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THE IMPACT OF RUSSIA'S FOREIGN TRADE ON ITS ACTUAL OPEN EMISSIONS OF CO2

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ABSTRACT: This article analyses the impact of Russia's trade with 78 selected countries on Russia's Actual-Open CO_2 Emissions (EAO) from 2000 to 2020, especially concerning the European Union's CO_2 emission reduction policies active during that period. The countries selected for analysis were identified based on trade significance, emissions data availability, and consistency with BP statistical reports. The methodological approach relies on the Actual-Open CO_2 Emissions (EAO) model, which reveals a significant influence of Russia's foreign trade on its CO_2 emissions. Results indicate that Russia's international trade substantially affected its emissions, primarily because Russia was a major CO_2 emitter and exported a considerable portion of its GDP. While the results also indicate emission shifts affecting Russia's trade partners, the analysis does not provide full EAO calculations for EU countries or others – only trade-attributed impacts are assessed. Differences indicate the presence of emission transfers via trade, complicating efforts to achieve emission reduction targets within the EU, which aimed for a 20% reduction by 2020. The findings of this study are particularly relevant in the context of the EU's current "Fit for 55" policy, which targets a 55% reduction in greenhouse gas emissions by 2030, underscoring the need to account for emission transfers in trade policy considerations.

KEYWORDS: international trade of Russia, CO2 emission, EU energy policy

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Introduction

We live in a globalised world, where actions taken by individual countries directly or indirectly affect others. However, this does not imply that all countries operate identically or follow uniform standards. While some nations bear significant costs to reduce their domestic CO_2 emissions, their efforts often have a limited impact on global emissions due to emission transfers via international trade. This study specifically investigates this issue through the lens of Russia's trade with 78 selected countries. It demonstrates that between 2000 and 2020, Russia's actual impact on global CO_2 emissions was lower than officially reported because Russia transferred more emissions abroad through exported goods than it imported via goods.

This example highlights that CO_2 emissions are indeed a global issue and underscores that individual countries' efforts must be supported by coordinated international strategies to effectively address global emissions.

The problem of international CO_2 emission transfers and the influence of CO_2 emissions through international trade, particularly concerning Actual-Open Emissions (EAO), relates to emission accounting in international trade (Kander et al., 2015; Kanemoto et al., 2011; Hasanov et al., 2018), carbon leakage (Grubb et al., 2022; Fu & Zhang, 2015), and consumption-based emission frameworks (Tukker et al., 2020; Mastrucci et al., 2020).

Between 2000 and 2020, Russia was among the top 20 global exporters and importers and ranked 8th among the world's largest economies based on Gross Domestic Product (GDP) in 2012 (UNCTAD, 2021; The World Bank, n.d. a; The World Bank, n.d. e). Russia's trade significantly impacted environmental conditions, including CO_2 emissions. The considerations presented in this study arise from the EU's energy policy framework, particularly the "20-20-20" objectives set for 2007–2020: a 20% reduction in greenhouse gas emissions relative to 1990 levels, increasing renewable energy consumption to 20%, and improving energy efficiency by 20% (European Commission, 2010). These goals directly align with sustainable development (SD) principles, which aim to satisfy current needs without compromising future generations' capabilities (Brundtland, 1987).

The study employs a circular economic flow model illustrating monetary flows within the economy. This model has two versions: a closed model (domestic) and an open model (including exports and imports). Similarly, CO_2 emissions can be categorised as Official-Closed Emissions (EOC), corresponding to emissions generated domestically, and Actual-Open Emissions (EAO), accounting for emissions embedded in international trade. The EAO approach better reflects reality in our globalised economy, where international trade significantly influences national emissions.

The primary objective of this paper is to analyse the impact of foreign trade on Russia's Actual-Open CO_2 Emissions (EAO) concerning trade with the 78 selected countries. The analysis does not focus solely on Official-Closed Emissions (EOC) but aims to quantify accurately the emissions embedded in products exported from and imported into Russia. Specifically, EAO is calculated by subtracting emissions embedded in exports from EOC and adding emissions embedded in imports. While services also contribute to emission transfers, they are excluded from the analysis due to data limitations. This simplification, focusing solely on traded goods, represents a methodological limitation of the study.

The fundamental research questions include: How significant was the impact of Russia's trade on global CO_2 emissions? What measures could the EU adopt to enhance the effectiveness of its energy policies? Should the EU reconsider its CO_2 reduction strategy to incorporate emission transfers from international trade? This revised approach aims to provide insights addressing these critical questions.

