UNOPS

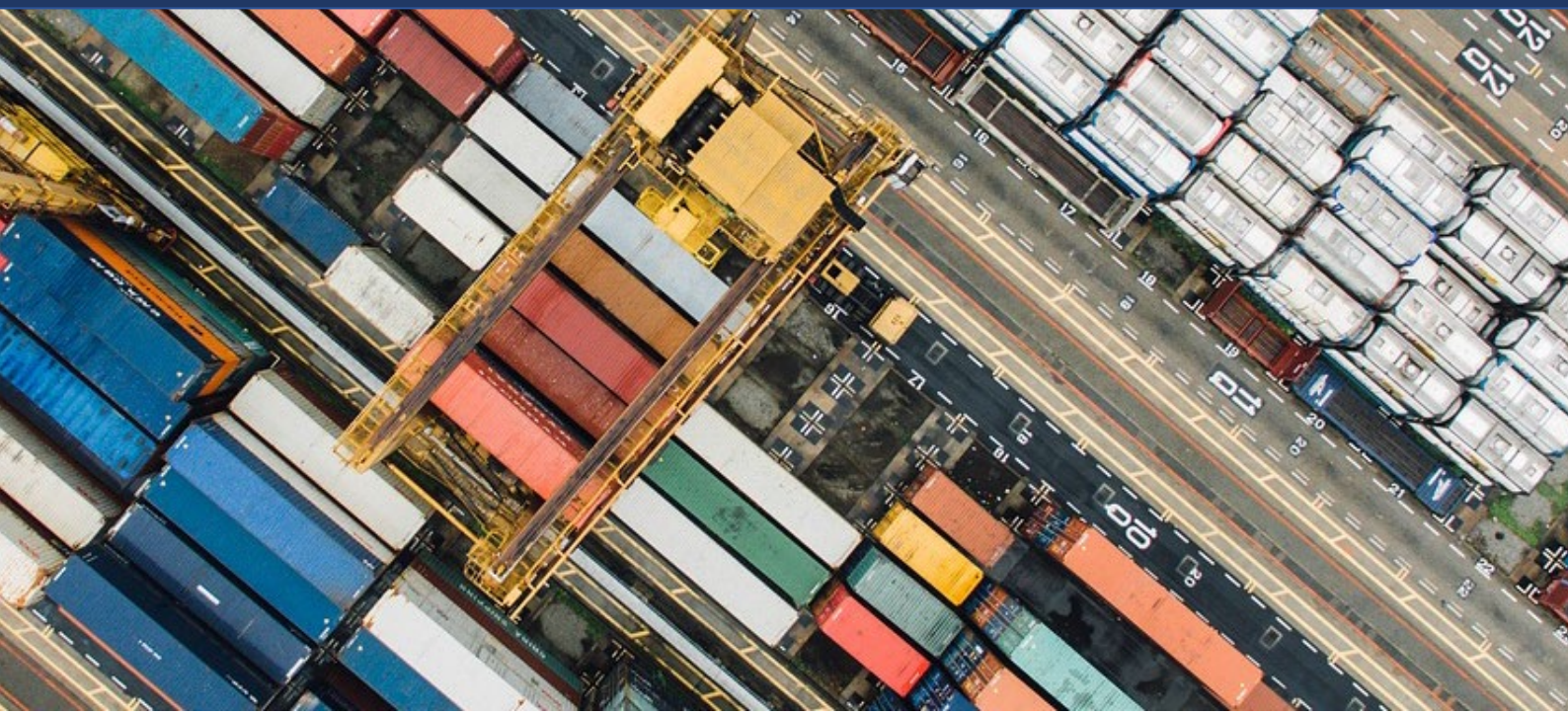
ENERGY TRANSITION PARTNERSHIP
Powering Prosperity and Enabling Sustainability in South East Asia

DCC
Department of Climate Change

CARBON BORDER ADJUSTMENT MECHANISM IMPACT ASSESSMENT REPORT FOR VIETNAM

Impact Assessment of EU's Carbon Border Adjustment Mechanism and Recommendations on Carbon Tax Policies for Vietnam

(Final Report)



3 May 2023

perspectives climate group

GREENCIC
Energy Climate Sustainability

nhquang&associates

AEMDA

CARBON BORDER ADJUSTMENT MECHANISM IMPACT ASSESSMENT REPORT FOR VIETNAM

Impact Assessment of EU's Carbon Border Adjustment Mechanism and Recommendations on Carbon Tax Policies for Vietnam

(Final Report)

3 May 2023

COLOPHON AND DISCLAIMER

Beneficiaries
Southeast Asia Energy Transition Partnership
14th Floor, 208 Wireless Road Building Lumphini, Bangkok 10330, Thailand | +669 8832 1614 | etp@unops.org
Department of Climate Change, Ministry of Natural Resources and Environment, Vietnam
10 Ton That Thuyet, Nam Tu Liem, Ha Noi, Vietnam | +8424 3775 9769 | info@dcc.gov.vn

Key Experts:
Dr. Long Chu, *Applied Economic Modelling and Data Analysis (AEMDA)*: Economic modelling lead
Dr. Thang Do, *AEMDA*: Policy lead
Quang H. Nguyen, *NHQuang&Associates*: Legal assessment lead
Minh A. Nguyen, *NHQuang&Associates*: Legal assessment
Loan Nguyen, *GreenCIC*: Sectoral mitigation lead
Linh P. Pham, *GreenCIC*: Primary data collection

Contributors:
AEMDA: Quoc Anh Ho; Lien Le; Khoi Dang; Thai Nguyen; Minh Anh Ta
NHQuang&Associates: Huyen T.T. Tran, Trang T.T. Dinh, Dang T.Luu, Mai T.T. Nguyen, Trinh Kieu T. Nguyen
GreenCIC: Can Nguyen, Dung Duong, Linh T. Pham

High Level Quality Assurance: Dr. Axel Michaelowa, *Perspectives Climate Group*

Acknowledgements
We would like to thank the following individuals and organisations for their collaboration and support, insightful comments and advice for the completion of this Report: *Ministry of Industry and Trade*: Centre of Industrial and Trade Information, Multilateral Trade Policy Department; *Ministry of Planning and Investment*: Duc Anh Dang – Vice President, Central Institute for Economic Management (CIEM), *General Statistics Office of Vietnam (GSO)*; *Vietnam Chamber of Commerce and Industry (VCCI)*; *Institute Of Agriculture Market And Institution Research (Vietnam)*; *Vietnam Aluminium Association*; *Vietnam Steel Association; Vietnam Cement Association*; *Vietnam Fertiliser Association*; Lan Huong Pham – *Economics Consultant*; Trinh Bui – *IO Data Specialist and Consultant*.

Suggested citation: Chu, H.L., Do, T.N. et al. (2023). *Carbon Border Adjustment Mechanism Impact Assessment Report for Vietnam*, prepared for the Energy Transition Partnership for Southeast Asia (ETP), Hanoi-Vietnam

ABSTRACT

The EU's Carbon Border Adjustment Mechanism (CBAM) is evolving rapidly, with many uncertainties remaining regarding its long-term scope, embedded emissions calculation, and reactions of EU-trade partners. In its current form, the CBAM can affect Vietnamese enterprises exporting to EU although its direct impacts on Vietnam's GDP are unlikely significant. If the CBAM is expanded to other trade-intensive sectors of Vietnam or taken up by other key trading partners of Vietnam, the impacts may grow quickly. Therefore, Vietnam should engage proactively with the CBAM and prepare for mitigation of potential impacts. One of the pro-active approaches is to accelerate and deepen the adoption of carbon pricing. This will facilitate energy transition, support achievement of Vietnam's climate change mitigation target (NDC) under the Paris Agreement and long-term net-zero targets and would allow to harness co-benefits. It is also advisable for Vietnam to engage in constructive dialogues with the EU in order to negotiate a fair implementation of CBAM that takes into account Vietnam's efforts. A key demand here should be the use of emissions credits instead of having to buy CBAM certificates.

EXECUTIVE SUMMARY

On December 13, 2022, the three relevant institutions of the European Union (EU Commission, European Parliament, and the European Council) agreed on the regulation establishing the world's first Carbon Border Adjustment Mechanism (CBAM), and the European Parliament and the European Council formally adopted it on April 18 and 25, 2023 respectively. This is part of the EU's target to accelerate the reduction of greenhouse gas (GHG) emissions and to achieve carbon neutrality by 2050. The CBAM proposal was first presented by the European Commission in July 2021, with the aim to address the risk of carbon leakage, i.e. movement of industrial production to non-European Union countries whose policies to mitigate climate change are less ambitious than those of the EU. CBAM is considered an effective way to level the playing field for EU producers and importers, alleviating the competitiveness challenges faced by the EU industry in the global market. From a cross-border perspective, CBAM aims to equalise the cost of GHG emissions inside and outside the EU. The CBAM will complement the EU's Emission Trading Scheme (EU ETS) and requires importers to buy certificates based on the GHG emission intensity of products they imported into the EU at a price equal to that of EU ETS certificates (EU allowances). Since 2017, the price of EU allowances has increased massively from a value of about 5 €/tCO_2, it recently exceeded 100 €.

Mandatory carbon prices in exporting countries will be credited under CBAM so only the differential to the EU ETS price remains to be paid. From an international-trade perspective, CBAM is an additional tax that reduces the competitiveness of goods imported to the EU from countries with zero or low costs of GHGs. Sectors covered include iron and steel, cement, aluminium, fertilisers, electricity, and hydrogen. Among the sectors, Vietnam does not export electricity to EU and the export of hydrogen to EU is negligible. Therefore, the CBAM impact assessment for Vietnam focuses on the four sectors: cement, iron and steel, aluminium and fertiliser.

Vietnam and the EU are important trading partners with strong economic ties. The two parties entered into a Free Trade Agreement (called EU-Vietnam Free Trade Agreement or EVFTA) which has officially taken effect from August 1, 2020. Vietnam is the EU's 15th largest trade-in goods partner and the EU's most prominent trading partner in ASEAN. Vietnam is also the 11th biggest exporter to the EU, with a share of 1.8% in the overall EU's import value. The specific CBAM-covered exports to the EU are however currently insignificant. Given these strong ties in trade relationship, the impacts of CBAM on Vietnam may become more substantial if CBAM coverage is to be extended in the future.

In addition to economic impacts, CBAM will influence Vietnam's climate policy. While being a low-middle-income country, Vietnam recognises the importance of mitigating climate change and has set an ambitious target to achieve net-zero emissions by 2050, similar to many developed countries. In

order to assess whether a consideration of carbon pricing is now warranted, up-to-date information on CBAM design and an initial estimate of CBAM's possible impacts on Vietnam is crucial. This information and estimates are important for preparing appropriate responses to CBAM and its associated impacts. They will be useful for the government of Vietnam to formulate an effective legal framework and policies to accelerate its own decarbonisation efforts and energy transition from fossil fuel to renewable energy.

This study analyses and quantifies CBAM impacts on the four CBAM-covered sectors, energy transition, implementation of Vietnam's climate change mitigation target (Nationally Determined Contribution, NDC) and the whole economy. The existing policies and legal framework on trade agreements/negotiations were also reviewed and assessed. Finally, recommendations for developing sectoral mitigation plans and policies and strategies are identified to minimize the negative impacts and enhance the positive impacts of CBAM on Vietnam.

Sectoral impacts of CBAM

We evaluate the current CBAM impact using a partial equilibrium framework. This framework is constructed to fit with the data availability in Vietnam and calibrated to a 10-year evaluation period, from 2026 (when CBAM takes effect) to 2035 when the emission quantity of Vietnam is expected to peak. The impact is estimated by comparing a BAU scenario, where current trends are continuing, with alternative scenarios. Considered alternative scenarios include whether or not Vietnam would adopt carbon pricing from 2028 as expected, and whether or not the emission intensity of Vietnam would decline. In scenarios where Vietnam would adopt carbon pricing, the carbon price is specified at 11 USD/tCO_2 (2019-USD value) - the lowest society's average cost to reduce emissions to achieve Vietnam's NDC (Prime Minister of Vietnam, 2022). In scenarios where the emission intensity of Vietnam would decline, the rate of decline is specified at 1%-1.5% per year, as specified in Vietnam's Green Growth Strategy. Below is the summary of the estimated impacts with specific values reported in Table 1.ES where numbers are rounded to the nearest 1-digit.

Steel sector

Given that the EU accounts for 5% - 10% of Vietnam's steel export markets (see Appendix Table 1), the application of CBAM in the EU would have some negative impacts on key economic performance indicators of the sector. For example, production output would decline by approximately 0.8% in 2030 (with the 95% confidence interval (CI) of [0%, 1.7%]), or approximately 0.4 million tonnes (CI = [0,0.8 million]). The estimated reduction in total export value is approximately 3.6% (CI = [0.4%, 5.4%]) in 2030 or around 0.7 billion USD (CI = [0.1, 1.1 billion]). The estimated reduction in export value to the EU is about 51.2% in 2030 (CI = [3.7%, 80.2%]), or 1.1 billion USD (CI = [0.1, 1.7 billion]). The estimated reduction in the total export revenue is lower than the reduction in the export revenue from the EU markets, indicating that Vietnam would export more steel to non-EU markets to partly compensate the impact of CBAM on the EU markets. As a result of the reduction in production output, the emission quantity would decline by about 0.9 million tCO_2 in 2030 (CI = [0, 1.8 million]). If the steel sector could reduce its emission intensity, the negative economic impacts of CBAM would be lessened while emission quantity would be further reduced from a reduction of 0.9 million tCO_2 in 2030 (CI = [0, 1.8 million]) to an emission reduction of 7.5 million tCO_2 in 2030 (CI= [6.7, 8.4 million]).

Aluminium sector

Due to the lack of data, we assume the emission intensity of Vietnam's aluminium production is equal to the global average. This may be an overestimation because Vietnam does not have many high-emission aluminium smelters. Thus, the result using global average of emission intensity in aluminium production can be considered as an upper bound of the impact estimates.

Given that the EU accounts for from 3% to 12% of Vietnam's aluminium export markets (see Appendix Table 2), the production would decline by approximately 0.4% (CI = [0%, 0.8%]). The estimated reduction in export value is approximately 4.3% in 2030 (CI = [0.7%, 5.7%]) or about 0.1 billion USD (CI = [0.0, 0.2 billion]). The estimated reduction in export value to the EU is about 72.2% in 2030 (CI = [10.2%, 96.6%]) or approximately 0.1 billion USD (CI= [0.0, 0.1 billion]). As a result of the reduction in production output, emissions would decline by about 0.2 million tCO_2 in 2030 (CI = [0, 0.5 million]). If the aluminium sector could reduce its emission intensity, the negative economic impacts of CBAM would be slightly lessened while emissions would be further reduced from a reduction of 0.2 million tCO_2 (CI = [0,0.5 million]) to a reduction of 3.6 million tCO_2 (CI= [3.5,3.9 million]) in 2030.

Fertiliser sector

The quantity of fertiliser exported from Vietnam to the EU is minimal (see Appendix Table 3), and the application of CBAM in the EU would have little impact on key economic performance indicators of the fertiliser sector.

Cement sector

Given that the EU accounts for around 1% of Vietnam's cement export markets (see Appendix Table 4), the application of CBAM in the EU would have only slightly negative impacts. The estimated reduction in production is around 0.1% (CI= [0, 0.2%]), and the estimated reduction in export is around 0.6% (CI= [0.2%, 0.8%]). The estimated emissions reductions are 0.1 million tCO_2 in 2030 (CI= [0, 0.2 million]). Reducing emission intensity in the cement sector would have only a minor effect in softening the negative economic impacts of CBAM, but it would significantly increase emission reductions, from a reduction of around 0.1 million tCO_2 in 2030 (CI= [0, 0.2 million]) to a reduction of 7.4 million tCO_2 (CI= [7.3, 7.5 million]).

Table 1.ES Estimated impacts of CBAM in the EU on the targeted sectors in 2030

	Steel		Aluminium		Fertiliser		Cement	
	BAU	Reducing emission intensity	BAU	Reducing emission intensity	BAU	Reducing emission intensity	BAU	Reducing emission intensity
Production output (%)	-0.8 [-1.7, -0.0]	-0.8 [-1.6, -0.0]	-0.4 [-0.8, -0.0]	-0.4 [-0.8, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.1 [-0.2, -0.0]	-0.1 [-0.2, -0.0]
Production output (million tonnes)	-0.4 [-0.8, -0.0]	-0.4 [-0.8, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.1 [-0.3, -0.0]	-0.1 [-0.3, -0.0]
Export values (%)	-3.6 [-5.4, -0.4]	-3.5 [-5.3, -0.4]	-4.3 [-5.7, -0.7]	-4.3 [-5.7, -0.7]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.6 [-0.8, -0.2]	-0.6 [-0.8, -0.2]
Export values (billion USD 2019 value)	-0.7 [-1.1, -0.1]	-0.7 [-1.1, -0.1]	-0.1 [-0.1, -0.0]	-0.1 [-0.1, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]
Export value to EU (%)	-51.2 [-80.2, -3.7]	-49.5 [-78.3, -3.5]	-72.2 [-96.6, -10.2]	-70.9 [-95.9, -9.7]	-75.5 [-97.3, -13.6]	-74.2 [-96.8, -12.9]	-89.4 [-100.0, -23.2]	-89.0 [-100.0, -22.4]
Export value to EU (billion USD)	-1.1 [-1.7, -0.1]	-1.0 [-1.6, -0.1]	-0.1 [-0.1, -0.0]	-0.1 [-0.1, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]
Emission amount (million tCO2)	-0.9 [-1.8, -0.0]	-7.5 [-8.4, -6.7]	-0.2 [-0.5, -0.0]	-3.6 [-3.9, -3.5]	-0.0 [-0.0, -0.0]	-1.6 [-1.6, -1.6]	-0.1 [-0.2, -0.0]	-7.4 [-7.5, -7.3]

Notes to Table 1.ES: Estimates of authors; Numbers are rounded to the nearest 1-digit; -0.0 and +0.0 (if any) refer to negative and positive numbers, respectively, with absolute values less than 0.05.

Estimated impacts on macroeconomic indicators

If CBAM is applied only by EU countries, the estimated impact on GDP would be a reduction of approximately 0.1 billion 2019-value USD in 2030 (CI= [0,0.2]) and 0.2 billion 2019-value USD in 2035 (CI = [0.1,0.4]). While enterprises who export CBAM-targeted commodities to the EU would be most impacted by these hundred-million-dollars reductions, the impacts are insignificant compared to the size of Vietnam's economy because of the small share of CBAM sectors in the economy. For example, in 2019, the contribution of all four CBAM-target sectors to Vietnam's GDP was only 3.2%; only around 12.6% of the total output of these sectors was exported, and the EU also accounted for a small share of Vietnam's total export of CBAM-target commodities (8% for iron-steel, 2% for aluminium, ~0% for fertiliser, and 1% for cement). Furthermore, the economy may respond to CBAM by reallocating resources away from impacted sectors to reduce the negative impacts.

If carbon pricing is implemented in addition to EU-CBAM, and if the emission intensity in all sectors remains unchanged, the estimated reduction in GDP would be 6.4 billion 2019-value USD in 2030 (CI= [3.6,9.3]) and 11.1 billion 2019-value USD in 2035 (CI= [6.6,16.1]). In a percentage term, the estimated reduction in GDP would be around 1% in 2030 (CI= [0.5%,1.5%]) and 1.2% in 2035 (CI=0.7%, 1.9%]). The fossil fuel price index would increase by 5.2% in 2030 (CI= [4.8%,5.6%]) and 5.3% in 2035 (CI= [4.9%,5.9%]). Employment would decline by 0.5% in 2030 (CI= [0,1%]) and 0.6% in 2035 (CI= [0,1.2%]). Net exports would decrease, but as GDP would also decline, the ratio of net exports to GDP would remain stable. The estimated revenue from the carbon tax would be 4.4 billion 2019-value USD in 2030 (CI= [3.9,4.9]) and 6.0 billion 2019-value USD in 2035 (CI= [5.5,6.6]).

If CBAM and carbon pricing can promote energy transition, their negative impacts on GDP will be reduced. If CBAM and carbon pricing could successfully reduce emission intensity by 1%-1.5% as specified in Decision 1658/QD-TTg 2021, the estimated impact on GDP would be lowered from a reduction of 6.4 billion (CI= [3.6,9.3]) to a reduction of 5.0 billion 2019-value USD in 2030 (CI=[2.4,7.8]), and from a reduction of 11.1 billion (CI= [6.6,16.1]) to 7.5 billion 2019-value USD in 2035 (CI=[3.4,12.0]). In a percentage term, if CBAM and carbon pricing can promote energy transition, the estimated reduction in GDP would be lowered from a reduction of 1% (CI= [0.5%,1.5%]) to a reduction of 0.8% (CI= [0.3%,1.3%]) in 2030, and from a reduction of 1.2% (CI= [0.7%,1.9%]) to a reduction of 0.9% (CI= [0.4%,1.4%]) in 2035. It shows the necessity to consider the adoption of carbon pricing policy in a broader context of energy transition, low carbon development of Vietnam and other associated co-benefits (environment, health, etc.).

Impacts on Vietnam’s NDC implementation

The quantity of fossil fuel emissions would decline with the application of CBAM, but the impacts would be insignificant if CBAM is applied in the EU only and there were no other changes, such as carbon pricing or reductions in emission intensity due to the small share of CBAM-subject sectors in Vietnam’s economy as discussed above.

The estimated mean of fossil fuel emissions in the BAU scenario would be 538 million tCO_2e in 2030, and the 95% confidence interval is [502,577 million]. This quantity of emissions exceeds the 2030 NDC target for the energy sector of 457 million tCO_2e specified in the National Strategy for Climate Change. In other words, if current trends continue, Vietnam is unlikely to achieve the 2030 NDC target, even with the lower confidence interval bound. Thus, if CBAM were to be applied to only current target sectors, its direct support of Vietnam's NDC implementation would be minimal.

However, CBAM can provide an incentive for producers to reduce emission intensity. Producers in CBAM-sectors would benefit by reducing their emission intensity because that would reduce the payment that need to make for purchasing the CBAM certificates to compensate for their emissions. If this impact could spread out to other sectors, the emission intensity of the entire economy would be lowered. We estimated that if the emission intensity of the economy could be lowered by 1-1.5%

per year as specified in Vietnam's Green Growth Strategy (Prime Minister of Vietnam, 2021, p. 2), the estimated fossil emissions in 2030 would be 517 million tCO_2 (CI = [482,553 million])–relatively lower than the BAU scenario. The lower bound of the 95% confidence interval is slightly higher than the 2030 NDC target, implying that there would be a very significant probability of not reaching the target.

CBAM can also provide an additional justification for carbon pricing, in a broader context of energy transition and low carbon development, from a government revenue-generation perspective. Vietnam's producers in CBAM-targeted sector would pay the CBAM fee for their export, and without carbon pricing in Vietnam, all revenue is collected by the EU. With carbon pricing, part of that revenue would be collected by Vietnam's government. In other words, if it were possible to impose a carbon price on the export of CBAM commodities to the EU when CBAM is in place, carbon pricing would generate positive impacts, instead of negative, by increasing government revenue while not further worsening producers' economic conditions. The negative economic impacts of carbon pricing would arise mostly when it impacted all commodities (that use fossil fuel directly or indirectly), not limited to CBAM commodities and not limited to export to the EU.

With emission intensity remaining unchanged, the estimated mean of fossil fuel emissions under carbon pricing would be 396 million tCO_2 (CI = [357,449 million]) in 2030. In this case, carbon pricing would help reduce fossil fuel emissions by providing a price signal for resource relocation toward sectors with lower emission intensity in the economy. If carbon pricing can promote the reduction in emission intensity, the estimated mean of fossil fuel emissions would be lowered to 379 million tCO_2 (CI= [339,430 million]) in 2030.

To summarise, while CBAM's direct support of Vietnam's NDC implementation is likely not large, it may provide incentives for reforms that can generate substantially higher impacts on NDC implementation.

Benefit of energy transition in Vietnam's electricity sector under CBAM and carbon pricing

To quantify the impact of energy transition in the electricity sector, we look at the scheduled composition of the total electricity output in 2030 (i.e., hydroelectric, coal-fired, FO-fired, diesel, gas fired, renewable). Comparing what has been scheduled for 2030 and what happened in 2019 implies a rough estimate of a 13% reduction in the emission intensity over eleven years (see Appendix Table 12). We use this estimate to calibrate the energy transition process for the electricity sector. To quantify the impact of the scheduled energy transition in the electricity sector on CBAM-target sectors, we reduced the emissions from electricity input in each sector by 13% over eleven years and used the share of electricity emissions in the total emissions to calculate the reduction in the emission intensity in each CBAM-target sector. The weight of electricity emissions in the total emissions for each CBAM-target sector is reported in Appendix Table 13.

Without carbon pricing (e.g., before 2028), energy transition would not generate benefits due to a small cost due to the relocation of resources away from fossil fuel sectors. However, from 2028 when carbon pricing is added, there are gains in GDP, and the gains would increase over time. This is because energy transition would shift economic resources away from fossil fuels which are becoming more expensive. Over the 10-year period from 2026 to 2035 inclusively, energy transition in the electricity sector would generate an estimated gain of 209 million 2019-value USD (CI = [143,283 million]) under carbon pricing only and 248 million 2019-value USD (CI= [173,336 million]) under both carbon pricing and CBAM.

Policy implications of findings

Our analysis indicates that the estimated impacts of CBAM depend on various assumptions, parameters, and the realisation of many future uncertainties. Although specific numerical results may

differ across scenarios, they provide several direct policy implications that decision-makers should consider.

First, CBAM in the currently proposed format directly impacts only a small part of Vietnam's entire economy. However, for directly impacted exporters to the EU, the impact would be significant. In the future, the scope of CBAM may expand (e.g. to ceramics, pulp, and paper which are in the EU's ETS) and thus become more relevant for Vietnam. Also, Vietnam may face significant indirect costs if exporters of CBAM covered goods to Vietnam implement GHG accounting and reporting systems and increase prices to cover these costs. But the effect could also go the other way – producers in neighbouring countries of Vietnam may offer their products at lower prices as their access to the EU market becomes more difficult. It is thus important to watch the CBAM evolvement closely. Vietnam's government and development partners may consider supporting further research and comprehensive data collection on the list of other commodities covered in the EU's ETS in the near future (2-3 years).It is also crucial for Vietnam to engage in negotiations with its key trading partners to prevent introduction of a CBAM beyond the EU. Government and development partners should provide support to studies that can provide further insight into the potential of energy transition to reduce the emission intensity of high-emission commodities, including commodities Vietnam does not export.

Second, it is technically possible to reduce emission intensity in CBAM-targeted sectors. The results from our enterprise survey reveal a significant difference in emission intensity between Vietnam's and the global average as well as across enterprises within each individual sector. This result indicates room for improvement in energy efficiency, where high-emission-intensity enterprises can catch up with their peers. It highlights the importance of research and development (R&D) activities to promote technological progress for overall efficiency, i.e., more output produced with less input, and also emphasises the role of economic tools to further promote emission intensity reduction by substituting fossil fuels with renewable inputs. Investing in R&D and implementing economic policies that encourage the adoption of cleaner technologies could lead to significant emission reductions and enhance the competitiveness of CBAM-targeted sectors.

Third, carbon pricing is essential to reduce fossil fuel emissions across Vietnam's economy. By putting a price on carbon, the cost of emissions would increase, providing direct incentives for private economic agents to substitute high-emission inputs or consumption goods with alternatives. In addition to this substitution effect, our findings suggest that carbon pricing may generate billions of dollars in revenue every year, which can be used to support technological changes and promote further the energy transition process. Therefore, if effectively implemented, carbon pricing would provide a framework for decision-makers in both the private and public sectors to reduce emissions. The adoption of carbon pricing should thus be considered in a broader context of energy transition, low carbon development of Vietnam and other associated co-benefits (environment, health, etc.)

Fourth, carbon pricing is a priority in Vietnam's NDC implementation. In addition to being part of NDC commitments, carbon pricing is crucial for Vietnam to achieve committed targets. Our results suggest that Vietnam would not be able to achieve its 2030 target of fossil fuel emissions if current trends continued. Even when Vietnam could, without carbon pricing, devote resources to promote energy transition as expected, achieving the 2030 target would not be guaranteed. Thus, incorporating a carbon pricing mechanism is key for Vietnam to meet its NDC targets, though there are other non-carbon pricing instruments such as subsidies for renewables may help achieve the NDC target as well.

Finally, acceleration of actions and policies toward Vietnam's emission targets should be considered whenever appropriate. According to the data of the International Energy Agency (IEA), the emissions from using fossil energy (oil, coal, and gas) in Vietnam increased from 148 million tCO_2 in 2014 to 296 million tCO_2 in 2020, i.e., an annual rate of 12%, far higher than the economic and demographic growth rates. As a result, the fossil emissions per capita have increased, and Vietnam has required more fossil emissions, instead of less, to produce one dollar of economic value-added. If the trend continues, it

will become increasingly difficult for the country to achieve its emissions reduction targets. Therefore, it is crucial to reverse or slow down this trend as soon as possible. Otherwise, Vietnam will have very limited time to achieve its committed emission targets, even with 'hard braking' measures which usually incur substantial costs in terms of economic and social conditions.

Recommendations for developing sectoral mitigation plans

As shown in the modelling results, to reduce the negative impacts of CBAM on producers and exporters of goods from Vietnam to the EU, it is necessary to reduce the emission intensity of the exported products in each of the CBAM sectors. The effort can also extend to other non-CBAM sectors and bring significant benefits on energy transition and decarbonisation. The modelling results also show that GHG mitigation can reduce or even neutralise the negative impacts of carbon pricing in Vietnam.

Among the CBAM sectors, the steel and aluminium sectors will be more impacted by CBAM than the other sectors. Mitigation potential however would be the highest in the cement sector, following by steel and aluminium.

It is recommended that sectoral mitigation plans should be developed and integrated in the sectoral development plan and strategy for each sector. The development of the plan should consider the following:

- Sectoral NDC targets;
- Identification of mitigation measures (may include those not identified in the NDC);
- Feasibility assessment of the mitigation measures;
- Marginal abatement costs of the measures;
- Identification of co-benefits;
- Prioritisation of the measures over the NDC implementation timeframe and beyond.

There is a high potential for reducing emission reductions in each sector by technology transfer and improvement of management practices. This should be further promoted through trainings, international cooperation on scientific and technological research, and technology transfer. Capacity building for GHG accounting is important for the sectors to understand their emission profile and be more prepared for CBAM and the adoption of carbon pricing framework in Vietnam in the coming time.

Recommendations for negotiation policies and strategies

Accepting the CBAM while seeking to reduce its negative impacts has emerged as a preferred option for Vietnam. The advantages clearly outweigh the disadvantages. This approach presents a proactive way for Vietnam to prepare for CBAM. Importantly, it would contribute to Vietnam's achievement of NDC targets, facilitate the greening of its economy, and elevate the country's position in the international arena. Consequently, Vietnam may receive more international financial and technical support. Vietnamese products can become more competitive in markets where consumers demand green products. But the approach can increase production costs initially, and domestic consumers may resist potentially increased energy prices. Improving technical and institutional capacity would also require resources.

It is recommended that the government:

- **Engage in constructive dialogues with EU**: This aims to seek clarification on the details of the CBAM and to negotiate a fair CBAM that takes into account Vietnam's concerns and efforts. This may involve seeking specific exemptions or compensation arrangements to mitigate the impacts of the CBAM on Vietnamese exporters. A reasonable request would be the use of emissions credits instead of having to purchase CBAM certificates.

- **Strengthen institutional and technical capacity for adapting CBAM:** This involves appointing a coordinating agency on CBAM, providing detailed guidelines for emission reporting that are compatible with the CBAM requirements, training for enterprises, and raising public awareness of CBAM.
- **Consider the adoption of carbon pricing in a broader context:** The adoption of carbon pricing needs to address the broader context of energy transition, low- carbon development and other co-benefits (including environment and health). Carbon pricing will re-direct the development of carbon-intensive sectors in a more sustainable way and the revenue from carbon price can be used to incentivise green transformation process and to mitigate the negative impacts on vulnerable groups. If appropriately designed, carbon pricing can be an effective instrument for Vietnam to accelerate the decarbonisation process toward the net zero by 2050.
- **Improve national legal frameworks for decarbonisation**: This includes legal preparation for adopting carbon pricing, enhancing energy efficiency, phasing out unabated coal power, and boosting the penetration of clean and renewable energy.
- **Enhance international cooperation:** This involves 1) strengthening cooperation with EU in other socioeconomic areas to consolidate mutual good will; 2) fostering cooperation with other countries that may be impacted by the CBAM to increase bargaining power with the EU, and 3) joining climate clubs similar to the just energy transition partnership (JETP) to further gain international support.

It is recommended that Vietnam-based enterprises which export to Europe in sectors covered by the EU ETS:

- Start to plan for CBAM if active in a sector currently covered by CBAM;
- Watch for CBAM developments if they are active in a sector not yet covered by CBAM but by the EU ETS;
- Prepare for emission reporting requirements;
- Engage with the government in the context of decarbonisation policies such as carbon pricing and boosting renewable energy uptake.

ABBREVIATIONS

AEMDA	Applied Economic Modelling and Data Analysis
BAU	Business As Usual
CBDRRC	Common But Differentiated Responsibilities and Respective Capabilities
CGE	Computable General Equilibrium
CI	Confidence Interval
CIEM	Central Institute for Economic Management
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide equivalent
COP	Conference of the Parties
DCC	Department of Climate Change
DMTP	Department of Multilateral Trade Policy
DSU	Dispute Settlement Understanding
DTAAs	Double Taxation Avoidance Agreements
EITE	Emissions Intensive and Trade Exposed
EPT	Environmental Protection Tax
ETP	Southeast Asia Energy Transition Partnership
EU	European Union
EU ETS	EU Emission Trading Scheme
GDP	Gross Domestic Product
GHG	Greenhouse gas
GSO	General Statistics Office of Vietnam
HHI	Herfindahl-Hirschman Index
I/O	Input/Output
IEA	International Energy Agency
IMT/EXT	Import/Export Tax
IPG	International Partners Group
ISP	Integrated Steel Plant
JET-P	Just Energy Transition Partnership
JVETS	Japanese Voluntary Emissions Trading Scheme
K-ETS	Korean Emission Trading Scheme
KgOE	Kilogram of Oil Equivalent
LDC	Least Developed Country
LULUCF	Land Use, Land Use Change and Forestry
MARD	Ministry of Agriculture and Rural development
MFN	Most-favoured Nation
MOC	Ministry of Construction
MOFA	Ministry of Foreign Affairs
MOIT	Ministry of Industry and Trade
MONRE	Ministry of Natural Resources and Environment
MOT	Ministry of Transportation
MPI	Ministry of Planning and Investment
N_2O	Nitrous Oxide
NDC	Nationally Determined Contribution
NRT	Natural Resources Tax
PDP VIII	National Power Development Master Plan for the 2021 – 2030 period with a vision to 2045
PFCs	Perfluorocarbons
R&D	Research and Development
RQ	Research Question

RUIE	Russian Union of Industrialist and Entrepreneurs
SCT	Special Consumption Tax
TFP	Total Factor Productivity
TOE	Tonnes of Oil Equivalent
TPES	Total Primary Energy Supply
UNFCCC	United Nations Framework Convention on Climate Change
VAT	Value-Added Tax
VCCI	Vietnam Chamber of Commerce and Industry
WTO	World Trade Organisation

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDIX TABLES

LIST OF FIGURES

1. INTRODUCTION

On December 13, 2022, three relevant institutions of the European Union (EU Commission, the European Parliament and the European Council) agreed on the regulation establishing the world's first Carbon Border Adjustment Mechanism (CBAM). This is part of the EU's target to accelerate the reduction of greenhouse gas (GHG) emissions and to achieve carbon neutrality by 2050. The CBAM proposal was first presented by the European Commission in July 2021 with the aim of addressing the risk of carbon leakage caused by non-EU countries whose policies to mitigate climate change are less ambitious than those of the EU. CBAM is considered an effective way to level the playing field for EU producers and importers, alleviating the competitiveness challenges faced by the EU industry in the global market. From a cross-border perspective, CBAM aims to equalise the cost of GHG inside and outside the EU. The CBAM will complement the EU's Emission Trading Scheme (EU ETS) and requires importers to buy certificates based on the GHG emission intensity of products they imported into the EU at a price equal to that of EU ETS certificates (EU allowances). Prices of EU allowances have fluctuated over the years and risen sharply since 2017 (see Figure 1-1).

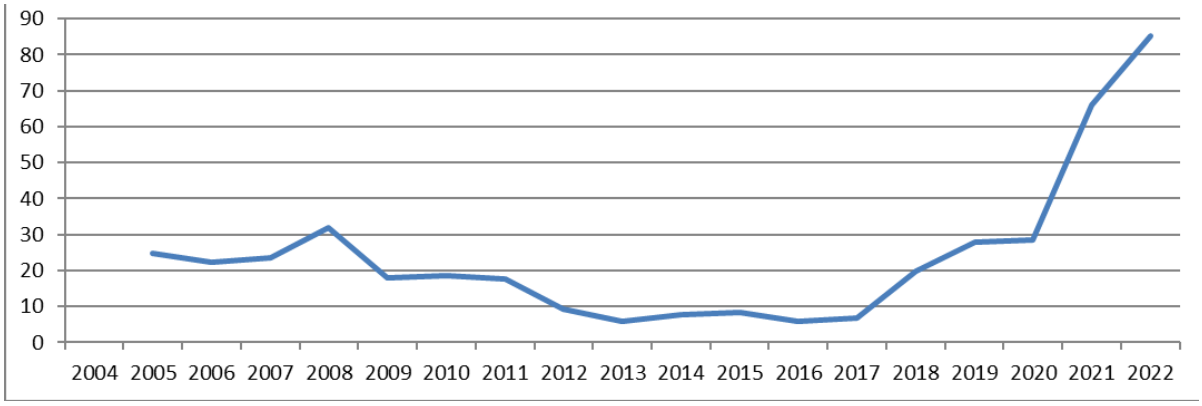


Figure 1-1: Average EU allowance prices since 2005 (USD per allowance)

Source: Annual carbon market reports by PointCarbon, Thomson Reuters and Refinitiv

Mandatory carbon prices in exporting countries will be credited under CBAM so only the differential to the EU ETS price remains to be paid. From an international-trade perspective, CBAM is a border tax or tariff that reduces the competitiveness of goods imported to the EU from countries with zero or low costs of GHG emissions. As of March 2023, sectors covered include iron and steel, cement, aluminium, fertilisers, electricity, and hydrogen.

