geographical structure of EU fertilizers imports. 2021-2022

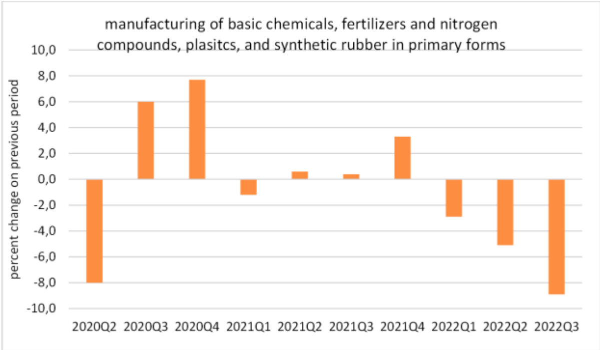


Sources: Eurostat, December 2022.

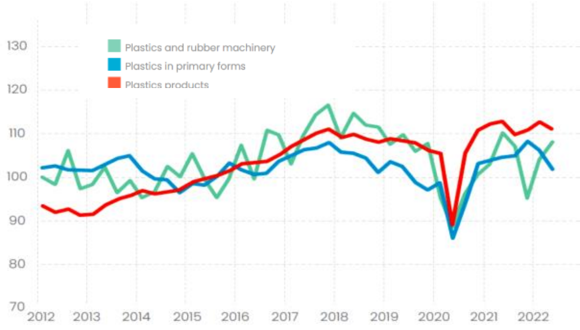
Other chemicals. After rebounding from COVID, production of basic chemicals stayed nearly stable in 2021 and faced a sharp reduction in 2022 (Figure 1). After a decrease in 2020 due to the COVID pandemic, European plastics production grew up to 57.2 million tons in 2021.[78] In 2022, the military operation in Ukraine aggravated the problems which had already existed in the supply chains and led to feedstock and energy price increase bringing down the plastics demand. Plastic production decline in 2022 is expected at 4%.[79] Russia is exporting relatively cheap chemicals to the EU, and also imports plastics from the EU (Figure 16). EU year-to-year imports from Russia were 45% down in March-September 2022 (Figure 18). Chemicals from Russia were partly substituted by China and the U.S.

[78] Plastics Europe. Plastics – the Facts 2022. OCTOBER 2022.
[79] Ibid.

Figure 16. **EU manufacturing of basic chemicals, fertilizers and nitrogen compounds, plastics and synthetic rubber in primary forms**



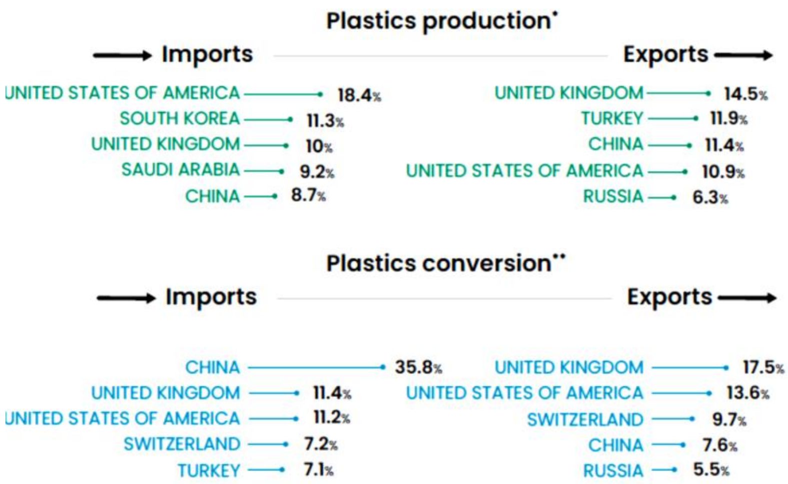
quarterly indexes of EU manufacturing of basic chemicals, fertilizers and nitrogen compounds, plastics and synthetic rubber in primary forms



plastics industry production in EU27

Sources: Eurostat, December 2022; Plastics Europe. Plastics – the Facts 2022. October 2022.

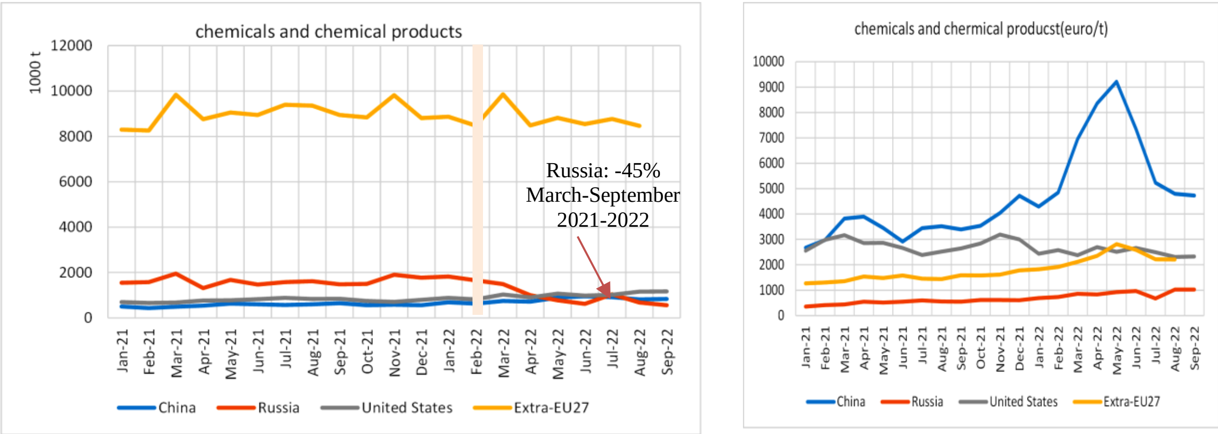
Figure 17. **Top extra EU trade partners (in value). Plastics. 2021**



* Plastics production – official Eurostat denomination: Manufacture of plastics in primary forms.
** Plastic products – official Eurostat denomination: Manufacture of plastics products.

Source: Plastics Europe. Plastics – the Facts 2022. October 2022.

Figure 18. Monthly EU chemicals imports and import prices. 2021-2022

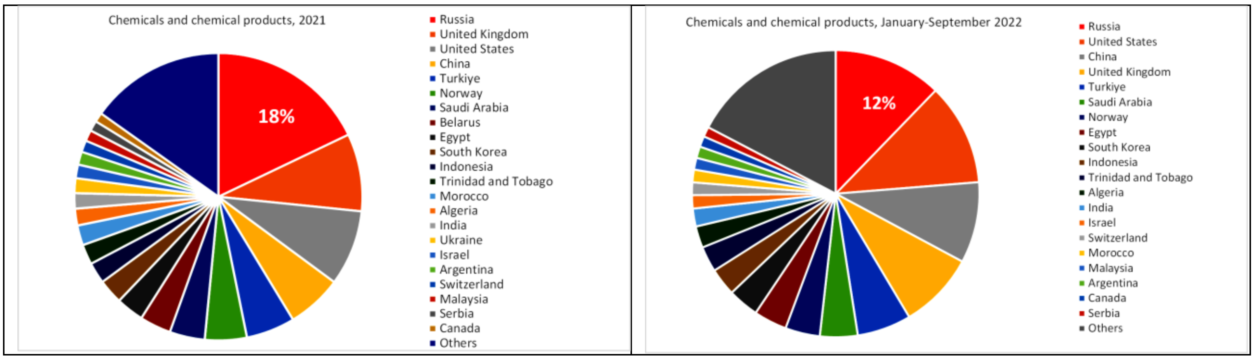


import volumes import prices

Source: CENEf-XXI based on Eurostat, 2022. Database DS-057009 "EU trade 1988-2022 by CPA 2008" http://epp.eurostat.ec.europa.eu/newxtweb/mainxtnet.do.

