The impact of China's foreign trade on their Actual-Open Emissions of CO_2 in the years 2000–2020 in the context of EU energy policy

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Aim: This article aims to analyze the impact of China's trade with 78 major trading partners on Actual-Open Emission of CO_2 (EAO) from 2000 to 2020 in light of the European Union's (EU) goal to reduce CO_2 emissions by 20% by 2020 compared to 1990 levels.

Research Methods: The research is based on the Actual-Open Emission of CO_2 model and employs the circular flow model to assess the influence of China's foreign trade on CO_2 emissions during the years 2000–2020.

Findings: The study revealed that China's foreign trade significantly influenced its CO_2 emissions in all years analyzed, with positive contributions to EAO due to a trade surplus (exports exceeding imports). As the world's largest exporter and the second-largest importer, China's trade activity resulted in substantial CO_2 emissions. Four key indicators were identified as influencing the difference between Official-Close Emission of CO_2 (EOC) and EAO: China's GDP, the percentage of exported GDP, the percentage of imported GDP, and EOC levels. These findings highlight the significant role of trade in China's CO_2 emissions, which is critical in the context of EU initiatives like "Fit for 55."

Keywords: International trade, China, CO_2 emissions, EU energy policy.
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1. Introduction

The second biggest economy in the world in the years 2000–2020 was China (worlddata.info). They were in first place in terms of GDP PPP from the year 2014 (Gentle 2016: 87). From 2000 to 2020, China was among the three countries with the world's most prominent export and importers (unctad.org; wits.worldbank.org). China's trade significantly impacted the natural environment, including CO_2 emissions. The considerations contained in this study result from the energy policy implemented by the EU. One of its basic assumptions in 2007–2020 was the rule – 3 times 20%.

EU policy and its energy policy directly refer to sustainable development (SD). Gro Harlem Brundtland proposes the basic definition of SD presented in the report "Our Common Future." SD is defined here as: "meeting the needs of the present without compromising the ability of future generations to meet their own needs." (Czaja, Becla 2002: 308–309; Górka et al. 1995: 78; Rao 2000: 85; Adamczyk 2001: 28–29).

We live in a global world, and therefore, the activities of particular countries have a direct or indirect impact on others. Nevertheless, it does not mean that all countries function in the same way and follow the same rules. Some countries contribute significantly to reducing global CO_2 emissions, bearing high costs compared to others; nonetheless, it does not bring the intended effects of an absolute reduction of CO_2 emissions. This study confirms the issue, especially regarding China's trade with 78 countries. The struggle of the EU with the issue of CO_2 emissions does not affect China with this problem. This study will show that China had, between 2000 and 2020, an impact on world CO_2 emissions lower than officially shown because they export more CO_2 than imported. By this example, it will also be shown that CO_2 emissions are a global problem, and the struggle of several countries does not change much in the universal aspect. Fundamental questions are as follows.

How significant influence did China trade on CO_2 emission globally? What should the EU do to make its energy policy more efficient? Should not all countries be involved in efforts to reduce CO_2 emissions? Should solutions be undertaken to encourage other countries to take a similar approach to the CO_2

issue? Should the European Union change its approach regarding CO_2 reduction and take international exchange into account?

This new approach should help to answer these questions.

China is one of the world leaders in terms of the value of CO_2 emissions and international exchange. According to the Economic Complexity Index (ECI) (The Observatory), it is the world's second-largest importer and exporter and one of the most complex economies.

The primary purpose of this paper is to show the impact of foreign trade on Actual-Open Emissions of CO_2 (E_{AO}) in China after considering trade with the 78 countries. It is not about the value of Official-Close Emission of CO_2 (E_{OC}) emissions but about its accurate volume in regard to the CO2 transfer both in export and import products. There should also be services that should have been considered in this research.

The survey is based on a circular economic flow model principle that shows money flows through the economy. There are two kinds of this model. Closed – inside the country, and Open – including export and import factors. The same refers to the open and closed economy. The Official-Close Emission of CO_2 is similar to the close circular flow model concept. Is it the right approach to this problem? It seems not to be. We live in a global world where international trade is one of the economy's most important and influential factors. This factor greatly influences CO_2 emission because producing goods and services accompanies CO_2 emission.