Methods

From 2007 onward, the EU energy policy was based on a framework of various EU legal acts, including both prior and after 2007 (e.g., European Commission, 2007; Directive, 1996; Directive, 2001; Directive, 2003; Directive, 2006; Directive, 2009; European Commission, 2010; European Commission, 2008c; European Commission, 2008a; European Commission, 2006; European Commission, 2008d; European Commission, 2008b). These documents defined core objectives for the EU energy sector development (Jeżowski, 2012). Major revisions and strategic targets of the EU energy policy were introduced starting from 2007, aimed explicitly at achieving the “3 × 20%” objectives by 2020: a 20% reduction in CO_2 emissions from 1990 levels, increasing renewable energy sources to 20% of the energy mix, and improving energy efficiency by 20% compared to 1990.

Actual-Open Emission of CO_2 (EAO) is calculated by adjusting a country’s Official-Closed Emissions (EOC) to reflect emissions transferred through international trade. Specifically, a country’s EAO equals its domestic emissions (EOC) minus emissions embodied in exported products and emissions embodied in imported products from other countries. The calculation method is presented by the following revised formulas:

$$SB_c=(Im_c/GDP_c)\times EOC_C-(Ex_{RUS}/GDP_{RUS})\times EOC_{RUS}, \tag{1}$$

$$EAO=EOC_{RUS}+SB_C. \tag{2}$$

where:
SB_c – CO_2 emissions balance resulting from Russia’s trade with the selected country (C),
EOC_{RUS} – Official-Closed Emissions of CO_2 generated within Russia,
EOC_C – Official-Closed Emissions of CO_2 generated within the selected country,
Ex_{RUS} – Value of Russia’s export of goods to the selected country,
Im_C – Value of imports from the selected country to Russia,
GDP_{RUS} – The gross domestic product of Russia,
GDP_c – The gross domestic product of a selected country,
$(Im_c/GDP_c)\times EOC_C$ – Quantity of CO_2 emissions imported from the selected country to Russia,
$(Ex_{RUS}/GDP_{RUS})\times EOC_{RUS}$ – Quantity of CO_2 emissions exported to the selected country by Russia,
EAO – Russia’s Actual-Open Emissions of CO_2 related to trade with the selected country.

The aggregate EAO for Russia, considering trade with all 78 selected countries, is calculated by summing Russia’s individual EAO for each selected country and for the analysed period. GDP data utilised in this research are expressed in USD. GDP data were obtained from the World Bank (The World Bank, n.d. a), and EOCC and EOC data were sourced from the BP Statistical Review (BP stats-review 2021). Export and import values were retrieved from the Observatory of Economic Complexity (2020).

The study covers Russia’s main 78 trading partners grouped by continents (Table 1), selected according to consistency with BP statistical reports. Africa includes four countries, Asia includes 29, Europe 32, North America four, Oceania two, and South America seven countries. Due to extensive data volume, this study focuses primarily on continental-level analyses, highlighting countries significantly impacting CO_2 trade balances.

Table 1. Countries participating in the study are divided into individual continents

Continent	Country	Continent	Country	Continent	Country
Africa	Algeria	Asia	Singapore	Europe	Lithuania
Africa	Egypt	Asia	Thailand	Europe	Luxembourg
Africa	Morocco	Asia	Turkmenistan	Europe	Latvia
Africa	South Africa	Asia	Turkey	Europe	North Macedonia
Asia	United Arab Emirates	Asia	Uzbekistan	Europe	Netherlands
Asia	Azerbaijan	Asia	Vietnam	Europe	Norway
Asia	Bangladesh	Asia	Chinese Taipei	Europe	Poland
Asia	China	Europe	Austria	Europe	Portugal
Asia	Cyprus	Europe	Belgium	Europe	Romania
Asia	Hong Kong	Europe	Bulgaria	Europe	Slovakia
Asia	Indonesia	Europe	Belarus	Europe	Slovenia

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Continent	Country	Continent	Country	Continent	Country
Asia	India	Europe	Switzerland	Europe	Sweden
Asia	Iran	Europe	Czechia	Europe	Ukraine
Asia	Iraq	Europe	Germany	North America	Canada
Asia	Israel	Europe	Denmark	North America	Mexico
Asia	Japan	Europe	Spain	North America	Trinidad and Tobago
Asia	Kazakhstan	Europe	Estonia	North America	United States (US)
Asia	South Korea	Europe	Finland	Oceania	Australia
Asia	Kuwait	Europe	France	Oceania	New Zealand
Asia	Sri Lanka	Europe	United Kingdom	South America	Argentina
Asia	Malaysia	Europe	Greece	South America	Brazil
Asia	Oman	Europe	Croatia	South America	Chile
Asia	Pakistan	Europe	Hungary	South America	Colombia
Asia	Philippines	Europe	Ireland	South America	Ecuador
Asia	Qatar	Europe	Iceland	South America	Peru
Asia	Saudi Arabia	Europe	Italy	South America	Venezuela