Vietnam and the EU are important trading partners with strong economic ties. The two parties entered into a Free Trade Agreement (called EU-Vietnam Free Trade Agreement or EVFTA) on June 30, 2019. EVFTA was ratified by the European Parliament on February 12, 2020, and by the National Assembly of Vietnam on June 8, 2020. On March 30, 2020, EVFTA was approved by the European Council and officially took effect on August 1, 2020. Vietnam is the EU's 15th trade-in goods partner and the EU's most prominent trading partner in ASEAN. Vietnam is also the 11th biggest exporter to the EU, with a share of 1.8%in the overall EU's imports value. The specific CBAM-covered exports to the EU in the cement, iron and steel, aluminium and fertiliser sectors are however currently insignificant. Given these strong ties in trade relationship, the impacts of CBAM on Vietnam may be more substantial, if CBAM coverage is to be extended in the future. In addition to economic impacts, CBAM will influence Vietnam's climate policy. Although Vietnam is a low-middle-income country, it recognises the importance of mitigating climate change and has set an ambitious target to achieve net-zero emissions by 2050, similar to many developed countries.

In order to assess whether a consideration of carbon pricing is now warranted, up-to-date information on CBAM design and an initial estimate of CBAM's possible impacts on Vietnam is crucial. This information and estimates are important for preparing appropriate responses to CBAM and its associated impacts. They will be useful for the Government of Vietnam to formulate an effective legal framework and policies to accelerate its own decarbonisation efforts and energy transition from fossil fuel to renewable energy. They will provide the research community, enterprises, and economic agents with up-to-date knowledge to respond appropriately to CBAM and minimise its negative impacts.

2. OVERALL GOAL AND SPECIFIC ATTEMPTED QUESTIONS

The overall goal of this study is to provide up-to-date knowledge and a data-driven assessment in relation to CBAM's potential impact on Vietnamese companies and the economy as a whole prior to its official introduction. The results of this study may be used to inform policy development strategies by providing policymakers with relevant evidence and insights that can guide their decision-making processes. However, this study does not claim to provide a comprehensive list of all the possible outcomes and scenarios that may arise in the future with regard to CBAM, nor does it attempt to quantify the non-measurable impacts of CBAM and its related developments.

This study aims to investigate the quantitative impacts of CBAM on Vietnam's economy in plausible scenarios as of March 2023. The quantitative impact evaluation includes both economy-wide impacts and sectoral impacts on directly impacted sectors. The assessment also covers possible CBAM impacts on the achievement of NDC targets along its pathway to a low-carbon economy and how CBAM may influence Vietnam's energy transition. Finally, policy implications and recommendations are provided in relation to energy transition, low carbon development and the establishment of the carbon pricing framework in Vietnam to minimise negative impacts and maximise benefits from CBAM.

Toward the overall goal, this study will address the following research questions (RQ):

- RQ1: What is the role of CBAM in a global context, and what design elements of the EU's CBAM remain uncertain?
- RQ2: Where is Vietnam's position regarding climate change mitigation policies and CBAM?
- RQ3: What are the possible impacts on sectors directly impacted by CBAM?
- RQ4: What are the possible overall impacts of CBAM on Vietnam's economy?
- RQ5: What possible roles will CBAM play in the Vietnam energy transition process and NDC implementation?
- RQ6: What are the policy implications of possible CBAM impacts?
- RQ7: What are policy recommendations?

In attempting to answer these questions, this study uses a review method, Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis, enterprise survey, legal impact assessment, and applied economic modelling, which will be described in detail in section 6 and the appendices. The research questions and the methodologies are summarised in Table 2-1.

Table 2-1 Summary of specific research questions and methodologies

Research questions	Methodologies
RQ1: What is the role of CBAM in a global context, and what design elements of the EU's CBAM remain uncertain?	Literature review
RQ2: Where is Vietnam's position regarding climate change mitigation policies and CBAM?	Literature review
RQ3: What are the possible impacts on sectors directly impacted by CBAM?	Partial equilibrium modelling
RQ4: What are the possible overall impacts of CBAM on Vietnam's economy?	General equilibrium modelling
RQ5: What possible roles will CBAM play in the Vietnam energy transition process and NDC implementation?	General equilibrium modelling
RQ6: What are the policy implications of possible CBAM impacts?	Data analysis and legal impact assessment
RQ7: What are policy recommendations?	Strengths-Weaknesses-Opportunities-Threats (SWOT)

The remaining of the report is organised as follows. Section 3 reviews previous studies and the development of economic approaches to climate change, and section 4 summarises current knowledge about CBAM, including a summary of the global markets of CBAM-impacted commodities (RQ1). Section 4.7 provides an overview of Vietnam's energy and climate change profile with a focus on CBAM directly impacted sectors (RQ2). Section 6 describes the methodology of the quantitative assessment, while section 7 provides a summary of surveyed results in relation to CBAM-directly-impacted sectors in Vietnam, and section 8 presents estimated sectoral impacts (RQ3). Section 9 presents the economy-wide impacts (RQ4), the implication of CBAM on Vietnam's energy transition process and NDC implementation (RQ5). Section 10 qualitatively outlines possible CBAM impacts on policy and regulations, and section 11 summarises key policy implications (RQ6). Section 12 provides recommendations for development of sectoral mitigation plan and Section 13 provides policy recommendations (RQ7).

3. ECONOMIC APPROACHES TO CLIMATE CHANGE

3.1. Concept of carbon pricing instruments

Economic climate change mitigation instruments aim to provide a clear carbon price signal to support lower carbon activities (Falkner 2013). Carbon pricing increases the prices of goods across the economy in proportion to their carbon content and, therefore, their impact on climate change (Stiglitz et al., 2017). By raising the relative price of carbon-intensive goods, carbon pricing encourages individuals and businesses to purchase less carbon-intensive alternatives (Kennedy, Kaufman, & Obeiter, 2015). There are several types of carbon pricing instruments, including carbon taxes, emission trading, and carbon credit systems (World Bank, 2022).

Carbon tax is a policy tool that the government imposes a fee on GHG emissions. Carbon tax provides a financial motivation to reduce emissions. In a carbon tax scheme, the government sets the price of carbon, and the market decides the amount of emissions reductions encouraged by the price (Royal Society, 2002). Carbon tax generates tax revenue for governments.

An emissions trading scheme (ETS) sets a limit or cap on the amount of GHG emissions in specific sectors of the economy. The government allocates or sells tradable emission allowances to entities covered under the cap, with each allowance representing the permission to emit a specific volume of emissions. The entities must submit allowances for their emissions during the compliance period, and they can buy extra allowances if necessary or sell any surplus allowances. This system is commonly referred to as a "cap-and-trade" system. On the other hand, an ETS can also use a "baseline-and-credit" approach, where there is no fixed limit on total emissions per sector, but covered entities can "earn" emission credits if they emit less than the baseline. These credits can be traded with entities that require additional credits to cover their surplus emissions compared to the baseline. In an ETS, the price of carbon is "not fixed by" the government but is instead determined by the supply and demand of emission allowances or credits (World Bank, 2022). ETS may generate revenue when emission quotas are auctioned.

Carbon crediting mechanisms refer to a system where tradable credits (typically representing a metric tonne of carbon dioxide equivalent) are generated through specific emission reduction or removal activities that are not driven by other mitigation policies. Carbon crediting mechanisms operate differently from carbon taxes and ETSs. Instead of requiring businesses to pay for emitting (i.e., the polluter pays principle), businesses and other organisations can generate carbon credits (and revenue) by demonstrating that emissions have been reduced or sequestered relative to a counterfactual baseline. There are three categories, two of which are driven by regulatory targets and one based on voluntary ones: (i) international crediting mechanisms such as Clean Development Mechanism or Article 6.4 of the Paris Agreement; (ii) regional, national and subnational crediting mechanisms such as Australia Emission Fund or US State of California's Compliance Offset Program, and (iii) private carbon market programmes for voluntary carbon markets such as Gold Standard or Verified Carbon Standard; (World Bank, 2020).

3.2. Carbon pricing and related policies in practice

Carbon tax and ETS have emerged as efficient measures to mitigate climate change. According to the World Bank (2022), 36 carbon tax regimes and 32 ETS are in operation as of June 2022 in 46 national jurisdictions. Approximately 23% of the total global GHG emissions are currently covered by these instruments.

In the 2016-2021 period, carbon pricing revenues increased steadily, from 22 billion USD in 2016 to 84 billion USD in 2021 (see Figure 3-1). While carbon taxes have historically generated more revenues than ETSs, the gap has narrowed in recent years, and in 2021, ETSs generated over two-thirds of total

revenue. This largely reflects the fact that ETS prices are rising faster than tax rates. A second factor is the increasing share of auctioned allowances rather than free allocation (World Bank, 2022).

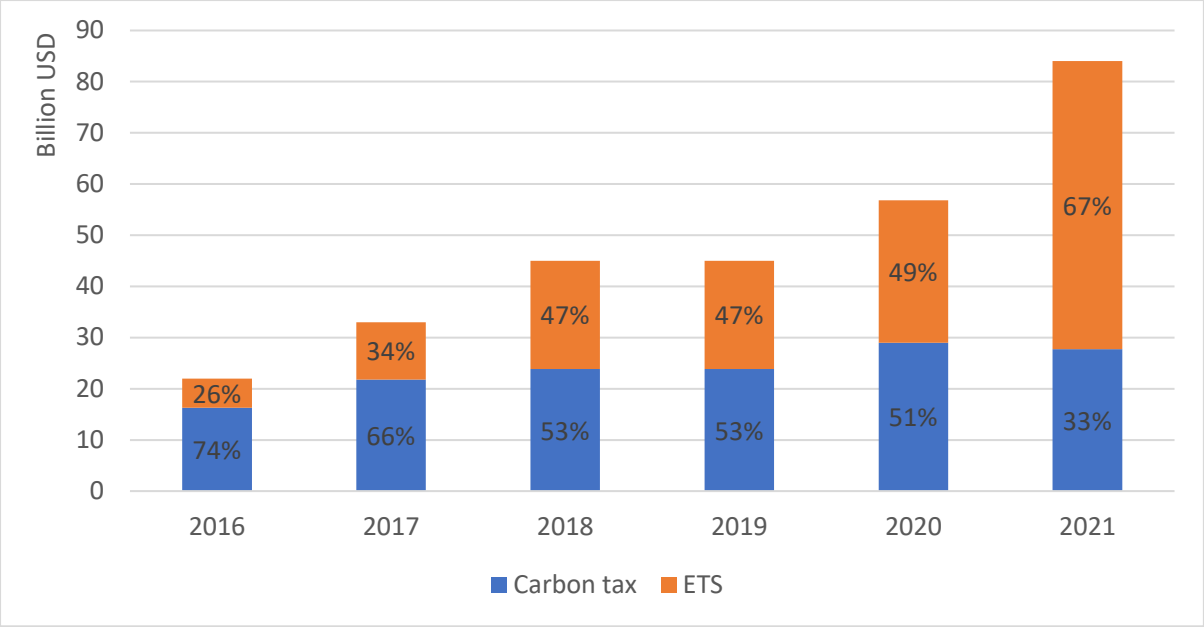


Figure 3-1 Evolution of global carbon pricing revenue, 2016-2021

Source: World Bank (2022)

3.2.1. The EU Emission Trading System

All member states of the European Union (plus Iceland, Liechtenstein, and Norway) are part of the EU ETS. In 2021, EU ETS was the only existing multilateral trading scheme for CO_2 and the world's largest mandatory cap-and-trade scheme, covering more than 10,000 power plants and factories in the 27 EU member states plus Iceland, Liechtenstein, and Norway, encompassing around 40% of the EU's total CO_2 emissions, and accounting for 41% of global carbon pricing revenue. All revenues from the EU ETS flow into the Energy and Climate Fund, which supports climate protection measures (renewable energies, energy efficiency investments, national and international climate protection projects, electro mobility) and the further development of the National Action Plan for Energy Efficiency (World Bank, 2022).

EU ETS has gone through three phases since its inception, with the allowance prices moving as shown in Figure 1-1. During the first phase from 2005 to 2007, over 12,000 organisations participated based on the amount of combustion installations exceeding 20MW, representing 40% of EU CO_2 emissions. The second phase, from 2008 to 2012, saw the expansion of the system with the inclusion of Norway, Iceland, Liechtenstein, and the aviation sector. During the third phase, from 2013 to 2020, the EU made changes such as a cap set by the EU, tighter restrictions on offsets, more sectors and gases included, and auctioning used as the default method for allocating allowances (instead of free allocation).

The EU ETS covers CO_2 emissions from a number of sectors. Examples include power stations, energy-intensive heavy industry (e.g., oil refineries, steelworks, and producers of iron, aluminium, cement, paper, and glass) and civil aviation (only those between and within countries in the European Economic Area must comply with the programme). Electricity producers had been obligated to buy all the allowances they need to generate electricity, while the manufacturing industry decreased its allowances for free from 80% in 2013 to 30% in 2020. For aviation, 82% is granted for free to aircraft operators, 15% is auctioned, and 3% is in a special reserve for distribution to fast-growing aircraft operators and new entrants. A market stability reserve began operating in January 2018 to address

the surplus of allowances and improve the system's resilience to major shocks by adjusting the supply of allowances to be auctioned (European Commission, 2021a).

The EU has been preparing for phase four (2021-2031), with the aim of strengthening the EU ETS as an investment driver and reinforcing market stability, while maintaining a decrease in EU CO_2 emission in total. The EU introduced its proposal for a revised ETS in July 2021, as part of the "Fit for 55" package, which is intended to enable the EU to achieve a net reduction of 55% in GHG emissions by 2030 compared to 1990 levels. Under the revised EU ETS Directive, the system of free allocation will be prolonged for another decade. Free allocation will focus on sectors at the highest risk of relocating their production outside of the EU. These sectors will receive 100% of their allocation for free. For less exposed sectors, free allocation is foreseen to be phased out after 2026 from a maximum of 30% to zero at the end of phase 4 (2030).

With the exception of Switzerland, Ukraine, and the United Kingdom (UK), all European countries that levy a carbon tax are also part of the EU ETS. Switzerland has its own ETS, starting in 2008 with a five-year voluntary phase. The system subsequently became mandatory for large, energy-intensive entities, while medium-sized entities may join voluntarily. The Swiss ETS linked[1] with the EU ETS in January 2020 (SFOE, 2022). After leaving the EU at the end of 2020, the UK, Scottish and Welsh Governments, and Northern Ireland governments replaced EU ETS with the UK ETS. The UK ETS came into force in January 2021 and works in a similar way to the EU scheme (UK Government, 2022). UK ETS and EU ETS have not been linked.

3.2.2. Carbon taxes in the EU

No carbon tax regime exists for the whole EU, but this pricing instrument is in operation at a national level in some jurisdictions, with 13 countries having carbon taxes as of April 2021. In 1990, Finland was the world's first country to introduce a carbon tax. Sweden has a carbon tax that is by far the highest in the EU –116.33 € per tonne of carbon emissions (tCO_2). On the other side of the spectrum, Poland has the lowest carbon tax rate at 0.07 €/tCO_2 (Surf Cleaner, 2022).

3.2.3. Related carbon pricing policies of EU's trading partners

In 2021, key trading partners of the EU include China (accounting for 16.2% of total trade), the United State (US) (14.7%), ASEAN (5%), Japan (2.9%), South Korea (2.5%), India (2.1%), Australia (1%) (EUROSTAT, 2022). Countries that do not have a carbon tax or ETS in place include ASEAN countries, India, and Australia. Some countries such as China, US, Japan, Korea, Canada, and New Zealand have carbon prices; however, they are incompatible with EU ETS due to differences in structures, operation mechanisms, and ambition levels. Importantly, there is a big gap between the EU ETS carbon price compared to that of these countries (see Figure 3-2).

[1] Linking compatible emissions trading systems with each other enables participants in one system to use units from another system for compliance purposes (European Commission 2023).

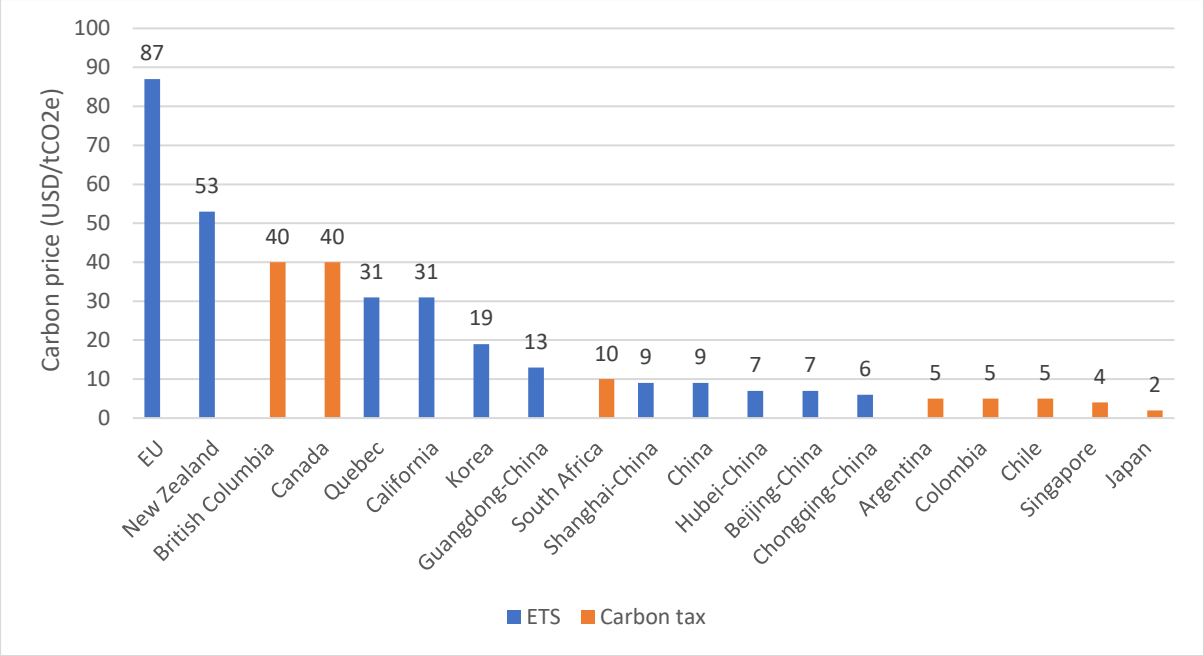


Figure 3-2 Carbon price of EU and some non-EU countries, April 1, 2022

Source: World Bank (2022)

China

China is the world's biggest emitter of CO_2. In 2021, China launched its national ETS based on a cap-and-trade model initially involving coal- and gas-fired power plants. It plans to add heavy industry and manufacturing to the scheme. Over 2,100 liable power stations participated during this cycle, covering about 4.5 billion tCO_2e per year—over 30% of China's total GHG emissions. A total of 179 million tCO_2e of allowances were traded in 2021, representing a cumulative turnover of close to 1.2 billion USD. However, the Chinese national ETS freely allocated all allowances during 2021, and as a result, no revenue was generated (World Bank, 2022).

The Chinese national ETS is perceived to be incompatible with the EU ETS due to differences in the type of cap as well as the fundamental level of ambition (Sun, 2022). The striking distinction is that China chose to pursue an intensity-based cap allowing polluters to emit more or less depending on the anticipated input and gross domestic product (GDP) output in any given year, which directly conflicts with EU's absolute cap allowancing at rigid and predetermined quantity. This means that, while the EU commits to a strict maximum number of allowances, China's intensity-based cap will act more like a moving target, losing stringency in years when economic production in China increases (Shen & Feng, 2017). Moreover, differences in the ambition level of each policy poses a massive deterrent to linking from the perspective of the EU. Europe is currently in the process of rapidly tightening its cap and launching allowance prices to historical highs, even reaching records of nearly 100 USD /tCO_2 in May of 2022. In contrast, China's cautious approach has only managed to achieve prices less than half that of the current EU ETS. (Li, Weng, & Duan, 2019).

United States

The US currently does not have a carbon tax. President Biden has pledged to cut emissions by 50% from 2005 level by 2030 and achieve net-zero by 2050. However, the concept of a carbon tax is regarded by the administration as politically risky and difficult to get passed in the US Congress (World Bank, 2022).

Some states in the US including California, Oregon and Massachusetts have formed their own ETS. Launched in 2013, California's ETS covering 80% of the state's emissions has notably become the fourth largest multi-sectoral emissions trading systems in the world. California's 2030 emissions reduction target of 40% below 1990 levels is currently aligned with the EU's, in terms of the target year, base year and percentage reduction. In 2018, California and the EU expressed their mutual political will to deepen their collaboration on emissions trading and align their carbon markets (European Commission 2018).

Due to some differences in structure and operational mechanism, all state ETSs in the US have not been linked with EU ETS. For example, unlike the EU ETS, California's economy-wide program covers fuel supply (upstream) in addition to direct emitters (downstream) and regulates a slightly broader range of GHGs. Moreover, compliance periods in the two programs are different in duration and, thus, unsynchronised. Another difference emerges in the provisions for offsets. The EU has abolished international offsets from its ETS but has not excluded the possibility for domestic (EU) offsets in the coming years. Conversely, California only accepts domestic (US) offsets with strict limitations, but could, potentially, allow restricted use of certain international credits from developing countries in the future (Kotzampasakis & Woerdman, 2020).

ASEAN countries

The ASEAN economic region has also seen recent development in establishing carbon pricing. Singapore introduced a carbon tax in 2019, which was set at 4 USD /tCO_2e, applying uniformly across all sectors. Indonesia launched a pilot voluntary ETS for the power sector from March 2021 to August 2021. Carbon pricing in Indonesia will be voluntarily implemented from 2021 to 2024 and is scheduled to become mandatory by 2025 (AMRO, 2022). In Malaysia, the Ministry of Environment and Water published a National Guide on Voluntary Carbon Market Mechanism in 2021 as the primary reference and guidance for domestic voluntary carbon market mechanisms, including the roles and functions of various parties in the carbon market mechanisms. In Thailand, GHG Management Organisation is drafting the Emission Trading System Law and is developing an ETS in the Eastern Economic Corridor region (Rosales et al., 2021). In November 2020, Vietnam passed legislation to establish a national ETS system. A pilot system will start in 2025 and will be fully implemented by 2028. Except for Singapore and Indonesia which has just introduced anETS for the power sector, other ASEAN countries have not yet had carbon price.

Japan and South Korea

In 2005, Japanese government implemented a Voluntary Emissions Trading Scheme (JVETS), but it was not successful. During its short period of operation, the voluntary ETS resulted in only 0.03% emissions reduction (compared to 1990 levels). Utility and energy intensive firms did not participate in JVETS and trading was scarce in the final year of its operation when average price of allowances was around 15 USD. Thus, JVETS was retired in 2012. In 2012, Japan passed a carbon tax rate, which is also one of the lowest amongst developed economies. With a tax rate of 2.65 USD/tCO_2, Japan is set to attain 26% reduction in carbon emissions by 2030. However, this target is substantially lower than one recommended by environmental scientists: a 76% reduction in carbon emissions by 2030 (Gokhale, 2021).

The Korea Emission Trading Scheme (K-ETS) began in January 2015. Through the scheme, the government aims to reduce GHG emissions by 37% below the Business As Usual (BAU) levels by 2030 (Asian Development Bank, 2018). In 2022, K-ETS covers more than 600 companies in industrial, power, buildings, waste, and domestic aviation sectors, which are accountable for approximately 68% of the nation's GHG output. The permit price was about 19 USD per tCO_2 in 2022. This price is lower than that of EU ETS and the K-ETS has not been linked with EU ETS.

India

Although India contributes roughly 7% of the world's CO_2 emissions, making it the world's third highest emitter after China and the US, the country has neither a carbon tax nor ETS in place. However, the Indian government has taken steps towards the introduction of a domestic carbon market. India's Bureau of Energy Efficiency proposed three phases towards the adoption of a Cap-and-Trade System (REUTERS, 2023). The first phase aims to increase voluntary demand for carbon credits in India, while the second phase seeks to increase the supply of carbon credits through the development, registration, and validation of emission reduction projects. The third phase aims to eventually evolve the voluntary market into a mandatory cap-and-trade system, in which specific sectors and companies are designated to generate only a certain volume of emissions (i.e., a cap). According to the blueprint, the national Cap-and-Trade System would have a similar design to EU ETS. In addition, in July 2022, the Indian Lower House of Parliament passed an amendment bill to the 2001 Energy Conservation Act that provides the legal basis for the establishment of a voluntary carbon credit trading scheme (ICAP, 2022).

Canada, Australia, New Zealand

Canada has a comprehensive carbon tax system at federal level, and a successful ETS also exists in some states. In March 2021, the Canadian Supreme Court determined that carbon tax was constitutional. Canada's approach is flexible: any province or territory can design its own pricing system tailored to local needs, or firms can choose the federal pricing system. The federal government sets minimum national stringency standards (40 USD/tCO_2e) that all systems must meet to ensure they are comparable and effective in reducing carbon emissions. If a province or territory decides not to price pollution, or proposes a system that does not meet these standards, the federal system is put in place (Government of Canada, 2023). ETS has been implemented successfully in Quebec since 2013, covering 80% of GHG emitted in the state. In 2022, compared to EU ETS, the ETS carbon price of Canada (31 USD/tCO_2e) is less than 50%. The Canadian ETS has not been linked with EU ETS.

Although Australia does not levy a direct carbon tax, which only existed 2012 to 2014, it has the Emissions Reduction Fund as a key element of the Australian Government's suite of climate change policies. Introduced in late 2014, it provides an incentive for industry, businesses, landowners, state and local governments and other organisations to adopt new practices and technologies to reduce emissions or store carbon. In 2020, over 80 million tCO_2 had been reduced under this fund (Australia Clean Energy Regulator, 2020). Carbon tax and ETS are not currently available in Australia.

Unlike Australia, New Zealand has successfully established its national ETS. All sectors of New Zealand's economy, apart from agriculture, pay for their emissions through their NZ ETS surrender obligation, covering 52% of total emission volume (New Zealand Ministry for the Environment, 2023). The carbon price of New Zealand ETS is 53 USD/tCO_2e in 2022. New Zealand ETS systems are not linked with EU ETS (European Commission, 2021a).

4. CBAM AS THE EU'S RESPONSE TO SLOW CARBON PRICING DIFFUSION

As a pioneer in climate protection and a major player in the international environmental agenda, the EU has pledged to becoming the world's first carbon-neutral region by 2050 (European Commission, 2019). Accordingly, in 2019, European Commission (2019) introduced the European Green Deal, which includes an updated target for 2030 to reduce GHG emissions by at least 55% compared to 1990 levels. In July 2021, the Commission (2021) proposed a set of legislative measures known as the "Fit for 55 package" to align the EU's sectoral legislation, including climate, energy, transport, and taxation, with its 2030 GHG emission reduction targets.

4.1. Why CBAM – addressing concerns about carbon leakage

Carbon leakage has emerged as a big concern for industry stakeholders and politicians alike (Aldy & Stavins, 2012). In principle, carbon pricing and the EU ETS encourage reduction of emissions along the entire value chain. These policies incentivise low-carbon innovation in primary emitting industries and increase costs for consumers, encouraging them to switch to low-carbon alternatives. However, competition from less regulated foreign producers may limit the pass-through of carbon costs and cause leakage. Full carbon cost internalisation is necessary for creating incentives for low-carbon consumption and production, but if costs are passed through to product prices, companies may lose market share. In contrast, if costs are not passed through, profitability declines and investment may be driven away (see Figure 4-1) (Grubb et al., 2022). In practice, companies can relocate production to other countries with less stringent emission constraints, leading to an increase in their total emissions which can be referred as carbon leakage (Koch & Mama, 2019).

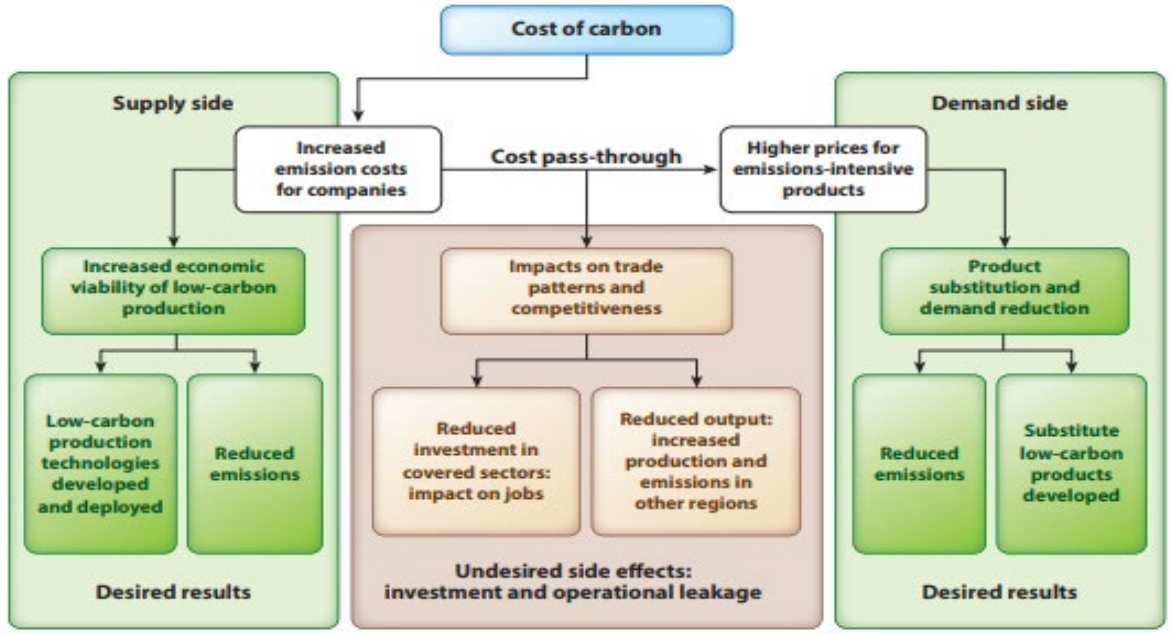


Figure 4-1 Carbon leakage risk in carbon-intensive industries

Source: Grubb et al. (2022)

4.2. The history of CBAM within the EU

Although there is no robust evidence that carbon leakage exists (Koch & Mama, 2019; Naegele & Zaklan, 2019; Verde, 2020), in July 2021, the European Commission proposed the CBAM to tackle carbon leakage. It is proposed that CBAM would gradually be phased in while phasing out EU ETS free

allowances by 2035. The targeted sector would include electricity, cement, certain fertilisers, basic iron, steel, and aluminium. The CBAM would oblige importers to buy carbon import certificates at the same cost as EU ETS allowances based on actual verified emissions of the imported goods in question. CBAM seeks to level the carbon price paid between goods produced domestically and abroad. Imported goods from other countries are subject to a carbon price at the same level as domestically produced goods (assuming no carbon price is already paid). Theoretically, CBAM would tackle carbon leakage by symmetrically charging importers and rebates exporters, ensuring that carbon prices paid in domestic production would not be undercut by producers elsewhere, avoiding these costs. This would render obsolete the rationale for free allocation of emissions permits to products that are sold to the domestic market, enabling full auctioning, and this full carbon price would be passed through, offering incentives for all mitigation options (Grubb et al., 2022).

The process of developing CBAM over time is shown in Figure 4-2.

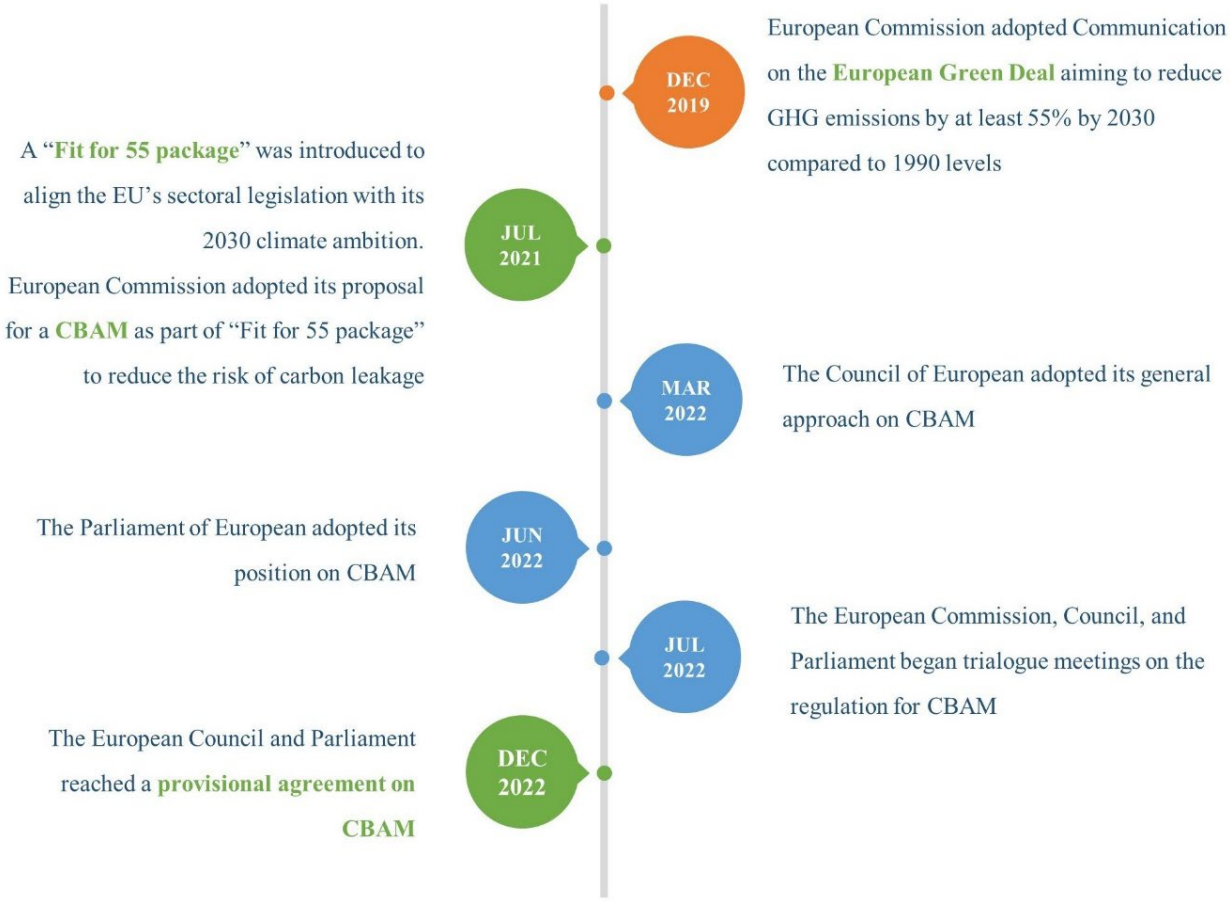


Figure 4-2 The legislative process of the EU's CBAM

Source: European Commission (2021d), European Parliament (2022b), and European Parliament (2022c)

On 14 July 2021, the European Commission (2021d) adopted its proposal for a CBAM as an essential toolbox to address the risk of carbon leakage and prevent increases in global emissions.

CBAM was adopted by the EU Council (2022b) on 15 March 2022 and the European Parliament (2022a) on 22 June 2022. The Commission, the Council and the Parliament began their negotiations on the final text of CBAM on 11 July 2022 before reaching a provisional agreement on 13 December 2022

(European Parliament, 2022c). On 8 February 2023, the European Parliament's Committee on the Environment, Public Health and Food Safety released a provisional agreement resulting from interinstitutional negotiations on CBAM regulation (European Parliament, 2023). On April 18, 2023, the European Parliament formally approved the CBAM. The European Council approved it on April 25, 2023.

4.2.1. Objectives

The primary objectives of CBAM are to prevent the risk of carbon leakage, ensure a level playing field for the EU industry, and promote environmental responsibility globally (Council of the European Union, 2022a). As repeatedly admitted by the EU, CBAM is designed to fully comply with World Trade Organisation (WTO) rules (European Parliament, 2022c).

CBAM will be applied at the border by placing a charge on imports of certain emission-intensive goods equivalent to the carbon price imposed on domestic goods under ETS. This charge is determined based on the carbon footprint of the products, which is calculated considering the emissions generated during its production process. This charge can be adjusted to reflect any mandatory carbon prices in the exporting countries. By placing an equivalent carbon price on the imports of covered goods, CBAM is also considered an effective way to level the playing field for the EU's producers and importers and alleviate the competitiveness challenges faced by the EU industry in the global market (European Commission, 2021d).

CBAM is also aimed at mitigating GHG emissions by promoting the use of more emission-efficient technologies in third-country manufacturing industries (European Commission, 2021d). The EU plans to collaborate with low and middle-income countries to facilitate the de-carbonisation of their manufacturing industries. Additionally, the EU would offer technical assistance and funding generated from the sale of CBAM certificates to the least developed countries (LDCs) to support them in meeting the new obligations established by this regulation. The European Commission (2021d:Article 2) proposed that import goods from certain countries/territories with climate policies equivalent to or linked to the EU's ETS may be exempt from CBAM. This will encourage the third countries with less stringent climate policies than the EU to enhance their climate ambition and join the global combat against climate change.