2. Methods

From 2007, the EU energy policy was created by rules, mechanisms, and economic and financial instruments (Komunikat UE KOM (2007) 1, Dyrektywa 96/61/WE, Dyrektywa 2001/80/WE, Dyrektywa 2003/87/WE, Dyrektywa 2006/32/WE, Dyrektywa 2009/28/WE, Komunikat UE KOM (2010) 639, Komunikat UE KOM (2008) 781, Komunikat UE KOM (2008) 772, Komunikat UE KOM (2006) 105, Komunikat UE KOM (2008) 13, Komunikat UE KOM (2008) 768). It outlines the basic directions for developing the EU energy sector (Jeżowski 2011). Energy policy came into force in the EU in 2007. The European energy policy aimed to

achieve $3 \times 20\%$ by 2020. It involves the reduction of CO_2 emissions by 20% in 1990, increasing participation of renewable energy sources in the energy mix to 20%, and improving energy use efficiency by 20% compared to 1990.

It should also be emphasized that the indicated aims are interconnected. The last two goals significantly influence the reduction of CO_2 emissions, which in turn impacts the changes in other objectives of the EU energy policy.

The Actual-Open Emission of CO_2 was determined as the CO_2 emissions of a particular country. It is diminished by emissions in exported goods and services of the country and magnified by emissions imported in products and services from the importing country. It means that the emissions balance of CO_2 should decrease Actual-Open Emissions of CO_2. The following formulas present a method used to calculate Actual-Open Emissions of CO_2 for the China:

$$S_B = \left(\frac{I_m}{GDP}\right)\% \times E_{OCC} - \left(\frac{E_x}{GDP}\right)\% \times E_{OC} \qquad (1)$$

$$\boldsymbol{E_{AO} = E_{OC} + S_B} \qquad (2)$$

S_B – The balance of CO_2 emissions in the selected country;

E_{OC} – The Official-Closed Emissions of CO_2 in China;

E_{OCC} – Official-Closed Emission of CO_2 in selected country;

Ex – Value of the China export to selected country;

Im – Value of the China import from a particular country;

GDP – The gross domestic product of a selected country;

(Im/GDP)% – part of the GDP of a specific country from with the China imported;

(Ex/GDP)% – part of China's GDP which was exported to a particular country;

(Im/GDP)%*E_{OCC} – Quantity of imported CO_2 in goods from a specific country to China;

(Ex/GDP)%*E_{OC} – Quantity of exported CO_2 from China to the particular state in exported goods;

E_{AO} – Actual-Open Emissions of CO_2 in China.

To show the E_{AO} in a specific country, we need the data of all China trade partners. In this survey, we have 78 main trade partners of China divided into five continents: Africa, Asia, Europe, North America, Oceania, and South America (table 1). Africa is represented by four countries, Asia by 29 countries, and Europe by 33 countries. Four countries represent North America, Oceania 2, and South America by seven countries. These countries and China are among the largest CO_2 emitters in the world.

They were responsible for 96–97% of the world's CO_2 emissions from 2000 to 2020. Due to the multitude of data, the research results in this study will be limited to individual continents, with an indication of the countries that had the most significant impact on CO_2 exchange.

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

Source: own elaboration.

3. Trade between China and 78 countries from 2000 to 2020

China is the second biggest economy in the world. Total exports of China in years had a grooving trend until 2008, 2009–2014, 2016–2018, and 2019–2020 (figure 1 and figure 2). The declines in total China exports in a survey time were in the years 2009, 2015–2016, and 2019. China's total exports reached 319,71 billion (B) USD in 2000, up to 2491,05 B USD in 2020. It increased almost eight times in the twenty-one years considered in this survey, and by 21 years considered in this survey, China exported a total of 78 countries, 32,35 trillion USD.

Between 2000 and 2020, China's exports to Asia countries achieved value from 156 B of USD in 2000 to 1168 B of USD in 2020. In the case of North American countries, China's exports were between 81 B of USD in 2000 and 615 B of USD in 2018. In survey time, China's exports to Europe reached 69 B USD in 2000 and 586 B in 2020. In 2007–2010 and 2019–2020, China's exports to European countries exceeded North American countries. Between 2000 and 2020, China's exports to South America achieved a value of 4 B USD in 2000 and 93 B USD in 2013. From 2000 to 2020, China's exports to Oceania have yet to reach 65 B USD; they level 43 B USD to Africa.