Trade between Russia and 78 countries from 2000-2020

During the period analysed, Russia's trade volume with the selected 78 countries increased steadily, with Europe and Asia being the most significant trading partners. Figure 1 illustrates not only the regional structure of exports but also how geopolitical and economic factors, such as the 2008 financial crisis and EU sanctions in 2014, contributed to Russia's gradual shift in trade focus from Europe toward Asian economies, particularly China. This figure illustrates the long-term geographic diversification of Russia's export structure, showing a gradual reorientation toward Asian markets following the 2008 financial crisis. Russia's total exports rose significantly from 96.5 billion USD in 2001 to a peak of 457.28 billion USD in 2012. During the analysed period (2000–2020), Russia exported goods worth approximately 6.276 trillion USD to the 78 selected countries, representing between 93.2% and 96.4% of Russia's total export value (The Observatory of Economic Complexity, 2020).

Russia's exports to Asian countries grew from 22.35 billion USD in 2000 to 155.79 billion USD in 2018. Exports to European countries varied from 65.4 billion USD in 2001 to a high of 298.95 billion USD in 2012. For North America, Russian exports ranged between 5.93 billion USD in 2003 and 22.61 billion USD in 2019. Exports to Africa increased from 0.99 billion USD in 2001 to 11.7 billion USD in 2018. Russian exports to South America remained below 5 billion USD annually throughout the study period, and exports to Oceania consistently remained around 2 billion USD or lower.

Russian imports demonstrated growth periods in 2000–2008, 2009–2013, and 2016–2019, while they declined in other years within the studied timeframe. Total Russian imports increased from 43.4 billion USD in 2000 to a maximum of 315.2 billion USD in 2013 (Fig. 2).

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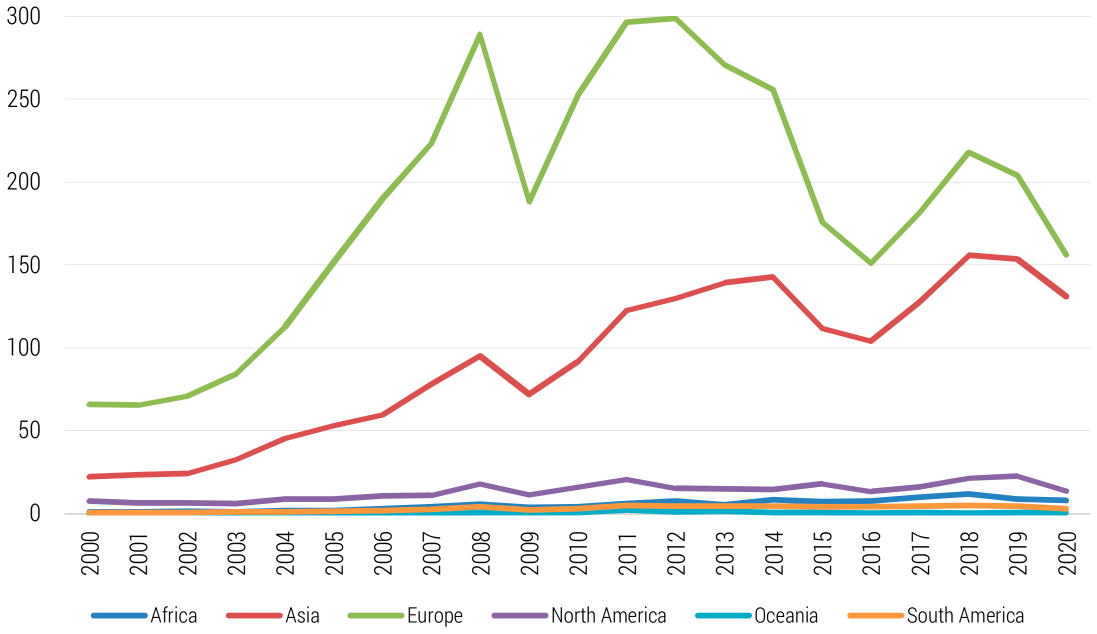

Figure 1. Russia's exports to Asia, Europe, Africa, North America, Oceania, and South America in the years 2000-2020 in USD billion

Source: authors' work based on The Observatory of Economic Complexity (2020).

