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REDEFINING CARBON ACCOUNTABILITY: THE IMPACT OF CONSUMPTION-BASED ACCOUNTING ON INDONESIA CLIMATE POLICY AND CARBON TRADING POTENTIAL

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ABSTRACT

Research Originality – This research distinguishes itself by pivoting from traditional carbon accounting to a more nuanced quantification of the fiscal implications inherent in export-embedded emissions. While the bulk of existing literature remains focused on the experiences of developed nations, this study explicitly links CBA to Indonesia's domestic carbon trading potential and its strategic roadmap toward net-zero.
Research Objectives – This study aims to examine how a shift toward CBA might reshape Indonesia's climate policy and carbon trading potential by quantifying emissions linked to international trade.
Research Methods – The study uses an environmentally extended Single-Region Input-Output (SRIO) analysis. The dataset spans two decades (2000-2022) and covers 35 industrial sectors. This approach was made possible by integrating two Input-Output datasets: World Input-Output Database and the Asian Development Bank, integrated along environmental accounts for CO_2 emissions.
Empirical Result – Roughly 24% of Indonesia's total carbon emissions are actually embedded in its net exports. By transitioning from PBA to a CBA framework, Indonesia could convert these export-related emissions into tradable carbon credits. This could potentially unlock a revenue stream of approximately USD 6.89 billion per year.
Implications – These findings provide an evidence-based framework for the Indonesian government to strengthen its leverage in global carbon markets and meet 2060 net-zero emissions target more aggressively. Theoretically, this paper contributes to the expanding field of carbon responsibility, demonstrating that CBA can be a vital tool for strengthening equity and transparency in global emissions accounting.

Keywords: Carbon Markets; Carbon Trading; Climate Policy; Consumption-Based Accounting (CBA); Export-Related Emissions.

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INTRODUCTION

Climate change is one of the most preeminent threats facing the world today. Rising global temperatures, more frequent extreme weather events, and changing climate patterns are already affecting ecosystems and human societies alike (IPCC, 2023; Weiskopf et al., 2020). These changes are linked to biodiversity loss, ecosystem disruption, and an increasing number of disasters, such as floods and droughts, all of which pose serious risks to food systems and public health (Pecl et al., 2017). Much of this trend is driven by carbon dioxide (CO_2) emissions (Davis & Caldeira, 2010). Once released, CO_2 can remain in the atmosphere for centuries, reinforcing warming over time and making reduction efforts both urgent and long-term in nature (Feinberg, 2026; IPCC, 2023; Romanello et al., 2024).

APPLICATIONS FOR PRACTICE

- CBA reveals that 24% of Indonesia's emissions are export-related and convertible into tradable carbon credits.
- Shifting to CBA could generate up to USD 6.89 billion annually from carbon trading.
- Centralized government control of carbon credits ensures alignment with national climate goals.
- Integrating CBA strengthens Indonesia's role in global carbon markets and climate negotiations.
- Regulatory reforms and international agreements are essential for global recognition of CBA-based credits.

Carbon accounting methods shape how responsibility is assigned and how policies are designed. The most widely used approach, Production-Based Accounting (PBA), records emissions at the point of production. While practical, this method can obscure the role of consumption, particularly in countries that are deeply integrated into global trade. For Indonesia, this raises concerns that current metrics may not fully capture the drivers of emissions.

As the world's fourth most populous country (World Bank, 2024c) and one of its twenty largest economies (World Bank, 2024b), Indonesia has experienced a steady rise in greenhouse gas emissions. In 2022, emissions increased by 10% compared to the previous year, the largest rise globally, accounting for 2.3% of total emissions (International Energy Agency, 2022). Within Southeast Asia, Indonesia is now the largest emitter (Amheka et al., 2022). These developments come as the government prepares to roll out a national carbon tax and expand carbon trading under Law No. 7/2021 starting in 2025.

The question of how emissions are counted becomes increasingly important. The choice of accounting method affects how carbon markets are structured, how many credits can be issued, and how Indonesia is viewed in international negotiations. Considering Indonesia's strong links to global trade, it is necessary to reevaluate whether production-based measures alone provide an adequate picture, with Consumption-Based Accounting (CBA) offers an alternative perspective by attributing emissions to consumption.

Even though developing nations accounted for 42.8% of the global carbon footprint in 2015, nearly double that of developed countries (Meng et al., 2023), much of the existing CBA work focuses on developed economies (Irfany & Klasen, 2017). Recent studies in Indonesia have begun to address this discrepancy. Kamil et al. (2023) examine the impact of carbon pricing across sectors and regions, while Rum et al. (2024) highlight provincial-level differences in emissions using both PBA and CBA perspectives. Imansyah et al. (2017) identify industries that are both emissions-intensive and economically important. Together, these studies show that how emissions are measured has practical consequences for policy design.