Figure 1. China exports to Asia, Europa and North America in the years 2000–2020 in USD billion
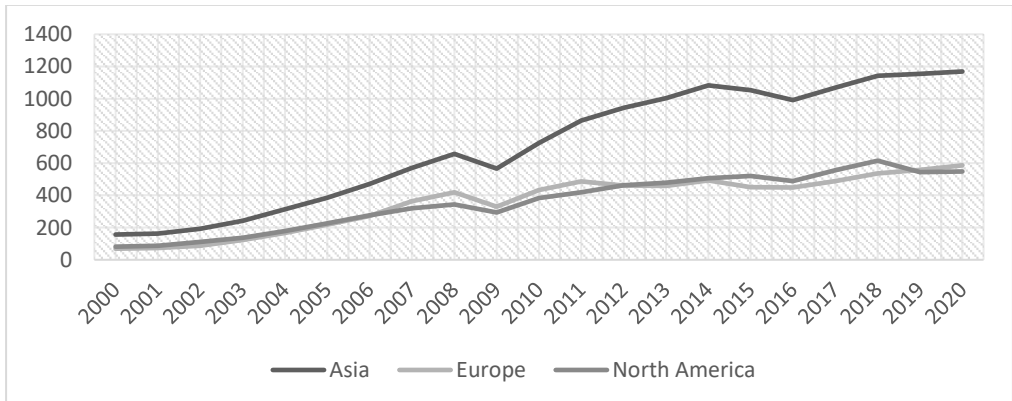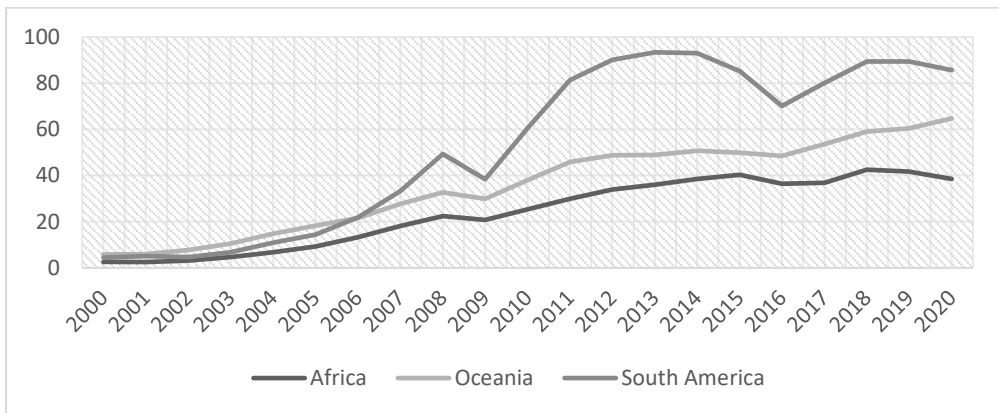

Source: own study based on The Observatory of Economic Complexity.

China's exports to Asia in 2000–2020 constituted between 42.8% (2007) – and 49% (2000) of total China exports, to North America 21.8% (2011) and 27.1% (2002); in the case of Europa, it was 20.5% (2015) and 27.5% (2008). In South America, China exported 1.2% (2002) and 4.4% (2012, 2013) of total their exports. Oceania reached a level of 2.6% and Africa 1.8%. It shows that in international trade, contacts with Asia, North America, and Europe are the most important partners for China.

Figure 2. China exports to Africa, Oceania and South America in years 2000–2020 in USD billion
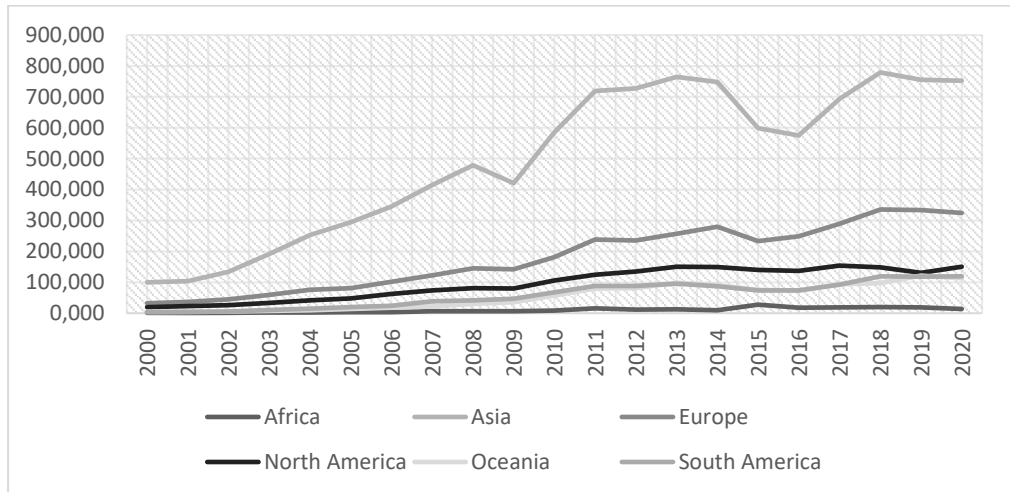

Source: own study based on The Observatory of Economic Complexity.