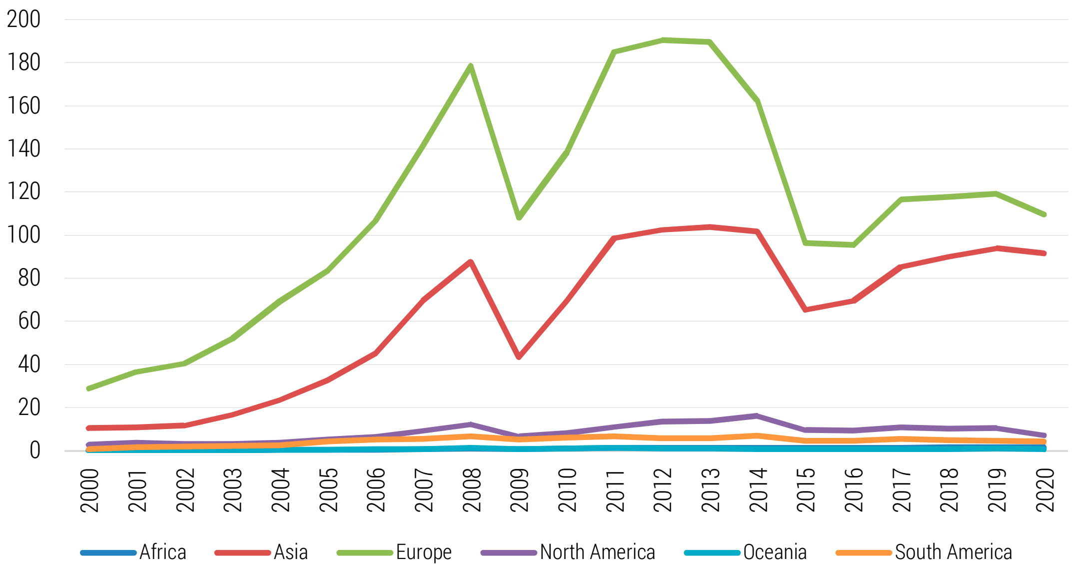

Figure 2. Russia's imports from Asia, Europe, Africa, North America, Oceania, and South America in the years 2000-2020 in USD billion

Source: authors' work based on The Observatory of Economic Complexity (2020).

Detailed trends show that Russian imports from Asia grew from 10.4 billion USD in 2000 to 103.7 billion USD in 2013. Imports from Europe ranged from 29 billion USD in 2000 to 190.5 billion USD in 2012. Imports from North America varied between 2.9 billion USD in 2000 and 16 billion USD in 2014. Imports from South America increased from 0.8 billion USD in 2000 to 6.8 billion USD in 2014. Imports from Oceania remained below 1.3 billion USD, and imports from African countries did not exceed 1.6 billion USD during the entire period (The Observatory of Economic Complexity, 2020).

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Official-Closed Emission of CO2 of Russia and the 78 countries

Countries participating in this research accounted for approximately 97% of global CO_2 emissions, according to data from the BP Statistical Review. Official-Closed Emission of CO_2 (EOC) refers specifically to emissions generated within the territorial boundaries of each country.

The 78 countries selected for this research collectively accounted for approximately 97% of fossil fuel-based CO_2 emissions worldwide, as reported by the BP Statistical Review. In this context, the Official-Closed CO_2 Emissions (EOC) indicator refers to territorial emissions generated within national borders.

Figure 3 illustrates emissions for Russia and the selected 78 countries. Russia was among the world's largest CO_2 emitters, responsible for between 6.1% (in 2000) and 4.6% (in 2020) of global emissions. During the analysed period (2000–2020), Russia emitted a total of 32.35 billion tonnes of CO_2, with annual emissions ranging between 1452.76 and 1605.96 Megatons (MT). Each year's emissions were lower than those recorded in 1990, primarily due to the economic collapse following the dissolution of the Soviet Union (Climate Transparency, 2015).

It is important to note a limitation of this study: the BP Statistical Review data include only CO_2 emissions resulting from fossil fuel combustion activities and do not encompass all sources of emissions. Additionally, historical emission data from BP since 1985 accounts separately for the USSR and its successor states, ensuring territorial comparability for Russia's emissions from 1990 onward.

A key limitation of this study stems from the scope of the BP Statistical Review data, which includes only CO_2 emissions from fossil fuel combustion. Other major sources of greenhouse gases – such as industrial processes, land-use changes, and agriculture – are not captured. Despite this, BP data are widely used due to their consistency, transparency, and availability across countries and decades. Furthermore, BP maintains separate historical records for the USSR and its successor states, making it possible to trace Russian emissions consistently from 1990 onwards.