Russia's market share in the EU imports of chemicals and chemical products has shrunk by 5.7% and was substituted by 2.8% growth for the U.S., 0.6% growth for China, 2.4% growth for the U.K., and 0.6% growth for Turkey (Figure 19). The U.S. share (11.5%) has thus approached the 2022 Russian share in the market.

Figure 19. Geographical structure of the EU chemicals and chemical products imports. 2021-2022



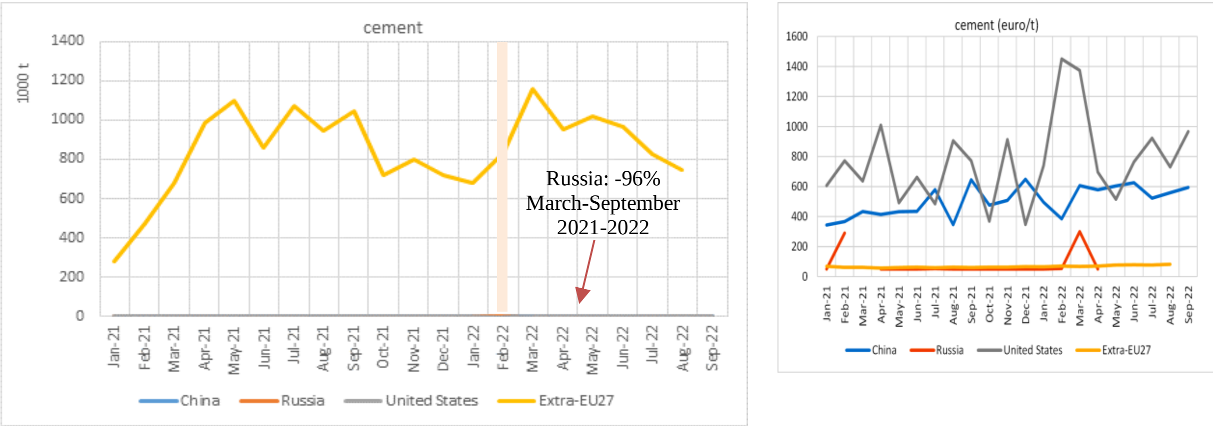
Sources: Eurostat, December 2022.

Cement. EU economic growth slowed down after March 2022. Nearly all key EU cement manufacturers faced 2-11% production decline in the first half of 2022 compared to 2021.[80] EU cement import volumes were also down after March (Figure 20). Russia used to be a minor supplier to the EU. In the first three quarters of 2022 its previously small amounts were down to negligible values (about zero with a 93% decline). Therefore, the earlier conclusion that CBAM impact on Russia's cement exports to the EU will be minor[81] is now even more robust.

[80] First half 2022 update on multinational cement producers - Cement industry news from Global Cement

[81] Bashmakov I.A. CBAM and Russian export. *Voprosy Ekonomiki*. 2022;(1):90-109. (In Russ.) https://doi.org/10.32609/0042-8736-2022-1-90-109$; CENEf (2021). CBAM. Impact on the Russian economy. Moscow: Center for Energy Efficiency-XXI. (In Russian).

Figure 20. Monthly EU cement imports and import prices. 2021-2022

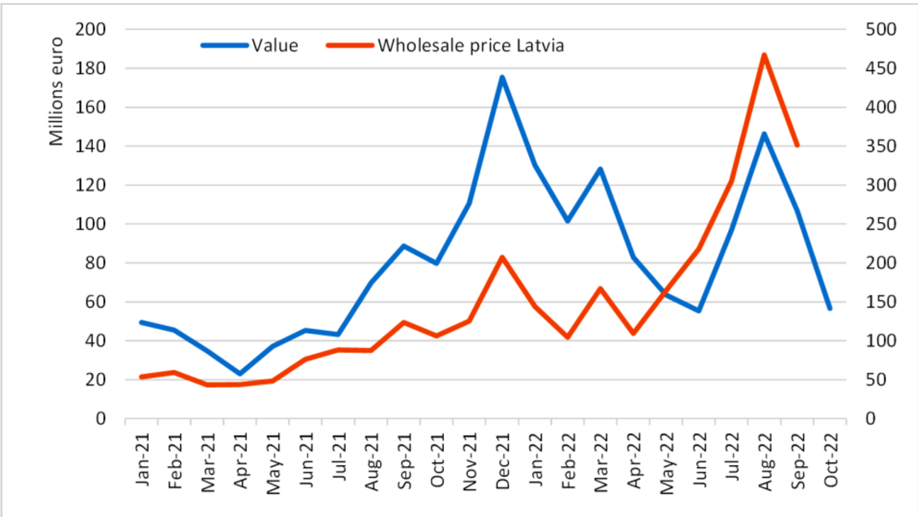


import volumes import prices

Source: CENEf-XXI based on Eurostat, 2022. Database DS-057009 "EU trade 1988-2022 by CPA 2008" http://epp.eurostat.ec.europa.eu/newxtweb/mainxtnet.do

Electricity. According to the Russian Federal Customs Service, EU imported from Russia 13 945 million kWh in 2021. Physical data on the 2022 imports are not available. Eurostat reports monthly data on Russian electricity sales to the EU (Figure 21). In January-September 2022, these doubled over the same 2021 period. Latvia's wholesale electricity price evolution was used to estimate the reduction in physical volumes after February 2022. Since June 2022, EU's electricity imports from Russia dropped 3-fold.