4.2.2. Scopes

The European Commission (2021d) and the European Council (2022b) proposed the CBAM apply to imports of five groups of commodities with specific custom commodity codes, namely goods from aluminium, cement, electricity, fertiliser, iron and steel. In June 2022, the EU Parliament proposed two additional sectors: chemicals and polymers (2022a). After negotiations, the Council and the Parliament reached a provisional agreement in December 2022 that CBAM would cover the five initial sectors proposed by the Commission, plus hydrogen (Council of the European Union, 2022c; European Parliament, 2022c). As a result, CBAM will cover six groups of commodities. The specific custom commodity codes of these groups are provided in Appendix 1.

The GHGs included in CBAM are carbon dioxide (CO_2), nitrous oxide (N_2O), and perfluorocarbons (PFCs). The official list of commodities (classified by the EU's 8-digit CN code) and the corresponding GHG will be released when the Parliament and Council formally approve the final text of the agreement. Indirect emissions, defined as GHG emissions from electricity production processes consumed during the production of goods, would also be included. With the expanded coverage, CBAM is estimated to cover more than 50% of the total emissions from sectors under the EU ETS when it is fully phased in (Taxation and Customs Union, 2022).

There are exemptions for the covered goods from certain countries/territories subject to specific conditions (European Commission, 2021d). The general exemption will be granted to countries implementing the EU ETS or having domestic ETS that is fully linked with the EU ETS, and the carbon

price paid in the originating country is charged without any rebate beyond those applied in the EU ETS. In some cases, particularly if the third country has an integrated electricity market with the Union internal market, and it is technically impossible to apply CBAM, the importation of the electricity will be exempt under other specific conditions. These conditions include the third countries' obligations to apply the Union law in the field of electricity, implement the main provisions of the Union electricity market legislation, commit to climate neutrality by 2050, demonstrate progress in aligning the domestic legislation with Union law in the field of climate action, and implement effective measures to prevent the indirect import from non-compliant third countries.

4.3. Plans for implementation as of April 2023

4.3.1. Provision of CBAM

The European Parliament (2022c) and the Council (2022d) have agreed that CBAM will start operating from 1 October 2023 with a three-year transitional phase (European Commission, 2022b). After the transition phase, the permanent system will enter into force on 1 January 2026 and become fully operational in 2034 (see Figure 4-3). During this period, CBAM will be gradually phased-in in parallel with the phasing-out of the free allowances under the EU's ETS. Accordingly, CBAM will only apply to the proportion of emissions not benefitting from free allowances under the ETS over the 2026 – 2034 (see Table 4-1) (European Parliament, 2022b).

Table 4-1 Phasing out of the EU's ETS free allowances

	2026	2027	2028	2029	2030	2031	2032	2033	2034
ETS Free Allowance (%)	97.5	95	90	77.5	51.5	39	26.5	14	0
CBAM (%)	2.5	5	10	22.5	48.5	61	73.5	86	100

Source: European Parliament (2022b)

Figure 4-3 CBAM phase-in over time

Source: European Commission (2021d), European Parliament (2022b), and European Parliament (2022c)

The operation of CBAM during its transitional phase will be subject to review before the definitive system takes effect in 2026 (European Parliament, 2022c). The Commission will be required to assess whether to broaden the scope to other goods identified during the negotiations, including certain downstream products and other sectors such as organic chemicals and polymers, as previously

proposed by the Parliament. It is planned to include all goods covered by the EU ETS by 2030 and the methodology to calculate indirect emissions shall be assessed at the same time.

The Commission plans to conduct a thorough examination of CBAM by the conclusion of 2027 (European Parliament, 2022c). This will involve evaluating the progress made in international negotiations on climate change, as well as the impact on imports from developing countries, particularly the least developed countries (LDCs).

4.3.2. How will CBAM work?

During the transition period, importers of the goods covered by CBAM will only have reporting obligations without any financial adjustment required. Every quarter of a calendar year, importers will need to submit a report containing information about the total quantity of each type of goods (in MWh for electricity and tonnes for other goods), total embedded (direct and indirect) emissions in the imported goods (in tonnes of CO_2e per MWh for electricity or tonnes of CO_2e per tonne of each type of goods other than electricity), and the carbon prices paid in the country of origin (without any form of compensation on exportation). The calculations of embedded emissions must follow the methods indicated in Annex III of the proposed regulation based on actual emissions or default values provided by the Commission. Indirect emissions of iron and steel and aluminium production are not calculated initially because financial measures to compensate for indirect emissions costs incurred from GHG emission costs passed on in electricity prices are still applied in the EU. However, during the transitional period, data on indirect emissions from those goods are still collected for the purpose of defining the methodology for the calculation of indirect emissions. If actual emissions values are used, they must be independently verified by an accredited verifier based on the verification principles set out in Annex V of the regulation.

The Commission will set up a CBAM registry to execute processes relating to CBAM certificates and to facilitate and ensure the proper functioning of the CBAM. Besides the information about each authorised CBAM declarant, CBAM registry also contains, in a separate section of the registry, the registered information of the operators and installations in third countries on their disclosure of verified embedded GHG emissions from the production of goods. Authorised CBAM declarants could choose to use the disclosed information to fulfil the verification obligation.

Starting from September 2025, importers of CBAM goods are required to register as authorised CBAM declarants before importing CBAM goods. Once the definitive system takes effect on 1 January 2026, declarants will need to submit an annual CBAM declaration (by 31 May of each year) for the preceding year. The minimum data required in the declaration includes information on the type and quantity of the imported goods, the total embedded emissions, and the corresponding number of CBAM certificates to be surrendered after adjusting for the reduction due to the carbon price paid in the country of origin.

From 2026, authorised declarants will be required to purchase CBAM certificates from the competent authority of each Member State. The price of these certificates will be determined based on the average price of the closing prices of EU ETS allowances on the common auction platform in the week prior to import. As of 1 December 2022, the price was above 80 € (Vinson and Elkins, 2022). The number of certificates purchased must equal the declared and verified embedded emissions. The number of certificates purchased must correspond to the declared and verified embedded emissions. Although CBAM certificates cannot be traded, declarants will have the ability to resell a limited number of excess certificates (up to one-third of the total purchased certificates) to the competent authority at the purchased price after the required certificates have been surrendered (European Commission, 2021d). Penalties are applied to infringements of the regulation and ensure that they are implemented. Specifically, the penalty level for the failure of an authorised CBAM declarant to surrender CBAM certificates is identical to penalties currently applied in case of infringement of EU ETS, which charges 100 € for each required EU allowance that is not surrendered.

4.4. Global markets and flows of CBAM commodities

4.4.1. Global market

In 2021, the export value of products covered by CBAM to the EU amounted to 98 billion USD, accounting for 0.4% of the global trade value of goods. China was the primary exporter of CBAM-covered products, exporting 133 billion USD, which accounts for 14.9% of the world's total. Germany, an EU country, ranked second with a total export value of 62.7 billion USD or 7% of the world's total, followed by Russia at 49.3 billion USD (5.5%), Japan at 37.2 billion USD (4.2%), and the Republic of Korea at 36.7 billion USD (4.1%). The top ten exporters comprise more than half of the world's export value of CBAM-covered products. Vietnam ranked 16th with a total export value of 17.5 billion USD, accounting for 1.9% of the world's total. China was the largest exporter of aluminium (19.5 billion USD) and iron and steel (101 billion USD). At the same time, Vietnam, Germany, and Russia were the top exporters of cement (1.6 billion USD), electrical energy (8.3 billion USD), and fertiliser (10.8 billion USD), respectively (see Table 4-2).

The EU is also a significant exporter of CBAM-covered products despite these industries accounting for only 3% of the Union's total export value. In 2021, all 27 EU countries exported 76.6 billion USD, equivalent to 8.6% of global exports of CBAM-covered products. The EU's exports of CBAM-covered products to the world included 10.5 billion USD of aluminium, 974 million USD of cement, 10 billion USD of electrical energy, 5.1 billion USD of fertiliser, and 50 billion USD of iron and steel. Notably, the EU accounted for 16.4% of the world's total exports of electricity. The UK is the largest CBAM export market for the EU, receiving 14 billion USD of CBAM-covered products, representing 18% of the EU's CBAM-covered product exports. Switzerland, the USA, Turkey, and China are also major importers of CBAM-covered products from the EU, accounting for over 37% of the EU's CBAM-covered product exports in 2021.

Table 4-2 World's top exporters of CBAM-covered products, 2021

No	Exporter	All products (bil. USD)	Exporter	Aluminium (bil. USD)	Exporter	Cement (bil.USD)
1	China	133.1	China	19.5	Vietnam	1.65
2	Germany	62.7	Germany	11.7	Turkey	1.37
3	Russia	49.3	Canada	9.88	UAE	0.64
4	Japan	37.2	Russia	8.34	Germany	0.62
5	Korea	36.7	India	7.95	Canada	0.54
6	Italy	35.5	UAE	7.21	Thailand	0.50
7	India	30.6	Malaysia	6.43	Spain	0.43
8	France	28.4	USA	5.80	Indonesia	0.41
9	USA	27.1	Norway	5.09	Egypt	0.39
10	Turkey	27.0	Italy	4.73	Japan	0.38
11	Others	427.9	Others	68.6	Others	5.61
	Exporter	**Electric Energy (bil. USD)**	**Exporter**	**Fertiliser (bil. USD)**	**Exporter**	**Iron and Steel (bil. USD)**
1	Germany	8.33	Russia	10.8	China	101.3
2	France	7.10	China	10.6	Germany	40.3
3	Switzerland	3.90	Morocco	5.15	Japan	34.7
4	Spain	3.11	Saudi Arabia	5.14	Korea	32.1
5	Belgium	2.77	USA	3.24	Italy	29.3
6	Czechia	2.76	Netherlands	2.75	Russia	28.7

No	Exporter	All products (bil. USD)	Exporter	Aluminium (bil. USD)	Exporter	Cement (bil.USD)
7	Canada	2.64	Qatar	2.74	India	22.0
8	Sweden	2.46	Tri. & Tobago	2.44	Turkey	20.9
9	Norway	1.98	Indonesia	1.74	USA	17.4
10	Austria	1.92	Belgium	1.70	France	17.0
11	Others	24.0	Others	24.1	Others	252.7

Source: Authors' calculation using data from UNCOMTRADE (2023)

4.4.2. EU market

In 2021, the European Union imported 98.3 billion USD of products covered by the EU's CBAM (see Figure 4-4). The majority of these imports were from a small group of leading exporters, with the top 10 accounting for two-thirds of the EU's total import value of CBAM products. Russia was the largest exporter, with exports worth nearly 14.4 billion USD, making up 14.7% of the EU's total import value of CBAM-covered products. Turkey, Norway, the UK, and China followed closely, contributing 9.8%, 7.7%, 6.8%, and 6.8% of the EU's import value of CBAM-covered products, respectively. Vietnam was ranked 12th, with an export value of nearly 2.3 billion USD or 2.3% of the EU's total CBAM import value.

Russia was the largest exporter of fertiliser and iron and steel to the EU, accounting for 30% and 15% of the EU's imports in value terms, respectively. Norway was the top exporter of aluminium (5 billion USD) and electrical energy (1.8 billion USD) to the EU. Meanwhile, Turkey dominated a significant proportion of the EU's total cement import, with 3 billion USD or 41.7% of the total market.

Notably, the EU is an essential market for the exports of CBAM-covered products for top exporters. For example, 29% of Russia's export value of CBAM products in 2021 went to the EU. The EU also imported 95% of Norway's total CBAM export value. The share of the UK's and Turkey's export to the EU in their global exports of CBAM products also recorded a high rate at 67% and 36%, respectively. However, only 5% of China's export value of CBAM products went to the EU.

To evaluate the potential impacts of CBAM on overall exports, it is essential to analyse the extent of each country's dependence on their export of CBAM-covered products (Magacho, Espagne, & Godin, 2022). For most of the leading exporters, CBAM-covered products exported to the EU represent only a minimal proportion of their total export value of all commodities to the world, ranging from 0.2% for China to 4.7% for Norway. However, Ukraine and Serbia are the exceptions, with 10% of their total exports being CBAM-covered products exported to the EU. When examining all exporters, Montenegro emerges as the most vulnerable country, with CBAM products to the EU accounting for 44.7% of its total exports in value terms. In addition, Iceland, Bosnia-Herzegovina, and Mozambique are also among the most affected exporters, with their exports of CBAM products to the EU making up 37.5%, 18.5%, and 17.1% of their total exports to the world, respectively.

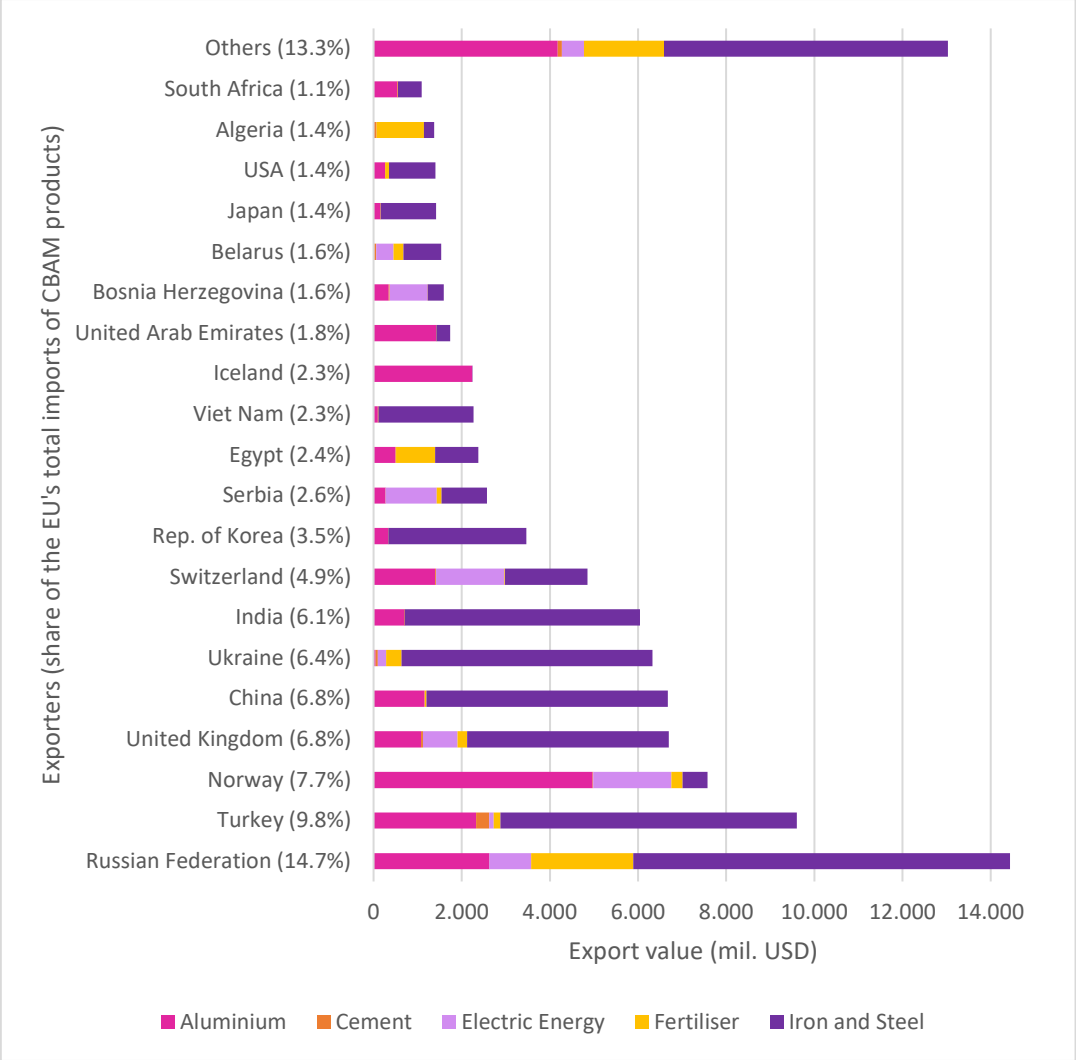


Figure 4-4 EU imports of CBAM-covered goods (million USD) in 2021

Source: Authors' calculation using data from UNCOMTRADE (2023)

Overall, the implementation of the EU's CBAM is unlikely to have significant economic impacts on the major exporters since the value of their export of CBAM-covered products to the EU contributes only small fractions to their total exports. However, as the EU is currently a significant market for the world's exports of CBAM-covered products, the exporters' industries associated with these products will be immediately affected by CBAM. Meanwhile, CBAM is anticipated to have substantial economic impacts on other smaller exporters that heavily rely on exporting CBAM products to the EU.

4.5. Potential challenges to the implementation of CBAM

Despite CBAM's potential benefits in reducing global carbon emissions, the feasibility of the regulation has been internationally challenged.

4.5.1. Compliance with international rules and principles

Although the EU has repeatedly assured that CBAM will comply with the World Trade Organisation's (WTO) rules, it will be challenging for the EU to reach an international agreement on the CBAM (Lim, Hong, Yoon, Chang, & Cheong, 2021; Newman, 2022). The most-favoured-nation (MFN) treatment, a fundamental principle of the WTO, requires that any advantage given to imported products from one WTO member must be granted to like products from all other members (Article 1:GATT, 1947). However, since CBAM tariffs would be assessed differently due to varying environmental regulations,

technology levels and other factors among member countries, it could lead to the violation of non-discriminatory practices in international trade (Lim et al., 2021). In addition, although Article 2 of GATT allows members country to impose a charge on any imported product equivalent to an internal tax imposed on the like domestic products, the EU would have to ensure fair and transparent assessments of third countries' products under CBAM to comply with the WTO's principle (Lowe, 2019).

Another concern related to the CBAM is its potential non-compliance with the Paris Agreement, specifically with the principle of Common but Differentiated Responsibilities (CBDR) and Respective Capabilities. CBAM does not provide an exception for the Least Developed Countries (LDCs), meaning that countries that are the least responsible for climate change but most affected by it could be penalised by the mechanism (Berahab, 2022). This raises questions about the fairness of the CBAM and whether it is consistent with the Paris Agreement's goal of ensuring equity in addressing climate change.

4.5.2. The complexity of the mechanism

The complexity of CBAM is another concern, as the calculation of embedded carbon is not easy and may lead to additional costs for all stakeholders. If the imported products have inputs from different countries, it would be expensive for importers to demonstrate whether their products should be eligible for an adjusted tax rate (Lowe, 2019). In countries where the emissions monitoring regulations are weak or absent, small businesses may find it difficult to measure carbon emissions accurately (Nedumpara & Pradeep, 2020). As a result, they may resort to other actions such as redirecting their exports to another market (Zachmann & McWilliams, 2020) or simply using the default embedded carbon rate determined by the EU, rather than taking steps to reduce the carbon content in their products (Ambec, 2022). Even implementing CBAM is not straightforward for the EU member states with weak border administrative capabilities, which requires additional support from the EU and lead to extra administrative costs (European Economic and Social Committee, 2021). Furthermore, the expansion of CBAM's scope would increase the administrative costs and technical complexity of implementation (Marcu, Mehling, & Cosbey, 2020).

4.5.3. Impacts on international trade

There are numerous concerns among exporters about the negative impacts of CBAM on international trade. The implementation of the regulation could lead to an increase in the prices of the targeted products, resulting in a reduction in global international trade and welfare loss, particularly in developing countries with high carbon content in their exported products (Lim et al., 2021). As discussed in Section 4.4, the smaller economies highly dependent on exports of CBAM products to the EU would be severely worse off. Even for the leading exporters such as China and Russia, although the total value of CBAM-covered products exported to the EU is minimal compared to their global export value, the impact on the targeted industries is substantial due to the high carbon intensity of their products (UNCTAD, 2021). Lowe (2021) estimated that when CBAM is expanded to all ETS-covered products, 16 billion USD of developing country export to the EU will be subject to the CBAM levy. Exports of other related industries, such as fossil fuel, will also be negatively affected due to the reduction of global demand (UNCTAD, 2021).

4.6. Summary of current knowledge of possible reactions from other countries

4.6.1. Negative reactions

China and large emerging economies

China has also raised concerns about the compatibility of the EU's CBAM with international principles and its potential impact on climate issues and global trade (Xu & Stanway, 2021). The representative from China's Ministry of Ecology and Environment (2021) claimed that CBAM is a unilateral measure that violates WTO rules and promotes protectionism, sabotaging international trust and economic

growth. He asserted that China supports multilateralism and that all countries should fight climate change together through broader global cooperation, taking into account their level of economic development.

Other large emerging economies will likely oppose the proposed CBAM as they would be the biggest losers from its implementation (Mishra, 2021). BRIC trade ministers cautioned that any measure to tackle climate change must conform with multilateral trading rules and not put arbitrary restrictions on international trade (Mishra, 2021). Furthermore, China Brazil, South Africa, and India also expressed concerns that the CBAM violates the UNFCCC CBDR (Common but Differentiated Responsibilities and Respective Capabilities) and the Paris Agreement's nationally determined spirit (Gore et al., 2021). In a joint Ministerial statement at COP26, the group emphasised that carbon border taxes or any similar measures that result in market distortion should be avoided (Hufbauer, Schott, Hogan, & Kim, 2022).

China is expected to expose the most to the impact of CBAM (Kardish, Li, Hellmich, Duan, & Tao, 2021). However, it is estimated that the five proposed sectors covered by CBAM account for only 1.8% of China's total exports to the EU in 2020 (Busch, Min, & Meian, 2022). This is because many of the covered products are located at the upstream end of the industrial value chain and are energy-intensive, which does not align with China's export policies (Feng, 2022). Ultimately, the impact of CBAM on China's international trade would be minimal in the early phase.

China has implemented its domestic emissions trading system since July 2021. China is recommended to strengthen its domestic ETS by expanding the coverage of the carbon-intensive sector and gradually increasing the domestic carbon prices to avoid high EU border levy and accelerate China's decarbonisation efforts while reducing its exposure to CBAM (Busch et al., 2022) (Feng, 2022).

Russia

Russia, the largest exporter of CBAM-covered products to the EU, has expressed the concerns that CBAM is a protectionist measure that is inconsistent with the WTO rules and the principles of the Paris Agreement (Gläser & Caspar, 2021), a position supported by the Russian government (WTO Council for Trade in Goods, 2020). EU's recent ban on the import of Russia products makes Russia less relevant in the discussion of EU CBAM impacts.

India

The EU is one of the largest trading partners for India in base metal and mineral products (Notani, 2022). According to UNCTAD (2021), India is the developing country most likely to be affected by CBAM. It is estimated to lose 2.9 – 4.7% of total energy-intensive product exports, equivalent to a real income loss of USD 1 – 1.7 billion.

India has consistently opposed the CBAM proposal (Notani, 2022; Schaik, Pauw, & Cretti, 2022) and insists that such a mechanism should consider the principle of common but differentiated responsibilities and respective capabilities (CBDRRC) in light of different national circumstances (WTO Committee on Trade and Environment, 2021). It is the first country formally announcing to lodge a complaint under the WTO. However, CBAM may be beneficial to India, as its two carbon trading schemes (Perform, Achieve, and Trade (PAT) and Renewable Energy Certificate system) provide a competitive edge over countries with less advanced climate policies (Schaik et al., 2022). India has been willing to engage in dialogue with the EU through ongoing FTA negotiations to establish reasonable default values and recognition of domestic carbon pricing measures for CBAM's implementation (Notani, 2022). The CBAM is also seen as an opportunity for India to accelerate its climate agenda as the country has committed to becoming climate neutral by 2070 (Bergin, Cheng, Gilbert, & Meijer, 2021; Schaik et al., 2022).

Least developed countries

There are concerns that the CBAM could create trade barriers for Least Developed Countries (LDCs) and hinder their efforts to diversify exports (Gore et al., 2021). Currently, the EU does not exempt LDCs from the CBAM, but the European Parliament (2021) has emphasised the need to give special treatment to LDCs and Small Island Developing States (SIDS) due to the potential negative impact of CBAM on their development. It is also argued that LDC imports should be exempted because of their small economic size, defined international status, and low historical carbon emissions (Parry et al., 2021). Exempting LDCs from CBAM is considered consistent with the CBDR principle and is allowed under the WTO's *Enabling Clause* (Cosbey, Droege, Fischer, & Munnings, 2019). Lowe (2021) proposes the EU provide a full, unconditional exemption to products from the LDCs and consider a partial, conditional exemption for low-middle-income countries. These exemptions would be temporary and will be adjusted according to the development progress of the targeted industries. The European Parliament (2022a) also consistently stressed that the EU would provide technical and financial support to help the LDCs with climate mitigation and adaptation.

4.6.2. Positive reactions

New Zealand

For New Zealand, the EU's CBAM is unlikely to have a significant impact on its exports unless CBAM applies to agriculture (Wannan, 2021). New Zealand government's initial stand on the EU's proposal on CBAM was uncertain, with some caution that CBAM must be environmentally effective, WTO compatible, least trade restrictive, predictable and evidence based. However, the New Zealand government has expressed concerns about the risk of carbon leakage in the cement industry. It is considering the merit of a CBAM for New Zealand starting with this industry (Office of the Minister of Finance and Office of the Minister of Revenue of New Zealand, 2022). It has also reached a free trade agreement with the EU on 30 June 2022 (European Commission, 2022a), committing to promoting emissions trading as an effective policy tool for reducing GHG emissions and promoting environmental integrity in the development of the international carbon market. New Zealand and the EU will push cooperation on policy and technical exchanges regarding the development and implementation of domestic and international carbon prices.

United Kingdom

The EU's CBAM is expected to have a minimal economic impact on the UK, given that the carbon price in the UK is higher than in Europe. However, administrative obligations will still incur some expenses (Environmental Audit Committee of the UK, 2021).

The UK is concerned about carbon leakage, and its current anti-carbon leakage measures are seen as insufficient to incentivise investments in decarbonisation. Therefore, the Environmental Audit Committee proposed a report on April 2022 recommending the UK government develop a comprehensive UK carbon border approach, including a CBAM.

Meanwhile, the risk of carbon leakage is also a big concern in the UK, while its current anti-carbon leakage measures are seen to weaken the incentive for investments in decarbonisation. Therefore, on 4 April 2022, the Environmental Audit Committee published its report recommending the UK government develop a comprehensive UK carbon border approach, including a CBAM (Environmental Audit Committee of the UK, 2022a).

The UK government responded by confirming its commitment to tackling climate change and consulting on implementing a range of options, including a UK CBAM. The response also highlighted the importance of a multilateral solution to regulating emissions and stressed the UK's active engagement with the EU on their CBAM proposal, hoping that the EU would recognise the UK's climate

ambition through its ETS and future carbon price support mechanism (Environmental Audit Committee of the UK, 2022b).

4.6.3. Mixed reactions

Japan

In the 2nd EU-Japan High-Level Economic Dialogue that took place on 25 October 2022 (Ministry of Economy, 2022a), Japan's Minister of Economy, Trade and Industry emphasised the importance of avoiding trade disputes related to the implementation CBAM. He added, in a press conference on 16 December 2022 (Ministry of Economy, 2022b), that Japan will continue holding dialogues with the EU on whether the mechanism is compliant with WTO rules.

Due to the country's low exports of covered goods to the EU (Tanabe, 2022) and its low carbon footprint. (Ministry of Economy, 2022b), Japan may gain when CBAM takes effect, as imports from Japan to the EU may increase (Vorst & Rousseau, 2022). Additionally, Japan's ambitious stance against climate change aligns with the EU's decarbonisation target, which may help it secure a spot on the list of exemptions (Bartlett & Imadegawa, 2021). The EU is said to assess Japan's efforts and compliance with the EU system to determine its eligibility for exemption from CBAM (Tanabe, 2022).

United States

The US's response to CBAM has been mixed showing concerns as well as interest to introduce a CBAM-type mechanism (Luyten, 2021).

The US representatives at the WTO repeatedly expressed concerns about the CBAM potentially violating international trade rules and creating new trade barriers (WTO Committee on Market Access, 2020) (WTO Committee of Trade and Environment, 2021). Currently, since the US has no harmonisation system for carbon pricing at the federal level or an accepted methodology for converting US standards into a total cost of carbon for products, importers of US products will likely be required to purchase CBAM certificates. As a result, they are advised to find alternative means of compliance to meet the EU threshold for CBAM (Benson, Majkut, Reinsch, & Steinberg, 2023).

The US is less likely to be instantly affected by CBAM due to the limited trade volume and the relatively lower carbon intensity of their products (Benson et al., 2023). However, it is noted that the effect of CBAM on exports from the US to the EU would quickly become more significant as the EU plans to expand the scope of targeted products (Luyten, 2021).

Despite the concern over the compliance and complexity of CBAM, the US appears to be keen on collaborating with the EU to push the global decarbonisation efforts and considering the idea of CBAM (Taylor, 2021). US President Biden is said to be especially interested in the mechanism and will assess whether the US could implement it to some extent (Natter, 2021). In an interview with EURACTIV (Simon, 2021), climate envoy Kerry affirmed that President Biden had instructed his team to evaluate the implication of the mechanism, which could become a necessary tool for the US to employ if other countries have insufficient efforts in reducing emissions.

5. WILL VIETNAM'S CLIMATE CHANGE MITIGATION BE DRIVEN BY CBAM?

5.1. Vietnam's GHG emissions profile

Historically, Vietnam has not been a major contributor to climate change. However, the country's rapid economic growth, urbanisation, and industrialisation over the last 30 years has led to rapidly rising GHG emissions. From 2000 to 2019, annual GHG emissions, including land use, land use change and forestry (LULUCF), escalated by 7 times reaching 438.11 million tCO_2e, which accounts for 0.88% of global emissions (see Figure 5-1) (ClimateWatch, 2022). GHG emissions per capita were 4.54 t CO_2 in 2019, about 5.75 times higher than in 2000, although still relatively low compared to the regional and global averages (ClimateWatch, 2022). Vietnam has become one of the most GHG-intensive economies in East and Southeast Asia, measured as emissions per unit of output, and its emissions are higher than those of China, South Korea, Japan, Malaysia, Thailand, and the Philippines (see Figure 5-2) (ClimateWatch, 2022).

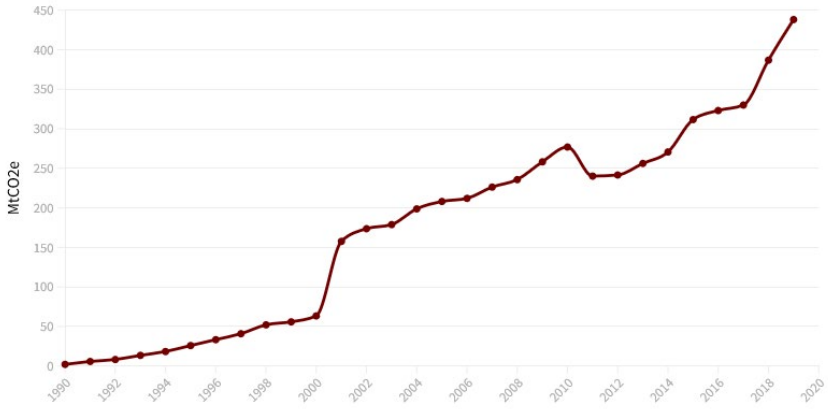


Figure 5-1 Historical GHG emissions in Vietnam (including LULUCF), 1990-2019

Source: https://www.climatewatchdata.org/ghg-emissions

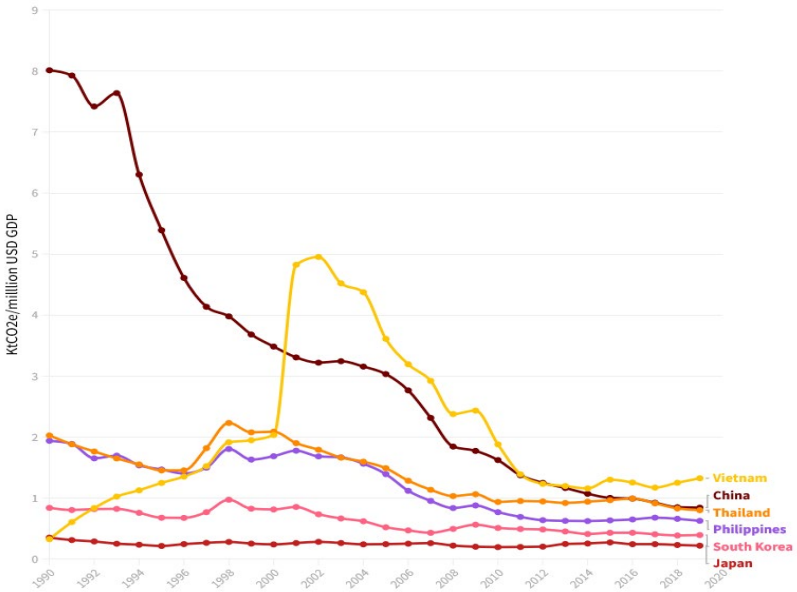


Figure 5-2 GHG emission intensity by countries (including LULUCF), 1990-2019

Source: https://www.climatewatchdata.org/ghg-emissions

When adjusting for trade to obtain consumption-based emissions[2], Vietnam is one of the increasing net exporters of emissions, meaning Vietnam exports more CO_2 embedded in goods than it imports (see Figure 5-3) (OurWorldInData, 2023a).

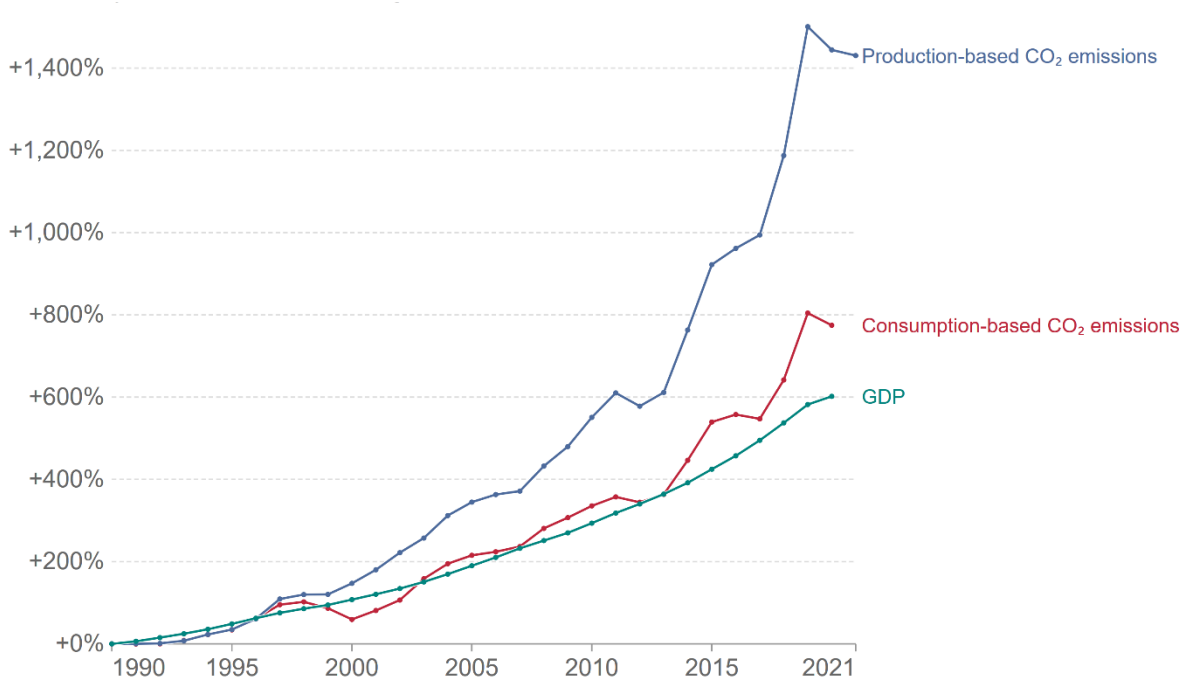


Figure 5-3 Changes in CO_2 emissions and GDP in Vietnam, 1990-2021

Source: Our World in Data based on the Global Carbon Project (2022) available at https://ourworldindata.org/CO_2/country/vietnam

The increasing GHG emissions are mainly attributed to emissions from energy, as the economy is powered by a coal-dependent energy supply. About 65% of GHG emissions in 2019 came from energy, followed by agriculture (16%), industrial processes (14%), and waste (5%) (ClimateWatch, 2022).

5.2. Vietnam's highly emissions intensive energy sector

The energy sector in Vietnam is characterised by high level of energy intensity, carbon intensity and coal dependence. Firstly, the Total Primary Energy Supply (TPES) per capita of Vietnam in 2019 (979 kilogram of oil equivalent (kgOE)) was relatively lower than that of many other countries and regions, including the ASEAN average of 1053 kgOE. However, the intensity of TPES per GDP (376 kgOE/1,000 USD) more than double the world average and was higher than that of many other East and South East Asian countries in 2019 (see Figure 5-4) (VNEEP, 2020).

[2] Consumption-based emissions are national emissions that have been adjusted for trade. It's production-based emissions minus emissions embedded in exports, plus emissions embedded in imports.