Even so, relatively few studies examine how adopting CBA could affect fiscal outcomes or carbon markets. This is particularly relevant for Indonesia, considering its role as a major exporter and its plans to expand carbon pricing. A different accounting method could change how emissions are reported and how policies are implemented. By focusing on where goods are consumed rather than produced, it captures emissions embedded in trade flows. This study asks: *How could adopting CBA influence Indonesia's climate policy and its carbon trading prospects?*

To explore this, the paper compares PBA and CBA using an environmentally extended Single-Region Input-Output (SRIO) model covering the period from 2000 to 2022. The aim is to estimate the share of emissions tied to international trade, and to examine how different accounting methods could affect policy choices, particularly as Indonesia moves forward with its commitments under the Paris Agreement (Afionis et al., 2017).

This study contributes in three ways. First, it provides a detailed CBA assessment for a large emerging economy with strong trade linkages. Second, it estimates the potential economic value of emissions embedded in exports. Third, it connects accounting choices with policy development, showing how they may influence Indonesia's trajectory to net-zero emissions by 2060.

LITERATURE REVIEW

Carbon accounting methods play a central role in distributing responsibility across countries. Under PBA, emissions are attributed to where they are produced. Although widely used, this approach tends to favor high-consumption economies that rely on imported goods, effectively relocating emissions to producing countries (Davis & Caldeira, 2010).

CBA offers a different perspective. It adjusts national emissions by subtracting exports and adding imports, linking emissions to final consumption. This approach has gained currency as supply chains have become more complex. For instance, research shows that in 2004, around 23% of global CO_2 emissions were associated with goods produced in countries such as China but consumed elsewhere (Davis & Caldeira, 2010). This highlights how trade can redistribute emissions across borders.

When emissions are outsourced through trade, reductions in one country may simply reappear in another. This weakens global mitigation efforts and makes accountability difficult under international agreements. CBA tackles this by connecting emissions more directly to consumption patterns, which is particularly relevant for economies deeply involved in global trade.

Recent studies have tried entangling carbon emissions practical consequences for policy design in Indonesia. Imansyah et al. (2017) examined key sectors responsible for CO_2 emissions from a production-based perspective using Input-Output analysis, drawing on enery input-output tables from BPS for the years, 1990, 1995, and 2010 across 76 production sectors. The study adopted the supply-side approach, measuring the income elasticity of carbon emissions, that is the proportional change in sectoral emissions in response to a one percent increase in value added. The study concluded that targeted fiscal instruments, including carbon taxes and technology incentives, should priorities high-elasticity sectors, such as chemical manufacturing, heavy manufacturing, and cement manufacturing, as interventions there yield the greatest emissions reductions per unit of economic activity.

In 2023, Kamil et al. analyzed the regional economic impact of carbon tax implementation on Indonesia's coal power plants (CPP) using interregional input-output (IRIO) model built from the 2016' Statistics Indonesia (BPS) IRIO table covering 17 sectors and 34 provinces aggregated into six island regions. The study simulated a carbon tax of IDR30,000 per tonne of CO_2e, the minimum tariff under Indonesia's Law No. 7/2021, and calculated potential tax revenues by identifying CPPs that had exceeded the government-set emission upper limit. The results showed that Java alone would contribute 73% of national carbon tax revenues (IDR177 billion), followed by Sumatra at 15%, reflecting the highly uneven geographic distribution of coal-fired power generation across the archipelago. The study then modelled revenue recycling scenarios, finding that reinvesting carbon tax proceeds into high-multiplier sectors could increase total national output by IDR451 billion, wages by IDR100 billion, and GRDP by IDR169 billion. These findings demonstrate that carbon pricing in Indonesia is not a uniform national instrument but one with pronounced regional and sectoral heterogeneity, shaped by each region's industrial composition and energy dependence.

Rum et al. (2024) provided the first comprehensive subnational assessment of both consumption-based and production-based carbon emissions across all 34 Indonesian provinces at a detailed sectoral level. The study constructed a multi-scale Environmentally Extended Multi-Regional Input-Output (EE-MRIO) model by integrating INDOTERM, a national MRIO covering 34 provinces, with EXIOBASE, a global EE-MRIO covering 43 countries, using 2010 as the base year. The study found a national carbon footprint expenditure elasticity of 1.07, indicating that consumption growth in Indonesia is associated with more than proportional increases in carbon emissions, a pattern more pronounced in non-Java provinces (elasticity of 1.14) than in Java (0.92). The provincial results reveal extreme heterogeneity in both carbon footprints and carbon intensities. Per capita carbon footprints ranged from 2.0 t CO_2e in East Nusa Tenggara to 13.84 t CO_2e in East Kalimantan, while carbon intensity varied from 0.83 kt CO_2e per million Euro in Jakarta to 2.37 kt CO_2e per million Euro in North Kalimantan. These findings illustrate concretely how the choice between PBA and CBA redistributes environmental responsibility across provinces: resource-producing regions bear heavier burdens under production-based measurement, while consumption-intensive urban regions appear more accountable under consumption-based measurement.