Figure 21. Monthly EU electricity imports from Russia. 2021-2022

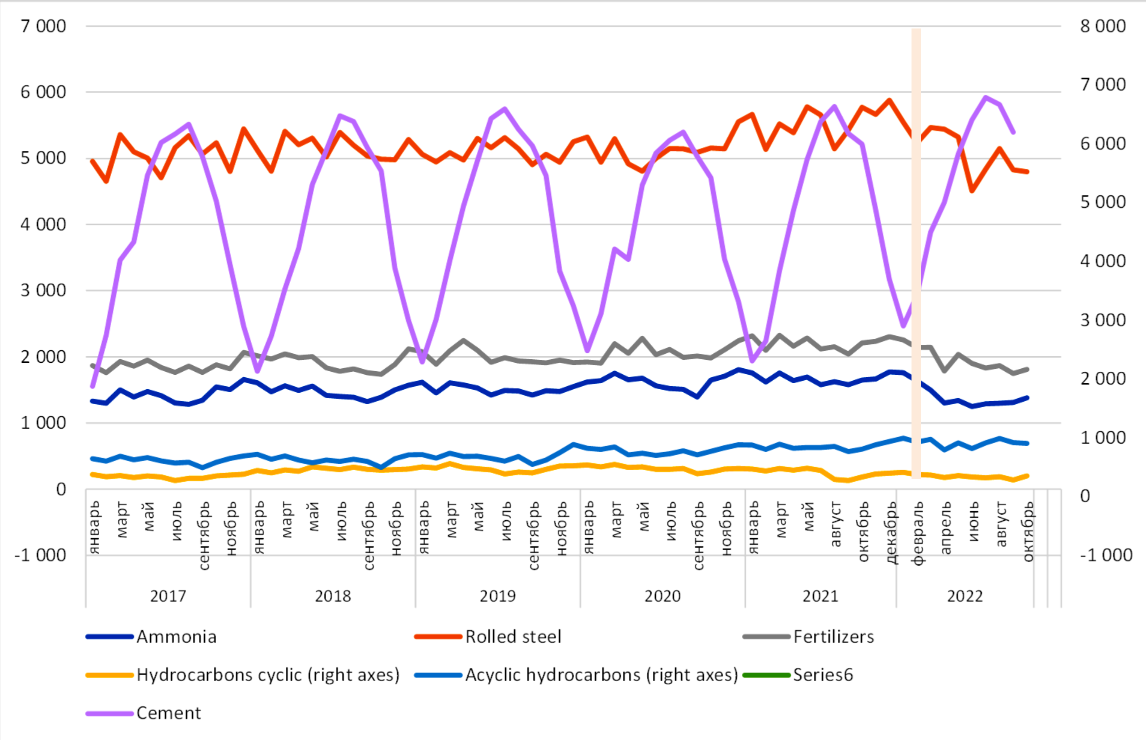


Source: CENEf-XXI based on Eurostat, 2022, and European wholesale electricity price data | Ember (ember-climate.org).

10. Recent implications on Russia's basic materials production

After years of growing (or relatively stable) basic materials production in Russia, February 2022 marked the beginning of the era of decline for many of them. Growing materials use for military purposes and the announced "turn to the East" failed to block the negative effects of the sanctions (Figure 22). As a result, over February-October 2022 ammonia production was 15,6% down; rolled steel (-8,3%); fertilizers (-15,4%); cyclic hydrocarbons (-5,6%); and acyclic hydrocarbons (-2,5%). Only cement production demonstrated growth, possibly due to its military use. But, like pointed out above, cement is not relevant for CBAM analysis.

Figure 22. Monthly CBAM basic materials production in Russia in 2017-2022 (1000 t)



Source: EMISS, Rosstat. Downloaded December 22, 2022.

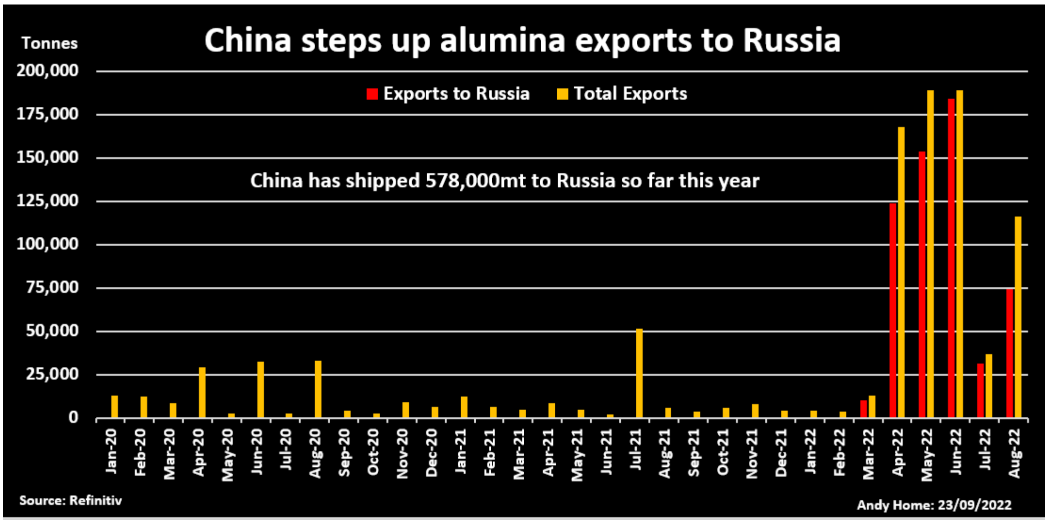
Aluminium. Russian statistics does not provide information on aluminium production, so it was explored separately.

Australia was the only government to impose sanctions on Russia's aluminium industry. Bauxite and alumina exports to Russia were banned. The supply from the Nikolaev refinery in Ukraine was lost. But the alumina gap is met by supply from China, which has shipped 577,000 tons of alumina to Russia since March, compared with only 1,250 tons in 2020 and 1,750 tons in 2021 (Figure 23). Rusal has ceased publishing its production data, but according to some estimates, it has increased production despite the disruption to raw materials supply chain.[82] Over March-June 2022, European average monthly aluminium imports from Russia were 13% up year-on-year and the U.S. imports were 21% up. There is obviously a potential for Rusal to supply more aluminium to Asia, particularly to China. Over the first eight months of 2022, imports from Russia to China

[82] Column: Russian supply uncertainty weighs on aluminium market | Reuters.

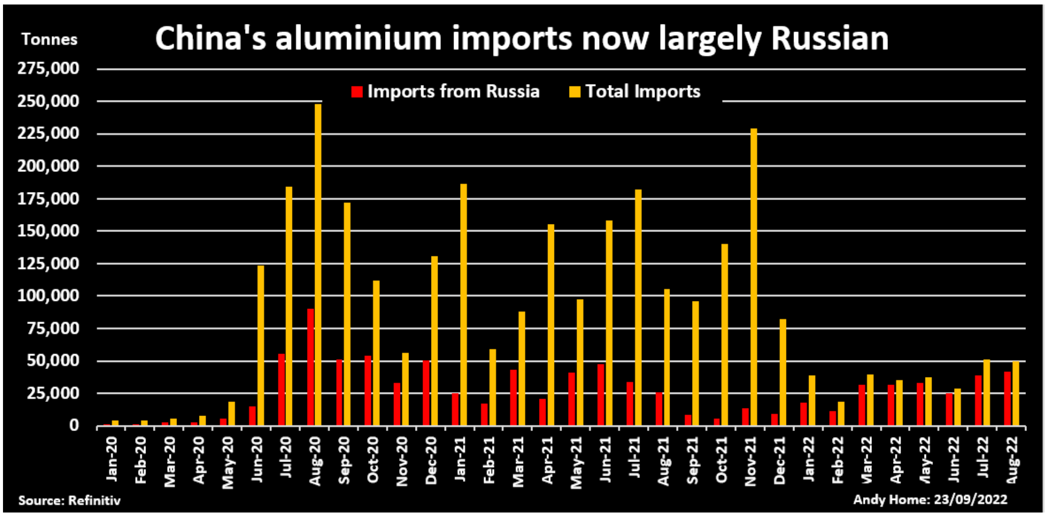
were 9% down to 231,000 tons and accounted for 78% of all inbound shipments to China (Figure 24).[83]

Figure 23. Evolution of Chinese alumina exports to Russia



Source: Column: Russian supply uncertainty weighs on aluminium market | Reuters.