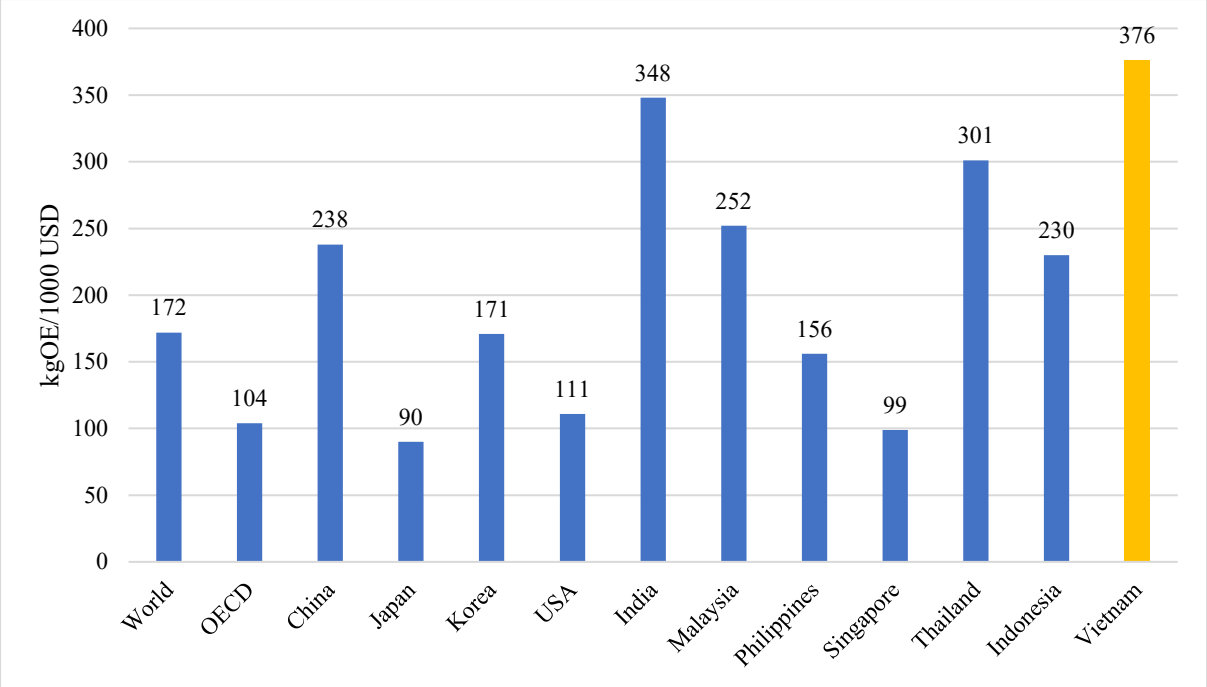


Figure 5-4 TPES per GDP by countries, 2019

Source: VNEEP (2020)

Secondly, emissions from fuel combustion alone were 273.4 $MtCO_2$ in 2020 (VNEEP, 2020). By sector, electricity and heat generation accounted for half the CO_2 emissions, while industry was the second largest sector for CO_2 emissions (29%), followed by transport (16%) in 2019 (see Figure 5-5) (Climate Transparency, 2020). By fossil fuel, coal made up 60.3% of emissions, followed by oil at 18.59%, and gas including flaring at 4.5%. Cement production is one of the industries that contribute largely to emissions (16.6%) in 2021 (see Figure 5-6) (OurWorldInData, 2023a).

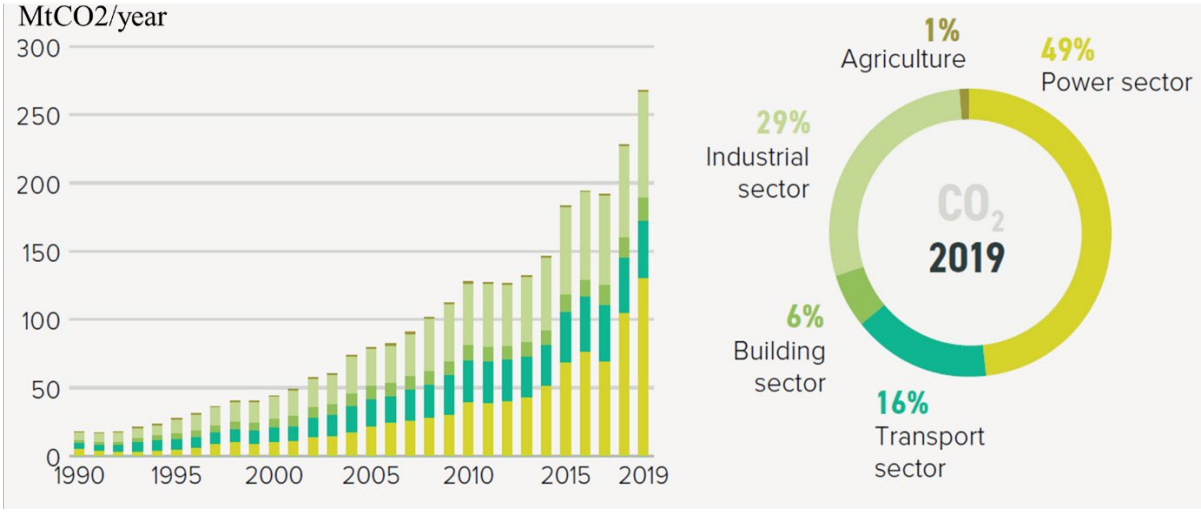


Figure 5-5 Annual CO_2 emissions from fuel combustion in Vietnam, 1990-2019

Source: Climate Transparency (2020)

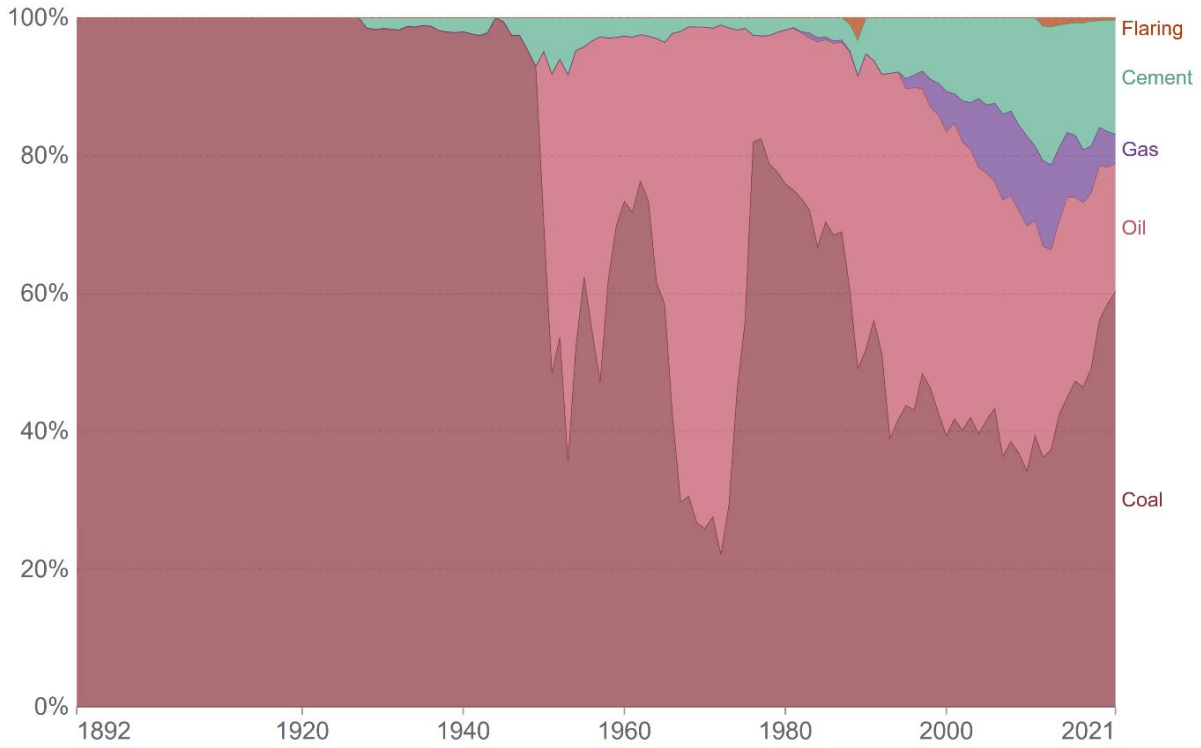


Figure 5-6 Share of CO_2 emissions by fuel or industry type in Vietnam, 1982-2021

Source: Our World in Data based on the Global Carbon Project (2022) available at https://ourworldindata.org/CO_2/country/vietnam

The emissions from energy per capita in Vietnam increased considerably from 1.,7 t CO_2/person in 2015 to 2.8 t CO_2/person in 2020 (VNEEP, 2020). Carbon intensity, measured as the amount of CO_2 emitted from fuel combustion per unit of GDP, increased from 1.02 kg CO_2/USD to 1.32 kg CO_2/USD between 2015 and 2020 (VNEEP, 2020). If measured as the amount of CO_2 emitted per unit of energy, the carbon intensity was 0.27 kg CO_2/kWh (OurWorldInData, 2023a). With either measurement, Vietnam's figures have surpassed those of many countries in East and Southeast Asia, including China, Thailand, Indonesia, the Philippines, Malaysia, Singapore, Japan, and South Korea (see Figure 5-7).

Thirdly, Vietnam has become a net energy importer since 2015 and more reliant on fossil fuels, especially coal. On the supply side, the ratio of net energy import/TPES increased rapidly from 8.4% in 2015 to 48% in 2020. Approximately 57% of the imports in 2020 were coal. From 2016 to 2020, coal's growth rate in terms of TPES was relatively high (17.1% per year) (VNEEP, 2020). Coal shifted from the third-largest fuel source in 2007 to the largest primary source in 2022 and has rapidly expanded its share (EREA&DEA, 2022). In 2015, coal accounted for 35.9% of TPES, and then rose to 52.0% in 2020. Oil was the second largest source (24.4%), followed by natural gas (8.2%). Despite considerable developments in renewable power such as solar and wind, which had a growth rate of 0.8% per year in TPES during the 2016-2020 period, the share of renewable energies in TPES declined from 22.4% in 2015 to 15.3% in 2020 (VNEEP, 2020). The Herfindahl-Hirschman Index (HHI), which reflects the diversity of energy sources of TPES (Rubio-Varas & Muñoz-Delgado, 2019), rose rapidly from 2,773 in 2015 to 3,597 in 2020, indicating an increasing concentration tendency. This raises concerns about increasing dominance of coal in TPES (see Figure 5-8).

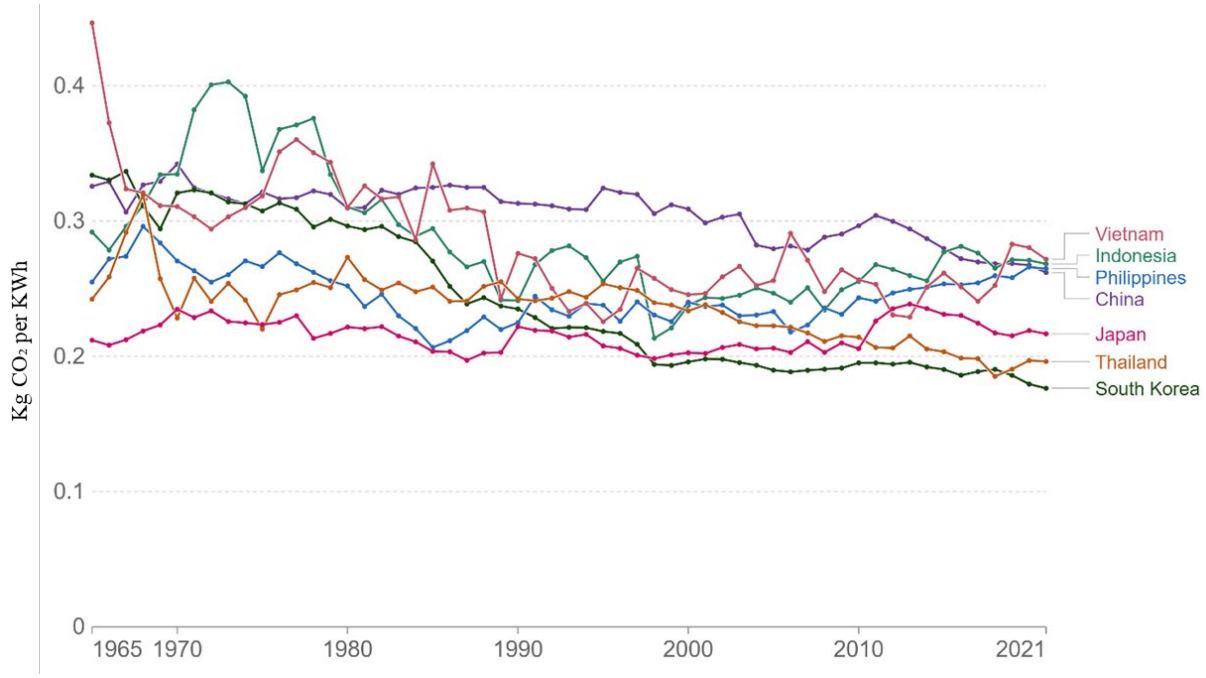


Figure 5-7 Carbon intensity of energy production by countries

Source: Our World in Data based on the Global Carbon Project (2022) available at https://ourworldindata.org/

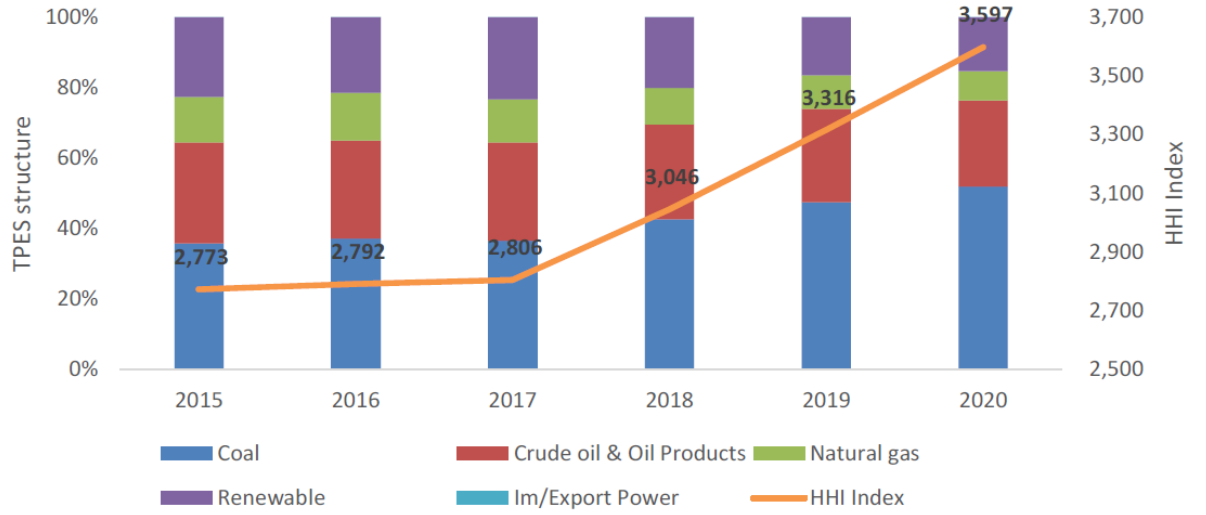


Figure 5-8 Structure and diversification level of TPES in Vietnam, 2015-2020

Source: VNEEP (2020)

On the consumption side, the industry sector has been the main energy consumer, expanding its share from 47.5% in 2019 to 53.1% in 2020. Other sectors were shrinking, especially residential energy use (VNEEP, 2020). The consumption of coal grew considerably, making up nearly 50% of total final energy consumption (OurWorldInData, 2023b). 63% was used for power generation and 35% for other industrial sectors (VNEEP, 2020) (Figure 5-9 and Figure 5-10).

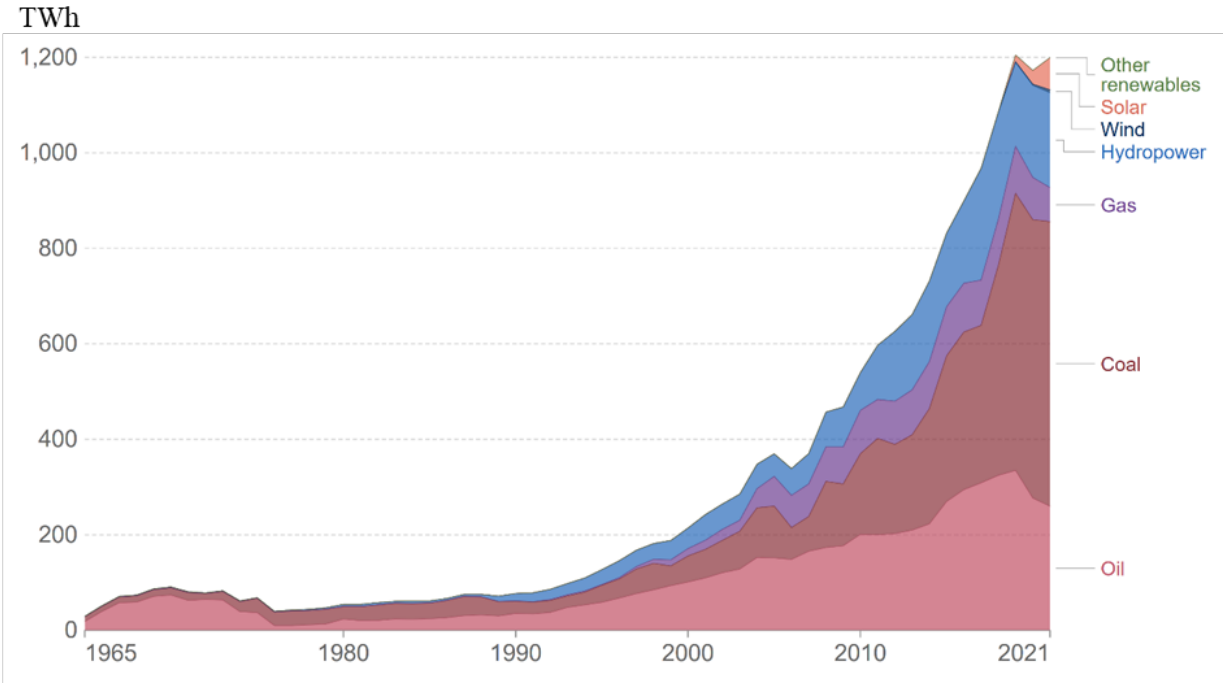


Figure 5-9 Primary energy consumption by source in Vietnam, 1965-2021

Source: Our World in Data based on the Global Carbon Project (2022) available at https://ourworldindata.org/energy/country/vietnam

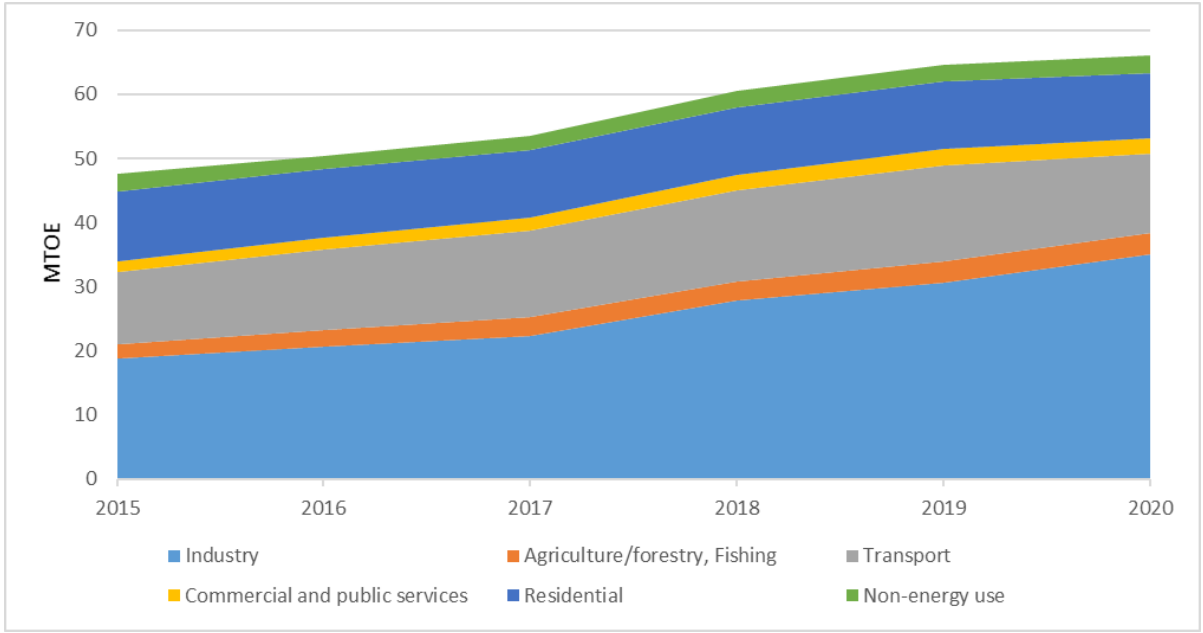


Figure 5-10 Final energy consumption by sector in Vietnam, 2015-2020

Source: VNEEP (2020)

5.3. Vietnam's climate and energy policy

Vietnam has expressed its ambition to become a high-income economy by 2045 and achieve net-zero emissions by 2050. The country ratified the Paris Agreement of the United Nations Framework Convention on Climate Change (Paris Agreement) in 2016 and regularly submits its updated nationally

determined contributions (NDC). It has introduced a number of strategies, policies and programs to address climate change (see **Table 5-1**).

Table 5-1 Some selected climate change policy and energy documents in Vietnam

No	Document	Issuing authority	Focal authority
National climate change documents			
1	National Climate Change Strategy to 2050 (2022)	Government	MONRE
2	Methane Emission Reduction Action Plan to 2030 (2022)	Government	MONRE
3	National Green Growth Action Plan 2021-2030 with a vision to 2050 (2022)	Government	MPI
4	NDC updated 2022	Government	MONRE
5	National Green Growth Strategy 2021-2030 with a vision to 2050 (2021) (VGGS)	Government	MPI
6	National plan to adapt to climate change for the period 2021-2030 with a vision to 2050 (2020)	Government	MONRE
7	Law on Environmental Protection (2020)	Parliament	MONRE
8	National Action Program on Sustainable Production and Consumption for the period 2021-2030 (2020)	Government	MOIT
9	Law on Forestry (2017)	Parliament	MARD
10	Plan for the Implementation of the Paris Agreement on Climate Change (2016)	Government	MONRE
11	Resolution No 24-NQ/TW on proactive response to climate change, enhanced resources management and environmental protection (2013)	Politburo	MONRE
12	Law on Natural Disaster Prevention and Control (2013)	Parliament	MARD
Energy sector			
1	Draft National Power Development Master Plan for the 2021 – 2030 period with a vision to 2045 (PDP VIII) (to be approved in 2023)	Government	MOT
2	Action Plan to respond to Climate Change and Green Growth of the Industry and Trade sector up to 2030 with a vision to 2050 (2022)	MOIT	MOIT
3	Action Program on Green Energy Transition and Reduction of Carbon and Methane Emissions of the Transportation Sector (2022)	MOT	MOT
4	Resolution No 55-NQ/TW on orientation of Vietnam's national energy development strategy to 2030, with a vision to 2045 (2020) (VEDS)	Politburo	MOIT
5	Action Plan to implement Resolution No 55-NQ/TW on orientation of Vietnam's national energy development strategy to 2030, with a vision to 2045 (2020) (VEDS AP)	Government	MOIT
6	Regulations on Incentive Mechanism for Solar Power Development in Vietnam (2020)	Government	MOIT
7	National Program on Economical and Efficient Use of Energy in the period of 2019-2030 (2019)	Government	MOIT
8	Master Plan on Development of Vietnam's Gas Industry to 2025, orientation to 2035 (2017)	Government	MOIT

No	Document	Issuing authority	Focal authority
9	National Power Development Master Plan for the 2011-2020 Period with the Vision to 2030 (PDP VII) (2011) and its revision in 2016	Government	MOIT
10	Renewable Energy Development Strategy 2016-2030 with vision to 2050 (2015)	Government	MOIT
11	Law on Economical and Efficient Use of Energy (2011)	Parliament	MOIT
Other sectors			
1	The Ministry of Foreign Affairs' Climate Diplomacy Action Plan aiming to implement Vietnam's commitments at COP26 in the period 2022-2025 (2022)	MOFA	MOFA
2	Action Plan of Construction sector in Climate Change Response for the period 2022-2030, with vision to 2050 in order to implement Vietnam's commitments at COP26 (2022)	MOC	MOC
3	Action Plan of Ministry of Industry and Trade to implement Vietnam's commitments at COP26 (2022)	MOIT	MOIT
4	Vietnam's Forestry Development Strategy for the period 2021-2030 (2021)	Government	MARD
5	Environmental Protection Plan for Industry and Trade in the period of 2025-2030 (2020)	MOIT	MOIT
6	Scheme on Sustainable Forest Management and Forest Certification (2018)	MARD	MARD
7	Scheme on Development of Organic Agriculture in the period of 2020 - 2030 (2018)	MARD	MARD
8	Vietnam's Transportation Development Strategy to 2020, with a vision to 2030 (2013)	Government	MOT

Source: Consolidated by the authors

- **National mitigation targets**

Vietnam set more ambitious mitigation targets in the latest NDC 2022 compared to NDC 2020. The country aims to achieve a net zero target by 2050 and implement the methane emission reduction action plan. The emission reduction target increases from 9% to 15.8% with unconditional contribution and from 27% to 43.5% with conditional contribution against the total GHG emissions relative to business-as-usual scenarios (see Table 5-2) (NDC, 2022). At the same time, the VGGS uses different indicators to set targets for 2030 and 2050. Accordingly, the intensity of GHG emissions as a percentage of GDP is aimed to decrease by at least 15% by 2030 and at least 30% by 2050 compared to 2014 (Government of Vietnam, 2021). Additionally, Vietnam aims to reduce at least 30% of total methane emissions by 2030 compared to 2020 levels in farming, animal husbandry, solid waste management, wastewater treatment, oil and gas extraction, coal mining and fossil fuel consumption (Government of Vietnam, 2022).

Table 5-2 Comparison of emission reduction targets by 2030 in NDC 2020 and NDC 2022

Sector	Unconditional contribution				Conditional contribution			
	NDC 2020		NDC 2022		NDC 2020		NDC 2022	
	%	Mt CO_2e	%	Mt CO_2e	%	$MtCO_2e$	%	$MtCO_2e$
Energy	5.5	51.5	7.0	64.8	16.7	155.8	24.4	227.0
Agriculture	0.7	6.8	1.3	12.4	3.5	32.6	5.5	50.9
LULUCF*	1.0	9.3	3.5	32.5	2.3	21.2	5.0	46.6

Sector	Unconditional contribution				Conditional contribution			
Waste	1.0	9.1	1.0	8.7	3.6	33.1	3.2	29.4
IP	0.8	7.2	3.0	27.9	0.9	8.0	5.4	49.8
Total	9.0	83.9	15.8	146.3	27.0	250.8	43.5	403.7

Source: NDC (2022)

Notes to Table 5-2: * Increasing GHG removal

- **Low-carbon energy transition and policies**

The low-carbon energy transition is identified as the priority mitigation strategy in Vietnam. For energy sector, the NDC 2022 stated 15 options with mitigation potential of 64.8 $MtCO_2$ with unconditional contribution and 227 $MtCO_2$ with conditional contribution by 2030, including (NDC, 2022):

- Energy usage: Use of high-efficiency air conditioning and refrigeration equipment in commercial and residential services; use of energy-saving lighting; use of solar water heaters; use of biogas and cleaner fuel instead of coal for household cooking in rural areas; use of measures to improve energy efficiency in industries; use of high-performance electrical equipment, high efficiency refrigeration equipment in services, commerce and trade; improvement, development and application of technology in the production of building materials; efficient use of energy in transportation; limitation of fuel consumption for motor vehicles; conversion of modes of transportation of passengers and goods; increase of the load factor of cars; use of CNG and biofuels; use of electric motorbikes, cars, and buses.
- Energy supply: Development of renewable energy such as small hydroelectricity, wind energy, solar energy; development of biomass thermal power, incineration and landfill waste power, and biogas power; use of combined gas turbine technology using LNG; development of supercritical thermoelectric technologies.

With these solution packages, it is expected that the energy sector will move towards more efficient, and less fossil-fuel dependent pathway as presented in **Table 5-3**.

Table 5-3 Transition pathway of energy sector in Vietnam

Target	2030	2045	2050	Document
Primary energy consumption per average GDP in every 10 years	A reduction of 1.0 – 1.5%/year		A reduction of 1.0%/year	VGGS (Government of Vietnam, 2021)
Share of renewable energy in the TPES (including hydro energy)	15 – 20%	25-30%	25 – 30%	VGGS (Government of Vietnam, 2021) and VEDS (Government of Vietnam, 2020; Politburo, 2020)
TPES	175-195 million tonnes of oil equivalent (TOE)	320-350 million TOE		VEDS (Government of Vietnam, 2020; Politburo, 2020)
Total capacity of all power sources	125-130GW			
Electricity output	550-600 billion kWh			

Target	2030	2045	2050	Document
TFEC	105-115 million TOE	160-190 million TOE		
Primary energy consumption intensity	420-460 kgOE/1,000 USD GDP	375-410 kgOE/1,000 USD GDP		
The ratio of energy savings to TFEC	7% against BAU	14% against BAU		
GHG missions from energy activities	A reduction of 15% against BAU	A reduction of 20% against BAU		
	A reduction of 7% (with unconditional contribution) and 24.4% (with conditional contribution) (against base year 2014)			NDC 2022 (NDC, 2022)

Source: Consolidated by the authors

Additionally, in the power generation sector particularly, the Draft PDP VIII has been submitted by MOIT for the sixth time to the Prime Minister for approval to establish a new foundation for a low-carbon energy transition. Some significant highlights focus on the composition of electricity sources and the phasing out of coal-fired power by 2030 (see Table 5-4).

Table 5-4 Proposed new transition pathway of power plants' installed capacity, Vietnam

Power source	2020*	2030	2050	Note
Hydropower (including small hydropower)	33.5%	19.8 – 22.5%	7.2 – 9.7%	
Pumped-storage hydroelectricity and storage batteries		1.2-1.8%	6.3-8.5%	
Coal-fired power	35.5%	20.3 – 29.8%	0%	- No new coal-fired power plants after 2030 - Stop of coal-fired power plants exceeding the technical lifetime (about 40 years) and conversion to biomass and ammonia before 2050 - Removal of the use of coal-fired power to produce electricity for the national electricity grid by 2050.

Power source	2020*	2030	2050	Note
Natural gas thermal power and LNG	11.9%	24.9 – 27%	- Natural gas thermal power: 1.6-2.1% - Complete conversion from gas to hydro: 1.4-1.9% - LNG with hydro: 1.5-3.7% - Complete conversion from LNG to hydro: 4.2-4.9% - Thermal power using biomass/ ammoniac: 5.1-7.8%	- No new natural gas power project after 2030. - Gradual transition to using Hydrogen. By 2050, most natural gas and LNG power plants would use hydrogen.
Renewable energy other than hydropower (wind power, solar power, biomass power, etc.)	15.6%	18 – 27%	54.9 – 58.9%	
Flexible source		0.2-0.3%	6.6-8.7%	
Imported electricity	1.25%	3.4%	2.2 – 3%	

Source: Draft PDP VIII (MOIT, 2022), *VNEEP (2020)

In addition to current policy and strategies, the Vietnam Energy Outlook Report is prepared every two years by the Electricity and Renewable Energy Authority under the Ministry of Industry and Trade together with the Danish Energy Agency. It suggests the transition of the energy and power sector to reach the net-zero target by 2050 at least costs. Accordingly, renewable electricity should be the main substitute for fossil fuels, either directly or indirectly through production of electro-fuels (see Table 5-5) (EREA&DEA, 2022).

Table 5-5 Energy and power transition pathway to net-zero emissions by 2050 in Vietnam

Power source	2050
Share of renewable energy in TPES	2030: 25%, 2040: 55%, 2050: 90%
Share of renewable energy-based electricity in TFEC	70%
Share of TFEC including aviation and shipping indirectly electrified by using liquid or gaseous fuels produced from renewable electricity (e-fuels)	8%
Power generation capacity including storage	2,200 GW
Share in electricity capacity and storage	
Storage	47%
Solar	43%
Wind	7%
The primary sources of renewable energy-based power production	Solar: 75%, Wind: 21%
Carbon budget	11.2 bn t CO_2 (2020-2050 period)
Emissions peak	no later than in 2035

Source: EREA&DEA (2022)

5.4. Vietnam's profile of CBAM-covered export products

5.4.1. Vietnam's production of CBAM commodities and their role in the economy

Although Vietnam does not have a very high comparative advantage in iron and steel, cement, aluminium, and fertilisers, these sectors play a critical role in the country's socio-economic development. Iron and steel, cement, aluminium are essential input materials for construction and production industries such as manufacturing, information technology, electronics, chemicals, and high-tech industries. They have contributed significantly to the industrialisation and urbanisation process. Fertilisers are also crucial inputs for agricultural production and have greatly contributed to intensive farming development, ensuring national food security. In recent years, the production of CBAM products in Vietnam has increased consistently to satisfy domestic demand and exports (see Figure 5-11).

5.4.2. Vietnam's position in global flows of CBAM commodities

Vietnam is not a big player in the global markets of CBAM commodities, except for cement. In 2022, Vietnam ranked 3rd in terms of cement production capacity (after China and India) (Statista, 2023a); 1st in Southeast Asia and 13th place in the world in terms of steel production (Worldsteel Assocation, 2023). Vietnam exported 58% of its iron and steel production, 27% of aluminium, 36% of cement, and 14% of fertilisers in 2021. However, except for cement, the country imported more than exported because these sectors either rely on imported input materials or must import other products that Vietnam cannot produce (see Figure 5-11). As a result, Vietnam often experienced trade deficits in the iron and steel, aluminium, and fertilisers sectors.

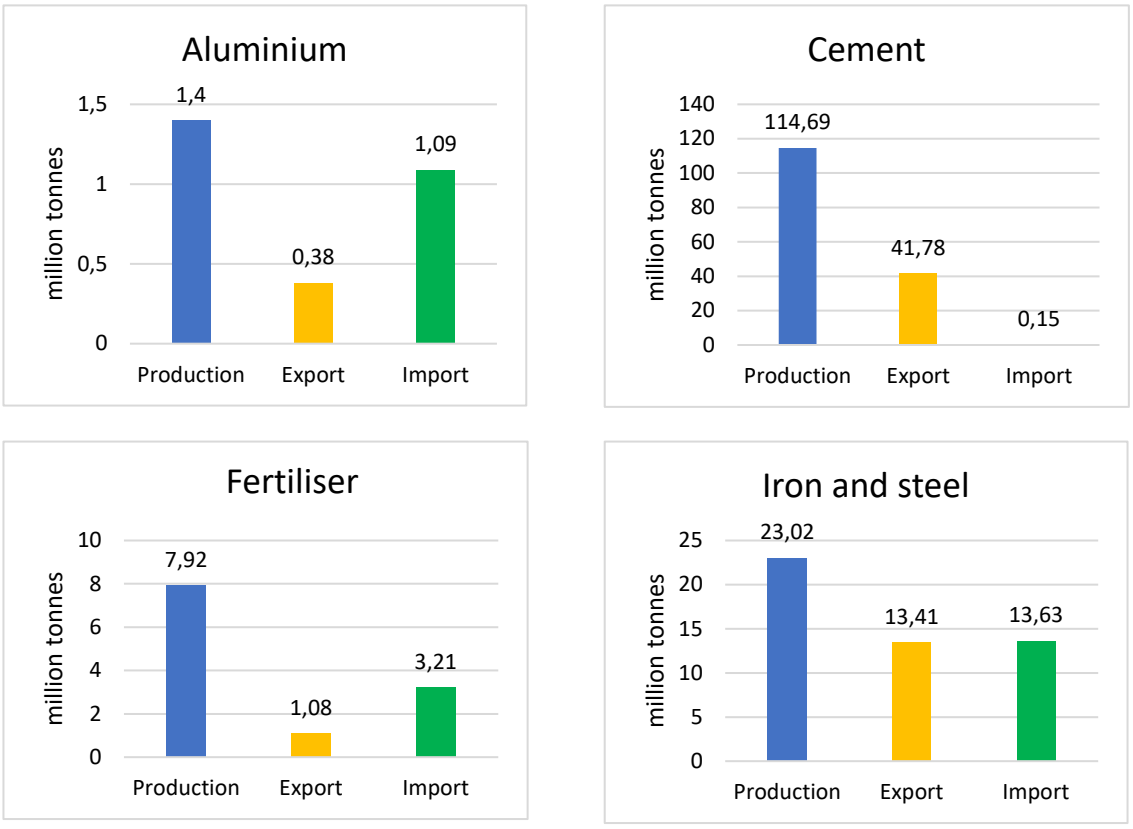


Figure 5-11 Production, imports and exports of Vietnam's CBAM products, 2021

Source: FAO (2023), GSO (2022), Statista (2023b), UNCOMTRADE (2023); Worldsteel Assocation (2023)

Vietnam contributed 18.8% of the global cement exports in value terms in 2021. However, the figures for iron and steel were only 2.5%, and for aluminium and fertilisers, it was less than 1%. In terms of EU market, Vietnam made up a modest share of 5.1% (or 2971 million USD) for iron and steel, 4.7% (or 21 million USD) for cement, and 0.6% (or 138.6 million USD) for aluminium. Vietnam did not export fertilisers to the EU in 2021 (UNCOMTRADE, 2023) (see Figure 5-12).