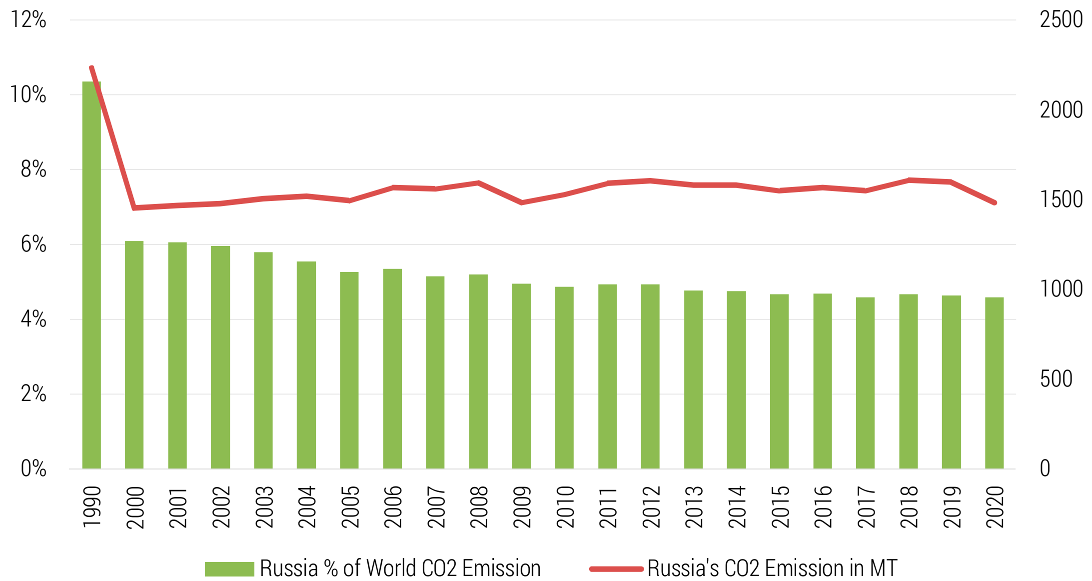

Figure 3. Russia Official-Closed Emissions of CO2 in MT in 1990, 2000-2020

Source: authors' work based on the BP stats-review .

When evaluating Russia's Official-Closed Emissions against the EU policy goal (reducing CO_2 emissions by at least 20% relative to 1990 levels), Russia consistently achieved this target throughout the study period (see Table 2). While aggregate emission data are available at the continental level, evaluating compliance with EU-style emission reduction goals requires country-level analysis. This is because international climate commitments – such as the EU's 20-20-20 targets – are implemented and measured at the level of individual countries. As a result, comparing compliance across continents without disaggregated data would be misleading. Throughout the analysed period, Russia's Official-Closed Emissions fluctuated between 65% and 72% of its 1990 emissions level.

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Table 2. Percentage of Russia's EOC in the years 2000-2020 to the reference year 1990

Year	2000	2001	2002	2003	2004	2005	2006
% of EOC	65.03%	65.63%	66.05%	67.39%	67.93%	66.94%	70.06%
Year	2007	2008	2009	2010	2011	2012	2013
% of EOC	69.87%	71.32%	66.41%	68.34%	71.22%	71.85%	70.77%
Year	2014	2015	2016	2017	2018	2019	2020
% of EOC	70.69%	69.36%	70.15%	69.32%	71.89%	71.43%	66.35%

Source: authors' work based on BP stats-review.

Actual-Open Emission of CO2 – after considering Russia's trade with the 78 countries

Using formula (1), the balance (SB) of embodied CO_2 emissions was calculated for trade between Russia and 78 countries across six continents. If the CO_2 balance (SB) is positive, it indicates that Russia "imported" more embodied CO_2 emissions via goods than it "exported." Conversely, a negative SB means that Russia "exported" more embodied emissions than it "imported." This balance was calculated exclusively for Russia in this study. Due to the extensive dataset, emissions balances were aggregated at the continental level (Tables 3a and 3b).