Figure 24. China aluminium imports from Russia

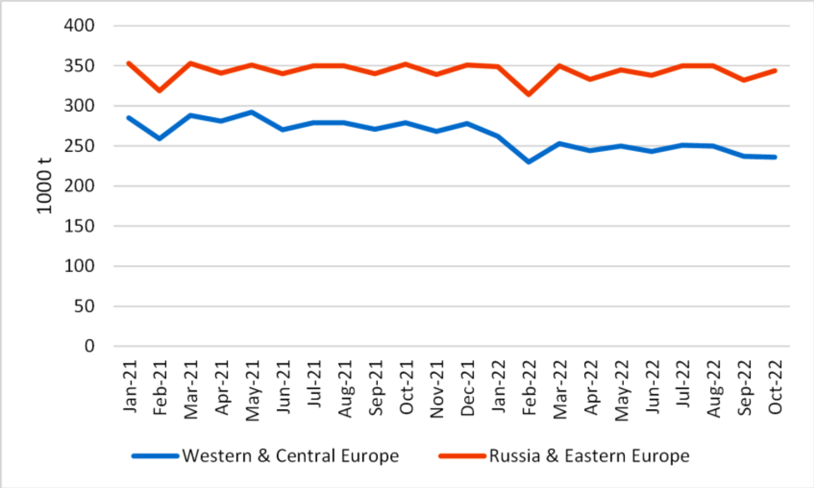


Source: Column: Russian supply uncertainty weighs on aluminium market | Reuters.

If aggregate Russia and Eastern Europe is used as a proxy for Russian production evolution, then until November 2022 there was no indication of aluminium production reduction. Moreover, Goldman Sachs estimates Russian metal exports to be 340,000 tons up in 2022 and another 200,000 tons up to reach 3.6 million tons in 2023.

[83] Ibid.

Figure 25. Primary aluminium production in Russia and Eastern Europe and in Western and Central Europe



Source: Primary Aluminium Production - International Aluminium Institute (international-aluminium.org).

11. The effects of the sanctions and CBAM regulation on Russian exports in the new reality

1.1 CBAM-RUS model

The effects of CBAM regulation on Russian exports in the new reality were assed using the second version of CBAM-RUS model developed by CENEf-XXI.[84] It works with the 32 CN product groups specified in the EU CBAM. Some more groups added in the final CBAM version were not considered, because the export volumes are small (see above). The new reality is outlined by the sanctions imposed by the EU on Russian exports as a response to the Russian “military operation” in Ukraine.

The model includes a special calculation block for each product group. All of the blocks have a similar design. CBAM-RUS imitates CBAM payments minimization strategies based on the reduction in specific GHG emissions by deploying low carbon technologies and implementing institutional measures to estimate the effects of carbon pricing introduction in Russia and (in the future) the effects of reshaping the geographical structure of Russia’s international trade. The model relies on the national customs service for the information on Russia’s 2016-2021 exports to other countries. The projection horizon is 2023-2050.

Key endogenous variables include:

- payments by EU importers for CBAM certificates to purchase Russian products;
- carbon payments in Russia;
- export volumes adjusted for CBAM-determined change in the market niches;
- prices of exported products, including the CBAM component and the carbon price in Russia;

[84] Brief model description is given in CENEf (2021). CBAM. Implications for the Russian economy. Moscow: Center for Energy Efficiency-XXI CBAM_and_the_Russian_exports_eng_dbe59f63da.pdf (cenef-xxi.ru). Full model description is presented in the full report (in Russian only) Cz_ENEF_XXI_CBAM_4c0a2fb4a3.pdf (cenef-xxi.ru).

- export value, both including and excluding CBAM payments and carbon prices in Russia;
- CBAM-driven change in the export value;
- Russia's export revenue loss in EU markets due to the sanctions.

Key scenario variables include:

- major pathways of CBAM-covered export volumes to the EU;
- carbon prices in the EU and Russia;
- fractions of free allowances allocated in Russia and EU;
- price elasticity coefficients of Russian exports to the EU;
- specific carbon intensity of CBAM products in Russia and EU;
- the fiscal-neutrality parameter for introducing the carbon price in Russia;
- sanction multiplier and expected sanction duration for each CBAM good.

The estimates of import volumes reduction, as well as of other CBAM effects, are largely determined by the price elasticity of EU imports. Other things equal, suppliers with the lowest carbon intensities will benefit. Growing relative prices of the Russian carbon intensive CBAM exports will lead to a reduction (against the baseline) in Russian export volumes to the EU. Price elasticity of imports reflects the pressure in the 'low carbon vice' through the following two effects:

- reduced demand in the EU market resulting from the increase in products prices of all of the suppliers by the effective carbon price;
- increased product supply to the EU market by the competitors with a lower carbon component in their prices due to a lower carbon intensity.

The CBAM-RUS model is based on the following concept. Russian exporters will only be required to provide information, but they are not expected to pay to the EU for their carbon emissions. The owners of EU plants will be purchasing allowances under the ETS. Importers of CBAM products will be purchasing CBAM certificates from the EU. The price of CBAM products in the EU market will increase for all suppliers, and this increment will be equal to the carbon markup, which is determined by the carbon intensity of a particular product. For EU producers, the price will grow as follows:

$$CarbonInteu * (1\text{-}deu) * CPriceETS * CPT,$$

where *deu* is the fraction of free allowances in the EU ETS;

CPT is cost pass through, depending on the product.

For the EU importers of CBAM products from Russia the price will grow as follows:

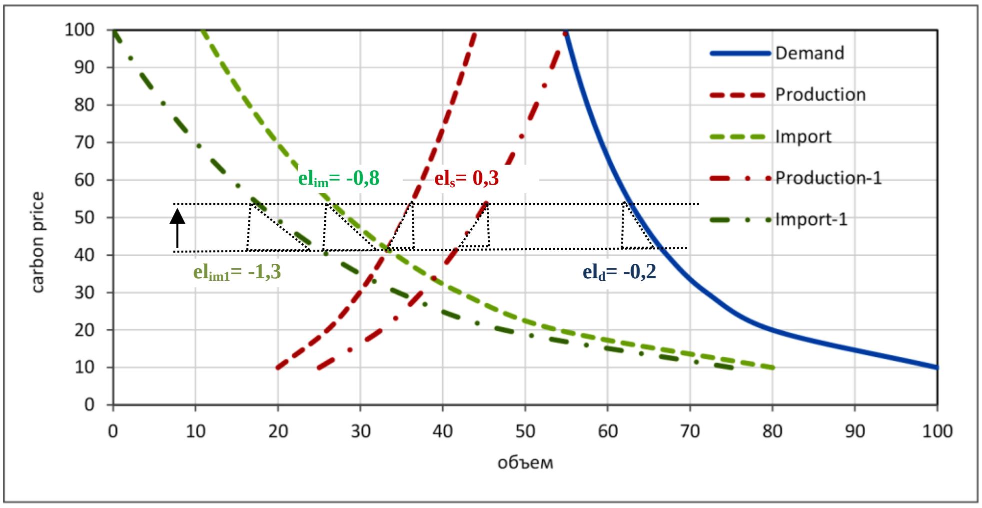
$$CarbonIntrus*((1\text{-}deu)*(CPriceETS\text{-}CPricerus*(1\text{-}drus))*CPT + Cpricerus*(1\text{-}drus)),$$

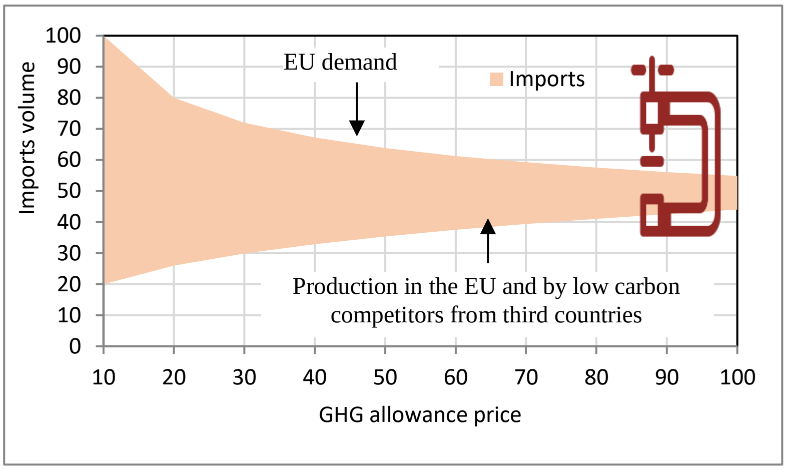
where *deu* is the fraction of free allowances in Russia;

Cpricerus is the price set for Russian exporters in Russia.