China's total imports grew in 2000–2008, 2009–2013, and 2016–2018 (figure 3). In the remaining years, the total China imports declined, according to a survey. China's imports reached 160 B USD (2000) to 1499 B USD (2018). It increased almost ten times over the 21 years of the studied period.

Between 2000 and 2020, China's imports from Asia increased from 99.9 B USD in 2000 to 778 B USD in 2018. In the case of European countries, the value of China's imports was between 32 B of USD in 2000 and 335 B of USD in 2018. In survey time, China's imports from North American countries achieved a value of 19 B of USD in 2000 and 1534 B in 2017. Between 2000 and 2020, China's imports from South America reached 3.6 B USD in 2000 and 119 B USD in 2020. China imports from 2000–2020 from Oceania achieved a value of 4.2 B USD in 2000 and 121 B USD in 2029. China's imports from African countries never reached 28 B USD.

Figure 3. China imports from six continents represented by 78 countries in USD billions in 2000–2020

Source: own study based on The Observatory of Economic Complexity.

China imports from the Asian countries in 2000–2020 constituted 63.8% (2005) – 51% (2019 and 2020) of the total China imports. Imports to China from European countries in the survey period were between 17.6% in 2005 and 22.5% in 2019; in the case of North American countries, it was 13.3% (2001) and 8.1% (2019). From South American countries, it was between 2.2% (2000) and 8.1% (2020) of total China imports. China imports from Australia and New Zealand in 2000–2020 constituted 2.4% (2001) – 8.2 (2019) of the total China imports. Africa never reached a level higher than 2.5%. It shows that China's contacts with Asia, North America, and Europe are the most critical partners in imports, similar to China's exports.

From 2000 to 2020, the value of China's imports from Europe fluctuated, but it was generally upward. This time, China had a positive balance in international trade with all European continents except the Island, Germany, and Switzerland. It means that they imported less from them than they exported to them. It means that China is a vital partner for almost all countries because they are massive international suppliers. It shows that in global trade, China was an essential partner for European countries, especially European Union countries. The EU can influence China's CO_2 emission policy to be more restrictive. It can be easier to establish because the trade

balance between China and Europe, especially with the EU, was positive. This situation is less challenging to achieve because China has more to lose.

4. Official-Closed Emission of CO_2 of China and the 78 countries

Reducing CO_2 emissions is one of the priorities of the EU energy policy. However, the reduction of CO_2 emissions assumption concerns only the EU, and except for the encouragement, there is no other possibility to convince other countries worldwide to undertake similar actions. Countries participating in this survey were responsible for around 97% of all CO_2 emissions.

Table 2. China Official-Closed Emissions of CO_2 in MT in 1990, 2000–2020

| Year	1990	2000	2001	2002	2003	2004	2005	2006
MT of CO2	2323.83	3360.87	3523.08	3843.40	4532.15	5334.89	6098.18	6677.29
China % of World Emission	10.78	14.09	14.57	15.54	17.46	19.54	21.47	22.80
Year		2007	2008	2009	2010	2011	2012	2013
MT of CO2		7239.76	7378.25	7713.90	8145.83	8827.19	9004.24	9247.43
China % of World Emission		23.87	24.11	25.74	26.03	27.44	27.70	27.96
Year		2014	2015	2016	2017	2018	2019	2020
MT of CO2		9293.19	9279.73	9278.98	9466.36	9652.69	9810.46	9899.33
China % of World Emission		28.04	27.95	27.81	28.07	28.10	28.55	30.63

Source: own study based on BP report.

Official-Close Emission of CO_2 is a value of CO_2 emitted by a country's economy. Table 2 and figure 4 presents China, 78 countries, and the whole world's emission of CO_2. From 2004, China was the world's biggest emitter of CO_2, and from 2000–2020, it was responsible for 14.09% (2000) to 30.63% (2020) of the world's emissions. In the survey, China emitted 157.61 BT of CO_2 and recorded 3360.87 – 9899.33 MT of CO_2. In the entire study, China emitted more CO_2 than in 1990.