Table 3a. Russia's SB and Actual-Open Emissions (EAO) of CO_2 (2000–2009, MT)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Africa	-5.42	-4.47	-4.56	-3.25	-3.85	-3.25	-4.01	-4.26	-4.12	-3.78
Asia	-86.50	-81.77	-74.95	-76.79	-69.81	-46.00	-25.03	-0.44	-0.56	-38.22
Europe	-302.54	-250.13	-248.13	-236.18	-224.27	-234.68	-234.45	-196.28	-202.35	-176.66
North America	-40.28	-27.48	-25.16	-19.09	-20.41	-14.95	-13.89	-9.23	-12.46	-11.51
Oceania	0.06	0.05	-0.04	-0.12	-0.08	0.00	0.20	0.19	-0.14	-0.20
South America	-2.99	-1.89	-1.46	-1.64	-1.11	-0.34	-0.54	-1.02	-1.77	-0.89
Total	-437.67	-365.69	-354.30	-337.07	-319.53	-299.22	-277.72	-211.04	-221.40	-231.26
EAO	1015.1	1100.4	1121.3	1168.4	1197.9	1196.6	1287.4	1349.8	1371.8	1252.2

Source: authors' work based on BP Statistical Review, IEA (2020) and The Observatory of Economic Complexity.

Table 3b. Russia's SB and Actual-Open Emissions (EAO) of CO_2 (2010–2020, MT)

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Africa	-3.03	-3.81	-4.55	-2.37	-5.14	-7.11	-8.14	-8.31	-10.00	-6.95	-6.66
Asia	-25.64	-12.83	-14.44	-19.39	-35.83	-79.18	-74.85	-64.76	-89.33	-80.45	-69.14
Europe	-182.09	-145.11	-132.73	-111.33	-134.66	-157.78	-142.91	-133.66	-169.12	-153.32	-122.22
North America	-12.96	-12.29	-6.96	-6.02	-6.12	-17.43	-13.52	-12.65	-18.17	-18.64	-11.98
Oceania	-0.07	-1.19	-0.46	-0.62	-0.31	-0.57	-0.13	-0.25	-0.02	-0.22	-0.21
South America	-1.57	-2.12	-1.74	-1.45	-1.70	-3.06	-3.69	-3.04	-3.39	-2.96	-1.60
Total	-225.36	-177.35	-160.88	-141.18	-183.76	-265.13	-243.24	-222.67	-290.03	-262.54	-211.81
EAO	1301.3	1413.7	1444.2	1439.9	1395.5	1284.4	1323.8	1325.9	1315.9	1333.1	1270.4

Source: authors' work based on BP Statistical Review, IEA (2020) and The Observatory of Economic Complexity (2020).

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Throughout the studied period (2000–2020), Russia's total SB with the 78 countries was negative, indicating Russia consistently "exported" more embodied CO_2 emissions than it "imported." The lowest annual negative SB occurred in 2000 (-437.68 MT CO_2), and the highest annual value was -141.17 MT CO_2 in 2013. Oceania briefly presented a positive SB in specific years (2000–2001, 2005–2007), but overall maintained a negative balance (-4.13 MT) across the entire period. Europe was the continent with which Russia had the most significant negative SB, totalling -3890.6 MT of CO_2 emissions (2000–2020), with annual values ranging from -302.54 MT (2000) to -111.33 MT (2013). Asia's total negative SB amounted to -1065.91 MT of CO_2 emissions.

Russia also had a negative balance of CO2 with North America, and the value was between -40.28 MT in 2000 and -6.02 MT in 2013. The total balance in the research time was -331.2 MT of CO_2. In the case of Africa, Russia had a negative balance of CO_2; its value was between -10 MT in 2018 and -2.37 MT in 2013. In all study years, it was -107.04 MT of CO_2. A similar situation was with South America. The CO_2 balance with Russia was at -3.69 MT in 2016 and -0.34 in 2005. The total value in 2000-2020 was -39.97 MT of CO_2.

The lowest individual negative SB values for Russia (2000–2020) occurred with the Netherlands (-749.63 MT), Italy (-444.32 MT), Germany (-338.22 MT), the USA (-296.16 MT), the United Kingdom (-267.92 MT), and Turkey (-248.41 MT). Positive SB values were observed with South Africa (2.84 MT), China (74.51 MT), Turkmenistan (0.96 MT), Uzbekistan (34.13 MT), Ukraine (72 MT), Chile (1.72 MT), and Ecuador (1.62 MT) (based on BP Statistical Review; IEA, 2020; The Observatory of Economic Complexity, 2020).

Russia's SB with EU countries was consistently negative (-3583.62 MT CO_2), indicating that the EU indirectly received more embodied emissions from Russia than vice versa. This situation suggests potential implications for the EU's achievement of its CO_2 reduction target when considering emissions embedded in imported goods, even though the EU's direct emissions were not calculated in this study.