The CBAM system works as a "low carbon vice" (see Figure 26). What really matters, is relative (compared to the competitors), rather than absolute, product price increase driven by the carbon markup. Depending on the price elasticity of demand, demand for CBAM-products in the EU market will go down, as the carbon component price grows up. Production in the EU, or supply from other competitors, will be growing, if the carbon intensity of CBAM products is lower, than in Russia. Demand for some imports from Russia may go down driven by the declining consumption and growing supply from competitors with lower carbon footprints.

Figure 26. “Low carbon vice”





Source: CENEf (2021). *CBAM. Implications for the Russian economy*. Moscow: Center for Energy Efficiency CBAM_and_the_Russian_exports_eng_dbe59f63da.pdf (cenef-xxi.ru)

Russian exporters’ income losses are due to the shrinking market share, where Russian goods have a higher carbon intensity compared to the EU and other competitors, rather than due to carbon price payments. Where Russian exporters can benefit from a lower carbon intensity compared to their competitors, CBAM might help them increase their market share. The major risk for the suppliers is associated with a rapid reduction in carbon intensity by the competitors.

Introduction of a carbon price in Russia only for CBAM products exported to the EU could reallocate potential CBAM payments to Russia, but will provide just limited incentives for Russia’s low carbon transition and, as CBAM coverage expands to include new products and geographical regions, will not remove the risks for Russia’s development. Introduction of a carbon price for all CBAM products manufactured in Russia would encourage carbon intensity reduction and reduce the risks of losing out current market niches in the future, when the potential CBAM-determined losses may grow manifold.

The key changes in the second version of the CBAM-RUS model are as follows:

- extension of base period for export volumes and export prices to 2021;
- introduction of sanction multiplier for some product groups;
- introduction of a new endogenous variable – export revenue loss in the EU market due to the sanctions;

- adjusted schedule for the elimination of EU ETS free allowances to meet the requirements of the final EU ETS regulation;
- the 2023 base EU carbon price was changed to 80 €/tCO_2 along with two options for perspective carbon prices – 80 €/tCO_2 and 100 €/tCO_2.[85]

In the first version of the CBAM-RUS model the assumption was that baseline export volumes are equal to the 2016-2020 averages. Now this period is extended to 2016-2021 with a correction of the EU market loss for the product groups subject to the EU sanctions. There is a long list of products banned for the EU imports from Russia.[86] Many of them are 4-8-digit CN codes items, while the CBAM-RUS model is bult for 4-digit items. These sanctions are captured through the sanctions multiplier for the all-product groups. The 4-digit groups covered by the sanctions are assigned the multiplier equal to 1. If only some of the positions in a 4-digit group are subject to the sanctions, then the multiplier is equal to the share of 6-8-digit subgroups covered by sanctions. An assumption was made that the sanctions will last 10 years.

1.2 Set of scenarios

Like in the previous study, 10 scenarios were developed to estimate the CBAM implications for Russian exports.[87] All of the scenarios are based on the assumption that baseline CBAM exports from Russia will be maintained at the 2016-2021 average level and base (i.e. before carbon process corrections) export prices for CBAM goods are equal to the 2016-2021 averages. Another assumption is that carbon price in the ETS will be growing up to 100 euros/t$CO_{2eq.}$ by 2050 to attain the carbon neutrality target in the EU industrial sector. The assumptions for Russia include either no carbon price until 2050 or the introduction of an effective carbon price equal to 50% of that in the ETS. Combinations of the key assumptions for each scenario are shown in Table 1.

[85] This range allows it to make attractive most low carbon technologies in industry. Bashmakov et al. 2022. Industry. In: *Climate Change 2022. Mitigation of Climate Change. Contribution of Working Group III to the IPCC Sixth Assessment Report (AR6)* [Skea, J. et al., (eds.)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[86] COUNCIL REGULATION (EU) No. 833/2014. of 31 July 2014 concerning restrictive measures in view of Russia's actions destabilising the situation in Ukraine (OJ L 229, 31.7.2014, p.1) Amended by: Council Regulation (EU) No. 960/2014 of 8 September 2014 L 271 3 12.9.2014; Council Regulation (EU) No 1290/2014 of 4 December 2014 L 349 20 5.12.2014; Council Regulation (EU) 2015/1797 of 7 October 2015 L 263 10 8.10.2015; Council Regulation (EU) 2017/2212 of 30 November 2017 L 316 15 1.12.2017; Commission Implementing Regulation (EU) 2019/1163 of 5 July 2019 L 182 33 8.7.2019; Council Regulation (EU) 2022/262 of 23 February 2022; L 42 I 74 23.2.2022; Council Regulation (EU) 2022/328 of 25 February 2022 L 49 1 25.2.2022; Council Regulation (EU) 2022/334 of 28 February 2022 L 57 1 28.2.2022; Council Regulation (EU) 2022/345 of 1 March 2022 L 63 1 2.3.2022; Council Regulation (EU) 2022/350 of 1 March 2022 L 65 1 2.3.2022; Council Regulation (EU) 2022/394 of 9 March 2022 L 81 1 9.3.2022; Council Regulation (EU) 2022/428 of 15 March 2022 L 87 I 13 15.3.2022; Council Regulation (EU) 2022/576 of 8 April 2022; L 111 1 8.4.2022; Commission Implementing Regulation (EU) 2022/595 of 11 April 2022 L 114 60 12.4.2022; Council Regulation (EU) 2022/879 of 3 June 2022 L 153 53 3.6.2022 02014R0833 — EN — 07.10.2022 — 011.001 — 1.

[87] Bashmakov I.A. CBAM and Russian export. *Voprosy Ekonomiki*. 2022;(1):90-109. (In Russ.) https://doi.org/10.32609/0042-8736-2022-1-90-109$; CENEf (2021). CBAM. Impact on the Russian economy. Moscow: Center for Energy Efficiency-XXI. (In Russian).

Table 1. **Scenario conditions**

Scenario number	Emission scope	EU ETS carbon price in 2050, €/tCO_2	Russian to EU ETS carbon price ratio (%)	Carbon intensity	
				EU	Russia
1	1+2+3	100	0%; Cost pass through = 100%	At current average levels	
2	1+2+3	100	0%; Cost pass through = 50%	At current average levels	
3	1+3	100	0%	At current average levels	
4	1+3	80	0%	At current average levels	
5	1+3	100	50%; free allocation share = that in EU ETS	At current average levels	
6	1+3	100	50%; free allocation share = that in EU ETS	At current average levels	For exported products 20-30% below average
7	1+3	100	50%; free allocation share = that in EU ETS; fiscally neutral	At current average levels	
8	1+3	100	50%; free allocation share = that in EU ETS	Decarbonization in the EU	At current average levels
9	1+3	100	50%; free allocation share = that in EU ETS	At current average levels	Decarbonization in Russia
10	1+3	100	50%; free allocation share = that in EU ETS	Decarbonization in the EU	Decarbonization in Russia

Source: Authors.