Collectively, these studies (Imansyah et al., 2017; Kamil et al., 2023; Rum et al., 2024) establish that emissions measurement, carbon policy design, and fiscal instrument calibration in Indonesia cannot be approached through a single accounting lens. These insights collectively motivate a closer examination of how adopting a CBA approach would affect the measurement of Indonesia's national emissions and the design of its evolving carbon pricing framework.

METHODS

The analysis draws on two main datasets. The first is the World Input-Output Database (WIOD), which covers 56 sectors from 2000 to 2006 (Timmer et al., 2015). The second comes from the Asian Development Bank (ADB), and covers 35 sectors from 2007 to 2022 (Asian Development Bank, 2023). Environmental data from WIOD provide CO_2 emissions for 2000 to 2016 (Corsatea et al., 2019). Sector-level emissions data beyond 2016 are limited, thus this study uses 2016 carbon intensity values for later years. More recent data exist from Statistics Indonesia (BPS) aggregated into fewer sectors and would reduce comparability. Using WIOD ensures consistency across the full time period, although it may not fully capture technological changes after 2016.

Our analysis involves two distinct sets of SRIO tables that categorize sectors differently: The World Input-Output Database (WIOD) includes data classified into 56 sectors and the Asian Development Bank (ADB) tables cover 35 sectors. To integrate these tables, we aligned the sectors using guidance from the International Standard Industrial Classification (ISIC) Revision 3 and ISIC Revision 4. This process involved matching corresponding sectors across the two databases and aggregating them to ensure consistency. As a result of this aggregation and the removal of sectors without input-output data, the final SRIO table comprises 32 sectors consistently from 2000 to 2022, as shown in Table 1.

Table 1 Final SRIO Table

Code	Sectors	Code	Sectors
c1	Agriculture, hunting, forestry, and fishing	c19	Sale, maintenance, and repair of motor vehicles and motorcycles; retail sale of fuel
c2	Mining and quarrying	c20	Wholesale trade and commission trade, except of motor vehicles and motorcycles
c3	Food, beverages, and tobacco	c21	Retail trade, except of motor vehicles and motorcycles; repair of household goods
c4-5	Textiles and textile products: Leather, leather products, and footwear	c22	Hotels and restaurants
c6	Wood and products of wood and cork	c23	Inland transport
c7	Pulp, paper, paper products, printing, and publishing	c24	Water transport
c8	Coke, refined petroleum, and nuclear fuel	c25	Air transport
c9	Chemicals and chemical products	c26	Other supporting and auxiliary transport activities; activities of travel agencies
c10	Rubber and plastics	c27	Post and telecommunications
c11	Other non-metallic minerals	c28	Financial intermediation
c12	Basic metals and fabricated metal	c29	Real estate activities
c13-14	Machinery, nec: Electrical and optical equipment	c30	Renting of M&Eq and other business activities
c15	Transport equipment	c31	Public administration and defense; compulsory social security
c16	Manufacturing, nec; recycling	c32	Education
c17	Electricity, gas, and water supply	c33	Health and social work
c18	Construction	c34	Other community, social, and personal services

Source: Processed by the authors

This streamlined sectoral framework is also used for environmental accounts, with the sector aggregation process detailed in Table 2.

Table 2 Sector Aggregation Process, Combinig SRIO Tables from WIOD and ADB

Code	Sectors	ADB_Code	WIOD_Code
c1	Agriculture, hunting, forestry, and fishing	c1	A01, A02, A03
c2	Mining and quarrying	c2	B
c3	Food, beverages, and tobacco	c3	C10-C12
c4-5	Textiles and textile products: Leather, leather products, and footwear	c4 and c4	C13-C15
c6	Wood and products of wood and cork	c6	C16
c7	Pulp, paper, paper products, printing, and publishing	c7	C17, C18, J58
c8	Coke, refined petroleum, and nuclear fuel	c8	C19
c9	Chemicals and chemical products	c9	C20, C21
c10	Rubber and plastics	c10	C22
c11	Other nonmetallic minerals	c11	C23
c12	Basic metals and fabricated metal	c12	C24, C25
c13-14	Machinery, nec: Electrical and optical equipment	c13 and c14	C26, C27, C28
c15	Transport equipment	c15	C29, C30
c16	Manufacturing, nec; recycling	c16	C31_C32, C33
c17	Electricity, gas, and water supply	c17	D35, E36, E37-E39
c18	Construction	c18	F
c19	Sale, maintenance, and repair of motor vehicles and motorcycles; retail sale of fuel	c19	G45
c20	Wholesale trade and commission trade, except of motor vehicles and motorcycles	c20	G46
c21	Retail trade, except of motor vehicles and motorcycles; repair of household goods	c21	G47
c22	Hotels and restaurants	c22	I
c23	Inland transport	c23	H49
c24	Water transport	c24	H50
c25	Air transport	c25	H51
c26	Other supporting and auxiliary transport activities; activities of travel agencies	c26	H52