Table 4. Percentage of Russia's EAO and EOC relative to 1990 emissions (2000–2020)

Year	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
EOC	100	65.03	65.63	66.05	67.39	67.93	66.94	70.06	69.87	71.32	66.41
EAO	-	45.44	49.26	50.19	52.30	53.62	53.54	57.63	60.42	61.41	56.05
Year	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
EOC	68.34	71.22	71.85	70.77	70.69	69.36	70.15	69.32	71.89	71.43	66.35
EAO	58.25	63.28	64.65	64.46	62.47	57.50	59.26	59.35	58.91	59.68	56.87

Source: authors' work based on BP Statistical Review, IEA (2020) and The Observatory of Economic Complexity (2020).

EAO values for 1990 are intentionally left blank, as this calculation was not applicable. Significant differences exist between EAO and EOC values for Russia (Tab.4). Russia's Official-Closed Emissions (EOC) remained consistently below 80% of 1990 levels throughout the study period – a level comparable to the EU's 20% reduction target – this reduction was largely the result of post-Soviet economic contraction rather than proactive climate policy. It is important to clarify that the EU's 20% reduction goal formally applies to domestic territorial emissions (EOC), and not to consumption-based or trade-adjusted metrics such as EAO. The lowest EAO relative to the 1990 baseline was in 2000 (45.44%), and the highest was in 2018 (71.89%). Russia's EAO values were lower than its Official-Closed Emissions for every analysed year.

These results directly relate to carbon leakage issues, highlighting how Russian trade influences global emissions distribution. However, it should be acknowledged that other factors, such as changes in the structure of exported goods, can also influence Russia's EAO.

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Discussion

Between 2000 and 2020, Russia maintained a positive trade balance with Africa, Asia, Europe, the EU, and North America. With Oceania, Russia recorded a negative trade balance except for the years 2011, 2013, and 2015. The same applied to South America, except for 2018 and 2019. (The Observatory of Economic Complexity, 2020) Russia's trade patterns had a measurable effect on Actual-Open CO_2 Emissions (EAO), particularly among the 78 countries studied. These trade-related emissions totalled 5438.85 MT CO_2, of which 3583,62 MT CO_2 (approximately 66.4%) were associated with EU countries. This finding is significant in the context of carbon leakage (Ambec et al., 2024; Chen et al., 2024).

Several factors influence EAO: not only the volume of Official-Closed Emissions (EOC) and trade, but also the type of goods traded, their carbon intensity, and the broader structure of economic exchange. For example, energy-intensive exports result in a higher embodied emissions transfer than low-emission goods or services.

This raises a central policy challenge: how can EU climate objectives be reconciled with emissions associated with international trade? The literature suggests two main strategies: continuing the internal reduction focus while recognising its limitations, or integrating consumption-based accounting frameworks into EU climate policy (Tukker et al., 2020; Caetano et al., 2025).

Instruments such as the Carbon Border Adjustment Mechanism (CBAM) offer potential pathways to address carbon leakage by assigning CO_2 cost adjustments at the point of import (Bellora & Fontagné, 2023; Lim et al., 2021). However, any such mechanisms must be compatible with WTO trade rules and carefully calibrated to reflect product-specific carbon footprints. Several ecological fiscal instruments discussed in the literature (e.g., Fortuński, Kryk, Bartniczak & Ptak) offer potential tools for aligning international trade with environmental goals. Rather than advocating uniform taxation, this paper supports differentiated carbon-related instruments that reflect actual product footprints. These proposals must account for legal and diplomatic challenges, including compatibility with WTO rules.

The analysis of EAO data underscores the difficulty of evaluating the effectiveness of international agreements when trade-related emissions are not fully accounted for. Gaps in cross-border emission tracking may weaken the real-world impact of such frameworks.

Potential retaliation or friction from trading partners is indeed a risk when introducing new environmental instruments. However, such reactions can also be opportunities for negotiation and innovation in global climate governance. A carefully designed, transparent policy would minimise trade tensions.

Finally, while Russia met the EU's 20% reduction benchmark (based on 1990 levels) about its EOC, this was largely the result of post-Soviet economic contraction rather than deliberate mitigation efforts. Therefore, the country's impact on EU Actual-Open Emissions remains significant and should be addressed within comprehensive EU climate strategies.

The study focuses on the period 2000–2020. Current (2025) geopolitical conditions – especially the decline in EU–Russia trade due to the Russia–Ukraine war – have reduced the flow of embodied emissions between the two. Thus, the study's findings apply primarily to the pre-war economic and emissions context, while underlining the importance of integrating emissions transfers into long-term EU climate strategies.

Summary

The European Union is widely regarded as a global leader in combating climate change, promoting clean energy, and reducing CO_2 emissions (Oberthür & Pallemaerts, 2010). However, despite these efforts, the EU's approach remains largely focused on internal emissions, without fully accounting for emissions embedded in international trade.