1.3 The effects of the sanctions and CBAM regulation

In Scenario 1, scopes 1+2+3 are applied, EU carbon price rises to 100 \$/tCO_2, there is no carbon pricing in Russia, and carbon intensities are fixed at the current levels. The results show (Figure 1), that:

- Until 2031, CBAM losses are limited to \$0.4 billion;
- This is \$0.35 billion below the last year's estimate,[88] as much of CBAM exports from Russia to the EU is assumed to be banned until 2032;
- The price as follows: sanctions-driven loss of export revenues for CBAM goods equals \$4.1-5.4 billion, depending on the assumptions made about baseline export volumes and prices (the lower end corresponds to the 2016-2021 averages, and the higher end to the 2021 values). This is half of CBAM exports from Russia to the EU;
- This means, that the Russian military operation and the resulting sanctions have closed the EU markets for some CBAM goods (mostly iron and steel products);
- If (when) the sanctions are lifted, the losses from CBAM for iron and steel products will be back on the agenda;
- The payments made by EU importers of Russian CBAM goods for certificates will saturate at \$3.4 billion after 2040;

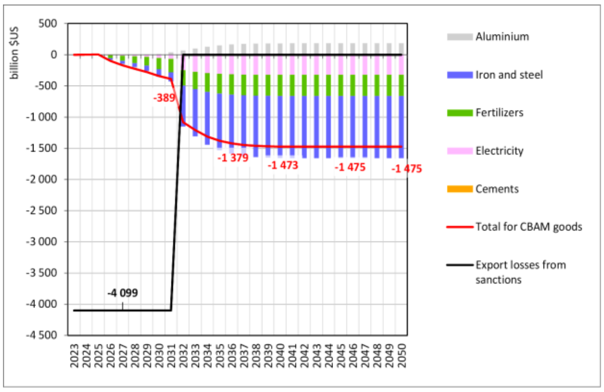
[88] Bashmakov I.A. CBAM and Russian export. *Voprosy Ekonomiki*. 2022;(1):90-109. (In Russ.) https://doi.org/10.32609/0042-8736-2022-1-90-109\$; CENEf (2021). CBAM. Impact on the Russian economy. Moscow: Center for Energy Efficiency-XXI. (In Russian).

- Such carbon markup on CBAM goods squeezes the market niches for the Russian exporters;
- Net CBAM export revenues loss stabilizes at -$1.5 billion after 2040. If the cost-pass-through coefficient is taken to be 50%, then this loss scales down to $1 billion, but the profit margin may be smaller as well;
- Aluminium is the only product which can gain an additional market niche and additional income, all other CBAM goods will only generate export revenues loss;
- The loss resulting from the sanctions is double or triple compared with the expected CBAM loss;
- In 2021, Russian policy-making and expert communities feared that CBAM losses (incorrectly estimated) would amount to some $5 billion,[89] and the fear came true in 2022-2023… yet for a very different reason.

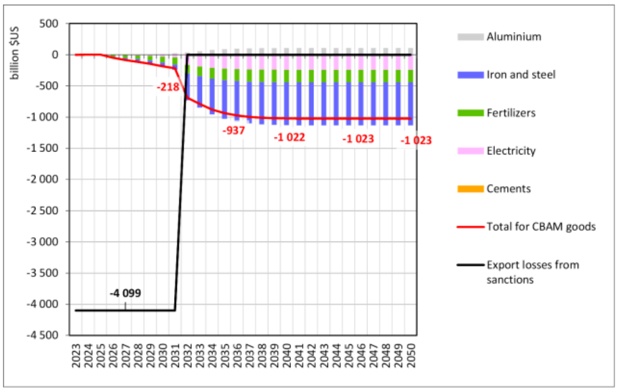
Comparative analysis of the 10 scenarios allows for the following conclusions (Figure 27):

- With a most likely combination of various scenario conditions, CBAM-associated losses of Russian companies will not exceed $1-1.5 billion by 2050;
- While applying Scope 1+3, there is no chance for expanding the market niche for aluminium, as Russia's and the EU's carbon intensities are about equal;
- If Russia introduces its own carbon pricing, then export revenues loss will still be same, but part of the CBAM payments will be made to Russia and could be used to finance industrial decarbonization;
- Exports from low carbon plants and installations would help bring net export revenues loss down to nearly zero;
- Fiscal-neutral carbon pricing in Russia would generate $2 billion in additional export revenues by limiting Russian exporters' price increments for CBAM-products;[90]

Figure 27. 10 scenarios: change in Russia's revenues from CBAM exports to the EU

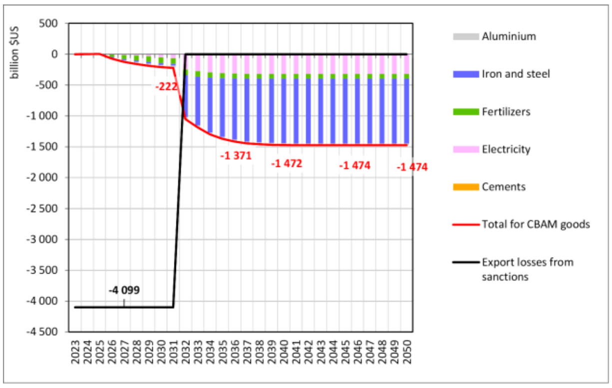


Scenario 1: Scope 1+2+3; CP_{eu}=100 euros/tCO_2; CP_{ru}=0; CI_{eu}=const; CI_{ru}=const

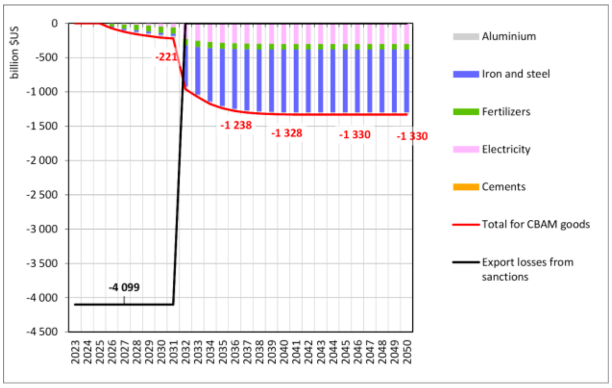


Scenario 2: Scope 1+2+3; CP_{eu}=100 euros/tCO_2; CP_{ru}=0; CI_{eu}=const; CI_{ru}=const; cost pass through = 50%

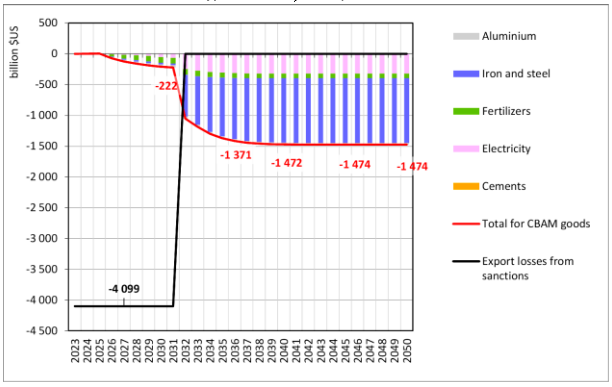
[89] Ibid.
[90] There could be problems with the final EU CBAM regulation in terms of lowering other taxes for CBAM goods.