In the year 1990, the following CO_2 emission values occurred in MT: African countries emitted 510.35, Asian countries – 6175.08, Europa – 7521.44, North

America – 5173.59, Oceania – 300.78 and South America – 535.42. At this time, European countries were the biggest CO_2 emitters in the world. In the years 2000–2020, African countries emitted a total of 16.41 BT of CO_2 and were responsible for around 2.5% of the world's emission of CO_2. In the same period, Asia emitted 316.67 BT of CO_2, equivalent to 36% (2000) and 58.9% (2020) of the world's emission of CO_2. Europa emitted 121.15 BT of CO_2 in survey time and was responsible for 25.2% (2000) – 14.37% of world emission of CO_2. From 2000–2020 North America emitted 134.98 BT of CO_2 and was responsible for 27.93% (2000) – 16.61% (2020) of world emissions. Oceania emitted 8.95 BT, and South America emitted 19.89 BT of CO_2 simultaneously.

The biggest emitter of CO_2 (2000–2020) in North America was the US, and in Asia was China. In the survey, China emitted 157.10 BT of CO_2 and had taken values in the range 9899.33 (2020) – 3360.87 (2000) MT of CO_2. In 2020, China was responsible for 30.6% of the world's CO_2 emissions.

Figure 4. The Official-Closed Emissions of CO_2 on six continents in MT in 2000–2020
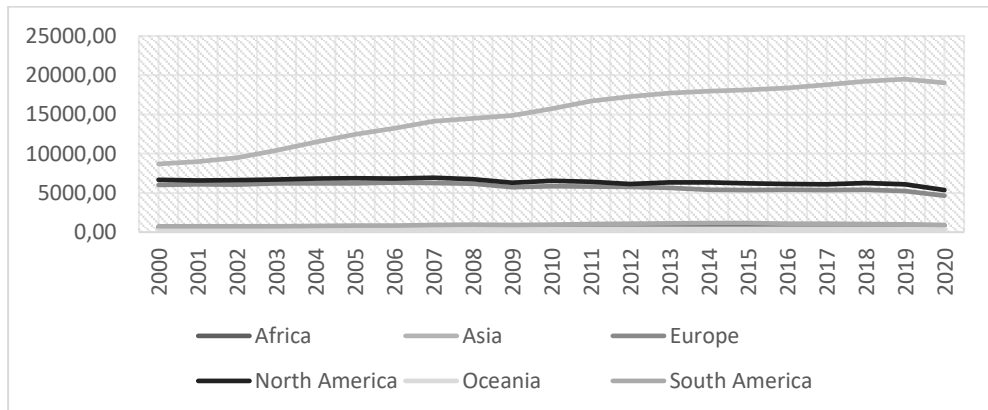
Source: own study based on BP report.

If we consider the Official-Closed Emission of CO_2, China did not fulfill in any survey years one of the three main aims of the EU energy policy – reduction of CO_2 emission to the level of 80% emission since the year 1990 (table 3). At this point it is impossible to present if continents fulfill the EU obligation because it must be

calculated for each country separately. Moreover, there was a noticeable upward trend in China's Official-Closed Emission of CO_2 throughout the entire period under study. Except for 2015 and 2016, in the whole period under study, the volume of this emission was higher than that recorded in the year 1990.

Table 3. China % of E_{OC} about 1990 in the years 2000–2020

Year	2000	2001	2002	2003	2004	2005	2006
% of E_{OC}	144.63	151.61	165.39	195.03	229.57	262.42	287.34
Year	2007	2008	2009	2010	2011	2012	2013
% of E_{OC}	311.54	317.50	331.95	350.53	379.85	387.47	397.94
Year	2014	2015	2016	2017	2018	2019	2020
% of E_{OC}	399.91	399.33	399.30	407.36	415.38	422.17	425.99

Source: own study based on BP report.

5. Actual-Open Emission of CO_2 – after considering the China trade with the 78 countries

Using the formula (1), the S_B of CO_2 emission was calculated for China and 78 countries from five continents. It shows us the balance of CO_2 emissions. If the value is positive, it means that China's import of CO_2 from a particular country was higher than its export to this country. If the value was negative, then the opposite situation took place – the export of CO_2 was higher than the import. We add the definite number to a particular country's emission amount, and if it is negative, we diminish it. Due to the large number of countries included in the study, individual countries were assigned to appropriate continents. The values given for individual continents are the sum of the CO_2 balance results for the particular countries participating in the study and located on the relevant continent (table 1). Therefore, these data are presented about individual continents. The results of the calculation are presented in the tables 4 and 5.