Source: Processed by the authors

Table 3 Sector Aggregation Process, Combinig SRIO Tables from WIOD and ADB (Continued)

Code	Sectors	ADB_Code	WIOD_Code
c27	Post and telecommunications	c27	H53, J61
c28	Financial intermediation	c28	K64, K65, K66
c29	Real estate activities	c29	L68
c30	Renting of M&Eq and other business activities	c30	J62_J63, M69_M70, M71, M72, M73, M74_M75, N
c31	Public administration and defense; compulsory social security	c31	O84
c32	Education	c32	P85
c33	Health and social work	c33	Q
c34	Other community, social, and personal services	c34	J59_J60, R_S

Source: Processed by the authors

To calculate the carbon footprint using SRIO analysis, we follow the methodologies outlined by Miller & Blair (2009) and Irfany & Klasen (2017). Initially, we calculate the technical coefficient for each sector using Equation (1), where a_{ij} represents the amount of input from sector *i* required to produce one unit of output in sector *j*, z_{ij} is the amount of goods/services sold by sector *i* to sector *j*, and x_j is the total output from sector *j*.

$$a_{ij} = \frac{z_{ij}}{x_j} \ldots (1)$$

All technical coefficients are then transformed into a matrix to facilitate further calculations, as shown below:

$$A = \begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{nn} \end{bmatrix} \ldots (2)$$

Given that we use multi-year SRIO, these technical coefficients A will vary each year from 2000 to 2022, unlike the basic assumption of a single-year SRIO, which assumes that technical coefficients are constant (Miller & Blair, 2009).

We apply the same procedure for calculating the total output x:

$$x = \begin{bmatrix} x_1 \\ \vdots \\ x_n \end{bmatrix} \ldots (3)$$

We then incorporate final demand f, which f_{n} is the total final demand from sector *n*:

$$f = \begin{bmatrix} f_1 \\ \vdots \\ f_n \end{bmatrix} \ldots (4)$$

To calculate the total output *x*, we then use this equation, where I is the identity matrix:

$$x = (I - A)^{-1} f \ldots (5)$$

The matrix $(I - A)^{-1}$ is also known as Leontief Inverse or the total requirements matrix (Miller & Blair, 2009).

To incorporate carbon emissions impacts, we denote C as the carbon emissions intensity, using this equation, where c_{n} is the amount of CO_2 generated per unit of output in sector n. To enable further analysis, we transform our C into a diagonal matrix:

$$C = \begin{bmatrix} c_1 & 0 & 0 \\ 0 & \ddots & 0 \\ 0 & 0 & c_n \end{bmatrix} \ldots (6)$$

c_{n} is calculated using this equation below, where $co2_{\mathrm{n}}$ is the total amount of CO_2 directly generated from sector *n*.

$$c_n = \frac{co2_n}{x_n} \ldots (7)$$

Like the technical coefficient A, this carbon emission intensity C will differ each year from 2000 to 2016. As the dataset for CO_2 emissions from WIOD is only available up to 2016, for 2017 to 2022, we will base our CO_2 estimates on the latest available data from 2016. This assumption introduces potential bias, because it does not capture sector-level technological change or decarbonization that may have occurred after 2016. While this limitation cannot be fully resolved due to the absence of sufficiently disaggregated and consistent data, we will address this by evaluating how our key findings compare with established estimates in the literature.

Lastly, to calculate the carbon footprint CO_2 driven by final demand, we use the following equation:

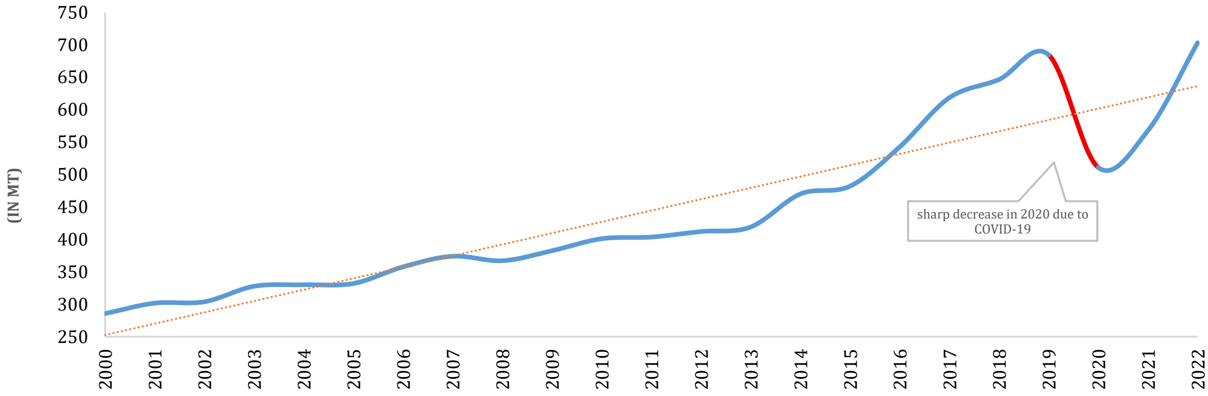
$$CO_2 = C(I-A)^{-1} f \dots (8)$$

This methodology leverages the dynamic nature of multi-year SRIO analysis to account for changes in economic activities and sectoral structure over time. for changes in economic activities and sectoral structure over time.

RESULT AND DISCUSSION

Using an environmentally extended SRIO model, we calculated Indonesia's total CO_2 emissions over the 2000–2022 period. As shown in Figure 1, emissions rose steadily, from 285.69 mega tonnes (Mt) in 2000 to 703.08 Mt in 2022. The increase tracks the country's expanding economic activity and rising energy use. Emissions climbed particularly quickly between 2015 and 2019, a period of strong growth. They then dropped to 510.79 Mt in 2020, largely due to the slowdown during the COVID-19 pandemic, before picking up again in 2021 and 2022. Taken together, these patterns suggest the need to reevaluate how Indonesia accounts for its emissions, including whether a transition from PBA to CBA would provide a more accurate picture.

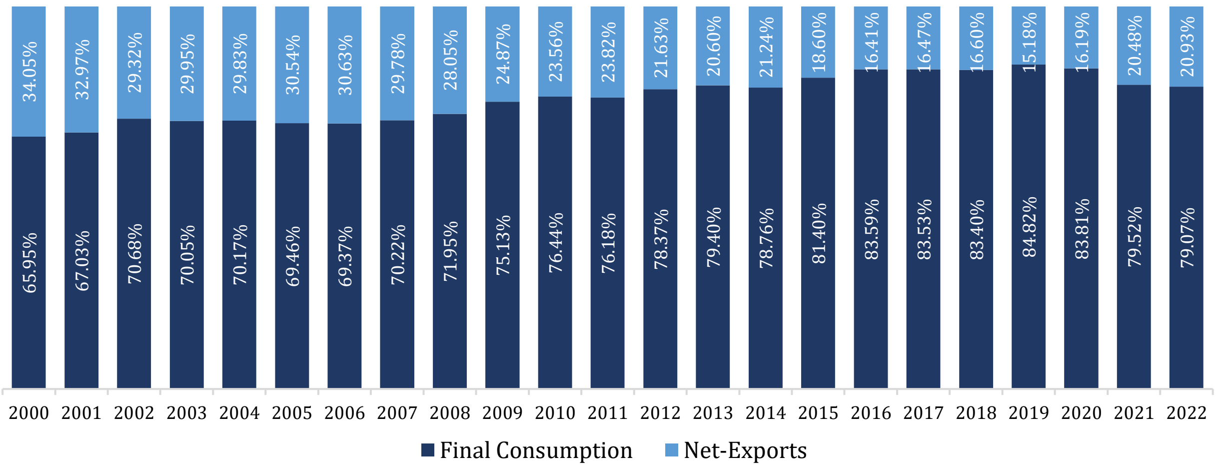
Figure 1 Indonesia's Total CO2 Emissions from 2000 to 2022



Source: Processed by the authors

Figure 1 illustrates the overall upward trend of total CO2 emissions in Indonesia from 2000 to 2022. The temporary decline in 2020 reflects the impact of the COVID-19 pandemic, after which emissions resumed their growth trajectory.

Figure 2 Indonesia CBA Carbon Footprint



Source: Processed by the authors

Figure 2 further breaks this down by separating emissions linked to domestic consumption from those tied to net exports using a CBA approach. Over the 2000–2022 period, about 76% of Indonesia's emissions came from domestic use, while roughly 24% were associated with goods produced for export. This highlights how much of the country's carbon output is connected to international trade.

Under the CBA, emissions linked to exports are counted against the countries that consume those goods, rather than the countries that produce them. This changes how responsibility is viewed. Using this approach to set global CO_2 targets would spread the burden more evenly between producers and consumers, and could provide a fairer basis for climate action.