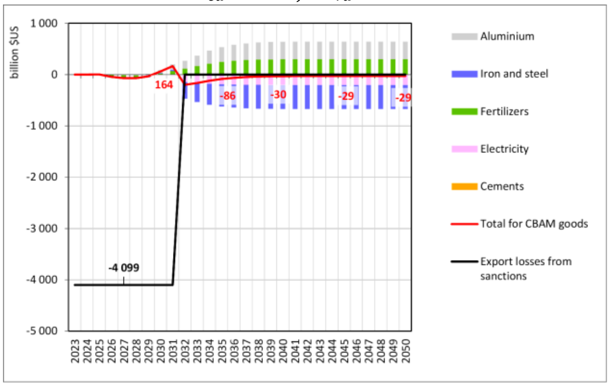
Scenario 3: Scope 1+3; CP_{eu}=100 euros/tCO_2; CP_{ru}=0; CI_{eu}=const; CI_{ru}=const



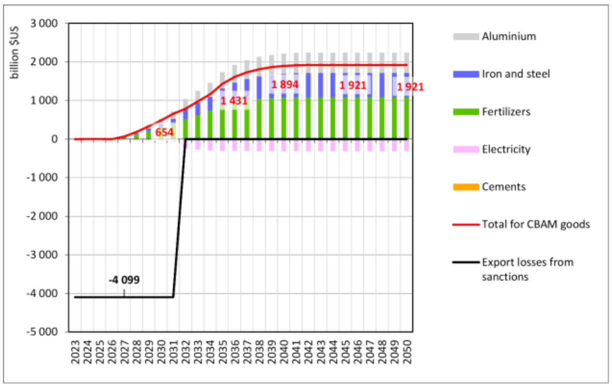
Scenario 4: Scope 1+3; CP_{eu}=80 euros/tCO_2; CP_{ru}=0; CI_{eu}=const; CI_{ru}=const



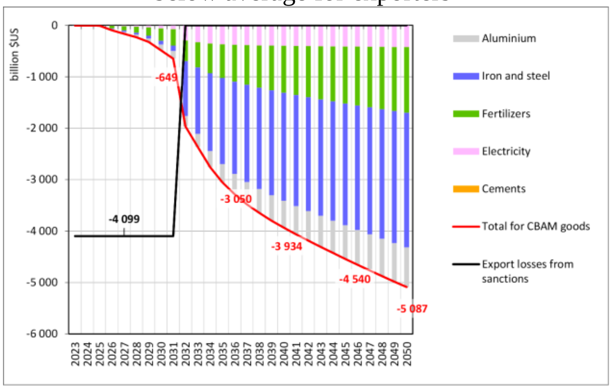
Scenario 5: Scope 1+3; CP_{eu}=100 euros/tCO_2; CP_{ru}=0.5* CP_{eu}; CI_{eu}=const, CI_{ru}=const



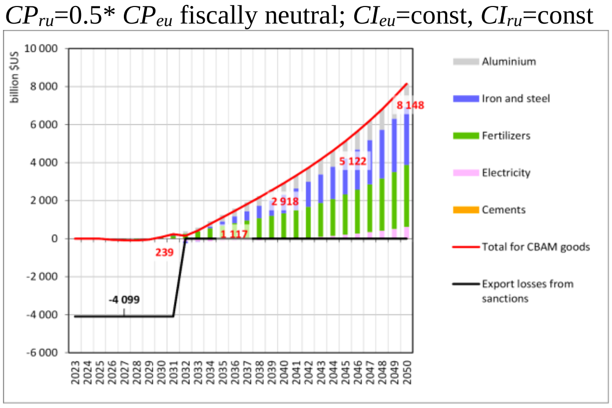
Scenario 6: Scope 1+3; CP_{eu}=100 euros/tCO_2; CP_{ru}=0.5* CP_{eu}; CI_{eu}=const, CI_{ru}=const, but 20-30% below average for exporters



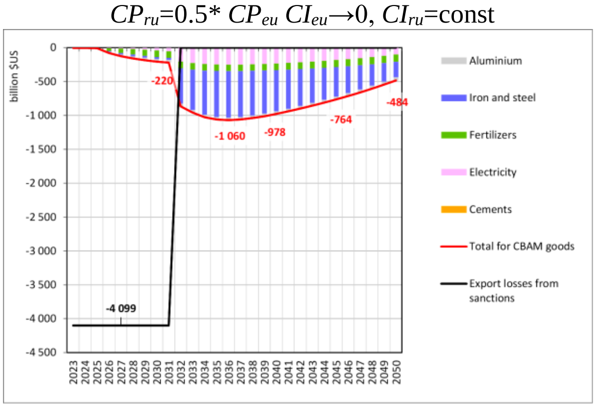
Scenario 7: Scope 1+3; CP_{eu}=100 euros/tCO_2; CP_{ru}=0.5* CP_{eu} fiscally neutral; CI_{eu}=const, CI_{ru}=const



Scenario 8: Scope 1+3; CP_{eu}=100 euros/tCO_2; CP_{ru}=0.5* CP_{eu} CI_{eu}→0, CI_{ru}=const



Scenario 9: Scope 1+3; CP_{eu}=100 euros/tCO_2; CP_{ru}=0.5* CP_{eu} CI_{eu}=const, CI_{ru}=→0



Scenario 10: Scope 1+3; CP_{eu}=100 euros/tCO_2; CP_{ru}=0.5* CP_{eu} CI_{eu}=→0; CI_{ru}=→0

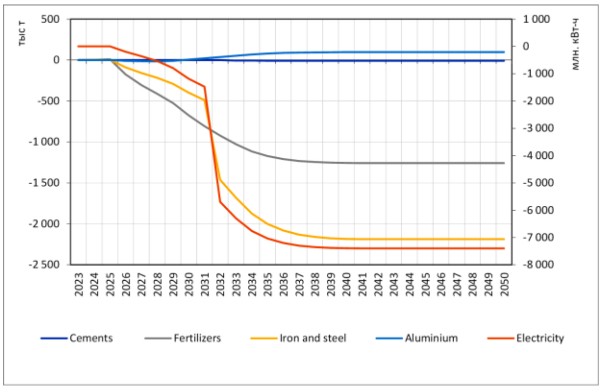
**CI* is carbon intensity; *CPeu* and *CPru* are carbon prices in ETS and in Russia.

Source: CENEf-XXI.