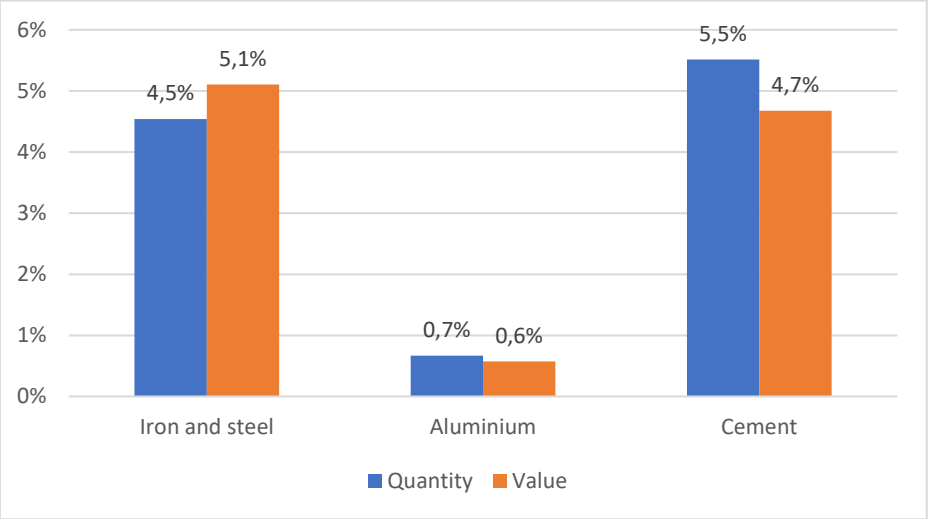


Figure 5-12 Share of Vietnam's CBAM products to EU market, 2021

Source: UNCOMTRADE (2023)

5.4.3. Energy intensity of CBAM export products

All of Vietnam's CBAM export products are energy intensive. The energy intensity of aluminium is the highest (78,83 GJ/tonne) (Springer, 2018), followed by those of iron and steel integrated steel plants (ISP) (29.5 GJ/tonne), fertilisers (28.7 GJ/tonne), and cement (3.04 GJ/tonne) (ADB, 2017) (see Figure 5-13). Except for fertilisers, the intensity of other products is higher than global benchmark (ADB, 2017; Springer, 2018).

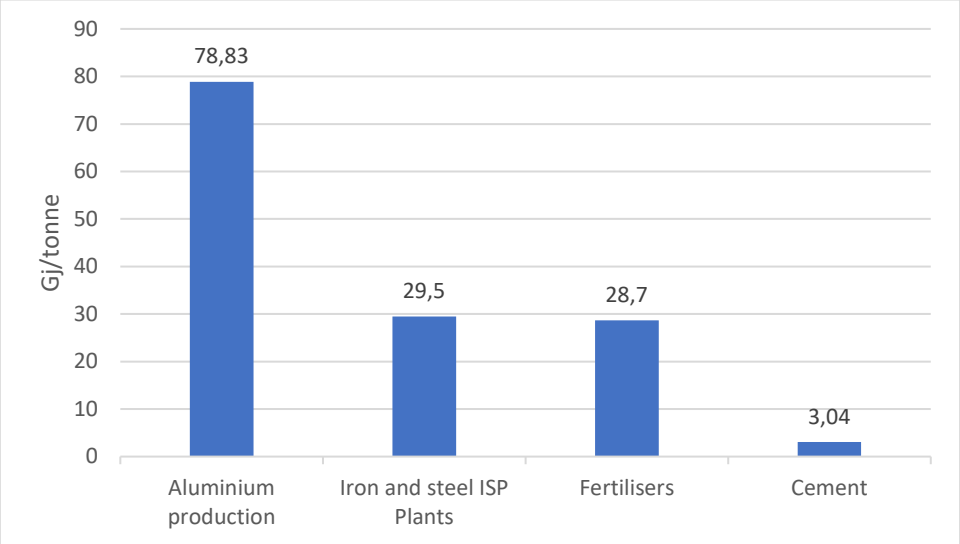


Figure 5-13 Energy Intensity of Vietnam's CBAM products

Source: Ernst & Young estimates cited in ADB (2017), and Springer (2018)

5.4.4. Carbon intensity of CBAM export products

Vietnam's CBAM products are highly carbon intensive compared to the EU and some developing countries, especially when indirect emissions[3] are taken into account. According to ERCST/WB (2021), the carbon intensity of Vietnam's steel is higher than that of Europe and Thailand. Similarly, that of aluminium is higher than the EU, Thailand and India, and that of cement is higher than the EU and India (see Figure 5-14, Figure 5-15, and Figure 5-16). To provide more updated inputs for the assessment in this report, we used data reported from our enterprise surveys for quantitative impact evaluation (see section 7 and Table 7-2).

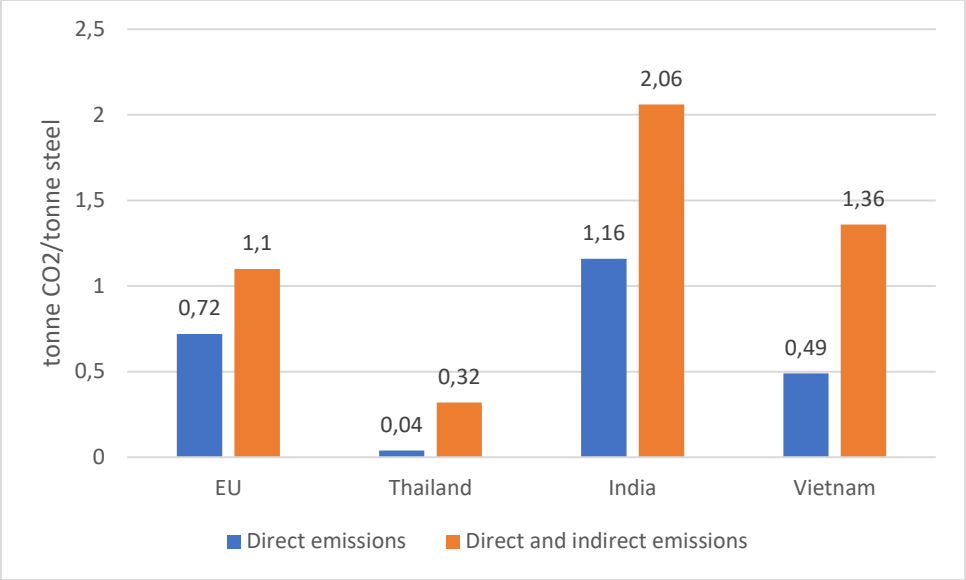


Figure 5-14 Carbon intensity of steel

Source: ERCST/WB (2021)

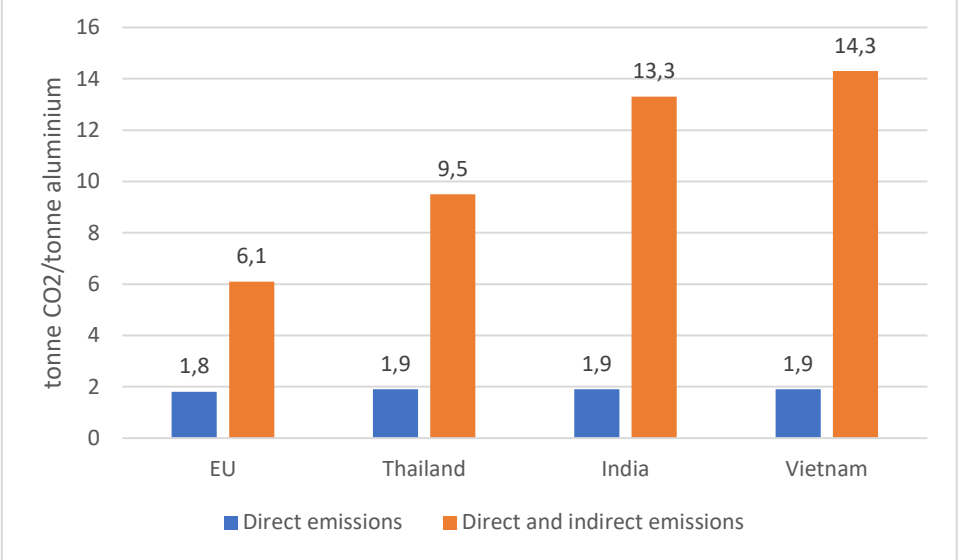


Figure 5-15 Carbon intensity of aluminium

Source: ERCST/WB (2021)

[3] Direct emissions occur from sources that are controlled or owned by an organisation (Scope 1). Indirect emissions are associated with the purchase of electricity, steam, heat, or cooling (Scope 2). (https://www.epa.gov/climateleadership/scope-1-and-scope-2-inventory-guidance)

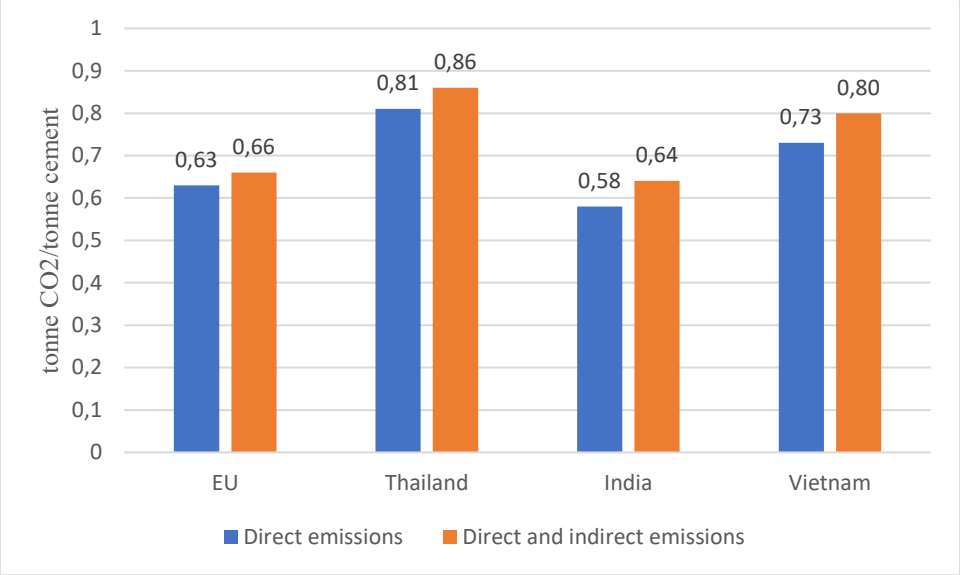


Figure 5-16 Carbon intensity of cement

Source: ERCST/WB (2021)

5.4.5. Vietnam's taxes on coal, oil, gas, electricity and CBAM products

Coal, oil, gas and electricity and CBAM products are subject to several taxes in Vietnam including Import/Export Tax (IMT/EXT)[4], Special Consumption Tax (SCT)[5], Value-Added Tax (VAT)[6], Natural Resources Tax (NRT)[7], and Environment Protection Tax (EPT)[8] (see Table 5-6 and Table 5-7). Among these taxes, the NRT and EPT are indirect taxes aimed at protecting natural resources and the environment. The NRT is imposed on coal, oil, gas, water for hydropower, cement, iron and steel, and aluminium, whereas the EPT is only levied on coal and oil. Coal is taxed at the highest level of EPT per ton of product (15,000 – 30,000 VND/tonne or 0.64-1.28 USD/tonne). The NRT is levied at a rate of 10% and more for all the products studied. Vietnam has not yet imposed any form of carbon tax on CBAM export products and fossil fuels. Although the NRT and EPT may have indirect effects on GHG emission mitigation, they are unlikely to be accounted for in the CBAM, as they are not direct taxes on carbon emissions. Even if the EPT is accounted for a carbon tax, the implicit carbon tax on coal, which Vietnam's energy sector largely depends on, is less than one USD, much lower than oil and significantly different from the carbon tax of the EU (see Table **5-8**). Additionally, Vietnam is only in the early preparation stage for an ETS. The ETS is going to be piloted from 2025 and officially operated from 2028, two years later than the pilot and official implementation timeline of CBAM. This gap between Vietnam's tax system and the EU's requirements could lead to a high level of CBAM payment being imposed on Vietnam's products when CBAM comes

[4] Import duty is a tax imposed by a government on specific commodity types imported from other countries. Export duty is a tax imposed by a government on specific commodity types exported to other countries. It is commonly expressed as a percentage of the product value.

[5] Special Consumption Tax is applied to a range of luxury goods and non-essential items. The tax rate is commonly expressed as a percentage of the sale price and collected once.

[6] Value-added tax is a type of indirect consumption tax assessed on the value added in each production stage of a good or service. It is commonly expressed as a percentage of the total cost.

[7] Natural Resources Tax collected from individuals and organisations when exploiting natural resources. It is expressed as a percentage of resource value.

[8] Environment Protection Tax collected on products and goods when used, causing adverse impacts on the environment. It is expressed as an amount per resource quantity unit.

into effect. Given that the average EU allowance price in 2022 was 85.2 EUR/tonne of CO_2e (Bray, 2022) and the carbon intensity of Vietnam's CBAM products is relatively high (especially in the case of taking into account both direct and indirect emission), Vietnam may lose its competitiveness in EU market.

Table 5-6 Taxes on coal, oil, gas, and electricity in Vietnam, 2022

Product		EPT		NRT	VAT	SCT	IMT*	EXT*
		VND	USD**					
Coal (per tonne)					10%		2-3% (0%)	10% (10%)
Lignite		15,000	0.64	12%				
Anthracite		30,000	1.28	10-12%				
Bituminous		15,000	0.64	12%				
Other coal		15,000	0.64	10%				
Oil (per litre)					10%			
Petrol (except ethanol)	2023	2,000	0.09					
	>2023	4,000	0.17			7-10%	10-30% (20%)	0% (0%)
Jet fuel	2023	1,000	0.04					
	>2023	3,000	0.13					
Diesel	2023	1,000	0.04					
	>2023	2,000	0.09					
Kerosene	2023	600	0.03					
	>2023	1,000	0.04					
Mazut	2023	1,000	0.04					
	>2023	2,000	0.09					
Lubricant	2023	1,000	0.04					
	>2023	2,000	0.09					
Grease	2023	1,000	0.04					
	>2023	2,000	0.09					
Crude oil							0% (0%)	10% (10%)
Exploited quantity:								
To 20000 barrels/day				7-10%				
From over 20000 to 50000 barrels/day				9-12%				
From over 50000 to 75000 barrels/day				11-14%				
From over 75000 to 100000 barrels/day				13-19%				
From over 100000 to 150000 barrels/day				18-24%				
Over 150000 barrels/day								
Natural gas					10%		LPG 5-7.5% (2.5%)	0%
Exploited quantity:								
To 5 million m3/day				1-2%				

Product	EPT		NRT	VAT	SCT	IMT*	EXT*
	VND	USD**					
From 5 to 10 million m3/day			3-5%				
Over 10 million m3/day			6-10%				
Electricity				10%		1-1.5% (0%)	0%
Natural water for hydropower			5%				

Notes to Table 5-6: * Number in brackets applied in EVFTA; ** Exchange rate VND/USD = 23,412 (average of 2022)

Source: Consolidated by the authors from Parliament of Vietnam (2015), Parliament of Vietnam (2018), Parliament of Vietnam (2022), Hon Gai Custom Branch (2023).

Table 5-7 Taxes on Vietnam's CBAM products, 2022

CBAM products	NRT	VAT	IMT*	EXT*
Iron and Steel	14%	10%		
Iron ore			0-5% (0%)	40% (26.6%)
Iron and steel scraps			0-5% (0%)	15-17% (15-17%)
Iron and steel materials			(0-22.5%) (0%)	-
Other products made of iron and steel			Varies	
Cement	10% (lime stone for cement production)	10%		
Cement clinker			25-37.5% (15.9%)	10%
Portland cement			32-48% (22.2%)	10%
Aluminium	12%	10%		
Aluminium ore			0-5% (0%)	30/20% (30/20%)
Unprocessed aluminium			3-4.5% (0%)	5% (15/0%)
Aluminium scraps			0-5% (0%)	20-22% (0/22%)
Aluminium materials			0-15% (0-5%)	10% (10%)
Other products made of aluminium			Varies	
Fertilisers		10%	0-9% (-0-3%)	0%

Notes to Table 5-7: * Number in brackets applied in EVFTA

Source: Consolidated by the authors from Parliament of Vietnam (2015), Parliament of Vietnam (2018), Parliament of Vietnam (2022), Hon Gai Custom Branch (2023)

Table 5-8 Environmental tax on tonne of CO2 of coal and oil in Vietnam, 2022

Fuel	Unit	Environmental tax (USD)	CO_2 emission factor	Environmental tax on tonne of CO_2 (USD/tCO_2)
Coal				
Lignite	tonne	0.64	1.41	0.46
Anthracite	tonne	1.28	2.86	0.45
Bituminous	tonne	0.64	2.47	0.26
Other coal	tonne	0.64	1.94	0.33
Oil				
Petrol	litre	0.17	0.0039	43.41
Jet fuel	litre	0.13	0.0026	49.74
Diesel	litre	0.09	0.0027	31.75
Kerosene	litre	0.04	0.0026	16.36
Lubricant	litre	0.09	0.0028	30.22

Source: Calculated by the authors

6. DATA SOURCES, MODELS, AND EVALUATION SCENARIOS

This section describes the materials and method for our quantitative analysis. For brevity, we use the term 'CBAM-target sectors', 'CBAM-target commodities', or 'CBAM-target products' to refer to Vietnam's exports subject to CBAM. The assessment of economic impacts covers only the affected commodities in the European Commission's latest proposal as of February 2023. The customs (HS) codes of these commodities are provided in Appendix 1. As a summary, there are six broad categories of commodities with a specific HS code: (i) iron and steel, (ii) aluminium, (iii) cement, (iv) fertiliser, (v) electricity, and (vi) hydrogen. Among these categories, electricity and hydrogen are not directly impacted, because Vietnam does not export electricity to EU and the export of hydrogen to EU is negligible – if any (the UNCOMTRADE database records that the EU imported 1000 USD of hydrogen from Vietnam in 2021 and zero in other years while there are no formal statistics about Vietnam's production of hydrogen). As a result, our CBAM-target sectors include iron and steel (steel), aluminium, fertiliser, and cement.

6.1. Data sources, challenges, and solutions

We combine various data sources for the quantitative analysis. We developed an enterprise questionnaire to collect primary data from firms currently operating in the CBAM-target sectors. This questionnaire focuses on firms' consumption of energy inputs, which is indispensable for CBAM impact evaluation, but not likely published elsewhere. We also used secondary data from official sources. For example, we obtained import and export trade data of the CBAM-target products from national statistics agencies, such as GSO and MOIT's Centre of Industrial and Trade Information. We were assisted by data experts from CIEM, GSO, and universities for an updated Input-Output table of Vietnam. Additionally, we used trade data from the UNCOMTRADE database, GHG emissions data from the International Energy Agency, and the macroeconomic indicators from the WDI database of the World Bank for our analysis.

There are significant challenges in our primary data collection process. These challenges required additional resources to undertake the impact evaluation, but they provide useful insights for sector analysis and direct evidence for our policy recommendations, which will be discussed in sections 11. For example, we had very low response rates in relation to energy-input consumption from all the CBAM-target sectors, with zero responses from aluminium producers as of the closing date of the data survey. This challenge required us to customise quantitative frameworks to fit with the available data (data-driven modelling) and implement a large number of evaluation rounds, each with different sets of parameter values, to construct the confidence intervals of estimated impacts. We summarise the challenges in the data collection process and how we responded to them in Table 6-1.

Table 6-1 Challenges in data availability and quality

Challenges	Solutions
Surveyed enterprises did not provide information	Extracting as much information as possible from existing data, using information for published literature (with citing sources for replicability and transparency), customising economic models to best fit with available data (data-driven modelling)
Some data is outdated, and many inconsistencies and incompatibilities	Updating data, cross-checking, customizing models (data-driven)
Uncertainties in CBAM implementation and possible responses from other countries	Survey and consultation with stakeholders, literature review

Challenges	Solutions
Inadequate data to estimate indispensable hyperparameters for modelling (e.g., price elasticity	Literature review, elicitation; using a large number of parameters randomised from conservative value ranges to construct confidence intervals rather than producing a single estimate of impacts

6.2. Modelling approaches

From an economic point of view, the CBAM is an additional tax applied to products imported into the EU. Therefore, evaluating the impact of CBAM follows standard economic approaches for assessing the impacts of taxes. However, as CBAM represents an unprecedented movement towards equalizing the cost of carbon emissions between the EU and non-EU countries, there are numerous uncertainties regarding its practical implementation and responses from related countries. We will use two quantitative economic frameworks, each with strengths and weaknesses, namely partial equilibrium modelling and general equilibrium modelling, for this assessment to provide robust insights into the research questions.

6.2.1. Partial equilibrium framework for sector impact evaluation

Partial equilibrium modelling focuses on a single product/market or a small group of products/markets. This modelling approach provides a tool for analysing possible CBAM impacts and responses on domestic production, export and import (in the case of two-way trade of a product), and the domestic market (via the substitution of domestic and international markets from producers' point of view and the possible substitution of domestic and imported products from the consumers' point of view). Partial equilibrium modelling can be implemented at a disaggregated level, which enables decision-makers to focus on a product or a small group of products. Furthermore, partial equilibrium models are intuitive, allowing effective communication of the results of individual economic sectors to a non-technical audience. However, while providing a high level of focus on a single product, partial equilibrium models do not account for interrelatedness across sectors of an economy, and thus, they cannot evaluate indirect impacts on products related to the CBAM-target sectors.

We developed a data-driven partial equilibrium framework to fit with the data availability and calibrated the framework to each CBAM sector to evaluate sectoral impacts. The structure of the partial equilibrium framework is graphically summarised in Figure 6-1, which shows the market supply comprising supply from M foreign producers (imported goods) and domestic producers. Domestically produced commodities can be sold in the national market or exported to N importing countries, some of which may impose CBAM on Vietnam's export, such as EU and possibly CBAM-friendly countries. This partial equilibrium framework is calibrated to evaluate the CBAM impacts under several alternative assumptions, i.e., whether or not carbon pricing in Vietnam will be implemented from 2028 as scheduled, whether or not the CBAM-target sectors will be able to improve their energy-use efficiency and reduce their emission intensity, and whether CBAM will be effective in EU only or in EU and CBAM-friendly countries. Further details can be found in section 6.3, and the mathematical specification of the partial equilibrium framework is provided in Appendix 3.

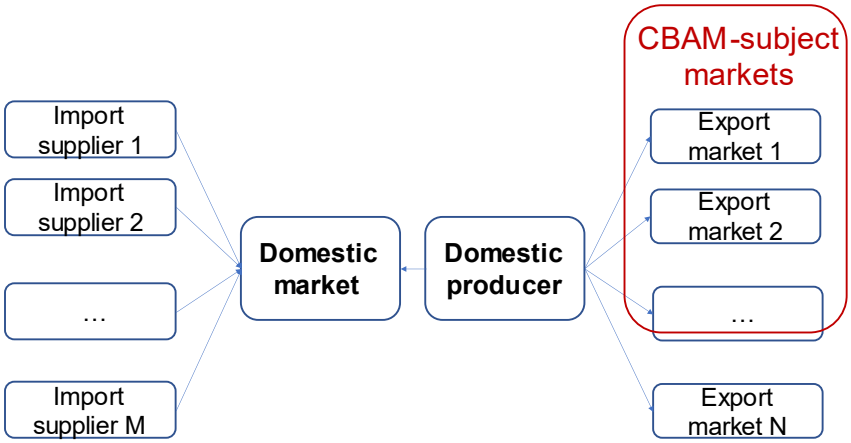


Figure 6-1 Schematic diagram of data-driven partial equilibrium modelling

6.2.2. General equilibrium framework for economy-wide impact evaluation

General equilibrium modelling (computable general equilibrium or CGE) is also a potent tool with uniqueness to answer what-if questions. CGE is a well-established model for analysing the impact of policy changes, such as taxes, fees, and prices, on an economy, and this modelling approach has also been used in the impact assessment of climate change policies. The key strength of a CGE model is its ability to take into account cross-sector links within an economy and to evaluate the impact of CBAM on targeted and non-targeted sectors (both direct and indirect impacts). CGE models can evaluate the mobility of resources across economic sectors, investment, and the dynamics of economic development. They can also be used to assess the macroeconomic impacts of CBAM and possible responses (e.g., impacts on GDP, tax revenue, international trade, and overall price). However, CGE models are data-demanding, cannot be too disaggregated with a focus on the details of a single market/product, and they are not as intuitive as partial equilibrium modelling.

The data driven CGE framework we developed to fit with available data is summarised in Figure 6-2. The general equilibrium framework is constructed to match Vietnam's most-disaggregated Input/Output table, which covers 164 sectors in 2019. Each sector uses capital, labour, and the output of other sectors as inputs to produce its own output. Imports also serve as a source of supply in the domestic market. The output of each production sector can be used domestically or exported, and the export is subject to international trade policies, such as CBAM. The CGE model includes a representative household sector, a government sector, and saving and investment components. Each production sector is subject to technological changes represented by total factor productivity (TFP). Labour supply is subject to demographic growth, and the capital stock is subject to depreciation and investment, making it a dynamic CGE model. The detailed mathematical specification of the CGE model is provided in Appendix 4.

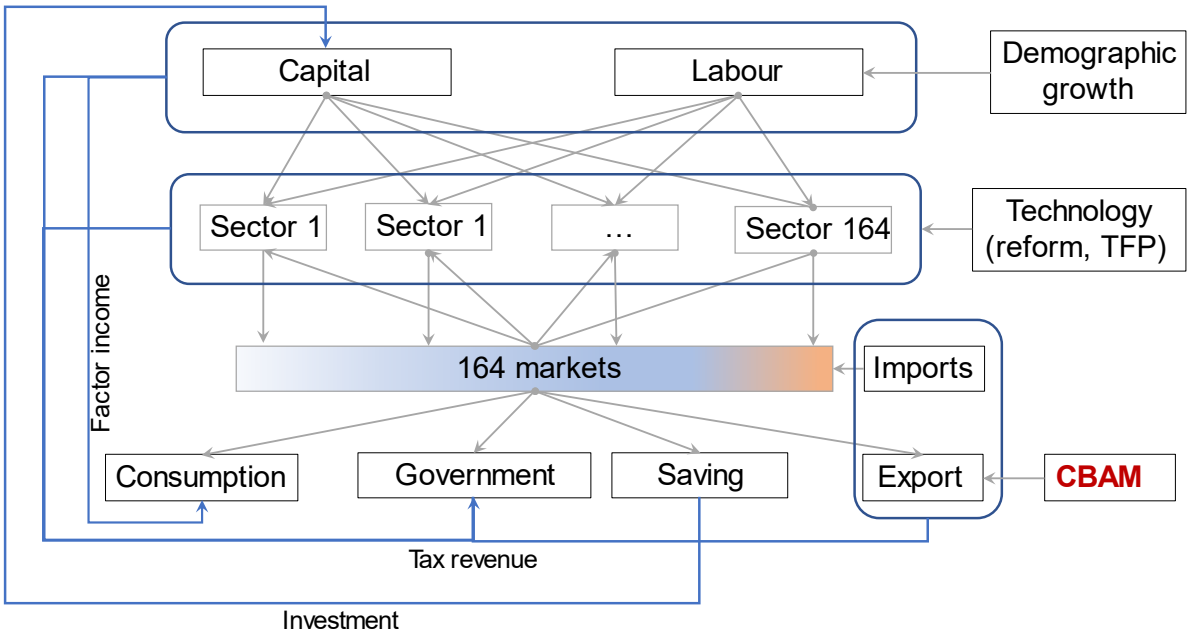


Figure 6-2 Schematic (simplified) diagram of data-driven CGE modelling

6.3. Evaluation scenarios

Scenarios are specific sets of conditions that can influence the outcome of a system. It is a tool used to explore and analyse different possibilities and outcomes of a particular system or phenomenon. The scenarios considered in this report provide a structured and systematic way of thinking about the possible influential factors of CBAM impacts. A 'Business-as-Usual' (BAU) scenario will be used as the reference for evaluation. The BAU scenario assumes that current trends and conditions will continue with no major policy changes or disruptions.

The evaluation timeframe for all considered scenarios is ten years, from 2026 to 2035 inclusive. The choice of the starting year of the evaluation timeframe is because CBAM is expected to take effect in 2026 (European Commission, 2021e). The ten-year planning and evaluation period aligns with the ten-year planning horizon and review of Vietnam's climate policy, as specified by Vietnam's Prime Minister (Prime Minister of Vietnam, 2022: p. 19-20). Furthermore, 2035 is the year when GHG emissions in Vietnam are expected to peak before declining to zero by 2050 (Prime Minister of Vietnam, 2022: p. 5), and 2035 is also when the carbon price in EU countries will no longer be influenced by the free emissions allowance.

CBAM impacts are evaluated by comparing projected outcomes with and without CBAM. CBAM impacts depend on various factors, including how future uncertainties unfold in Vietnam and its trading partners. The impact of CBAM may also differ based on whether Vietnam can implement its carbon pricing policy and enhance energy efficiency before and during the evaluation period. Figure 6-3 provides a systematic summary of considered scenarios for each quantitative analysis, i.e., impact evaluation for each CBAM-target sector and economy-wide impact evaluation. We evaluate and compare the outcome of the reference scenario with alternative scenarios. There are four alternative scenarios combining (i) whether emission intensity in Vietnam would remain or reduce over the evaluation period, (ii) whether carbon pricing would be implemented from 2028.

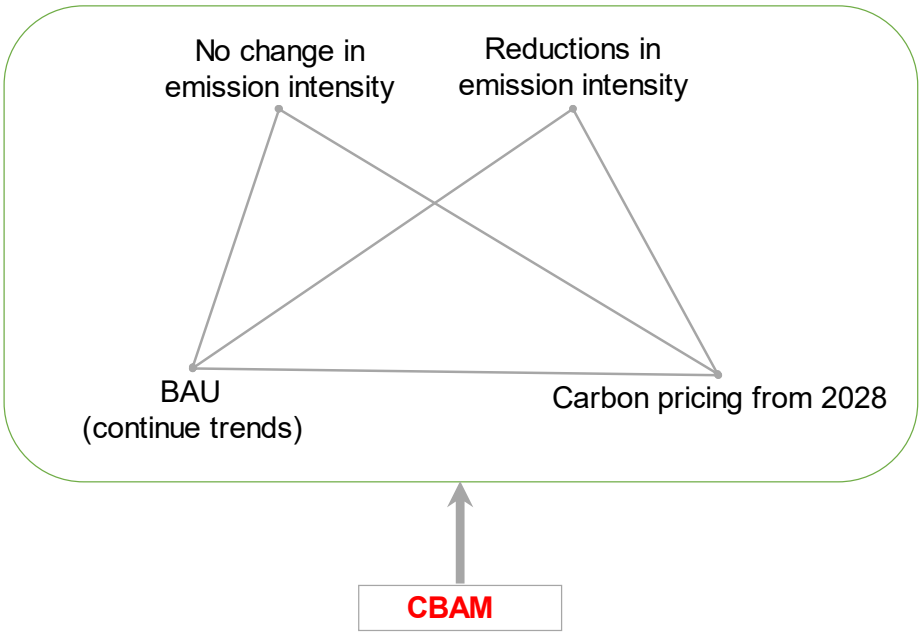


Figure 6-3 Summary of considered scenarios for each quantitative analysis

We drew from Vietnam's government documents and existing literature to parameterise and calibrate key assumptions in these scenarios. For example, our BAU scenario in the economy-wide analysis is parameterised using the assumption that increases in labour, capital, and total factor productivity would generate an annual GDP growth rate of 6.5%, a conservative target set by Vietnam's master plan for 2021-2030 with a vision to 2050 (Vietnam's National Assembly, 2021: p. 4). In relation to reductions in emission intensity, two governmental regulations can possibly be used to calibrate this modelling assumption, (i) Prime Minister's Decision 896/QD-TTg 2022 approving the National strategy for climate change until 2050 in Vietnam and (ii) Prime Minister's Decision 1658/QD-TTg 2021 approving the National strategy for green growth in 2021-2023 period, vision to 2050. Decision 896/QD-TTg 2022 is newer, but what is mentioned in Decision 1658/QD-TTg 2021 (i.e., emission intensity is reduced by 1-1.5% per year) is more relevant. Thus, the parameterisation of reduced emission intensity assumes that the quantity of energy inputs to produce the same quantity of output in Vietnam's economic sectors would fall by 1%-1.5% per year as specified in Vietnam's national strategy for green growth (Prime Minister of Vietnam, 2022: p. 42).

The models developed for this research can be used to evaluate the impact of different levels of the CBAM tax rate and carbon price in Vietnam. While uncertainties surround these two key parameters, and there is no reliable data to predict their numerical values, they are indispensable to producing concrete numerical simulations. Therefore, we must use our best available knowledge to specify these parameter values. Specifically, there is little information about what carbon price Vietnam would apply when carbon pricing starts in 2028. As a result, we must scan regulations, published reports, legal documents to extract quantitative information about the government's estimate of the society cost of carbon emissions or how much it would cost the society to reduce a certain quantity of carbon emissions. The only specific information is from Vietnam's NDC 2022 (SRV, 2022: table 3) which provides estimates of the quantity emission reductions and associated cost. Based on this estimate in NDC, the most cost-effective estimate of social cost of carbon is around 11USD/tCO_2, and we use this in our quantitative analysis. This carbon price is on top of any existing environmental non-carbon-index tax on goods harmful to the natural environment, as specified in Vietnam's Law on Environment Protection (Article 2).

In relation to the CBAM tax rate, which is linked to the EU's ETS price (European Commission, 2021c), we convert the latest (2022) carbon price in the EU's ETS (~80 €/tCO_2) to around 65 USD/tCO_2 (2019-USD value). We assume that this price would increase in real terms during the 2026-2035 period when free emission allowances are phased out in the EU. The incremental price increase of the EU allowances for simulation over the 2026-2035 period is specified at 30%, corresponding to the updated phase-out plan for free emission allowances in the EU's industrial sectors from 30% in 2026 (European Court of Auditors, 2020: figure 4) to 0%, i.e., completely removed in 2034 (KPMG, 2022: p. 3). This incremental rate in the EU's ETS reflects the price response to the reduction in allowances (see, e.g., D'Arcangelo, Pisu, Raj, & Dender, 2022: Tables 1-2; Engström et al., 2020) and the overall declining trend in emissions among EU countries with ETS in place (see, e.g., European Commission, 2022c: figure 8).

7. SURVEY ON CBAM-TARGET ENTERPRISES AND ESTIMATED EMISSION INTENSITY IN CBAM-TARGET SECTORS

7.1 Survey on CBAM-target enterprises

7.1.1 Survey design

We conducted a survey on enterprises in four CBAM-target sectors. The aims of this survey were to provide data inputs for the modelling, valuable insights for constructing the mitigation recommendations, and a foundation for a national CBAM database.

We developed four sectoral-specific questionnaires to collect bottom-up data on the following subjects:

- Energy and raw material consumption data from 2017-2021;
- Annual production and revenue of sale of goods for 2017-2021;
- Annual cost structure of each enterprise or each group of enterprises;
- Awareness and opinions of enterprise about CBAM and existing environmental taxes, fees, and charges in Vietnam.

In total, we selected 379 enterprises which were potentially subject to CBAM and would provide information that are representative of the industry. The survey subjects covered all exporters of CBAM-target commodities and all enterprises in four CBAM-target sectors that are public companies and/or listed in Decision no. 01/2022/QD-TTg dated 18/01/2022 on promulgating the list of sectors, GHG-emitting establishments subject to GHG inventory, as well as some major producers. The list of surveyed enterprises and questionnaire forms are in Appendix 4. Figure 7-1 shows the distribution of enterprises by types of enterprises (e.g., exporters, Decision 01's subjects, and public companies).

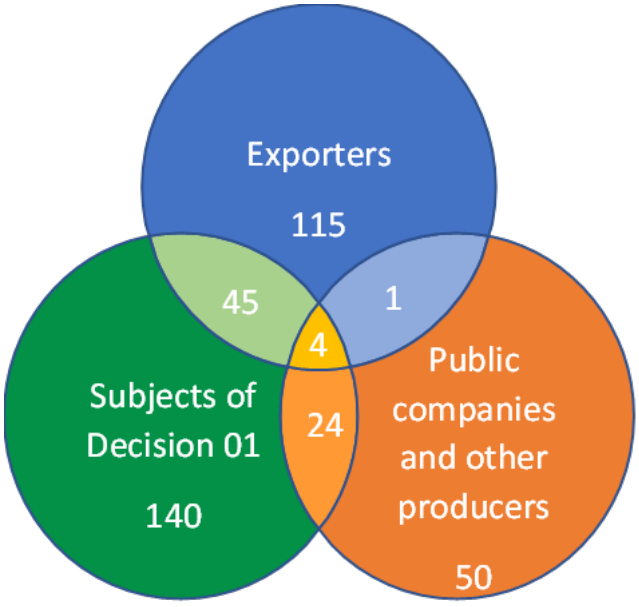


Figure 7-1 Distribution of surveyed enterprises by groups

The survey was sent via post and email from 11/01/2023 – 13/01/2023. The enterprises were given one month to respond to allow sufficient time for the modelling. Due to the Lunar New Year holiday, the actual data collection period was approximately two weeks. However, we employed various methods to maximise the number of responses in this period. All questionnaires were accompanied with an Official Letter from the Department of Climate Change, MONRE and descriptions of benefits for companies participated in the survey. Several rounds of follow-up calls and emails were arranged

to get more data. Also, we engaged with sectoral associations and VCCI to improve the survey contents, facilitate the survey process, and to gain a better understanding of the national-wide and sectoral-wide production and development status. In addition, we verified the collected data and gained additional information by contacting several responding companies and conducting site visits to 12 companies.

7.1.2 Summary of survey results

Table 7-1 presents the number of enterprises answering the questionnaire by sectors and data categories. As of 13/02/2023, we received a total of 39 questionnaires, which data was used for initial CBAM impact assessment. From the initial survey closing date (13/02/2023) to 23/03/2023, we obtained 7 more responses (see Notes under Table 7-1).

Table 7-1 Number of questionnaires dispatched and returned by sectors and by categories of data

	Number of Questionnaires Sent	Questionnaire Returned		Number of Returned questionnaires by data categories			
		By number	By %	Energy consumption	Production	CBAM awareness	Finance
Steel	133	16 (+2)	12.0 (+1.5)	12 (+1)	7 (+1)	16 (+2)	7
Fertiliser	16	5	31.3	5	5	5	5
Cement	56	9 (+2)	16.1 (+3.5)	6 (+2)	5 (+2)	9 (+2)	4 (+2)
Aluminium	170	8 (+3)	4.7 (+1.8)	7 (+2)	0 (+3)	8 (+3)	2 (+2)
Aluminium, Iron and Steel	4	1	25.0	1	0	1	1
Total	**379**	**39 (+7)**	**10.3 (+1.8)**	**31 (+5)**	**17 (+6)**	**39 (+7)**	**19 (+4)**

Notes to Table 7-1:

- The returned questionnaires by data categories indicates the number of enterprises that provide data for at least one field in a category.
- The numbers in the brackets indicate the number of questionnaires received after 13/02/2023.