Figure 2 illustrates that, on average, approximately 24% of Indonesia's total carbon emissions from 2000 to 2022, calculated using a consumption-based approach, were associated with net-export activities, while the remaining emissions were attributed to domestic final consumption. Table 3 provides a detailed breakdown of the data from 2000 to 2022.

Table 3 Indonesia Consumption-Based Accounting Carbon Footprint (2000 – 2022)

Year	Carbon Emission (in Mt)			Net-Export Related Carbon Percentage (%)
	Net Export-Related	CBA	Total Emission (PBA)	
2000	97,29	188,40	285,69	34,05
2001	99,50	202,25	301,75	32,97
2002	89,08	214,78	303,86	29,32
2003	98,18	229,58	327,76	29,96
2004	98,46	231,61	330,07	29,83
2005	101,41	230,63	332,04	30,54
2006	109,56	248,13	357,70	30,63
2007	111,40	262,63	374,03	29,78
2008	102,99	264,15	367,13	28,05
2009	95,15	287,39	382,53	24,87
2010	94,49	306,55	401,04	23,56
2011	96,13	307,50	403,63	23,82
2012	89,15	322,96	412,11	21,63
2013	86,33	332,77	419,10	20,60
2014	99,85	370,15	470,00	21,24
2015	89,67	392,33	482,00	18,60
2016	89,01	453,44	542,45	16,41
2017	101,84	516,46	618,30	16,47
2018	107,28	539,13	646,41	16,60
2019	103,90	580,52	684,41	15,18
2020	82,68	428,12	510,79	16,19
2021	116,28	451,50	567,78	20,48
2022	147,18	555,90	703,08	20,93
		Average		**23,99**

Source: Processed by the authors

The data also show that the share of emissions linked to net exports has declined over time, falling from 34% in 2000 to 21% in 2022. Trade is still important, but a growing share of emissions now comes from domestic activity, reflecting heavier reliance on carbon-intensive energy and production at home. This trend suggests that future policy will need to pay closer attention to domestic sources of emissions, particularly as Indonesia moves toward full implementation of carbon trading in 2025.

To understand what drives export-related emissions, Figure 3 breaks down sectoral contributions. The results show a heavy concentration in upstream industries. Mining and quarrying account for 33.05% of export-related emissions, followed by electricity, gas, and water supply at 15.79%. Together, these sectors make up nearly half of the total, indicating that Indonesia's export-related carbon footprint is largely rooted in extractive industries and energy generation.

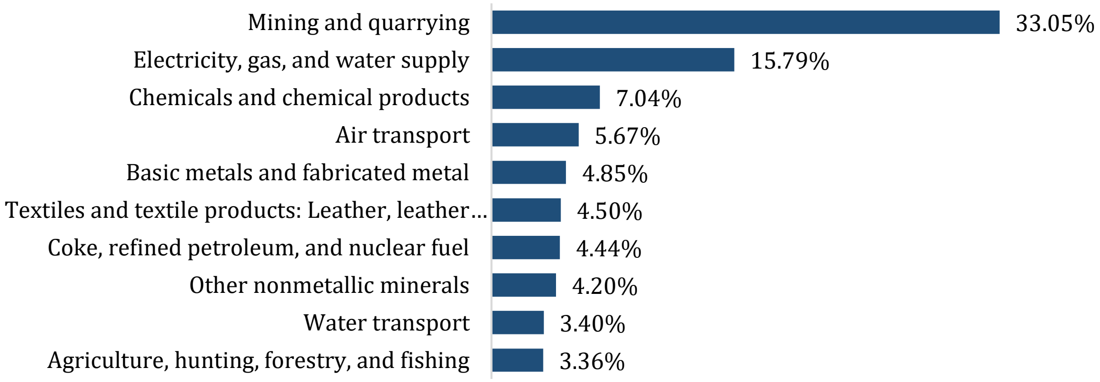
Figure 3 displays the ten largest sectoral contributors to Indonesia's export-related carbon emissions, averaged over the 2000–2022 period. Mining, quarrying, and electricity, gas, and water supply are the dominant sources.

Indonesia's Intended Nationally Determined Contribution (INDC), submitted to the United Nations Framework Convention on Climate Change in 2022, reflects a growing commitment to cutting greenhouse gas emissions (UNFCC, 2022). Building on its earlier Nationally Determined Contribution (NDC), the updated plan slightly lowers the Business-as-Usual (BAU) emissions projection for 2030 from 2,881 Mt CO_2 to 2,869 Mt CO_2. While the numerical change is modest, it reflects an effort to keep national policy aligned with global climate commitments under the Paris Agreement.