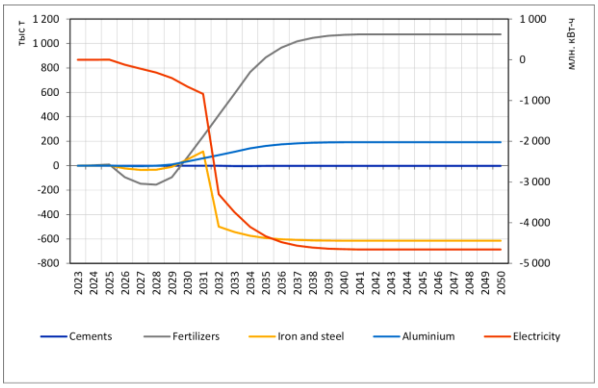
- If Russia lags much behind the EU in decarbonizing CBAM industries, takes no action and conserves current carbon intensities, export revenues loss may escalate to $5 billion by 2050 and exceed the effect of the sanctions. In this case, the initially small losses will eventually grow to become quite big;
- On the contrary, Russia's leap to the carbon neutrality target, coupled with the EU's passivity, may deliver more than $8 billion in additional export revenues by 2050;
- If Russia and the EU race in parallel, applying effective industrial GHG emission reduction policies, Russia's export revenues loss will peak at $1 billion in the mid-30s and then will halve towards 2050. Only proactive reduction in carbon intensities of Russian CBAM products and (or) the introduction of fiscal-neutral carbon payments will help reduce the losses or even obtain additional export revenues.

If carbon intensity remains high, there may be large market losses for fertilizers and electricity and then (if the sanctions are relaxed) for iron and steel products (Figure 28). Sanctions for iron and steel items have removed 7.6 million tons of Russian iron and steel products from the EU market. CBAM might eliminate nearly two thirds of this, if the EU is effective in decarbonizing the industry while Russia is not. On the contrary, the situation can open larger markets for Russian steel products, fertilizers, and aluminium if low and high carbon assets are separated by the Russian exporters, the change in physical exports will be moderate.

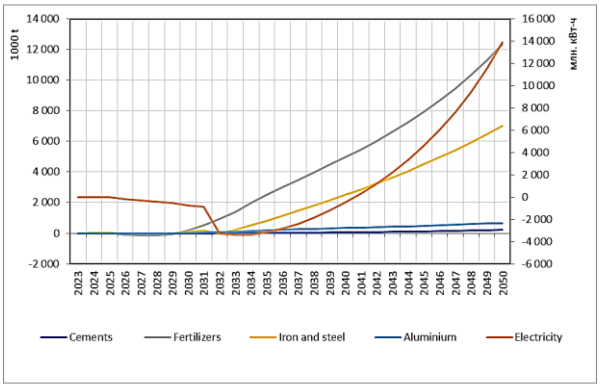
Figure 28. Change in Russia's CBAM goods exports to the EU



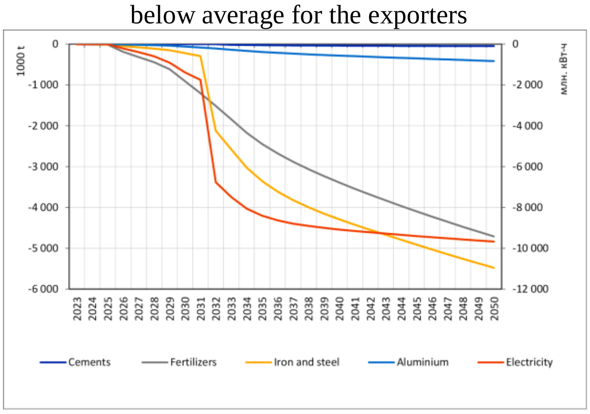
Scenario 1: Scope 1+2+3; CP_{eu}=100 euros/tCO$_2$; CP_{ru}=0; CI_{eu}=const; CI_{ru}=const



Scenario 6: Scope 1+3; CP_{eu}=100 euros/tCO$_2$; CP_{ru}=0.5* CP_{eu}; CI_{eu}=const, CI_{ru}=const, but 20-30% below average for the exporters



Scenario 9: Scope 1+3; CP_{eu}=100 euros/tCO$_2$; CP_{ru}=0.5* CP_{eu} CI_{eu}=const, CI_{ru}=→0

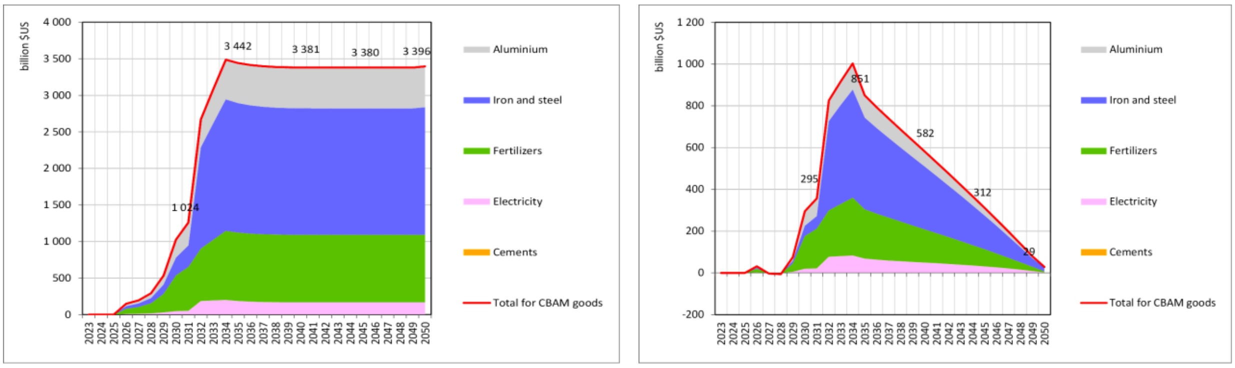


Scenario 8: Scope 1+3; CP_{eu}=100 euros/tCO$_2$; CP_{ru}=0.5* CP_{eu} CI_{eu}→0, CI_{ru}=const

Source: CENEf-XXI.

CBAM payments are no indication of the losses suffered by the Russian companies. The smaller the losses, or the greater the advantages of Russian companies, the higher the CBAM payments due from the European importers (given the same levels of carbon intensity). These payments could be taken down to zero through the decarbonization of Russian exports (Figure 29). These volumes are payments by the EU importers to the EU budget to get a *level playing field* at the expense of the European consumers of basic materials.

Figure 29. CBAM payments by EU importers of Russian CBAM products



CBAM payments by EU importers.
Scenario 1: Scope 1+2+3; CP_{eu}=100 euros/tCO_2; CP_{ru}=0; CI_{eu}=const; CI_{ru}=const

CBAM payments by EU importers = carbon payments in Russia. Scenario 10: Scope 1+3; CP_{eu}=100 euros/tCO_2; CP_{ru}=0.5* CP_{eu} CI_{eu}=⟶0; CI_{ru}=⟶0

Source: CENEf-XXI.

12. What needs to be done?

The last year's report on CBAM[91] was concluded with a section "What can we do?" Many of the recommendations from that report can be repeated with a few modifications:

- Stop military operation and work with the EU to remove the sanctions;
- Develop a position and negotiate the CBAM scheme with the EU;
- Establish a system of mandatory data collection to estimate the carbon intensity of Russian products; specify the requirements to the data quality and data submission; develop Russian benchmarking systems. Include plant-level data into the data collection system;
- Develop and adopt long-term decarbonizations plans for the key Russian industries;
- Provide incentives for the production of low carbon materials;
- Win new markets, including low carbon ones, for the low carbon brands of Russian products (like ALLOW);
- Look for other regional markets;
- Win and expand product niches in the exponentially growing global low carbon markets.

[91] Bashmakov I.A. CBAM and Russian export. *Voprosy Ekonomiki*. 2022;(1):90-109. (In Russ.) https://doi.org/10.32609/0042-8736-2022-1-90-109$; CENEf (2021). CBAM. Impact on the Russian economy. Moscow: Center for Energy Efficiency-XXI. (In Russian).