The limited survey period might be the biggest reason contributing to the unimpressive numbers of returned questionnaires, but there are other factors to be considered. The low response rates show that enterprises may not be aware of or find the CBAM regulation not relevant to them yet, especially when the CBAM regulation has not officially been finalised and come into force. Among the 379 surveyed companies, only 165 companies are exporters of CBAM-target products but many of these CBAM-target products are only parts and components of their main products. Besides, many of these products, especially products made from aluminium, were not targeted in the CBAM proposal until the latest provisional agreement dated 08/02/2023. Apart from that, enterprises may have difficulties accessing historical data or lack of time and resources to collect data for the period of 5 years. Moreover, enterprises may not wish to share possibly confidential data on their competitiveness, especially production data and cost structure.

Regarding the validity of the collected data, since most of the responding enterprises are significant in their sectors, although the number of returned questionnaires is low, their contribution in terms of emissions and economic value is quite significant. For example, in steel sector, we were able to get

survey data from major steel producers in Vietnam, such as Hoa Phat Hai Duong, Formosa Ha Tinh, Southern Steel - VNSTEEL, etc. The average production outputs of responded steel enterprises account for over 40% of average steel production volume in 2017-2021 period. In the fertiliser sector, the survey data cover nearly 50% of Vietnam's average inorganic fertiliser production in 2017-2021 with data from major fertiliser producers such as PetroVietnam Fertilizer & Chemicals Corp, Habac Nitrogenous Fertilizer & Chemicals JSC. In addition, we have filled in the data gaps and improved data validity by collecting additional data and cross-checking the collected data with secondary sources. The data inputs for modelling are based on the average of the reported data and ensure representativeness of the evaluated sectors.

Going beyond the CBAM question, the low response rates and lack of energy data emphasise the importance of enhancing the quality of Vietnam's data systems to support policymaking, particularly regarding climate change policies. This also highlights the need to raise awareness of climate policies and their implications in the business community as Vietnam works towards its objectives of net-zero emissions by 2050.

7.2 Estimated emission intensity in CBAM-target sectors

Table 7-2 presents estimated emission intensities in the CBAM-target sectors in Vietnam alongside the global average. The estimated emission intensities in Vietnam result from the questionnaire data. The average emission intensity in the steel and cement sectors is higher than the global average, while the average emission intensity in fertilisers falls within the global range. There are significant differences between the estimated lowest and highest levels of emission intensity in these sectors. This disparity may be due to differences in the scope of production process or types of product. For example, many steel and aluminium enterprises manufacture finished products from imported ingots instead of producing from raw materials, hence, they consume much less energy than primary producers. Similarly, producing NPK fertiliser by mixing fertiliser components are also much less energy-intensive than producing urea fertiliser from ammonia. Another issue may be related to data quality, such as enterprises reporting underestimated levels of energy use relative to output. Moreover, energy efficiency may vary across time and enterprises, suggesting that there is room for improvement among inefficient producers. As of 13/02/2023 when we compiled data for the impact evaluation process, no response was received from the aluminium sector regarding production data, and we thus used the global average as the representative number for Vietnam. This may be an overestimation because Vietnam does not have many high-emission aluminium smelters. Thus, the result using global average of emission intensity in aluminium production can be considered as an upper bound of the impact estimates.

Table 7-2 Estimated emission intensity in CBAM-target sectors

Unit: tCO_2/tonne of output	Mean	Min	Max	World average
Steel (22)	2.17	0.52	4.05	1.8
BOF Steel (12)	2.35	2.09	4.05	
EAF Steel (10)	6.62	0.52	0.74	
Fertilisers (15)	2.22	1.24	7.87	1.7-2.3
Cement (29)	0.86	0.41	1.29	0.5
Aluminium	NA	NA	NA	16.6

Notes to Table 7-2:

- Numbers after the sector names indicate the number of observations obtained from the enterprise survey. Other numbers are rounded to the nearest digit.

- The emission intensity estimate in Vietnam is based on current protocols specified in regulations and international standards (seeAppendix 6 for details), including emissions from the use of electricity.
- The global average numbers are extracted from existing estimates (Hoxha & Christensen, 2018; International Aluminium Institute, 2022b; Liao, Wang, Xia, & Tang, 2022; Pandit, Watson, & Qader, 2020).
- The world average emission intensity of fertilisers varies across types of fertilisers.

7.3 Enterprises' awareness of CBAM

In the questionnaire, enterprises were asked questions related to their awareness and reactions to the EU's CBAM, environmental-related tax and domestic carbon market. Figure 7-2 presents the responses of enterprises for their opinions of the EU's CBAM. The majority of responding enterprises had low awareness of CBAM. Specifically, over 60% of enterprises have heard about the EU's CBAM, but most of them knew from nearly nothing to just general information about it. About one-third of the enterprises had no opinion or believed CBAM would cause no impact on their businesses and another one-third thought that the effect would be minimal. This might explain why approximately 60% of the enterprises did not expect to develop a CBAM response plan while only 4% (equal to 2 enterprises) already had a plan responding to CBAM.

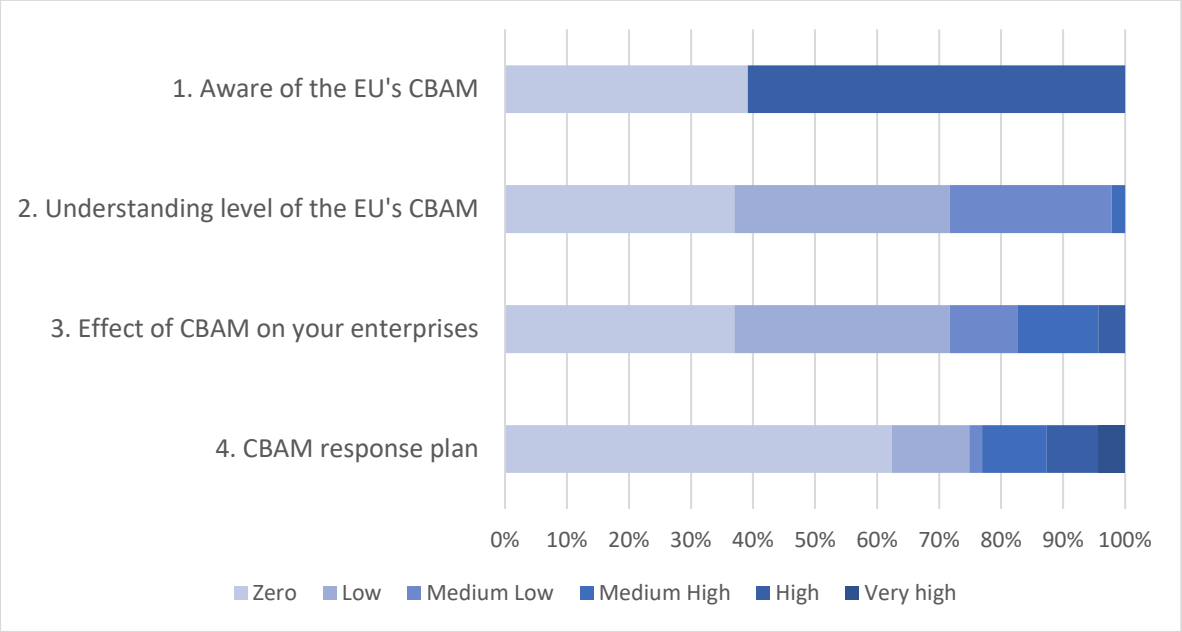


Figure 7-2 Responses of surveyed enterprise to CBAM-related questions

Notes to Figure 7-2:

- The scale of awareness for the category "CBAM response plan" is based on the enterprise's awareness and understanding level of CBAM and whether enterprise had a CBAM response plan or how early enterprise intent to have a CBAM response plan. The earlier the year enterprise develops plan for CBAM, the higher the awareness level of the CBAM.

When asked about the best options for Vietnam-based enterprises to respond to the EU's CBAM, the majority of enterprises choose either of the three following choices: 1) No opinion; 2) Complying with the domestic carbon market; 03 3)Complying with the CBAM (see Figure 7-3). No enterprise preferred to change their export market and only around 2% thought opposition to CBAM or no action is the best plan. They might indicate the importance of the EU market to Vietnam-based exporters. Generally, these responses also show that enterprises would be willing to follow the international and

national's effort of implementing strong GHG emission measures. This would be taken into consideration for the analysis of CBAM's implications on Vietnam.

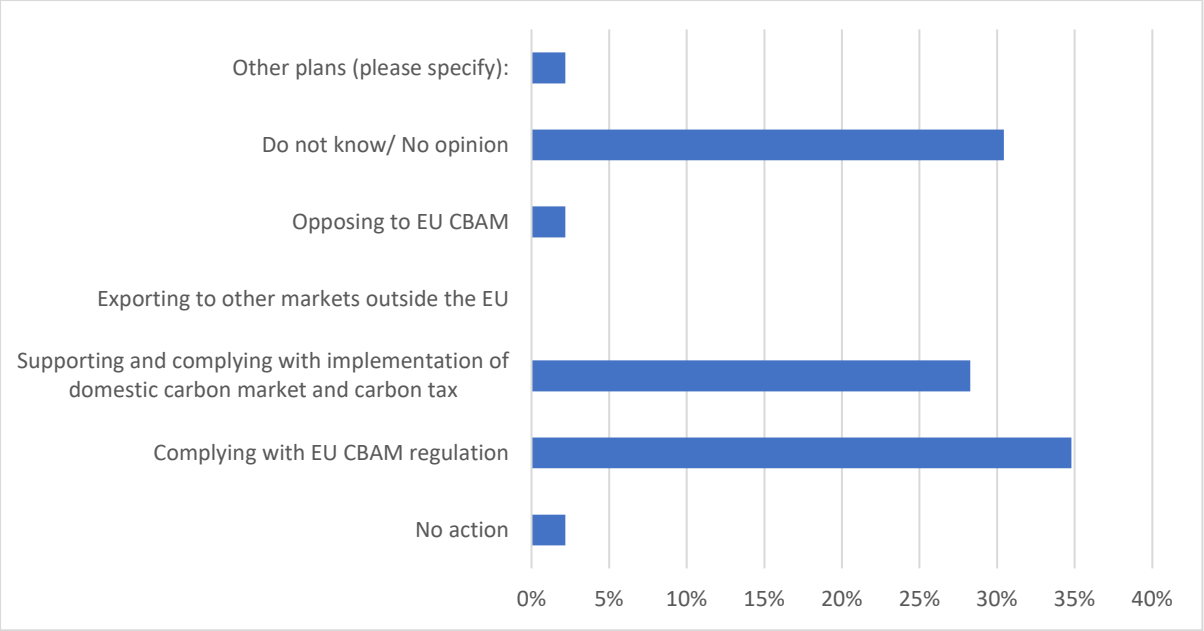


Figure 7-3 Enterprises' choices for the most important plan for Vietnam-based enterprises to respond to the EU's CBAM

7.4 Development of the national database system on import and export activities of goods to and from EU

7.4.1 Status of import/export and GHG emission data

At the time of conducting this project, there was no national database in the CBAM-target sectors that is centralised, easily accessible, and regularly updated. There exist some sources of data, such as import/export data from General Department of Vietnam Customs, emission data from National GHG Inventories or from research projects. Also, different ministries/agencies may have their own database for specific management purposes, but it is not a regular practice to share or develop a common database.

7.4.2 Development of a national database system for CBAM

Objective of the national database system for CBAM

The development of the national database system for CBAM is important for Vietnam to:

- Have a good understanding of trading activities between Vietnam and EU in CBAM sectors;
- Have a good understanding of the emission intensity of the goods export to EU under CBAM;
- Closely monitor the development trend between Vietnam and EU in CBAM sectors, both in terms of trading and GHG emission volumes.
- Develop and adjust negotiation policies and strategies for CBAM; and
- Support management activities and inform management policies on trading with EU;
- Support management activities and inform the management policies on GHG emission from CBAM sectors;
- Inform the development of carbon pricing policies and energy transition policies for the achievement of NDC and Net-zero targets.

General structure of the national database system for CBAM

The general structure of the national database system for CBAM includes:

i) enterprise-level data, that consist of reported data on import from and export of goods to EU for CBAM sectors (including volume and value);
ii) GHG emission intensity of the exported goods (estimated value based on returned questionnaires of enterprises and would improve later based on reported data from enterprises when CBAM starts effect)
iii) sectoral- and national- level on imported/exported data with EU (including volume and value)
iv) sectoral- and national- level GHG emission volume from CBAM sector and comparative analysis of GHG intensity for different types of exported products.

It would be optimal that the national database system for CBAM would be linked to the import/export data from General Department of Vietnam Custom and the GHG inventory report data at facility-level that is being developed by the Department of Climate Change for the list of enterprises that shall conduct GHG inventory in accordance with Decision 01/2022/QD-TTg of the Prime Minister.

The development of a comprehensive database system for CBAM will support collecting, calculating, archiving, and managing trading activities related to CBAM. It was designed to be compatible with the Monitoring, Reporting and Verification system developed for the GHG emission inventory according to the Environmental Protection Law 2020 and guidance by Ministry of Natural Resources and Environment and relevant ministries and to international best methodologies and standards on GHG accounting.

The first version of the national database system for CBAM

The first effort for the nation database system is established based on the survey questionnaire for CBAM impact assessment and top-down data of trading activities with the EU. The database system developed under this project covers enterprises in the four CBAM-target sectors: aluminium, cement, iron and steel, and fertiliser.

The database system consists of general description and guidance for database input, a summary of key data calculation results, a template for data collection at enterprise-level, a calculation tool for GHG emission at enterprise level, and a general database consisting of export data, energy consumption, production and GHG emissions of all enterprises. The result is an excel-based database toolkit covering 5 year-consecutive data of 23 enterprises in four CBAM-target sectors. These 23 enterprises are the ones that participated in the survey and provided complete data for total GHG emissions and emission intensity, such as energy consumption, production outputs, etc. in five consecutive years. Figure 7-4 captures a part of the data input template for enterprises and Figure 7-5 shows an example of the general database.

Technical Assistance Project on Impact Assessment of EU's Carbon Border Adjustment Mechanism and Recommendations on Carbon Tax Policies for Viet Nam
Data Collection Template for production, import/export, and emissions activities

1.	ENTERPRISE GENERAL INFORMATION	
1.1	Name of enterprise:	
1.1a	Sector:	
1.2	Address:	
1.2a	Province:	
1.3	Phone:	
1.4	Email:	
1.5	Type of enterprise:	
1.5a	% state capital	
1.5b	% foreign capital	
1.6	Type of business:	
1.7	Production technology:	
1.8	Countries that enterprise export product to:	

2.	INFORMATION ON ENERGY AND RAW MATERIAL CONSUMPTION						
	Type of energy/ materials	Unit	2017	2018	2019	2020	2021
2.1	Electricity (1000 kWh)	1000 kWh					
2.2	Coal (Ton)	Ton					
2.3	Diesel Oil (1000 litres)	1000 litres					
2.4	Gasoline (1000 litres)	1000 litres					
2.5	Fuel Oil (1000 litres)	1000 litres					
2.6	LPG (Ton)	Ton					
2.7	CNG (1000m3)	1000m3					
2.8	Clinker (Ton)	Ton					
2.9	Other raw materials or energy sources						

Figure 7-4 Example of data input template for enterprise

0. No	1.1 Enterprise name	1.1a Sector	Year	3.1.1 Electricity consumption	3.1.2 Coal consumption (Tấn)	3.1.3 DO consumption (1000 l)	3.1.4 Gasoline consumption (1000 lít)	3.1.5 FO consumption (1000 l)	3.1.6 LPG consumption (Tons)	3.1.7 Gas consumption (1000m3)	3.1.8 Clanke consumption (Tons)	3.1.9 Other fuels	3 Đ
	Enterprise A	Fertilizer	2017	50,213	20,037			1				Biomass/ton/175	
	Enterprise A	Fertilizer	2018	55,166	19,459			1				Biomass/ton/195	
	Enterprise A	Fertilizer	2019	42,507	8,412			108				Biomass/ton/141	
	Enterprise A	Fertilizer	2020	36,696	51			99				Biomass/ton/126	
	Enterprise A	Fertilizer	2021	36,630	-			184				Biomass/ton/149	
	Enterprise B	Steel	2017	687	1,376,896		7925	3018		501			
	Enterprise B	Steel	2018	672	1,381,820		10327	3210		484			
	Enterprise B	Steel	2019	713	1,411,918		10867	3384		569			
	Enterprise B	Steel	2020	717	1,421,968		9940	3545		593			
	Enterprise B	Steel	2021	721	1,695,444		12594	3562		578			
	Enterprise B	Steel	2020	18,475	44,492			264					
	Enterprise B	Steel	2021	19,985	59,025			549					
	Enterprise C	Steel	2017	131,608	3,804		31	210		3370			
	Enterprise C	Steel	2018	131,158	3,371		32	236		3613			
	Enterprise C	Steel	2019	123,175	2,311		15	179		3109			
	Enterprise C	Steel	2020	136,499	2,284		11	190		1640			
	Enterprise C	Steel	2021	117,190	1,680		6	158		1855			
	Enterprise D	Steel	2017	1,958,755	1,667		3	24	81425				
	Enterprise D	Steel	2018	3,134,099	3,506		3	27	372420				
	Enterprise D	Steel	2019	3,316,732	3,932		3	49	504147				
	Enterprise D	Steel	2020	2,980,160	3,799		4	51	556323				
	Enterprise D	Steel	2021	3,386,912	4,405		4	43	577857				
	Enterprise E	Steel	2017	378,762	17,765			1047				CNG/1000 m3/1432	
	Enterprise E	Steel	2018	377,519	12,518			930				CNG/1000 m3/137	
	Enterprise E	Steel	2019	386,539	13,156			835				CNG/1000 m3/1288	
	Enterprise E	Steel	2020	364,998	10,477			899				CNG/1000 m3/1368	
	Enterprise E	Steel	2021	314,018	8,467			820				CNG/1000 m3/1270	
	Enterprise F	Cement	2017	303,260	376,218			2736			2794926	Limestone/Ton/34	
	Enterprise F	Cement	2018	300,169	429,272			2092			3036598	Limestone/Ton/36	
	Enterprise F	Cement	2019	312,896	410,834			607			3048166	Limestone/Ton/36	
	Enterprise F	Cement	2020	320,909	452,835			750			3378294	Limestone/Ton/40	

Figure 7-5 Example of a general database for all enterprises

The first version of the national database system consists of the following main aspects:

- General information of the enterprises
- Production and export data
- Energy and raw material consumption data
- Total GHG emission and intensity at enterprise level
- Average GHG emission intensity at sectoral level

7.4.3 Recommendations for further improvement of the national database system

Since this is the first attempt to develop a national database system, additional efforts are needed to improve the database and make it fully compatible and adaptable to specific requirements of relevant authorities. The following are some recommendations for the next steps:

Stakeholder consultation: It is necessary to further consult with relevant authorities on the establishment and functions of the national database system for CBAM in order to make sure it serves the intended purposes and be useful for management activities.

Develop data collection protocol: The data input is crucial for the functioning of the national database system. Once fully developed, relevant management authorities will need to develop data collection protocol to ensure sufficient data input to the system. This can be done through contracting with data providing sources or promulgating legal documents to require data report from enterprises.

Management of the database: It is importance to develop a management methodology to ensure the transparency and confidentiality of the national database system, especially when this database system is intended to be shared between different ministries/agencies. The management of the database system will require joined effort between relevant ministries, such as MONRE, MOIT, and MOC. Ministries can set up a common management board for the database system or assign responsibilities to corresponding ministerial departments.

Updating the database: The national database should be updated annually to monitor changes in trading activities and GHG emission pattern. The data collection for updating the database firstly should include all CBAM-target exporters and energy-intensive facilities and gradually expanded to all enterprises in four CBAM-target sectors and other potential sectors. There should be a detailed approach for each targeting groups of enterprises such including incentives or mandates to increase the response rate.

Setting up an online platform for enterprises to report their data or linking it with existing online database: This recommendation would facilitate and reduce the cost of data collection, as well as database management, especially if the database is shared between several ministries/agencies. The reporting platform can be incorporated into the platform for GHG emission inventory reporting as well, since the national database system aims to provide data satisfying the reporting requirement of Decree 06/2022/ND-CP being compatible with the national GHG emission reduction MRV system.

8. CBAM IMPACTS ON TARGETED SECTORS

This section reports the quantitative impact evaluation on individual sectors of which – as discussed above - only four sectors are relevant, namely iron and steel (steel), aluminium, fertiliser, and cement. Below is the summary of the estimated impacts based on data reports from surveyed enterprises – unless otherwise indicated.

8.1. Steel sector

Table 8-1 summarises the estimated impacts of CBAM and some possible related factors on the steel sector. Given that the EU accounts for 5% - 10% of Vietnam's steel export markets (see Appendix Table 1), the application of CBAM in the EU would have some negative impacts on key economic performance indicators of the sector. For example, production output would decline by approximately 0.8% in 2030. This estimated reduction in percentage points has a 95% confidence interval (CI) of [0%, 1.7%]. In an absolute-value term, this is a reduction of around 0.4 million tonnes (CI = [0,0.8 million]).

The estimated reduction in total export value is approximately 3.6% (CI = [0.4%,5.4%]) in 2030, or around 0.7 billion USD (CI = [0.1,1.1 billion]). The estimated reduction in total export value in 2035 is 3.8% in 2035 (CI = [0.4%,5.7%]), or approximately 1.3 billion USD (CI = [0.1,1.9 billion]). The estimated reduction in export value to the EU is about 51.2% in 2030 (CI = [3.7%, 80.2%]), or 1.1 billion USD (CI = [0.1,1.7 billion]). The estimated reduction in export value to the EU in 2035 is 54.5% in 2035 (CI = [4.1%, 83.7%]), or 1.8 billion USD (CI = [0.1,2.8 billion]). The estimated impact on import values is modest, with the CI ranging from a reduction of 1.3% to an increase of 0.7% in 2030, and from a reduction of 1.4% to an increase of 0.8% in 2035.

As a result of the reduction in production output, the emission quantity would decline by about 0.9 million tCO_2 in 2030 (CI = [0,1.8 million]) and by about 1.5 million tCO_2 in 2035 (CI = [0.1,3.1 million]). If the steel sector could reduce its emission intensity, the negative economic impacts of CBAM would be slightly lessened while emission quantity would be further reduced. In this case, the estimated reduction in emission quantity would be 7.5 million tCO_2 in 2030 (CI= [6.7,8.4 million]) and 22.2 million tCO_2 in 2035 (CI= [21.0, 23.6 million]).

Carbon pricing has both negative and positive impacts. Carbon pricing would increase the cost of production and reduce the price competitiveness of products. As a result, production output and exports would decline with carbon pricing. The estimated carbon pricing revenue is about 1.2 billion USD (CI = [1.1,1.2 billion]) in 2030 and 1.9 billion USD (CI = [1.8,1.9 billion]) in 2035. In addition, with carbon pricing revenue, emission quantity would decline by about 4.9 million tCO_2 in 2023 (CI = [0.4, 9.2 million]) and 8.1 million tCO_2 in 2035 (CI = [0.6,14.9 million]), a much higher emission reduction than when there was no carbon pricing and no reduction in emission intensity. Reducing emission intensity, if occurring at the same time as carbon pricing, would further reduce emission from the sector and slightly soften the negative impacts of CBAM and carbon pricing on production output and exports. As a result of the emissions reductions, the carbon pricing revenue would also slightly reduce.

Table 8-1 Estimated impacts on the steel sector with CBAM in the EU

Indicators	No carbon pricing, No change in emission intensity		No carbon pricing, Reduced emission intensity		Carbon pricing, No change in emission intensity		Carbon pricing, Reduced emission intensity	
	2030	2035	2030	2035	2030	2035	2030	2035
Production output (%)	-0.8 [-1.7, -0.0]	-0.8 [-1.8, -0.0]	-0.8 [-1.6, -0.0]	-0.8 [-1.7, -0.0]	-4.5 [-8.3, -0.3]	-4.5 [-8.4, -0.3]	-4.2 [-7.9, -0.3]	-4.1 [-7.6, -0.3]
Production output (million tonnes)	-0.4 [-0.8, -0.0]	-0.7 [-1.4, -0.0]	-0.4 [-0.8, -0.0]	-0.6 [-1.4, -0.0]	-2.3 [-4.2, -0.2]	-3.7 [-6.9, -0.3]	-2.2 [-4.0, -0.2]	-3.3 [-6.2, -0.2]
Export values (%)	-3.6 [-5.4, -0.4]	-3.8 [-5.7, -0.4]	-3.5 [-5.3, -0.4]	-3.6 [-5.4, -0.4]	-6.4 [-13.3, +0.8]	-6.6 [-13.5, +0.7]	-6.1 [-12.6, +0.7]	-6.0 [-12.3, +0.6]
Export values (billion USD)	-0.7 [-1.1, -0.1]	-1.3 [-1.9, -0.1]	-0.7 [-1.1, -0.1]	-1.2 [-1.8, -0.1]	-1.3 [-2.8, +0.2]	-2.2 [-4.5, +0.2]	-1.3 [-2.6, +0.2]	-2.0 [-4.1, +0.2]
Export value to EU (%)	-51.2 [-80.2, -3.7]	-54.5 [-83.7, -4.1]	-49.5 [-78.3, -3.5]	-51.0 [-80.1, -3.7]	-47.8 [-76.8, -2.2]	-51.5 [-80.8, -2.5]	-46.1 [-74.8, -2.1]	-48.1 [-77.0, -2.3]
Export value to EU (billion USD)	-1.1 [-1.7, -0.1]	-1.8 [-2.8, -0.1]	-1.0 [-1.6, -0.1]	-1.7 [-2.7, -0.1]	-1.0 [-1.6, -0.0]	-1.7 [-2.7, -0.1]	-1.0 [-1.6, -0.0]	-1.6 [-2.6, -0.1]
Import values (%)	-0.3 [-1.3, +0.7]	-0.3 [-1.4, +0.8]	-0.3 [-1.2, +0.7]	-0.3 [-1.3, +0.7]	+0.5 [-1.6, +3.2]	+0.5 [-1.6, +3.2]	+0.5 [-1.5, +3.0]	+0.4 [-1.4, +2.8]
Import values (billion USD)	-0.1 [-0.4, +0.2]	-0.1 [-0.7, +0.4]	-0.1 [-0.4, +0.2]	-0.1 [-0.7, +0.4]	+0.2 [-0.5, +1.0]	+0.2 [-0.8, +1.6]	+0.1 [-0.5, +1.0]	+0.2 [-0.7, +1.4]
Carbon pricing revenue (billion USD)					+1.2 [+1.1, +1.2]	+1.9 [+1.8, +1.9]	+1.1 [+1.0, +1.1]	+1.7 [+1.6, +1.7]
Emission quantity (million tCO_2)	-0.9 [-1.8, -0.0]	-1.5 [-3.1, -0.1]	-7.5 [-8.4, -6.7]	-22.2 [-23.6, -21.0]	-4.9 [-9.2, -0.4]	-8.1 [-14.9, -0.6]	-11.1 [-14.9, -7.0]	-27.3 [-32.8, -21.5]

Notes to Table 8-1:

- Positive numbers represent increases from the BAU scenario, and negative numbers represent decreases.
- Numbers are rounded to the nearest 1-digit; -0.0 and +0.0 (if any) refer to negative and positive numbers, respectively, with absolute values less than 0.05.
- The estimated means are outside the brackets, and the 95% confidence intervals are inside the brackets.

8.2. Aluminium sector

Table 8-2 summarises the estimated impacts of CBAM. Due to the lack of data the evaluation process assumes the emission intensity of Vietnam's aluminium production at the global average, which may be an overestimation because Vietnam does not have much high-emission aluminium smelting manufactures. Thus, this estimate can be considered as an upper bound of the impact estimates.

Given that the EU accounts for from 3% to 12% of Vietnam's aluminium export markets (see Appendix Table 2), the production output would decline by approximately 0.4% (CI = [0%, 0.8%]). The estimated reduction in export value is approximately 4.3% in 2030 (CI = [0.7%,5.7%]) and 4.5% in 2035 (CI = [0.8%, 5.8%]). In an absolute-value term, this estimated reduction is around 0.1 billion USD (CI = [0.0 0.2 billion]). The estimated reduction in export value to the EU in 2030 is about 72.2% (CI = [10.2%,96.6%]) or approximately 0.1 billion USD (CI= [0.0,0.1 billion]). The estimated reduction in export value to the EU in 2035 is about 74.7% (CI = [11.2%, 97.6%]), or 0.2 billion USD (CI=[0,0.2 billion]). The estimated impact on import values is small, with the CI ranging from a reduction of around 0.7% to an increase of 0.4%.

As a result of the reduction in production output, the emission quantity would decline by about 0.2 million tCO_2 in 2030 (CI = [0,0.5]) and by about 0.4 million tCO_2 in 2035 (CI = [0,0.8 million]). If the aluminium sector could reduce its emission intensity, the negative economic impacts of CBAM would be slightly lessened while emission quantity would be further reduced, from a reduction of 0.2 million tCO_2 (CI = [0,0.5]) to a reduction of 3.6 million tCO_2 (CI= [3.5,3.9 million]) in 2030, and from a reduction of 0.4 million tCO_2 (CI = [0, 0.8]) to a reduction of 11.1 million tCO_2 in 2035 (CI = [10.8, 11.4 million]).

Carbon pricing would generate significant revenue while reducing the price competitiveness of products. With carbon pricing, the production output and exports would reduce by around 8.7% (CI= [1.0%,15.9%]). However, carbon pricing would generate revenue from the aluminium sector of about 0.6 billion USD in 2030 (CI = [0.5,0.6]) and 0.9 billion USD (CI = [0.8,1.0]) in 2035. In addition, the emission quantity would decline by about 4.9 million tCO_2 in 2023 (CI = [0.6,9.0]) and 7.9 million tCO_2 in 2035 (CI = [0.9,14.5 million]), a much higher emission reduction quantity than when there was no carbon pricing.

Reducing the emission intensity, if implemented simultaneously with carbon pricing, would further reduce the emission quantity from the sector and slightly soften the negative impacts of CBAM and carbon pricing on production output and exports. However, due to the reductions in emission quantity, the carbon pricing revenue would slightly decrease, from 0.6 billion USD to 0.5 billion USD in 2030 and from 0.9 billion USD to 0.8 billion USD in 2035.

Table 8-2 Estimated impacts on the aluminium sector with CBAM in the EU

Indicators	No carbon pricing, No change in emission intensity		No carbon pricing, Reduced emission intensity		Carbon pricing, No change in emission intensity		Carbon pricing, Reduced emission intensity	
	2030	2035	2030	2035	2030	2035	2030	2035
Production output (%)	-0.4 [-0.8, -0.0]	-0.4 [-0.8, -0.0]	-0.4 [-0.8, -0.0]	-0.4 [-0.8, -0.0]	-8.7 [-15.9, -1.0]	-8.7 [-15.9, -1.0]	-8.2 [-15.0, -0.9]	-7.7 [-14.2, -0.9]
Production output (million tonnes)	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.3 [-0.5, -0.0]	-0.5 [-0.9, -0.1]	-0.3 [-0.5, -0.0]	-0.4 [-0.8, -0.0]
Export values (%)	-4.3 [-5.7, -0.7]	-4.5 [-5.8, -0.8]	-4.3 [-5.7, -0.7]	-4.3 [-5.7, -0.7]	-11.9 [-27.5, +1.2]	-12.1 [-27.6, +1.1]	-11.4 [-26.2, +1.1]	-11.0 [-25.1, +1.0]
Export values (billion USD)	-0.1 [-0.1, -0.0]	-0.1 [-0.2, -0.0]	-0.1 [-0.1, -0.0]	-0.1 [-0.2, -0.0]	-0.2 [-0.5, +0.0]	-0.4 [-0.9, +0.0]	-0.2 [-0.5, +0.0]	-0.4 [-0.8, +0.0]
Export value to EU (%)	-72.2 [-96.6, -10.2]	-74.7 [-97.6, -11.2]	-70.9 [-95.9, -9.7]	-72.1 [-96.5, -10.1]	-69.4 [-95.4, -7.4]	-72.3 [-96.8, -8.5]	-68.0 [-94.6, -7.0]	-69.6 [-95.5, -7.7]
Export value to EU (billion USD)	-0.1 [-0.1, -0.0]	-0.2 [-0.2, -0.0]	-0.1 [-0.1, -0.0]	-0.2 [-0.2, -0.0]	-0.1 [-0.1, -0.0]	-0.2 [-0.2, -0.0]	-0.1 [-0.1, -0.0]	-0.2 [-0.2, -0.0]
Import values (%)	-0.1 [-0.7, +0.4]	-0.1 [-0.8, +0.5]	-0.1 [-0.7, +0.4]	-0.1 [-0.7, +0.4]	+1.7 [-5.5, +9.9]	+1.7 [-5.5, +9.9]	+1.6 [-5.2, +9.3]	+1.5 [-4.9, +8.7]
Import values (billion USD)	-0.0 [-0.1, +0.0]	-0.0 [-0.1, +0.1]	-0.0 [-0.1, +0.0]	-0.0 [-0.1, +0.1]	+0.1 [-0.4, +0.8]	+0.2 [-0.7, +1.3]	+0.1 [-0.4, +0.7]	+0.2 [-0.6, +1.1]
Carbon pricing revenue (billion USD)					+0.6 [+0.5, +0.6]	+0.9 [+0.8, +1.0]	+0.5 [+0.5, +0.6]	+0.8 [+0.8, +0.9]
Emission quantity (million tCO_2)	-0.2 [-0.5, -0.0]	-0.4 [-0.8, -0.0]	-3.6 [-3.9, -3.5]	-11.1 [-11.4, -10.8]	-4.9 [-9.0, -0.6]	-7.9 [-14.5, -0.9]	-7.8 [-11.5, -3.9]	-17.0 [-22.2, -11.5]

Notes to Table 8-2:

- Positive numbers represent increases from the BAU scenario, and negative numbers represent decreases.
- Numbers are rounded to the nearest 1-digit; -0.0 and +0.0 (if any) refer to negative and positive numbers, respectively, with absolute values less than 0.05.
- The estimated means are outside the brackets, and the 95% confidence intervals are inside the brackets.

8.3. Fertiliser sector

Table 8-3 summarises the estimated impacts of CBAM and some possible related factors on the fertiliser sector. The quantity of fertiliser exported from Vietnam to the EU is minimal (see Appendix Table 3), and the application of CBAM in the EU would have little impact on key economic performance indicators of the fertiliser sector.

Carbon pricing would increase the cost of production and thus somewhat reduce the price competitiveness of Vietnam's fertiliser sector. The estimated impact of carbon pricing is more significant because while CBAM would only increase the price of Vietnam's export to EU, carbon pricing would increase the cost of all Vietnam's products, including those consumed in domestic markets. In particular, the estimated reduction in production output is expected to be around 7.7% (CI = [1%,13.3%]), and the CI of the estimated reduction in exports ranges from a reduction of 26.3% to an increase of 1.8%. Carbon pricing would generate a revenue from the fertiliser sector, estimated at about 0.3 billion USD. In addition, with carbon pricing, the emission quantity would decline by about 2.1 million tCO_2 in 2030 (CI = [0.3,3.6]) and 2.6 million tCO_2 in 2035 (CI = [0.3,4.4 million]). Reducing emission intensity, if occurring at the same time as carbon pricing, would reduce the emission quantity by 3.5 million tCO_2 in 2030 (CI = [1.9,4.8 million]) and by 6.0 million tCO_2 in 2035 (CI = [4.2,7.4 million]).

Table 8-3 Estimated impacts on the fertiliser sector with CBAM in the EU

Indicators	No carbon pricing, No change in emission intensity		No carbon pricing, Reduced emission intensity		Carbon pricing, No change in emission intensity		Carbon pricing, Reduced emission intensity	
	2030	2035	2030	2035	2030	2035	2030	2035
Production output (%)	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-7.7 [-13.3, -1.0]	-7.7 [-13.3, -1.0]	-7.3 [-12.5, -1.0]	-6.9 [-11.8, -0.9]
Production output (million tonnes)	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.9 [-1.6, -0.1]	-1.2 [-2.0, -0.2]	-0.9 [-1.5, -0.1]	-1.0 [-1.8, -0.1]
Export values (%)	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-10.0 [-26.3, +1.8]	-10.0 [-26.3, +1.8]	-9.4 [-24.9, +1.7]	-8.9 [-23.6, +1.6]
Export values (billion USD)	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.1, +0.0]	-0.1 [-0.2, +0.0]	-0.0 [-0.1, +0.0]	-0.1 [-0.1, +0.0]
Export value to EU (%)	-75.5 [-97.3, -13.6]	-77.9 [-98.2, -14.9]	-74.2 [-96.8, -12.9]	-75.4 [-97.3, -13.5]	-72.9 [-96.4, -9.7]	-75.7 [-97.6, -11.1]	-71.5 [-95.8, -9.2]	-73.1 [-96.5, -10.1]
Export value to EU (billion USD)	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]
Import values (%)	-0.0 [-0.0, +0.0]	-0.0 [-0.0, +0.0]	-0.0 [-0.0, +0.0]	-0.0 [-0.0, +0.0]	+5.5 [-6.1, +20.7]	+5.5 [-6.1, +20.7]	+5.2 [-5.8, +19.4]	+4.8 [-5.4, +18.2]
Import values (billion USD)	-0.0 [-0.0, +0.0]	-0.0 [-0.0, +0.0]	-0.0 [-0.0, +0.0]	-0.0 [-0.0, +0.0]	+0.1 [-0.1, +0.3]	+0.1 [-0.1, +0.4]	+0.1 [-0.1, +0.3]	+0.1 [-0.1, +0.3]
Carbon pricing revenue (billion USD)					+0.3 [+0.3, +0.3]	+0.3 [+0.3, +0.4]	+0.3 [+0.2, +0.3]	+0.3 [+0.3, +0.3]
Emission quantity (million tCO_2)	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-1.6 [-1.6, -1.6]	-3.9 [-3.9, -3.9]	-2.1 [-3.6, -0.3]	-2.6 [-4.4, -0.3]	-3.5 [-4.8, -1.9]	-6.0 [-7.4, -4.2]

Notes to Table 8-3:

- Positive numbers represent increases from the BAU scenario, and negative numbers represent decreases.
- Numbers are rounded to the nearest 1-digit; -0.0 and +0.0 (if any) refer to negative and positive numbers, respectively, with absolute values less than 0.05.
- The estimated means are outside the brackets, and the 95% confidence intervals are inside the brackets.