One key finding from this study is that around 24% of Indonesia's total emissions are tied to net exports. This has direct consequences for how national climate targets are understood and assessed. Current commitments rely mainly on a production-based accounting (PBA) approach, which records emissions where they occur. However, the data shows that a sizeable share of emissions is driven by demand from outside the country. This raises questions about fairness, carbon leakage, and Indonesia's position in international carbon markets, and it supports consideration of consumption-based accounting (CBA) alongside existing methods.

The INDC also outlines sector-level projections and targets, with forestry, land use, and energy making up about 97% of the national commitment. Emissions data show a steady rise, from 285.69 Mt in 2000 to 703.08 Mt in 2022. This increase suggests that emissions growth is closely tied to the structure of Indonesia's economy rather than to short-term disruptions.

Figure 3 Indonesia's Top 10 Sectoral Contributions to Export-Related CO_2 Emissions



Source: Processed by the authors

In practical terms, the 24% share of export-related emissions changes how responsibility is viewed. Under PBA, emissions are counted where they are produced. Yet much of this output serves overseas markets. Nearly a quarter of Indonesia's emissions are therefore linked to consumption elsewhere. This supports incorporating CBA elements, particularly in international discussions on responsibility and carbon leakage.

Emissions have more than doubled over two decades, indicating that carbon output is embedded in industrial activity (Meng et al., 2023). Sectoral data show that export-related emissions are concentrated in upstream industries that require large amounts of energy. Mining and quarrying account for about 33.05%, followed by electricity, gas, and water supply at 15.79%. These sectors feed into both domestic production and exports, passing their carbon intensity through supply chains. This pattern reinforces the government's focus on energy transition and land-use management. Reducing emissions in these areas would affect both domestic output and export-linked emissions. It also suggests that focusing only on downstream industries will not be enough without changes in energy production and resource extraction.

Indonesia has set targets to cut emissions by 31.89% by 2030 under an unconditional scenario, and by 43.20% with international support. These targets exceed earlier commitments of 29% and 41%, showing a stronger push toward a low-carbon economy. Energy policy plays a central role in this effort. Under Government Regulation No. 79/2014, Indonesia aims to raise the share of renewable energy to at least 23% by 2025 and 31% by 2050. Oil use is targeted to fall below 25% by 2025 and 20% by 2050. Coal is expected to decline to 30% and then 25%, while gas remains at around 22–24%. Together, these measures are intended to guide the country toward lower emissions.

The estimate that 24% of emissions are embedded in trade is consistent with global research. Davis & Caldeira (2010) suggest that about 23% of global emissions are linked to traded goods. Although this study relies on 2016 carbon intensity data for later years, the results remain credible. Further analysis shows that export-related emissions stem from upstream production, particularly energy generation and extraction. The 24% figure reflects how foreign demand drives carbon-intensive activities within Indonesia through supply chain links. This underlines the country's dependence on global value chains in shaping its emissions profile.

Including CBA in national accounting would allow some responsibility for these emissions to be shared with importing countries. This could support more balanced discussions at the global level and may help Indonesia move more quickly toward its net-zero target of 2060. Applying CBA more widely under frameworks such as the Paris Agreement would mean countries are responsible not only for what they produce, but also for what they consume. This approach could encourage cooperation between producers and consumers and lead to more effective climate action.

Assuming Law No. 7/2021 on the Harmonization of Tax Regulations provides the legal basis for carbon pricing in Indonesia, covering both carbon taxes and emissions trading. The law applies to activities and goods that generate greenhouse gases, including CO_2, N_2O, and CH_4, and is designed to ensure that emitters bear part of the environmental cost.

Indonesia is introducing carbon pricing in stages. A trading framework began taking shape in 2021, followed by pilot schemes between 2022 and 2024 focused on coal-fired power plants. Full implementation across multiple sectors is planned from 2025, depending on readiness. While the carbon tax targets domestic emissions, emissions trading opens the door to international markets. It allows Indonesia to generate and trade carbon credits from emissions reductions. This becomes particularly relevant when considering export-related emissions. If emissions linked to exports are included, the potential scale of carbon trading increases significantly. Based on the BAU projection of 2,869 Mt CO_2 for 2030, 24% corresponds to about 688.56 Mt CO_2. In theory, this could form a large pool of tradable credits, provided domestic targets are met first.

Under PBA, these emissions remain Indonesia's responsibility. Under CBA, responsibility is shared along supply chains, reflecting the role of foreign demand. This distinction is well established in trade and climate literature.

There are, however, several challenges. Importing countries may resist taking on additional responsibility. Global recognition of such credits is not yet consistent, which may affect pricing and demand. There is also a risk of double-counting unless clear verification systems are in place. For this reason, management of export-related carbon credits should remain with the government rather than individual firms. Central oversight enables these credits to be used to support national climate goals and strengthens Indonesia's position in international negotiations.