Table 4. China's balance of CO_2 emissions (S_B) and Actual-Open Emissions of CO_2 (E_{AO}) in 2000–2009 in MT

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Africa	-5.11	-4.54	-5.44	-9.20	-15.31	-20.32	-27.51	-29.78	-27.31	-24.11
Asia	-357.62	-342.52	-398.06	-508.06	-666.85	-819.35	-912.71	-910.95	-774.35	-596.91
Europe	-144.75	-140.82	-182.22	-285.89	-403.75	-536.22	-612.42	-697.46	-626.02	-446.00
North America	-214.61	-214.94	-273.97	-358.49	-467.17	-583.42	-643.76	-622.28	-518.87	-415.34
Oceania	-12.61	-11.44	-15.51	-23.10	-34.62	-41.18	-43.35	-46.22	-40.91	-29.94
South America	-10.26	-10.34	-7.83	-10.95	-21.03	-28.41	-42.85	-52.55	-64.35	-42.33
Total	-744.96	-724.60	-883.03	-1195.69	-1608.74	-2028.90	-2282.61	-2359.24	-2051.81	-1554.64
E_{AO}	2615.91	2798.48	2960.37	3336.46	3726.16	4069.29	4394.68	4880.53	5326.44	6159.26

Source: own study based on BP report, CO_2 EMISSIONS FROM FUEL COMBUSTION Highlights and The Observatory of Economic Complexity.

In the considered period, the total China trade balance of CO_2 emission with the 78 countries taken together was negative, meaning that China imported less CO_2 than exported. China's lowest value in 2007 was -2359.24 MT of CO_2, and the highest was in 2001 -724.60 MT of CO_2. However, if we consider each continent separately, only in the case of African countries, we notice a positive balance of CO_2. It was +1.57 MT of CO_2 (2015). From 2000 to 2020, China had a negative balance with Africa; by those years, it was -318.08 MT. In the case of the rest of the continents, China exported more CO_2 than imported every year considered period. This means that their CO_2 balance was negative throughout the entire research period. Asia was the continent with China having the lowest negative balance of CO_2. Its value ranged from -342.52MT of CO_2 (2001) to -912.71 MT of CO_2 (2006), and by the considered period,

it was -11904.86 MT of CO_2. The next continent with which China had a negative balance of CO_2 was North America. The CO_2 balance ranged from -643.76 MT (2006) to -214.61 MT (2000), and in the years 2000–2020, the total value was -8702.02 MT of CO_2.

The next continent with which China had a negative balance of CO_2 was Europa, and the value was between -140.82 MT in 2001 and -697.46 MT in the year 2007. The total balance in the survey time was -7955.21 MT of CO_2. In the case of South America, China had a negative balance of CO_2; its value was between -7.83 MT in 2002 and -71.18 MT in 2011. In all survey years, it was -798.84 MT of CO_2. A similar situation was with Oceania. The CO_2 balance with China was at a value of -11.44 MT in 2001 and -46.22 in 2007. The total value in 2000–2020 was -523.17 MT of CO_2.

Table 5. China's balance of CO_2 emissions (S_B) and Actual-Open Emissions of CO_2 (E_{AO}) in 2010–2020 in MT

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Africa	-25.75	-19.83	-25.02	-22.50	-23.55	1.57	-4.18	-5.75	-8.46	-6.91	-9.07
Asia	-640.22	-629.20	-614.15	-561.80	-558.87	-533.60	-496.84	-445.57	-379.02	-371.54	-386.65
Europe	-519.74	-497.89	-414.36	-372.09	-359.65	-298.11	-284.64	-285.71	-269.37	-280.02	-298.07
North America	-475.05	-447.66	-445.49	-414.88	-403.81	-393.67	-363.59	-385.51	-386.71	-339.12	-333.68
Oceania	-31.36	-31.32	-31.17	-23.30	-21.19	-19.69	-16.45	-14.04	-14.91	-7.57	-13.31
South America	-61.97	-71.18	-70.59	-63.68	-58.95	-47.59	-34.49	-32.35	-23.65	-22.78	-20.71
Total	-1754.09	-1697.08	-1600.78	-1458.23	-1426.02	-1291.08	-1200.20	-1168.92	-1082.12	-1027.94	-1061.49
E_{AO}	6391.74	7130.11	7403.47	7789.19	7867.17	7988.65	8078.78	8297.44	8570.57	8782.51	8837.85

Source: own study based on BP report, CO_2 EMISSIONS FROM FUEL COMBUSTION Highlights and The Observatory of Economic Complexity.