8.4. Cement sector

Table 8-4 summarises the estimated impacts of CBAM and some possible related factors on the cement sector. Given that the EU accounts for around 1% of Vietnam's cement export markets (see Appendix Table 4), the application of CBAM in the EU would have only slightly negative impacts on key economic performance indicators of the sector. The estimated reduction in production output is around 0.1% (CI= [0,0.2%]), and the estimated reduction in export is around 0.6% (CI= [0.2%,0.8%]). The estimated reductions in emission quantity are 0.1 million tCO_2 (CI= [0,0.2 million]).

Reducing emission intensity in the cement sector would have only a minor effect in softening the negative economic impacts of CBAM, but it would significantly increase the desired impact of emission reductions, from a reduction of around 0.1 million tCO_2 in 2030 (CI= [0,0.2 million]) to a reduction of 7.4 million tCO_2 (CI= [7.3,7.5 million]), and from a reduction 0.1 million tCO_2 in 2035 (CI= [0.0,0.3 million]) to a reduction of 16.5 million tCO_2 by 2035 (CI= [16.4,16.6 million]).

The estimated economic impact of carbon pricing is substantial, but with a very wide range of possible values. With carbon pricing, the estimated reduction in output is 24.7% (CI= [3.4%,43.6%]), and the estimated impact on export is a reduction of 27.6% (CI= [10.8%,66.1%]). The carbon pricing would generate a revenue of 1.0 billion USD in 2030 (CI= [0.7,1.3 billion]) and 1.1 billion USD in 2035 (CI= [0.9,1.5 billion]). Furthermore, with carbon pricing, the estimated reduction in emission quantity is 29.5 million tCO_2 by 2030 (CI= [4.1,52.0 million]) and 34.2 million tCO_2 by 2035 (CI= [4.7,60.3 million]). Reducing the emission intensity, if implemented simultaneously with carbon pricing, would further reduce emissions from the sector.

Table 8-4 Estimated impacts on the cement sector with CBAM in the EU

Indicators	No carbon pricing, No change in emission intensity		No carbon pricing, Reduced emission intensity		Carbon pricing, No change in emission intensity		Carbon pricing, Reduced emission intensity	
	2030	2035	2030	2035	2030	2035	2030	2035
Production output (%)	-0.1 [-0.2, -0.0]	-0.1 [-0.2, -0.0]	-0.1 [-0.2, -0.0]	-0.1 [-0.2, -0.0]	-24.7 [-43.6, -3.4]	-24.7 [-43.6, -3.4]	-23.5 [-41.6, -3.2]	-22.3 [-39.6, -3.0]
Production output (million tonnes)	-0.1 [-0.3, -0.0]	-0.2 [-0.3, -0.0]	-0.1 [-0.3, -0.0]	-0.2 [-0.3, -0.0]	-34.4 [-60.7, -4.8]	-39.9 [-70.4, -5.5]	-32.7 [-57.9, -4.5]	-36.0 [-64.0, -4.8]
Export values (%)	-0.6 [-0.8, -0.2]	-0.6 [-0.8, -0.2]	-0.6 [-0.8, -0.2]	-0.6 [-0.8, -0.2]	-27.6 [-66.1, -10.8]	-27.6 [-66.1, -10.8]	-26.3 [-63.6, -10.2]	-25.1 [-61.2, -9.5]
Export values (billion USD)	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.5 [-1.1, -0.2]	-0.5 [-1.3, -0.2]	-0.4 [-1.1, -0.2]	-0.5 [-1.2, -0.2]
Export value to EU (%)	-89.4 [-100.0, -23.2]	-90.2 [-100.0, -24.8]	-89.0 [-100.0, -22.4]	-89.4 [-100.0, -23.1]	-87.4 [-100.0, -11.8]	-88.4 [-100.0, -13.7]	-87.0 [-100.0, -11.5]	-87.6 [-100.0, -13.2]
Export value to EU (billion USD)	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]
Import values (%)	-0.1 [-0.7, +0.1]	-0.1 [-0.7, +0.1]	-0.1 [-0.7, +0.1]	-0.1 [-0.7, +0.1]	+40.8 [-27.5, +237.4]	+40.8 [-27.5, +237.4]	+37.2 [-26.0, +215.1]	+34.0 [-24.6, +195.2]
Import values (billion USD)	-0.0 [-0.0, +0.0]	-0.0 [-0.0, +0.0]	-0.0 [-0.0, +0.0]	-0.0 [-0.0, +0.0]	+0.0 [-0.0, +0.1]	+0.0 [-0.0, +0.1]	+0.0 [-0.0, +0.1]	+0.0 [-0.0, +0.1]
Carbon pricing revenue (billion USD)					+1.0 [+0.7, +1.3]	+1.1 [+0.9, +1.5]	+0.9 [+0.7, +1.2]	+1.0 [+0.8, +1.3]
Emission quantity (million tCO_2)	-0.1 [-0.2, -0.0]	-0.1 [-0.3, -0.0]	-7.4 [-7.5, -7.3]	-16.5 [-16.6, -16.4]	-29.5 [-52.0, -4.1]	-34.2 [-60.3, -4.7]	-33.6 [-53.8, -10.9]	-43.5 [-64.7, -20.0]

Notes to Table 8-4:

- Positive numbers represent increases from the BAU scenario, and negative numbers represent decreases.
- Numbers are rounded to the nearest 1-digit; -0.0 and +0.0 (if any) refer to negative and positive numbers, respectively, with absolute values less than 0.05.
- The estimated means are outside the brackets, and the 95% confidence intervals are inside the brackets.

9. ECONOMY-WIDE IMPACTS

9.1. Macroeconomic indicators

Table 9-1 summarises the estimated impacts of CBAM and some possible related factors on key macroeconomic indicators. If CBAM is applied only by EU countries, the estimated impact on GDP would be a reduction of approximately 0.1 billion 2019-value USD in 2030 (CI= [0,0.2 billion]) and 0.2 billion 2019-value USD in 2035 (CI = [0.1,0.4 billion]). While enterprises who export CBAM-targeted commodities to EU would be most impacted by these hundred-million-dollars reductions, the impacts are insignificant compared to the size of Vietnam's economy because of the small share of CBAM sectors in the economy. For example, in 2019, the contribution of all four CBAM-target sectors to Vietnam's GDP was only 3.2%; only around 12.6% of the total output of these sectors was exported, and the EU also accounted for a small share of Vietnam's total export of CBAM-target commodities (8% for iron-steel, 2% for aluminium, ~0% for fertiliser, and 1% for cement). Furthermore, the economy may respond to CBAM by reallocating resources away from impacted sectors to reduce the negative impacts.

If carbon pricing is implemented in addition to CBAM in the EU, and if the emission intensity in all sectors remain unchanged, the estimated reduction in GDP would be 6.4 billion 2019-value USD in 2030 (CI= [3.6,9.3 billion]) and 11.1 billion 2019-value USD in 2035 (CI= [6.6,16.1 billion]). In a percentage term, the estimated reduction in GDP would be around 1% in 2030 (CI= [0.5%,1.5%]) and 1.2% in 2035 (CI=0.7%, 1.9%]). The fossil fuel price index would increase by 5.2% in 2030 (CI= [4.8%,5.6%]) and 5.3% in 2035 (CI= [4.9% 5.9%]). Employment would decline by 0.5% in 2030 (CI= [0,1%]) and 0.6% in 2035 (CI= [0, 1.2%]). Net exports would worsen, but as GDP would also decline, the ratio of net exports to GDP would remain stable. The estimated revenue from the carbon pricing would be 4.4 billion 2019-value USD in 2030 (CI= [3.9,4.9 billion]) and 6.0 billion 2019-value USD in 2035 (CI= [5.5,6.6 billion]).

If CBAM and carbon pricing can promote energy transition, their negative impacts on GDP will be lessened. If CBAM and carbon pricing could successfully reduce emission intensity as planned, the estimated impact on GDP would be lowered from a reduction of 6.4 billion 2019-value USD (CI= [3.6,9.3 billion]) to a reduction of 5.0 billion 2019-value USD in 2030 (CI= [2.4,7.8 billion]), and from a reduction of 11.1 billion 2019-value USD (CI= [6.6,16.1 billion]) to a reduction of 7.5 billion 2019-value USD in 2035 (CI= [3.4,12.0 billion]). In a percentage term, if CBAM and carbon pricing can promote energy transition, the estimated reduction in GDP would be lowered from a reduction of 1% (CI= [0.5%,1.5%]) to a reduction of 0.8% (CI= [0.3%,1.3%]) in 2030, and from a reduction of 1.2% (CI= [0.7%,1.9%]) in to a reduction of 0.9% (CI= [0.4%,1.4%]) in 2035. It shows the necessity to consider the adoption of carbon pricing in a broader context of energy transition, low carbon development of Vietnam and other associated co-benefits (environment, health, etc.).

Table 9-1 Estimated impacts of CBAM in the EU on macroeconomic indicators

Indicators	No carbon pricing, No change in emission intensity		Carbon pricing, No change in emission intensity		Carbon pricing, Reduced emission intensity	
	2030	2035	2030	2035	2030	2035
GDP (billion USD 2019 value)	-0.1 [-0.2, -0.0]	-0.2 [-0.4, -0.1]	-6.4 [-9.3, -3.6]	-11.1 [-16.1, -6.6]	-5.0 [-7.8, -2.4]	-7.5 [-12.0, -3.4]
GDP (%)	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-1.0 [-1.5, -0.5]	-1.2 [-1.9, -0.7]	-0.8 [-1.3, -0.3]	-0.9 [-1.4 ,-0.4]
Domestic fossil fuel price (%)	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	+5.2 [+4.8, +5.6]	+5.3 [+4.9, +5.9]	+5.2 [+4.8, +5.6]	+5.3 [+4.8, +5.9]

Indicators	No carbon pricing, No change in emission intensity		Carbon pricing, No change in emission intensity		Carbon pricing, Reduced emission intensity	
	2030	2035	2030	2035	2030	2035
Employment (%)	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	-0.5 [-1.0, -0.0]	-0.6 [-1.2, -0.0]	-0.5 [-0.9, -0.0]	-0.5 [-0.9, -0.0]
Share of net export in GDP (%)	-0.0 [-0.0, -0.0]	-0.0 [-0.0, -0.0]	+0.0 [+0.0, +0.0]	+0.0 [+0.0, +0.0]	+0.0 [+0.0, +0.0]	+0.0 [+0.0, +0.0]
Carbon pricing revenue (billion USD 2019 value)			+4.4 [+3.9, +4.9]	+6.0 [+5.5, +6.6]	+4.2 [+3.7, +4.7]	+5.5 [+4.9, +6.0]

Notes to Table 9-1:

- Positive numbers represent increases if CBAM is added from 2026 and/or carbon pricing is added from 2028 (other conditions remain), and negative numbers represent decreases.
- Numbers are rounded to the nearest 1-digit; -0.0 and +0.0 (if any) refer to negative and positive numbers, respectively, with absolute values less than 0.05.
- Outside brackets are the estimated means, and inside brackets are the 95% confidence intervals.

9.2. Impacts on NDC implementation

The quantity of fossil fuel emissions would decline with the application of CBAM, but the impacts would be insignificant if CBAM is applied in the EU only and there were no other changes, such as carbon pricing or reductions in emission intensity. The main reason is the small share of CBAM-subject sectors in Vietnam's economy (3.2% of GDP in 2019), and only a fraction of the total output of these sectors was exported.

The estimated mean of fossil fuel emissions in the BAU scenario would be 538 million t CO_2 e in 2030, and the 95% confidence interval is [502, 577 million]. This quantity of emissions exceeds the 2030 NDC milestone for the energy sector of 457 million tCO_2e specified in the National Strategy for Climate Change (Prime Minister of Vietnam, 2022, p. 5). In other words, if current trends continue, Vietnam is unlikely to achieve the 2030 NDC target, even with the lower confidence interval bound. Thus, if CBAM were to be applied to only current target sectors, its direct support of Vietnam's NDC implementation would be minimal.

However, CBAM can provide an incentive for producers to reduce emission intensity. Producers in CBAM-sectors would benefit by reducing their emission intensity because that would reduce the payment that need to make for purchasing the CBAM certificates to compensate for their emissions. If this impact could spread out to other sectors, the emission intensity of the entire economy would be lowered. We estimated that if the emission intensity of the economy could be lowered by 1-1.5% per year as specified in Vietnam's national strategy on climate change (Prime Minister of Vietnam, 2021, p. 2), the estimated fossil emissions in 2030 would be 517 million tCO_2 (CI = [482,553 million])– relatively lower than the BAU scenario. The lower bound of the 95% confidence interval is slightly higher than the 2030 NDC target, implying that there would be a very significant probability of not reaching the milestone.

CBAM can also provide an additional justification for carbon pricing, though needs to be considered in a broader context of energy transition and low carbon development, from a revenue-generation perspective. Without carbon pricing, some emissions in Vietnam would be charged at the EU's ETS price and all pricing revenue would be collected by the EU. With carbon pricing, part of that revenue would be retained in Vietnam. The negative economic impacts of carbon pricing would arise mostly

when it impacted all commodities (that use fossil fuel directly or indirectly), not limited to CBAM commodities and not limited to export to the EU.

With emission intensity remaining unchanged, the estimated mean of fossil fuel emissions under carbon pricing would be 396 million tCO_2 (CI = [357, 449 million]). In this case, carbon pricing would help reduce fossil fuel emissions by providing a price signal for resource relocation toward sectors with lower emission intensity in the economy. If carbon pricing can promote the reduction in emission intensity, the estimated mean of fossil fuel emissions would be lowered to 379 million tCO_2 (CI= [339,430 million]) in 2023. Thus, while CBAM's direct support of Vietnam's NDC implementation is likely not large, it may provide incentives for reforms that can generate substantially higher impacts on NDC implementation.

Table 9-2 Estimated fossil fuel emissions in Vietnam 2030 and 2035 (million t CO_2)

Scenarios	2030	2035
BAU (continuing trends)	+538 [+502, +577]	+736 [+649, +831]
No carbon pricing, emission intensity remains	+538 [+502, +577]	+735 [+648, +832]
No carbon pricing, reduced emission intensity	+517 [+482, +553]	+673 [+595, +762]
Carbon pricing, emission intensity remains	+396 [+357, +449]	+548 [+496, +603]
Carbon pricing, reduced emission intensity	+379 [+339, +430]	+496 [+449, +547]

9.3. The benefits of the energy transition in Vietnam's electricity sector under carbon pricing and CBAM

Energy transition is expected to generate economic benefits under CBAM and carbon pricing. While available data and information do not allow an assessment of possible energy transitions in all 164 sectors of the economy, we attempted to evaluate the economic incentives of energy transition in Vietnam's electricity sector. In particular, we evaluated the gain (or loss) in GDP generated by the energy transition under CBAM and carbon pricing. In other words, we compare GDP - the most common measure of the value of an economy – between with- and without-energy-transition process if CBAM and carbon pricing are implemented.

To quantify the impact of energy transition in the electricity sector, we draw from Vietnam's legal documents (MOIT, 2022; Politburo, 2020) for the scheduled composition of the total electricity output in 2030 (i.e., hydroelectric, coal-fired, fuel oil-fired, diesel gas fired, renewable). Comparing what has been scheduled for 2030 and what happened in 2019 implies a rough estimate of a 13% reduction in the emission intensity over eleven years (see Appendix Table 12). We use this estimate to calibrate the energy transition process for the electricity sector. To quantify the impact of the scheduled energy transition in the electricity sector on CBAM-target sectors, we scaled down the emissions from electricity input in each sector by 13% over eleven years and used the share of electricity emissions in the total emissions to calculate the reduction in the emission intensity in each CBAM-target sector. The weight of electricity emissions in the total emissions for each CBAM-target sector is reported in Appendix Table 13.

Without carbon pricing (e.g., before 2028), energy transition would not generate benefits due to a small cost due to the relocation of resources, away from fossil fuel sectors. However, from 2028 when carbon pricing is added, there are gains in GDP, and the gains would increase over time. This is because

energy transition would shift economic resources away from fossil fuel which has become more expensive. Over the 10-year period from 2026 to 2035 inclusively, energy transition in the electricity sector would generate an estimated gain of 209 million 2019-value USD (CI = [143, 283 million]) under carbon pricing only and 248 million 2019-value USD (CI=173, 336 million]) under both carbon pricing and CBAM.

Table 9-3 GDP gains/losses generated by energy transition in Vietnam's electricity sector (million USD)

Year	Carbon pricing, no CBAM	Carbon pricing and CBAM
2026	-2 CI [-2, -1]	-1 CI [-2, -1]
2027	-3 CI [-5, -2]	-3 CI [-4, -1]
2028	+7 CI [+5, +10]	+8 CI [+6, +12]
2029	+11 CI [+7, +15]	+13 CI [+9, +18]
2030	+15 CI [+10, +21]	+18 CI [+12, +25]
2031	+21 CI [+14, +28]	+24 CI [+17, +33]
2032	+27 CI [+19, +37]	+32 CI [+22, +43]
2033	+35 CI [+24, +47]	+41 CI [+29, +55]
2034	+43 CI [+30, +59]	+51 CI [+36, +70]
2035	+54 CI [+37, +72]	+64 CI [+45, +86]
Total 2026-2035 period	+209 CI [+143, +283]	+248 CI [+173, +336]

Notes to Table 9-3:

- Positive numbers mean the energy transition generates gains in GDP, and negative numbers mean losses.
- Outside brackets are the estimated means, and inside brackets are the 95% confidence intervals.

10. IMPACTS ON POLICY AND REGULATIONS

This section discusses the potential impact of the CBAM on Vietnam's policy and regulations.

10.1. CBAM legal impact assessment

In terms of trade relations, the introduction of the CBAM shall be consistent with a number of WTO principles as well as a broader set of trade agreements that have been in place between Vietnam and EU, such as the EVFTA.

10.1.1. Vietnam's engagement in WTO, EVFTA and other international trade agreements with the EU

Vietnam became the 150th member of the WTO in 2007, and since then, the country and the EU have continued to strengthen their cooperative relationship through signing international agreements such as the EVFTA and the Double Taxation Avoidance Agreements.

The EVFTA aims to liberalise and facilitate trade and investment among Vietnam and EU member countries[9], based on the conformity with WTO regulations, Article XXIV of GATT 1994 and Article V of GATS[10]. Under the EVFTA, Vietnam and the EU continue adhere to the non-discrimination principles stipulated in the WTO Agreement, which includes national treatment and most-favour-nation treatment. The EVFTA requires the Parties to extend the same terms on trade, tariff, and foreign direct investment to all partners. Additionally, Vietnam has signed double taxation avoidance agreements with 80 countries and territories, including EU member countries, with the aim of eliminating double taxation and promoting cooperation between the tax authorities.

As the EVFTA is built on the basis of respective rights and obligations of the Parties under the WTO Agreement, Part 4.2 of the report will focus on assessing the compatibility of the CBAM with the non-discrimination principles of the WTO and EVFTA.

10.1.2. Challenging the CBAM under WTO Agreement and FTAs between the EU and Vietnam

The implementation of the CBAM is subject to a number of legal issues, including:

(i) *Compatibility with international trade rules*: CBAM may be incompatible with international trade rules, such as those established by WTO, if it is seen as discriminatory against foreign goods. The CBAM is required to ensure that it does not violate WTO rules on trade-related aspects of environmental measures or other trade agreements.
(ii) *International coordination* among other countries for the avoidance of unfair competition between countries or regions.

These are some of the main legal considerations that need to be taken into account by Vietnam when conducting an analysis of the CBAM, but there may be other issues arisen depending on the Vietnamese policies and decision.

The compatibility of the CBAM with WTO principles, the GATT and the FTAs signed between the EU and other countries (including Vietnam) is a subject of ongoing debate and legal analysis. On one hand, the CBAM could be seen as a measure to address a specific environmental problem and could be justified under the WTO's agreement on trade and environment (GATT, Article XX). This agreement allows members to take measures to protect the environment, provided they are not applied in a manner that would constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade. On the other hand, some countries and experts argue that the CBAM would be in violation of the most-favoured nation (MFN) principle under GATT, which requires that

[9] Viet Nam and EU (2020), Article 1.2
[10] Viet Nam and EU (2020), Article 1.1

WTO members provide equal treatment to goods from all other WTO members. They argue that the CBAM would discriminate against goods from countries without similar carbon pricing systems, creating an uneven playing field and potentially violating WTO rules.

Some have argued that the CBAM **may conflict** with the WTO principles of non-discrimination and most favoured nation treatment, as it imposes a carbon border price on imported products that have higher emissions than their European counterparts while non-discrimination principle requires that imported products be treated no less favourably than domestically produced products and that a country cannot discriminate between its trading partners. The carbon border price may make imported products more expensive and thus less competitive compared to domestically produced products, which would be seen as discriminatory.

However, Article 31.1(b)(new) of the amendment of CBAM made by the European Parliament on June 22, 2022 would make CBAM no longer fully compatible with the national treatment principle. This amendment provides for the continuation of free allocation, provided that such products are produced for export to third countries without carbon pricing mechanisms similar to the EU ETS. This could make these products more competitive in foreign markets. However, others argue that the CBAM is compatible with the non-discrimination provisions of the WTO and GATT, as (i) it aims to level the playing field for European businesses and ensure that imported goods face the same carbon costs as domestically produced goods. By doing so, the CBAM helps to eliminate the incentive for companies to shift production to countries with less stringent environmental regulations, which could help reduce emissions globally; and (ii) that the CBAM is a legitimate environmental policy measure, and that the WTO and GATT provisions on environmental protection allow for measures to be taken to protect the environment, provided that they are non-discriminatory and not used as a disguised restriction on trade.

Article XXXVII:3(c) GATT requires WTO members to have special regard to the trade interests of less-developed contracting parties when considering the application of other measures permitted under this Agreement to meet particular problems, and explore all possibilities of constructive remedies before applying such measures where they would affect essential interests of those contracting parties. This regulation means that, when proposing CBAM, the EU should consider the status of developing and less-developed countries so as not to suddenly impact their development. To ensure the obligation in Article XXXVII:3(c) GATT 1994, the idea of introducing a transitional period for CBAM adoption would likely make it compatible with the S&D principle.

For instance, some African lower-income countries disagree with CBAM. They worry it would apply an unfair economic burden on them and undermine their right to development, underscoring that the EU would be imposing climate policies on countries with lower levels of economic development. It also came on top of sentiments concerning the EU being neo-colonial about climate policy by aiming to secure raw materials for energy transition and selling instead of sharing its green technology. Indeed, some of the countries with relatively high exposure and vulnerability to CBAM are located in Africa. Experts warn that CBAM could damage some African economies, such as Egypt, Nigeria and Algeria, and could severely affect their ability to continue with industrialisation. Foremost among them is Mozambique, which exports 54.1% of its aluminium to the EU (5.8% of EU imports) and where CBAM impact might cause its GDP to fall by 1.6% (Pauw, van Schaik, & Cretti, 2022, p. 3).

In Vietnam, a developing country (it is ranked a low middle-income country) (The World Bank, 2022), a carbon pricing market/system will not be launched and operated until 2028. From 2022 to the end of 2027, Vietnam is still in the development and pilot phase[11]. In the meantime, the law-making procedure in Vietnam often takes a long time and involves many steps, requiring consultation with various agencies, mass organisations and authorities, such as:[12] (i) inserting the law-making proposal

[11] The Government of Viet Nam (2022), Article 17

[12] The National Assembly of Viet Nam (2015), Chapter III

into the legislative program[13]; (ii) law drafting[14]; (iii) draft evaluation by the Government[15]; (iv) draft appraisal by the NA Standing Committee about law projects[16]; (v) discussing, revising, approving law projects[17]; (vi) announcing laws[18].

In Vietnam, the policies/laws impact assessment step is nested in the step (i) named inserting the law-making proposal into the legislative agenda, which is prescribed as follows (see Figure 10-1) (Ministry of Justice, 2018, pp. 11-12):

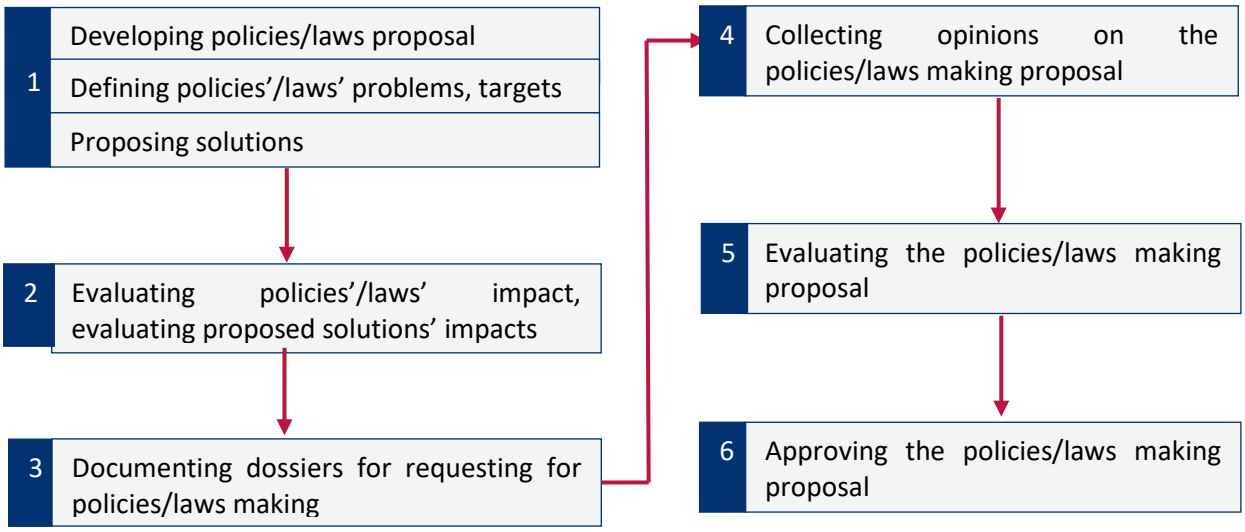


Figure 10-1. Policies/laws impact assessment steps in Vietnam

The above diagram aims to summarise the preliminary tasks of the policies/laws impact assessment to be carried out at in the first step of the law making/policy making process. The whole process will require more complex tasks and take time.

If the law cannot be developed or adjusted in time to form a carbon pricing market/system before 2026, Vietnam's exported products and goods to the EU will have to buy carbon certificate under CBAM Regulation. This can be detrimental to Vietnamese exporters and CBAM's 3-year transitional period does not seem to be really feasible for the current situation of formulating a carbon pricing market/system in Vietnam.

a) Whether or not CBAM is a measure necessary to protect human, animal or plant life or health under Article XX GATT

The CBAM could be seen as a measure necessary to protect human, animal, or plant life or health, as it aims to reduce the emissions associated with the production and import of goods, which are a major contributor to climate change. Climate change is a global threat to human, animal, and plant life, and addressing this threat through measures such as the CBAM could be seen as necessary to protect life and health. In proposing the CBAM, the EU cautiously considers the CBAM as a climate measure, which primarily aims at preventing carbon leaks associated with ETS tightening. The CBAM is built by the EU

[13] The National Assembly of Viet Nam (2015), Section 1
[14] The National Assembly of Viet Nam (2015), Section 2
[15] The National Assembly of Viet Nam (2015), Section 3
[16] The National Assembly of Viet Nam (2015), Section 4
[17] The National Assembly of Viet Nam (2015), Section 5
[18] The National Assembly of Viet Nam (2015), Section 6

based on international commitments on reducing GHG emissions and protecting the environment in the Paris Agreement. Accordingly, each committing party must prepare the (NDC) for this global goal, reflecting the "highest possible ambitions" as well as "reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances" [19].

The CBAM Proposal sets out its "general objectives" of "addressing climate change by reducing GHG emissions in the EU and globally" (European Commission, 2021c, p. 47). In which, it is important to ensure that EU products and those imported into EU have an equal basis for ETS carbon pricing. The adoption of CBAM could also lead to "specific objectives" (European Commission, 2021b, p. 15), in particular, "encouraging manufacturers in third countries that export to the EU to adopt low carbon technologies" to strengthen the necessary common climate action by all committing Parties of the Paris Agreement to achieve the goal of limiting the average annual temperature increase by about 1.5°C/2°C. In its impact assessment report, the European Parliament also argues that the CBAM is a "health and environment" measure and "relates to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption", which falls into the exception under Article XX(b) and Article XX(g) of GATT. There are still many objections to the EU's argument that the CBAM as an environmental protection measure subject to the exception of Article XX GATT 1994 and therefore "has no legal significance" (Bacchus, 2021, p. 4). It is impossible to draw any conclusion about the legitimacy of the CBAM based solely on the basic objectives stated by the EU.

b) CBAM's compatibility with EVFTA

The compatibility of the CBAM with the trade agreements between Vietnam and the EU would hinge on whether the mechanism aligns with the shared goals of environmental protection and sustainable development. On the other hand, if the CBAM is seen as a trade barrier or a hindrance to free trade, it may be viewed as incompatible with these agreements. This is because the CBAM would impose a border carbon price on imported goods from Vietnam, which is currently in the process of establishing its own equivalent carbon pricing system. EVFTA refers to the national treatment principle of GATT 1994. The assessment of CBAM's compatibility with the national treatment principle in EVFTA, therefore, will be similar to the assessment for the national treatment principle in GATT 1994 in the above section.

Furthermore, the EVFTA includes provisions that "*A Party shall not maintain or adopt any duties, taxes, or other charges of any kind imposed on, or in connection with, the exportation of a good to the territory of the other Party that are in excess of those imposed on like goods destined for domestic consumption, other than in accordance with the schedule EU/VN/en 16 included in Appendix 2-A-3 (Export Duty Schedule of Vietnam) to Annex 2- A (Reduction or Elimination of Customs Duties)*" [20]. As such, Vietnam should consider whether the EU is obligated to refrain from imposing charges on the EU importers for purchase of the CBAM certificate under Article 2.11 of EVFTA.

In brief, even though, that additional charges may be necessary to ensure that imported goods face the same costs as domestically produced goods, and to prevent companies from shifting production to countries with less stringent environmental regulations. The CBAM should not adopt additional charges that are in excess of those imposed on like goods for domestic consumption, as this could be seen as discriminatory and a violation of the EVFTA, non-discrimination provisions of WTO and the GATT.

c) CBAM's compatibility with Double Taxation Avoidance Agreements (DTAAs) between Vietnam and EU member countries

[19] United Nations (2015), Article 4(3)

[20] Viet Nam and EU (2020), Article 2.11 (1)

So far, Vietnam has signed double taxation avoidance agreements with most of the EU member countries. Accordingly, the parties undertake not to levy double taxation on the incomes or assets of Vietnam's residents or residents of the other party within the governance scope of such agreement if the income or assets of such residents may be taxed in Vietnam or in the other party.

From our review of the taxes mentioned in the double taxation avoidance agreements of Vietnam and EU member countries, these agreements only focus on income tax (of individuals or businesses) and do not refer to carbon tax or other state levies related to GHG emissions arising from the production of goods. Therefore, if the EU applies the CBAM to export products of Vietnamese enterprises, this will not affect the commitments in the double taxation avoidance agreements that EU member countries have signed.

To summarise, some countries view the CBAM as a trade barrier. Additionally, the CBAM could also have implications for the EU's existing FTAs, particularly if they include provisions on the elimination of trade barriers. For example, a trade partner may challenge the CBAM as a violation of the EU's obligations under an FTA, arguing that it constitutes an unjustified trade restriction. However, it's also possible that the CBAM could be seen as a necessary step in the transition towards a low-carbon economy. In that sense, the CBAM could be seen as a tool to support the goals of the Paris Agreement and encourage other countries to adopt similar measures.

The compatibility of the CBAM with the WTO, GATT as well as FTAs signed with Vietnam is a complex issue, and the final verdict will likely depend on the outcome of any legal challenges that may be brought to the WTO or other international courts as well as political considerations and the views of different stakeholder groups. It is important to note that the CBAM is still a relatively new policy, and its compatibility with international trade rules will likely continue to be evaluated and debated in the coming years.

10.2. CBAM impacts on existing policies and legal framework of Vietnam

10.2.1. Policies and legal framework related

In order to fight climate change, reduce GHG emissions and achieve green growth, Vietnam has made several international commitments as well as promulgated a wide range of domestic policies and related regulations such as: (i) The United Nations Framework Convention on Climate Change (UNFCCC) signed on June 11, 1992 and ratified on November 16, 1994; (ii) The Kyoto Protocol of the UNFCCC signed on December 3, 1998 and ratified on September 25, 2002; (iii) The Paris Agreement on climate change signed on April 22, 2016; (iv) NDC of Vietnam first drafted in 2015, amended in 2020 and 2022); (v) Political Declaration on establishing the Just Energy Transition Partnership (JETP) agreement officially made between the Socialist Republic of Vietnam and the International Partners Group in December 2022.

Notably, at the COP26 Conference, Vietnam pledged to achieve "net zero emissions" by 2050. One year later, at the COP27 Conference, Vietnam reaffirmed its commitment to promoting fair and just energy transition continued discussion with the International Partners Group (IPG)[21] to ensure legal and equitable energy transition in Vietnam.

According to the NDC updated in 2022, Vietnam has set emissions reduction goals in energy, agriculture, LULUCF (land use, land use change and forestry), waste and industrial processes by 2030 compared to BAU higher than those in the NDC 2020.

Regarding national regulatory aspect, Vietnam has promulgated several policies, strategies, plans and action programs from the central to local levels in response to climate change, reduction of GHG emissions to achieve the goal of green and sustainable development. Most recently, Resolution No.

[21] The IPG includes the G7 and G7 extended countries as development partner countries led by the G7 Group of Industrialised Countries.

01/NQ-CP has set out major tasks and solutions in accordance with Vietnam's socio-economic development plan in 2023. Among them are such important tasks as: implementing energy restructure, reducing carbon emissions toward carbon neutrality by 2050[22]; strengthening communication and dissemination of international regulations in the application of emission standards, especially the CBAM for goods exporting to the EU market[23].

The national policies also emphasise the importance of researching and developing the carbon market, as well as carbon pricing tools effectively to achieve its goals of proactively responding to climate change and reducing GHG emissions towards the country's net zero emissions by 2050.

10.2.2. Possible impacts of CBAM on Vietnam's energy transition, existing policies, and legal framework

In general, the CBAM may provide an incentive for Vietnamese companies to adopt more sustainable production methods, to transition to lower carbon-intensive production processes to avoid paying the carbon price imposed by the CBAM. Additionally, the development of low-carbon production methods could also spur the growth of a domestic carbon market in Vietnam, as companies may look to generate and sell carbon credits. Such credits could be used against a domestic ETS or carbon tax or be sold under the international carbon market under Article 6 of the Paris Agreement. This could support Vietnam's energy transition strategy by encouraging the adoption of renewable energy and energy efficiency measures, and reducing the carbon footprint of Vietnamese export as well as to drive the transition towards a low-carbon economy in Vietnam and support the country's NDC and Paris Agreement goals. Another positive impact is to support to improve the country's competitiveness in the long term, and position it as a leader in the global shift towards a low-carbon economy.

Regarding, its existing legal framework, Vietnam has taken steps to address the issue of climate change and has shown interest in implementing a carbon pricing mechanism as part of its efforts to reduce GHG emissions. However, the country's legal framework for carbon pricing is still under development and an effective carbon pricing mechanism is still far away that triggers relevant mitigation.

Vietnam has committed to reducing its GHG emissions as part of the Paris Agreement and has set a target to reduce its emissions by 15.8% unconditionally and 43.5% conditionally on international support compared to BAU by 2030. The government has also shown support for the use of market-based mechanisms to achieve these reductions. However, the implementation of a domestic carbon market in Vietnam will require the development of a comprehensive legal framework that includes the design and implementation of the mechanism, the generation of emission credits or allocation of allowances a cap and trade system is chosen, and the enforcement of compliance for such a system. This will require close coordination among various government agencies, as well as stakeholder consultation to ensure that the mechanism is effective and equitable.

- Article 99. (2) of the Law on Environmental Protection 2020 provides 05 principles to reduce GHG emissions, including "organizing and developing the domestic carbon market". Accordingly, domestic carbon market accommodates the exchange of GHG emission allowances[24] and carbon credits[25] obtained from the mechanism of exchanging and offsetting carbon credits domestically and internationally in accordance with the laws and international

[22] The Government of Viet Nam (2023), II.5 (c)

[23] The Government of Viet Nam (2023), II.6 (g)

[24] GHG emission limit means a GHG volume calculated in ton of carbon dioxide (CO2) or ton of CO2 equivalent which a country or an organisation or individual is allowed to emit during a given period (according to Law on Environmental Protection in 2020, Article 3, Clause 33).

[25] Carbon pricing means any tradable certificate showing the right to emit one ton of CO2 or one ton of CO2 equivalent (according to Law on Environmental Protection in 2020, Article 3, Clause 35).

treaties to which the Socialist Republic of Vietnam is a contracting party. In addition, the Law on Environmental Protection 2020 has yet to identify a specific carbon price as noted in the existing domestic policies.