Russia, as one of the EU's major trading partners, has played a significant role in shaping the Actual-Open Emissions (EAO) profile of EU countries. From 2000 to 2020, Russia's exports consistently exceeded its imports in CO_2-intensive products, resulting in a negative carbon trade balance and a total transfer of 5438.85 MT of CO_2 emissions, of which 3583.62 MT impacted the EU directly. Euro-

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pean countries – particularly those in the EU – absorbed the majority of Russia's exported CO_2 emissions, thereby inflating their own EAO despite reductions in domestic emissions (EOC).

Although Russia's EOC remained below 80% of 1990 levels throughout the period, its stable emissions and the scale of CO_2 exports highlight the need for broader international policy instruments. These instruments could be applied both within Russia and among its trading partners to address transboundary carbon flows more effectively. This situation demonstrates that internal efforts to meet climate targets can be undermined by imported emissions – an issue commonly referred to as carbon leakage.

Carbon leakage occurs when companies relocate CO_2-intensive production to countries with laxer environmental standards or when high-emission goods are imported into the EU from such regions (European Commission, 2025; Misch & Wingender, 2024; Caetano et al., 2025). The EU's strong environmental regulations can unintentionally drive businesses to outsource emissions, thereby weakening the net global impact of its climate policy.

To address this issue, the EU must begin to think more globally. Policies should account for CO_2 emissions embedded in goods and services imported from countries with less stringent climate rules. One potential solution is the introduction of an eco-energy tax or carbon-related tariff, applied to all products based on their embedded CO_2 emissions, or selectively to countries that do not align with EU-level emission standards (Bielecki et al., 2016).

Fortunately, such a mechanism is already being developed: the EU's Carbon Border Adjustment Mechanism (CBAM), which aims to level the playing field between domestic and foreign producers by adjusting carbon costs at the border (Salzman, 2023; European Commission, 2025). However, even CBAM may face opposition and economic consequences, including trade retaliation, transaction costs, or political disputes. Therefore, its implementation must be carefully coordinated and legally robust.

Ultimately, if the EU wishes to maintain leadership in sustainability, its energy and climate policies must extend beyond its borders. Emissions accounting should reflect global realities, not just domestic performance. This would enhance the credibility, fairness, and effectiveness of its climate action strategy in the context of sustainable development.

The contribution of the authors

Conceptualisation, B.F.; literature review, B.F. and A.B.; methodology, B.F.; formal analysis, B.F. and A.B.; writing, B.F. and A.B.; conclusions and discussion, B.F. and A.B.

The authors have read and agreed to the published version of the manuscript.

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Bartosz FORTUŃSKI • Arnold BERNACIAK

WPŁYW HANDLU ZAGRANICZNEGO ROSJI NA JEJ RZECZYWISTĄ EMISJĘ CO_2

STRESZCZENIE: Głównym problemem tego artykułu jest analiza wpływu handlu Rosji z 78 głównymi partnerami handlowymi na rzeczywistą emisję CO_2 (EAO) w latach 2000-2020 w odniesieniu do wymogu UE dotyczącego redukcji emisji CO_2 o 20%. Rozwiązaniem problemu może być wykorzystanie modelu EAO, który wskazał, że handel zagraniczny Rosji znacząco wpłynął na jej emisję CO_2 w latach 2000-2020. Badania przeprowadzone w artykule opierają się na zasadzie modelu przepływu okrężnego. Wyniki tego badania pokazują, że wpływ handlu Rosji na emisje CO_2 był znaczący, ponieważ Rosja była bardziej znaczącym emitentem CO_2 i eksportowała znaczną część swojego PKB. Sytuację tę spowodowały cztery czynniki: PKB Rosji, procent eksportowanego PKB z Rosji, procent importowanego PKB do Rosji z wybranego kraju oraz wielkość oficjalnej emisji CO_2 (EOC), które są danymi wyjściowymi do obliczeń w przypadku Rosji i wybranego kraju. Spowodowało to znaczną różnicę między EOC i EAO w Rosji, UE i innych krajach, co mogło negatywnie wpłynąć na realizację unijnego celu redukcji emisji CO_2. Wyniki niniejszego badania są również kluczowe w kontekście „Fit for 55" Które jest nową polityką UE i ma na celu zmniejszenie emisji gazów cieplarnianych o 55% do 2030 roku.

SŁOWA KLUCZOWE: handel międzynarodowy Rosji, emisja CO_2, polityka energetyczna UE

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