Assuming a conservative carbon market price of USD 10 per ton (World Bank, 2024a), Indonesia could potentially earn around USD 6.89 billion annually from the sale of these credits or approximately IDR 110.17 trillion (Kementerian Keuangan, 2024). To fully realize this potential, revenues would need to be managed centrally by the government, with a clear focus on national climate priorities. Channeling the funds through a dedicated climate fund or similar mechanism would help ensure the money is reinvested in long-term programs, rather than absorbed into general spending. This would tie the proceeds from carbon trading directly to decarbonization efforts and climate resilience.

A transparent system will be important if this revenue is to become a stable and repeatable source of funding. Clear rules on allocation should prioritize sectors where the impact is greatest. In manufacturing, Clear rules could support cleaner, more energy-efficient production in carbon-intensive industries such as metals, chemicals, and textiles. In the energy sector, investment would need to accelerate the deployment of renewables and reduce the carbon intensity of electricity used in both domestic and export-oriented production. Forestry and land use would also require sustained funding, particularly for peatland protection and reforestation, to strengthen carbon sinks. Alongside emissions cuts, these efforts should also support the development of green technologies and skills needed for a low-carbon economy (Akomea-Frimpong et al., 2024).

Gaining international acceptance for export-related carbon credits will require coordination with trading partners and participation in global carbon markets, including mechanisms linked to the Paris Agreement. Indonesia will also need strong institutions, reliable verification systems, and adherence to international standards to build credibility in the market.

Carbon accounting influences how countries position themselves in emerging carbon markets. If implemented carefully, the use of CBA alongside an expanded carbon trading system could strengthen Indonesia's role in the global carbon economy. Over time, this could provide a steady source of funding for the country's transition to lower emissions while supporting its target of reaching net-zero by 2060.

Bringing CBA into Indonesia's carbon trading system creates both opportunities and practical issues. To make it work, policymakers need to focus on a few key areas. First, the regulatory framework needs to be tightened. Law No. 7/2021 already sets the groundwork for carbon pricing, but more detailed rules are required to support CBA and carbon trading. This includes clear legal definitions of how export-related emissions are counted, especially the roughly 24% associated with net exports identified in this study. It also requires compliance with international carbon market standards and a governance structure where the government, rather than individual industries, manages carbon credits. A centralized system would help ensure that credits generated from trade support national climate targets instead of narrow sectoral interests.

Second, international cooperation will be essential. If Indonesia wants to trade carbon credits linked to its exported emissions, it will need to reach agreements with key trading partners. As a net exporter of carbon-intensive goods, the country must engage major importers such as China, India, and Japan. These agreements should cover mutual recognition of carbon credits, consistent accounting methods, and safeguards against double-counting. Active participation in global carbon market platforms under frameworks such as the Paris Agreement would also help Indonesia secure fairer trading conditions and broader acceptance of its credits.

Third, revenue management needs careful planning. A national climate fund could serve as the central channel for income generated from carbon trading. Managing funds at the national level would reduce fragmentation and allow revenues to be directed toward priority programs. These include renewable energy expansion, forest restoration, and low-carbon infrastructure. Clear rules on allocation, transparency, and monitoring will be important to ensure that funds deliver measurable emissions reductions and support long-term sustainability. If managed well, this approach could strengthen Indonesia's course toward its net-zero target by 2060 while supporting economic resilience.

CONCLUSION

This paper examines how adopting CBA could shape Indonesia's climate policy and carbon trading prospects. Moving from a PBA approach to CBA allows a more complete picture of national emissions, particularly the roughly 24% linked to net exports. Recognizing this share could enable the treatment of export-related emissions as tradable carbon credits, which could strengthen Indonesia's role in international carbon markets.

The findings underline the importance of managing these credits at the national level. A centralized system would help ensure that any revenue generated supports climate priorities rather than being dispersed across sectors. With potential annual earnings estimated at around USD 6.89 billion, such revenues could be directed into renewable energy, reforestation, and low-carbon infrastructure. These investments would support Indonesia's target of reaching net-zero emissions by 2060.

At the same time, several issues need to be addressed. Regulatory frameworks must be strengthened to accommodate CBA, including clear rules on how export-related emissions are counted and managed. Indonesia will also need to meet international carbon market standards and work with trading partners to secure recognition of its carbon credits, including through mechanisms linked to the Paris Agreement.

Overall, adopting CBA offers Indonesia a way to better reflect the link between its emissions and global trade. With the right policy framework and international cooperation, the country could enhance its participation in carbon markets while supporting its transition to a lower-carbon economy.

This study, however, is limited by data availability and the assumption of stable carbon intensities in the post-2016 period. Future research could address this by incorporating updated environmentally extended input-output tables as they become available, and by extending the provincial disaggregation of consumption-based emissions to better inform the regional distribution of carbon credit revenues under Indonesia's evolving carbon pricing framework.

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