China had the lowest negative S_B of CO_2 emission for 21 years of the survey, with the US (-7367.21 MT), Hong Kong (-5055 MT), Japan (-2938.62 MT), Germany (-1489.23 MT), United Kingdom (-1153.05 MT) and Netherlands (-1016.23 MT). The only countries with which China had a positive value of S_B of CO_2 by the survey years were Uzbekistan (10 MT), Turkmenistan (112 MT), Saudi Arabia (118 MT), Qatar (15 MT), Oman (158 MT), Kuwait (25 MT), Kazakhstan (50 MT), Iraq (45 MT) and Iran (122 MT). In the case of South America: Brazil (-342.35 MT), Oceania: Australia (-433.56 MT) and Africa: Egypt (-140.48 MT).

China had negative S_B of CO_2 emission in all 21 years, as considered in this survey with all EU countries (-7561.69 MT). This means the EU had an E_{AO} higher than the E_{OC} because China exported much more CO_2 to EU countries than it did to China. This situation influenced meeting the requirements of the EU energy policy – 20% less CO_2 emissions compared to 1990. The same is true in the case of E_{OC}.

Table 6. China % of E_{AO} and E_{OC} about 1990 in 2000–2020

Year	1990	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
E_{OC}	100	144.63	151.61	165.39	195.03	229.57	262.42	287.34	311.54	317.50	331.95
E_{AO}		112.57	120.42	127.39	143.58	160.35	175.11	189.11	210.02	229.21	265.05
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
E_{OC}	350.53	379.85	387.47	397.94	399.91	399.33	399.30	407.36	415.38	422.17	425.99
E_{AO}	275.05	306.83	318.59	335.19	338.54	343.77	347.65	357.06	368.81	377.93	380.31

Source: own study based on BP report, CO_2 EMISSIONS FROM FUEL COMBUSTION Highlights and The Observatory of Economic Complexity.

The E_{AO} was calculated by using formula (2). In the case of China, the changes in the percentage of E_{AO} CO_2 emission in 1990 were significant (table 6). In all survey years, China had higher E_{AO} than the emission in 1990. China's E_{OC} in 2000–2020 was never lower than its value in 1990. The lowest increase of E_{AO} relative to E_{OC} was in 2000 (44.63%), and the highest was 325.99% (2020). China did not fulfil the EU energy policy (reduction of CO_2 emission) in any of the survey years. The E_{AO} in

China in each survey year was lower than the their Official-Close Emission of CO_2. The smallest spread between the two of them was in the year 2000, and it was 32.06% of China's emission of CO_2 from the year 1990. The highest spread between E_{OC} and E_{AO} in China was in 2007, 101.52%. The highest E_{AO} in China was in 2020, which was 380.31% of CO_2 from 1990. This data shows that China was a substantial net exporter of CO_2 emissions in all survey years.

6. Discussion

It is worth stressing that the EU's actions in implementing the EU energy policy are limited only to the EU area. Between 2000 and 2020, China, in all survey years, had a positive trade balance with African, Asian, European, EU, and North American countries. With Oceanian countries, China had a positive trade balance from 2000 to 2008, and South American countries had a positive trade balance from 2000 to 2001. Throughout the review, the total China foreign trade balance considering five continents was negative in Oceania – 2009–2020 and South America – 2002–2020. The total China balance by 21 years of the survey was 13533 B USD. By those 21 years, the total positive China trade balance was Asia (4478 B of USD), Europe (3716 B of USD), North America (5560 B of USD), and Africa (294 B of USD). The only continents with which China had a negative trade balance from 2000 to 2020 were Oceania, which was -390 B of USD, and South America's -126 B of USD. China's trade balance had a tremendous impact on E_{AO} in all of the 78 countries that participated in the research.

What does influence on value of E_{AO}? It is Official-Close Emission of CO_2 of a particular country, the % of GDP exported goods from the China. It must be considered also the % of GDP of countries from which the China imported goods. This directly results in China's enormous influence on CO_2 emissions in other countries.

EU is the world leader in CO_2 reduction. One of its tolls is the EU energy policy. What can/should the EU do to make other countries do more to reduce CO_2 emissions? What are the challenges that the EU faces? There are two possibilities. One is doing nothing, living it without changes. The EU will be content with its energy policy, with

a reduction of CO_2 emissions inside the EU. However, it will change nothing. The EU will still import CO_2 from outside the EU through products and services and continue contributing to CO_2 emissions outside the EU. The second option is to change its approach to the energy policy to be more global. The EU should take into account the CO_2 emissions that are imported into the EU. The EU should consider some instruments that encourage countries outside the EU to do similar activities to reduce CO_2 emissions. For example, ecological taxes (Fortuński 2012–2023; Bogrocz 2008; Graczyk, Jakubczyk 2005; Kaczmarski 2010; Kryk 2012a, 2012b). The E_{AO} also indicates the ineffectiveness of international agreements in reducing emissions of CO_2, such as the Kyoto Agreement.

The main challenges in the case of the second solution are retaliation activity undertaken by the countries from which the EU imports and on each of these "ecological taxes" or other instruments would be imposed. This will, among others, include transaction costs. The other challenge will be how to promote the reduction of CO_2 emissions in countries outside the EU. Because China, as we saw in previous data, imports from European countries are much smaller than China's exports to those countries, it will be easier for the EU to decrease China's CO_2 emissions. This is because China is more interested in not losing the EU as a destination for export – it would be more costly for China than for the EU to establish a new form of CO_2 tax.

The appropriate would be tariffs on all kinds of products and services imported from China to the EU. Such a tariff from the EU would likely trigger a counteraction from China in the form of tariffs on products from the EU.

Another problem is determining the reference period to which the volume of CO_2 emissions in China should be referred. Setting this to 1990 seems unrealistic. In this context, it should be noted that China's official CO_2 emissions increased throughout the period under review. The same applies to the reduction in CO_2 emissions. In the fit for 55 documents, there is talk of a 55% reduction in CO_2 emissions by 2030 (compared to 1990) and achieving climate neutrality by 2050.

About China, there is no mention of any reduction in emissions, whether compared to 1990, 2000, or even 2010. it also seems that not addressing the issue of the export and import of CO_2 emissions and its limitation by the EU on non-EU countries is deceiving EU citizens. The EU spends vast amounts of money on climate

transformation. People bear the costs associated with this daily in the form of higher electricity bills and loss of jobs in emission sectors. Other countries outside the EU do not bear such expenses, which is unfair.

Another problem is that the EU is responsible for a small percentage of global CO_2 emissions – about 8%. This means that if the EU does not engage other countries in similar actions, particularly the largest CO_2 emitters, which are also its largest trading partners, climate protection actions will not bring benefits at the global level.

7 Summary

The European Union is regarded as the leader in the fight against global warming, a battle for clean energy, and a reduction of CO_2 emissions. Unfortunately, its actions are isolated, which leads to the situation that even such a large economy as the EU, which is strongly economically related to other countries through trade, can only change a little within this issue. The EU and China are leaders in world trade. The EU could use its position in international trade to achieve its own energy policy goals – reducing CO_2 emissions.

Trade relates to a balance of CO_2 hidden in goods imported to and exported from China. It affects the E_{AO} in all 78 countries from this survey. The impact of China's international trade was very high, and for most of the years, continents negatively impacted other countries. This means that China mainly exported CO_2 to those countries. It was also the case for UE countries. The impact of the trade on CO_2 emission was huge because of the substantial international trade in goods and services between China and the EU.

The effectiveness of its members implementing the EU energy policy is limited only to the EU's territory. It can result in the EU energy policy not being regarded as a SD policy and being related to high costs. If the EU is interested in reducing CO_2 emissions, it must consider it. Because of those high costs, EU countries try to reduce them by importing parts, components, and products from cheaper countries, which very often have higher emissions of CO_2. It is usually because, in those countries, environmental law is more relaxed than in the EU.

This situation brings some challenges ahead of the EU, especially in their energy policy in the CO_2 aspect. The survey has shown that the EU should consider changes in its energy policy. This policy should take into account an element of CO_2 emission more globally. The results of the research indicate that CO_2 emission is a global problem. It requires the EU to consider introducing a new instrument that would incentivize countries outside the EU to take effective action to reduce CO_2 emissions. A new instrument, an eco-energy tax, could be introduced for that purpose. The EU would apply it to all trade partners, individual countries, or groups of countries. Additionally, this tax would concern the volume of particular countries exporting to the EU (Bielecki et al. 2016: 43–46). Fortunately, EU will have some new carbon tax shortly (Salzman 2023; Carbon Border Adjustment Mechanism). Unfortunately, this kind of action could bring contractions.

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