Pursuant to the Law on Environmental Protection Tax, the "environmental protection tax"[26] is an indirect tax imposed on products which, when being used, cause adverse impacts on the environment, including *gasoline, oil, grease; coal; hydro-chloro-fluoro-carbon solution; herbicides of restricted use; termite insecticides of restricted use; forest product preservation drugs of the restricted use category; warehouse disinfectants are restricted to use*. In addition, the Standing Committee of the National Assembly may consider and prescribe additional taxable objects from time to time[27].

- The Law on Natural Resources Tax 2009 defines "natural resources tax" as a tax imposed on the exploited natural resources including: *metal minerals; non-metallic minerals; crude oil; natural gas, coal gas; products of natural forests, excluding animals; natural seafood, including marine animals and plants; natural water, including surface water and underground water, except for natural water used for agriculture, forestry, fishery and salt production; Bird's nest and other natural resources as prescribed by the National Assembly Standing Committee.*

Furthermore, the environmental protection fee[28] under applicable Vietnamese law is only applied in certain cases, namely for wastewater and mineral exploitation. In Resolution No. 01/NQ-CP dated January 06, 2023, Appendix V, Section 18, the Government has assigned specific tasks for the Ministry of Finance to promulgate the "Decree regulating environmental protection fees for emissions" by December 2023. Compared to the goods covered by the CBAM in the early stage, including iron and steel, cement, aluminium, fertiliser and electricity (which can be extended to organic chemicals, plastics, hydrogen and ammonia, oil refining), Vietnam's current taxes and fees on environmental protection and natural resources have governed a part but not the whole of the goods covered by the CBAM (coal is used in manufacturing iron and steel, cement, aluminium, fertiliser and electricity).

Vietnam's policies and regulations on domestic carbon market

Pursuant to the Law on Environmental Protection 2020, the domestic carbon market includes any activity to exchange the GHG emission allowances and carbon credits in accordance with the provisions of law and other international treaties to which Vietnam is a member[29].

- GHG emitters can only emit GHGs within their allocated allowances; in the case that any demand for emissions exceeds the allocated allowances, they would need to buy allowances from other entities in the domestic carbon market[30]. In return, the GHG emitters that reduce

[26] According to Law on Environmental Protection 2020, Article 136, clause 1, Environmental protection tax shall be imposed on products and goods the use of which causes adverse environmental impacts or generates environmental pollutants. Environmental protection tax rates shall be determined based on extent of adverse environmental impacts.

[27] Details about taxable and non-taxable objects are specified in *Law on Environmental Protection Tax 2010*, Articles 3, 4 and *Decree No. 67/2011/ND-CP*, Article 2; *Decree No. 69/2012/ND-CP*, Article 1; *Circular No. 152/2011/TT-BTC*, Article 1, Article 2; *Circular No. 159/2012/TT-BTC*, Article 1.

[28] According to *Law on Environmental Protection 2020*, Article 136, Clause 2, environmental protection fee shall be imposed on discharge of wastes into the environment; exploitation of minerals or exertion of adverse environmental impacts; public services in the field of environmental protection in accordance with the law on charges and fees.

[29], Article 139.(1)
[30], Article 139.(4)

GHG emissions or do not use up their allocated emission allowances can sell their allowances to others via domestic carbon market[31].

- GHG emitters involved in domestic carbon market will exchange, auction, borrow, pay, or transfer their GHG emission allowances and carbon credits; implement mechanisms for trading and offsetting carbon credits inside and outside the country in accordance with the provisions of law and international treaties that Vietnam is a member[32].

According to the provisions of the Law on Environmental Protection 2020 on domestic carbon market, on January 7, 2022, the Government issued Decree No. 06/2022/ND-CP on emission reduction GHG and ozone layer protection, including detailed regulations on organisation and development of carbon markets. Accordingly, in Article 17 of this Decree, the roadmap and time for developing the domestic carbon market includes 2 phases (till the end of 2027 and from 2028), and each phase has its main tasks as follows:

Phase	*Till the end of 2027*	*From 2028*
Main Tasks	• To establish regulations on carbon credit management, GHG emissions allowance and carbon credit exchange; to establish regulations on operation of carbon credit trading market; • To implement experimental mechanisms for carbon credit exchange and reimbursement in potential sectors; to guide the mechanisms for carbon credit exchange and reimbursement on national and international scale in accordance with laws and international treaties that Vietnam is a member of; • To establish and pilot carbon credit trading market from 2025; • To organise activities of capacity building, raising awareness of the carbon market.	• To officially establish and operate the domestic carbon market in 2028; • To establish rules on activities of connecting and exchanging carbon credits between the domestic market and regional and global ones.

Decree No. 06/2022/ND-CP provides a set of fundamental regulations for the exchange of GHG emission allowances and carbon credits within the domestic carbon market. It also outlines the procedures for certifying carbon credits and GHG emission allowances purchased within this market[33].

However, the Ministry of Finance and the Ministry of Natural Resources and Environment have yet to issue guidelines on the financial management and operational mechanisms necessary for the establishment of the domestic carbon market, in addition to the regulations set out in the Law on Environmental Protection 2020 and Decree No. 06/2022/ND-CP.

According to Article 9.1 of CBAM Regulation and amendment 81: "*An authorised declarant may claim in its CBAM declaration a reduction in the number of CBAM certificates to be surrendered in order for the explicit carbon price paid in the country of origin for the declared emissions embedded to be taken into account. That reduction may also be 100% if the carbon price paid in the country of origin is*

[31], Article 139.(5)
[32], Article 139.(7)
[33], Articles 18, 19

equivalent to or higher than the Union carbon price."[34] It means that it is possible to reduce the number of CBAM certificates required to be surrendered in their declaration by citing the explicit carbon price paid in the country of origin for the declared emissions embedded. This reduction can be up to 100% if the carbon price paid in the country of origin matches or exceeds the Union carbon price. To avoid the need for Vietnamese exporters to purchase CBAM certificates, it is important to ensure that the carbon price in Vietnam is at least equal to, or higher than, the EU carbon price. Achieving this requires Vietnam to establish and enforce regulations for carbon pricing and ensure that they are in compliance with the EU carbon price. While Vietnam's Law on Environmental Protection 2020 contains some specific regulations for the domestic carbon market, including ETS, further development of the carbon market in Vietnam is necessary. To this end, on November 26, 2021, the Ministry of Natural Resources and Environment submitted Report No. 87/TTr-BTNMT to the Prime Minister for approval of a project aimed at developing the carbon market in Vietnam. However, the project is still awaiting approval.

Vietnam's legal framework for carbon pricing is still under development, and its current rules on environmental taxes and other fees only partially address some goods within the scope of CBAM. A full implementation to address an expanded CBAM would only be needed in the 2030s.

10.3. Should Vietnam join a WTO case against the EU about the EU CBAM?

Whether or not Vietnam should join a WTO case against the EU over the CBAM is a complicated and nuanced question depending on the interests and priorities of the Vietnamese government, and the broader implications for the country's trade relationship with the EU. Under the current CBAM coverage, taking legal action against the EU would does more harm than good, and make it more difficult to negotiate mutually beneficial trade agreements in the future.

The generation of carbon credit in Vietnam under current laws will not start before 2028. The government can thus put pressure on the EU to allow offset submission instead of paying the CBAM charge in the next five years; however, it needs to be able to show a credible threat potential.

Vietnam is entitled to apply for the WTO's dispute settlement system

According to WTO statistics, Vietnam has been the claimant of 5 cases at WTO to date (i.e., 4 cases with respondents being US, 1 case with respondent being Indonesia). Vietnam has been the third party of 39 cases (; The World Trade Organization, n.d.). None of these cases relates to environmental regulations. Therefore, it is deemed that Vietnam's experience from the filed cases in the past could not be considered as precedents for suing CBAM in the future (if any).

It should be noted that currently the WTO's dispute settlement system is stalled as panel members are not replaced and there is no legal remedy to mandate parties to do so.

A number of arguments exist against filing a WTO case; they are specified below:

First, the proceedings take times and burden of costs

Although Article 12.9 of the DSU prescribes a nine-months for panel proceedings, they typically take around 15 months, which can extend up to 18 months if the report is appealed. This is followed by a stage of surveillance of implementation of recommendations and rulings, which may take an average of 10 months. The World Trade Organization (n.d.).

The lengthy duration of dispute resolution can result in substantial expenses for parties involved, particularly developing countries. According to Nguyen (2012) and Ramizo (2012), in 2015, the estimated costs for one party to file a case at WTO was approximately 500,000 USD, calculated from

[34], Article 9.1

the launch of the case to the adoption of the dispute settlement report and depending on the complexity of the case (The World Trade Organization, n.d.). The current cost maybe even higher. Pursuing a case mandate at WTO incurs expenses related to evidence collection, case files, consultations with lawyers and experts (both natives and foreigners) and monitoring implementation of recommendations and rulings.

With the new CBAM Regulation, extensive research before suing CBAM is essential, and professional lawyers and experts may be necessary for these tasks. The limited loss from CBAM calculated above shows that incurring high transaction costs may not make sense.

Second, political, and economic pressures

Ultimately, the decision of whether to join a WTO case would need to be made based on a careful assessment of the potential benefits and risks, and in light of the broader interests of the Vietnamese government and the country as a whole. It may also be useful to consider alternative approaches, such as engaging in constructive dialogue with the EU, seeking specific exemptions or compensation arrangements, or pursuing alternative low-carbon production methods.

11. POLICY IMPLICATIONS OF FINDINGS

Our analysis indicates that the estimated impacts depend on various assumptions, parameters, and the uncertainties remain significant as one moves towards the future. Although specific numerical results may differ across scenarios, they provide several direct policy implications that decision-makers should consider.

First, CBAM in the currently proposed format directly impacts only a small part of Vietnam's entire economy. However, for directly impacted exporters to the EU, the impact can be significant. In the future, the scope of CBAM may expand (e.g. to ceramics, pulp, and paper which are in the EU's ETS) and thus become more relevant for Vietnam. Moreover, significant indirect costs may arise in relation to GHG accounting and reporting systems across the value chain of a product. But the CBAM may also drive exporter in other Asian countries to redirect exports to Vietnam, maybe even at lower prices than before. Therefore, it is important to watch the CBAM evolvement closely. Vietnam's government and development partners may consider supporting further research and comprehensive data collection on the list of commodities in the EU's ETS in near future (2-3 years).It is also crucial for Vietnam to engage in negotiations with its key trading partners .

Second, CBAM can provide benefits for producers that would like to reduce emission intensity. They would increase their competitiveness in the EU market by the reduced payment having to make for purchasing the CBAM certificates to compensate for their emissions. If this impact could spread out to other sectors, the emission intensity of the entire economy would be lowered. We estimated that if the emission intensity of the economy could be lowered by 1%-1.5% per year as specified in Vietnam's green growth strategy, the estimated fossil emissions would be significantly, but there would be a non-trivial probability of not reaching the milestone of Vietnam's NDC. Government and department partners should provide support to studies that can provide further insight into the potential of energy transition to reduce the emission intensity of high-emission commodities, including commodities Vietnam do not export.

Third, it is technically possible to reduce emission intensity in CBAM-targeted sectors. The results from our enterprise survey reveal a significant difference in emission intensity between Vietnam's and the global average as well as across enterprises within each individual sector. This result indicates room for improvement in energy efficiency, where high-emission-intensity enterprises can catch up with their peers. It highlights the importance of research and development (R&D) activities to promote technological progress for overall efficiency, i.e., more output produced with less input, and also emphasises the role of economic tools to further promote emission intensity reduction by substituting fossil fuels with renewable inputs. Investing in R&D and implementing economic policies that encourage the adoption of cleaner technologies could lead to significant emission reductions and enhance the competitiveness of CBAM-targeted sectors.

Fourth, carbon pricing is essential to reduce fossil fuel emissions across Vietnam's economy. By putting a price on carbon, the cost of emissions would increase, providing direct incentives for private economic agents to substitute high-emission inputs or consumption goods with alternatives. In addition to this substitution effect, our findings suggest that carbon pricing may generate billions of dollars in revenue every year, which can be used to support technological changes and promote further the energy transition process. Therefore, if effectively implemented, carbon pricing would provide a framework for decision-makers in both the private and public sectors to reduce emissions.

Fifth, carbon pricing is a priority in Vietnam's NDC implementation. In addition to being part of NDC commitments, carbon pricing is crucial for Vietnam to achieve committed targets. Our results suggest that Vietnam would not be able to achieve its 2030 target of fossil fuel emissions if current trends continued. Even when Vietnam could, without carbon pricing, devote resources to promote energy transition as expected, achieving the 2030 target would not be guaranteed. Thus, incorporating a

carbon pricing mechanism is key for Vietnam to meet its NDC targets, though there are other non-carbon pricing instruments such as subsidies for renewables may help achieve the NDC as well.

Finally, acceleration of actions and policies toward Vietnam's emission targets should be considered whenever appropriate. According to the data of the International Energy Agency (IEA), the emissions from using fossil energy (oil, coal, and gas) in Vietnam increased from 148 million tCO_2 in 2014 to 296 million tCO_2 in 2020, i.e., an annual rate of 12%, far higher than the economic and demographic growth rates. As a result, the fossil emissions per capita have increased, and Vietnam has required more fossil emissions, instead of less, to produce one dollar of economic value-add. If the trend continues, it will become increasingly difficult for the country to achieve its emissions reduction targets. Therefore, it is crucial to reverse or slow down this trend as soon as possible. Otherwise, Vietnam will have very limited time to achieve its committed emission targets, even with 'hard braking' measures which usually incur substantial costs in terms of economic and social conditions.

12. RECOMMENDATIONS FOR DEVELOPING SECTORAL MITIGATION PLANS

As shown in the modelling results, to reduce the negative impacts of CBAM on producers and exporters of goods from Vietnam to the EU, it is necessary to reduce the emission intensity of the exported products in each of the CBAM sectors. For a consistent and effective approach, the effort should be taken at the sectoral level. The effort can also extend to other sectors and bring significant benefits on energy transition and decarbonisation. The modelling results also show that GHG mitigation can reduce or even neutralise the negative impacts of carbon pricing in Vietnam.

12.1. Steel sector

Emissions by iron and steel sector come from two main routes of steel production, namely Blast Furnace/Basic Oxygen Furnace (BF-BOF) route and scrap steel/Electric Arc Furnace (EAF) (The World Trade Organization, n.d.). Each technology involves different processes of steel making and thus different carbon emission intensities. The main energy inputs for BF-BOF processes are coking coal, so most of the emission comes from the consumption of this input material. Scrap-based technology mainly utilises electricity for energy inputs and have lower GHG emissions. According to the report No. 2152/BCT-CN of the Ministry of Industry and Trade (MOIT) to the Prime Minister on the proposal to develop the "Strategy to develop Vietnam's steel industry to 2030, with a vision to 2050", in 2021 there were 42% of crude steel production utilizing scrap-based technology and 58% utilizing BF-BOF technology (The World Trade Organization, n.d.).

The surveyed average carbon intensity of Vietnam's iron and steel sector under this assignment is determined at 2.3 tCO_2/tonne of output. Based on the production output of 23.02 million tonnes in 2021, the total carbon emission by Vietnam's iron and steel production is estimated at around 53 million tCO_2e.

12.1.1. Sectoral mitigation target in 2022 NDC

According to the BAU emission scenario for iron and steel sector in the 2022 NDC, total emissions by this sector will be at 49.7 million tCO_2e and 70 million tCO_2e by 2025 and 2030 respectively.

The 2022 NDC also identifies five mitigation measures with respective emission reduction potentials for iron and steel production for period 2025-2030. The measures are divided into unconditional contribution measures and conditional contribution measures. Details of mitigation measures, their emission reduction potentials, abatement cost and financial needs as well as assumptions are provided in the table below.

Table 12-1 Mitigation measures for iron and steel sector in Vietnam's updated NDC 2022

Measure	Emission reduction potential (million t CO_{2e})			Abatement cost	Financial need for 2021-2030	Assumption
	2025	2030	2021 -2030	USD/tO_{2e}	million USD	
Unconditional mitigation measures						
E12. Preheating of scrap steel before	0.01	0.06	0.23	-60.39	8.7	By 2030, the measure of preheating scrap steel

Measure	Emission reduction potential (million t CO_{2e})			Abatement cost	Financial need for 2021-2030	Assumption
	2025	2030	2021 -2030	USD/tO_{2e}	million USD	
putting it into electric arc furnace (EAF)						before being put into EAF will be applied to produce about 30% of EAF steel output
E13. Heating in steel rolling mills	0.08	0.34	1.38	-72.21	36.2	By 2030, heating in steel rolling mills will be applied to produce about 50% of steel output by EAF technology
E14. Heat recovery from blast oxygen furnaces (BOF)	0.39	1.25	5.31	-34.16	120.7	By 2030, heat recovery from blast furnaces will be applied to the production of 100% of steel output BOF technology
E15. Spray powdered anthracite coal into blast furnace	0.22	1.41	4.57	-85.45	37.7	By 2030, the measure of spraying powdered anthracite coal into blast furnaces will be applied for the

Measure	Emission reduction potential (million t CO_{2e})			Abatement cost	Financial need for 2021-2030	Assumption
	2025	2030	2021 -2030	USD/tO_{2e}	million USD	
						production of 100% of cast iron output
Conditional mitigation measure						
I4s. Applying the best technology to reduce emissions in the iron and steel industry (improvement of BOF technology)	5.28	16.35	61	24.14	1,472.65	During period 2025 – 2030 iron and steel sector needs to improve its production efficiency to achieve IPCC CO_2 emission intensity and 50% of steel companies achieve CO2 emission intensity of 1.22 $tCO_{2/t\text{-}steel}$

Source: Compiled from Vietnam's updated technical NDC 2022

Notes to Table 12-1:

- Abatement cost: the additional cost (using 2020 value) to reduce emissions by 1 t-CO_2e compared to the case where no emission reduction measures are applied. If the economic benefit from the emission reduction measure is greater than the cost, the abatement cost is negative. The above abatement costs are estimates, based on some assumptions that may not be exhaustive.
- Additional financial need: the additional investment cost (using 2020 value) to implement emission reduction measures.

By implementing unconditional mitigation measures for iron and steel production, Vietnam could reduce 11.49 million t-CO_2e for period 2025-2030. This requires an additional financial investment of 303.3 USD million, but it could also help the sector save 252.21 USD for each t CO_2e emission reduced.

Conditional mitigation measures could help reduce 61 million tCO_2e during period 2025-2030 and requires USD 1.5 billion additional international financial support.

12.1.2. Gap analysis

Even though being an important economic sector with a growth rate of 17.5%/year period 2011-2020, Vietnam's iron and steel sector has not had its own development plan and strategy (The World Trade Organization, n.d.). The iron and steel sector development plan issued by MOIT in 2013 has been expired and not suitable for the new economic context. There are ambitions to reduce carbon intensity in steel production in legal documents such as the NDC, VGGS, but there is no national standard on GHG emissions for iron and steel sector.

In terms of technology, Vietnam has a big capacity for crude steel production, but most blast furnaces in the country are small capacity ones (blast furnaces ranging from 50 - 110 m^3 capacity) except for big players such as VNSteel, Hoa Phat and Formosa. Many small and medium enterprises installed 50 – 70 m^3 blast furnaces which have been used for many years with low efficiency. Investment in heat recovery and innovative technologies will be a challenge and result in low efficiency and low economic return. Besides, there are hundreds of small downstream steel processing facilities that carried out finishing steps, such as milling, coating, finishing, etc., and their production depends on steel price and demand of the market. There is little motivation for them to adopt new technologies.

Despite their significant potential in reducing carbon intensity in steel production, it is generally agreed that breakthrough technologies such as hydrogen and electrolysis will not be commercially available before 2030. Some of those technologies such as carbon capture and storage are only likely to be feasible in very specific locations with suitable geological structures and are therefore not feasible in Vietnam.

Vietnam's iron and steel production highly depends on imported raw materials whose prices fluctuate according to the world market. In 2022, Vietnam imported 18 million tonnes of iron ore for blast furnaces, about 6-6.5 million tonnes of scrap steel for electric furnaces, 6.5 million tonnes of coking coals and about 10,000 tonnes of graphite electrodes (Nottage, 2009). This high dependency on input materials and fuel unable companies to plan for long term decarbonisation plan adopt new technologies.

12.1.3. Recommendations

Vietnam needs to have a clear development plan and strategy for iron and steel sector as soon as possible. This will act as the guidelines for enterprises in the sector to navigate their development strategy where decarbonisation should be prioritised as a requirement. It is recommended to make the implementation of mitigation measures as a criterion in investment in building new iron and steel plants or improved old ones to ensure sustainable development and environmental protection. The sectoral development plan should identify a clear decarbonisation roadmap taking into account the mitigation targets set for iron and steel sector stipulated in the NDC and VGGS. Furthermore, a national standard on GHG emissions for the iron and steel industry should be developed, possibly based on the international standard ISO 14404. This is an important legal basis that needs to be concretised to serve emission reduction efforts by enterprises.

The government also needs to have special policies to incentivise decarbonisation efforts from enterprises, for example carbon pricing instruments. The project component CS2.2 under VNPMR project proposed to develop a crediting program for the iron and steel sector in Vietnam. This program would server multiple purposes including supporting the achievement of NDC targets, mobilizing funding from international sources and supporting the preparation for the implementation of the domestic ETS.

At the same time, steel enterprises need to select and apply advanced processing and production technology focusing on cleaner production technology. Besides, Vietnamese iron and steel enterprises need to continue to research and apply not only measure indicated in the NDC but other energy saving solutions, in which focusing on improving the common practices and management system can result in great emission reduction. On the other hand, it is necessary to consolidate and improve the qualifications of technicians and environmental management staff in steel production through trainings and international cooperation on scientific and technological research.

12.2. Aluminium sector

Vietnam holds nearly 19% of the world bauxite reserves with an estimation of 5.8 billion tons (Ramizo, 2012). In Vietnam, bauxite-alumina industry is relatively young and has only developed over the last ten years. All alumina produced in Vietnam is exported.

Because Vietnam currently does not have the capacity for aluminium smelting, manufacturers in the aluminium industry still completely depend on importing aluminium ingots and billets to produce aluminium products, such as aluminium profiles, structural products, and industrial production components. The aluminium electrolysis is a very energy intensive process, and the operation of an aluminium smelter would create extra load on the grid without careful planning. Thus, aluminium manufacturing process in Vietnam only cover aluminium casting (extrusion, rolling) and plating/coating. Figure 12-1 describes a simplified aluminium production process and types of GHG emission resulted from the process. Because of the dependency on raw material import which leads to the complexity in setting the system boundary for aluminium in Vietnam, it is extremely difficult to estimate the energy consumption and emission intensity of the aluminium sector.

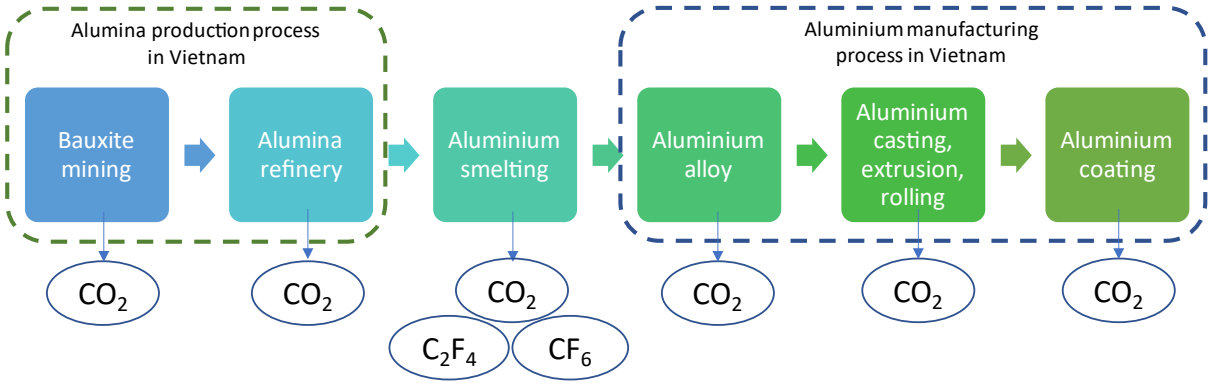


Figure 12-1 Aluminium production process and GHG emission sources

Source: Compiled by the authors (Nguyen, 2012)

According to Decision 167/2007/QD-TTg dated 01/11/2007 on Approving the zoning plan for exploration, mining, processing and use of bauxite ore in the 2007-2015 period with a vision to 2025, during the 2007-2015 period, four alumina projects were planned to be built with total alumina capacity of 5.1-6.6 million tonnes/year and development of power-aluminium electrolysis complexes with total aluminium capacity of 200,000-400,000 tonnes/year and, during the 2016-2025, the capacity of both alumina and aluminium electrolysis projects might be expanded (Lin, Yang, Ma, Li, & Ni, 2021). However, as of 2023, the total production of alumina is about 1-1.5 million tonnes/year, and no aluminium smelter is in operation in Vietnam. Still, the bauxite-alumina-aluminium industry in Vietnam has promising developing potential as several investors express interest in the industry (Leonard, McArthur, & Hochuli, 2016). Some large corporations proposed to develop industrial complex projects with ore mining and processing plants, alumina refineries, aluminium smelters, and renewable power plants. The first aluminium smelter in Vietnam, Dak Nong Aluminium Smelter is

under construction with capacity of 450,000 tonnes/year and expected to produce the first batch of aluminium using alumina from Nhan Co Aluminium Plant in 2024 (T. A. Le, 2022). This will lay the first steppingstone for Vietnam to master the whole aluminium production chain as well as change the emission profile of the aluminium sector.

12.2.1. Emission reduction measures

Unlike other CBAM-target sectors, aluminium sector does not have sectoral-specific emission reduction measures and roadmap in the NDC. However, as the emission from the aluminium manufacturing in Vietnam is mainly from the use of electricity, mazut, and LPG, the best practices for emission mitigation is to promote fuel switch, energy efficiency, and energy saving in the sector. These measures would also be applicable when Vietnam has the capacity for aluminium casting and owns the whole aluminium production value chain. Some of the following mitigation measures for the energy sectors in the updated NDC 2022 could be applied to reduce the carbon emission in the aluminium sector:

- E3. Using energy-saving lights
- E16. Improving energy efficiency in industry sub-sectors (except for three sub-sectors, including bricks, cement and iron and steel production)
- E27. Using high-performance electrical energy appliances in commercial services
- I5s. Using climate-friendly refrigerants (replacing low GWP-HFC in cooling sector, enhance recycling and reuse of refrigerants)

In addition to the NDC's measures, some aluminium manufacturers have successfully implemented several measures to bring down the energy consumption and decrease the emission (DCSVN; Survey, 2023). Some of the examples are:

- Apply inverter technology in cooling system and oil pump motors;
- Improve ventilation to improve air compressor performance;
- Mixing activated carbon to recover aluminium in aluminium slag to reduce the rate of aluminium loss in slag and replace material of conveyor belt in rolling machine to reduce tearing and aluminium waste;
- Conduct maintenance and repair furnace and oil injection to reduce heat loss to the environment to increase furnace efficiency.

In addition, Best Available Techniques in accordance with the EU's Industrial Emission Directive 2010/75/EU for industrial installation in the aluminium value chain can be taken into consideration when Vietnam produce aluminium from cradle-to-gate.

12.2.2. Gap analysis

In term of policy, the most notable gap for aluminium's sector emission reduction plan is the lack of a sectoral development plan and strategy. The Decision 167/2007/QD-TTg focuses mainly on the bauxite industry and no longer practical to the current situation of the whole sector. Also, the missing of emission mitigation targets and measures in the NDC for the aluminium sector is the cause for the lack of guidance for emission reduction and underestimation of the sector's emission.

In addition, as there exists a missing link in the aluminium value chain of Vietnam, Vietnam cannot utilise the domestic alumina and must import raw material. This gap creates difficulty in controlling the emission source, determining sectoral total emission and emission intensity, and decreasing emission reduction potential of the sector. On the other hand, the production of aluminium relies heavily on electricity, so the emission reduction potential of the sector is also dependent on the emission reduction plan of the electricity sector. Last but not least, abatement technologies may not always feasible and require high investment cost.

12.2.3. Recommendations

It is recommended from stakeholder consultation that a sectoral development master plan needs to be developed to replace the Decision 167/2007/QD-TTg. The master plan should not only draw a roadmap for the mining, producing and processing of bauxite-alumina-aluminium industry but also to promote sustainable bauxite-alumina-aluminium industry. The sectoral master plan can be developed in harmony with the national development plan for mineral to promote bauxite-alumina-aluminium complex and investment for renewable energy in parallel with bauxite processing. Moreover, there should be incentives and supporting policies for implementation GHG emission abatement technologies.

The future updated NDC should include mitigation measures for the aluminium sector, especially when Vietnam start producing aluminium by electrolysis, which is extremely energy intensive. Aluminium projects should be developed with circular economy concept and combined with renewable power plants projects in order to reduce pressure on the national power grid while reducing emission intensity.

Finally, as the sector strategy is to serve export markets including the EU, it is equally important to enhance awareness, organise training or capacity building on GHG emission inventory, monitoring and reduction for enterprises in the sector.

12.3. Fertiliser sector

According to Vietnam's Chemical Industry Development Strategy by 2030 with vision towards 2040 stated in Decision No. 726/QD-TTg[35] by the Prime Minister dated June 16, 2022, the fertiliser sector is expected to grow at a rate of 3%-5%/year in the 2021 - 2030 period, and 4%-6% in the 2031 - 2040 period. Based on the production value of 2021, the predicted grow rate and the sector's emissions intensity, the amount of fertiliser produced and the sector's total emissions of 2030 and 2035 are estimated as follows.

Table 12-2 Estimated production and emissions of the fertiliser sector

Year	Average annual production (million tonnes)	Sector average emissions intensity (tCO_2/t fertiliser)	Average annual sector emissions ($mtCO_2e$)
2021	7.92	2.1	16.63
2030	11.31		23.75
2035	14.51		30.47

Source: Compiled by the Authors

Understanding the emissions characteristics of the fertiliser sector is the key to identifying suitable emissions mitigation actions. In Vietnam, the type of fertilisers being used are single nutrient fertilisers such as Urea, Super Phosphate, and Potash and complex fertilisers such as NPK and DAP(167/2007/QD-TTg, 2007; International Aluminium Institute, 2022a). Each type of fertiliser has different feedstocks and productions processes, which lead to a variety of end products emission intensity.

[35] Decision No: 726/QD-TTg by the Prime Minister dated June 16,2022, Link: https://thuvienphapluat.vn/van-ban/Dau-tu/Quyet-dinh-726-QD-TTg-2022-Chien-luoc-phat-trien-nganh-cong-nghiep-hoa-chat-den-2030-517617.aspx

12.3.1. Sectoral mitigation target in 2022 NDC

The 2022 NDC only identifies a mitigation measure with respective emission reduction potentials for fertiliser production for period 2025-2030 (see Table 12-3).

Table 12-3 Mitigation measure for fertiliser sector in Vietnam's updated NDC 2022

Measure	Emission reduction potential (million t CO_{2e})			Abatement cost	Financial need	Assumption
	2025	*2030*	*2021 - 2030*	*USD/t-CO_{2e}*	*Million USD*	
Unconditional mitigation measure						
I3. Apply Best Available Technologies to reduce N_2O emissions in chemicals and fertiliser production	0.34	2.3	5.64	1.34	6.05	100% of enterprises apply N_2O reduction technology in the production of chemicals and fertilisers

Source: Compiled from Vietnam's updated technical NDC 2022

Based on Decision No: 726/QD-TTg, Vietnam NDC 2022 Technical report, the CCTI report and the survey, different mitigation measures have been identified for the fertilisers sector.

Switch Fuel/Feedstock

Urea is produced from ammonia, which is either synthesised from coal or natural gas. In Vietnam, coal-based Urea production is the most energy and emission intensive production process, with the emissions intensity of 7.8 tCO_2e/t urea (Survey). On the other hand, natural gas-based urea emission intensity is lower, performing similarly to the modern international plants, about 1.7 tCO_2e/t urea (Survey). Thus, switching the inputs material and fuel from coal to natural gas will reduce the emissions intensity of ammonia and urea.

In Vietnam in 2021, 2 out of the 4 biggest plants which is equivalent to 1,65 million t urea, have been using coal, while the other 2 plants, which is equivalent to 0.91 million t urea, have been using natural gas (Hanh, 2022). If all domestic production used natural gas as fuel and feedstock, it has the potential to reduce 5.57 million tCO_2e annually.

However, switching production techniques will require a large investment in new equipment and international technology patents. For example, a natural gas-based urea plant used in southern Vietnam uses patented Danish technology for ammonia production, Italian technology for urea production, and Japanese technology for granulation. This results in emission intensity performance on par with international plants. The investment cost for this plant, which has the capacity of 0.8 million t urea annually, was about 900 million USD. In addition, switching to 100% natural gas also increases the dependency on natural gas, increasing the sector vulnerability of the sector in the energy crisis (D. Le & XuanHanh, 2022).

In addition, emission intensity from the natural gas-based urea can also be reduced by mixing "permeate gas" in the feedstock. Fertiliser plants can utilise the permeate gas as part of the feedstock, which is the by-product of gas production plant. One of the surveyed plants has been using this measure to reduce its nature gas consumption since 2019. Natural gas-based urea plants can apply

this measure easily since it does not affect the performance of the plant while boosting circular economy (Chi).

Since fertiliser production is energy intensive, switching to biomass for heat generation is also a suitable mitigation action. Wood and saw dust have been used to fuel the boiler by one of the surveyed plants since 2017. This measure can reduce the amount of fossil fuel used for heating.

Improve energy efficiency

Similar to other manufacturing industries, the fertiliser sector uses a lot of industrial equipment. Thus, there is potential to increase energy efficiency for production equipment such as lighting equipment, motor, boiler. The NDC has identified a measure that focus on increasing energy efficiency in production processes, that have the abatement cost of -71.69 USD/tCO_2e. This measure not only reduces emissions, but it also reduces the cost for energy purchase, thus the abatement cost is negative. However, the mitigation potential of this measure is quite low, i.e., a total of 8.52 million tCO_2e in the 2021-2030 period for all industries (except iron and steel, cement and brick sector) in Vietnam.

Reduce N_2O emissions

The production of N-nutrient fertiliser also emits N_2O (in nitric acid production) in addition to the CO2 from using fossil fuel. The mitigation measure identified in the NDC assumes that if 100% of fertiliser plants used the best available technology (BAT) to reduce N2O, the sector has the potential to reduce 0.34 million tCO_2e in 2025, 2.3 million in 2030 and 5.64 million in the 2021-2030 period. The estimated cost for this measure is 1.34 USD/tCO_2e reduced.

However, the NDC did not specified which type of technologies are applicable in Vietnam. Based on international experience, some of the suitable BAT in nitric acid production includes optimisation of production process and catalytic reduction.

Formulate and revise national technical regulations on chemical fertiliser

The Vietnam's Chemical Industry Development Strategy propose to formulate and revise the national technical regulations on chemical fertiliser. The national technical regulation on emission of chemical fertiliser manufacturing industry QC21:2009/BTNMT only regulates the concentration of Particulate matter, SO_2, NO_x, NH_3, H_2SO_4, and F in the exhaust gas of fertiliser plants. Thus, CO_2 and N_2O emissions from ammonia and nitric acid production are not controlled by any regulation.

12.3.2. Gap analysis

There are many types of fertilisers being produced in Vietnam, with many different processes and emission sources. The emission intensity of fertiliser products in Vietnam were not extensively studied, thus there were a lack of statistic and reference to compared to the result of this study.

The emission mitigation measures in the NDC in the fertiliser sector were not sufficient and only covered a portion of the impact of the sector. The measures I3 only covered the N_2O emissions from fertiliser and did not cover the CO_2 emission from ammonia production. According to BUR3, in 2016, ammonia production is responsible for 1.271 million tCO_2e while N_2O emission in nitric acid production was only equivalent to 0.024 million tCO_2e.

Vietnam's Chemical Industry Development Strategy by 2030 with vision towards 2040 is lacking in emissions goals, as well as emission mitigation measures. The national technical regulation on emission of chemical fertiliser manufacturing industry also does not control CO_2 and N_2O emission, thus companies are not required or have the incentive to reduce their emissions.

12.3.3. Recommendations

The emissions intensity of different types of fertilisers, urea and supe phosphate, varies widely. Thus, it is recommended to have separate indicators to track the emission intensity of each group of products, instead of one average indicator for the whole sector. It is also recommended to conduct an updated in-depth study on the emissions of fertiliser production, since the most recent study was published in 2013. It is also recommended to develop a GHG inventory and guideline to conduct emission inventory for the sector so that enterprises can understand and manage their emissions. Since this sector is more complex, it is a challenging task for enterprises to account for the GHG emissions on their own.

Even though the 2022 NDC added a measure on the N_2O reduction, this measure does not cover the emissions of the entire sector. It is recommended to conduct feasibility study and develop other mitigation measures that include emissions from ammonia production such as switching fuel/feedstock, improving energy efficiency, improve catalyst to capture GHG from exhaust… It is also important to prioritise measures that have significant emission reduction potential such as switching fuel/feedstock, reducing the production of coal-based ammonia. Other efficiency improvement measures can also be implemented in tandem since the abatement cost is lower and the technologies are available.

Finally, it is recommended for the sector to have a clear development plan and mitigation strategy regarding its emissions. It will act as the guidelines for enterprises in the sector to navigate their development strategy where decarbonisation should be prioritised as a requirement.

12.4. Cement sector

Around 8% of global CO_2 emissions came from cement production in 2021 (2.9 billion t). Cement production is a highly energy-intensive industry, resulting in significant GHG emissions, particularly CO_2. The majority of CO_2 emissions from cement production are from the production and use of clinker, which is used to create Portland cement. Overall CO_2 originates from two main sources: The decomposition of limestone (clinker production) which accounts for approximately 50-60% of emissions, and the combustion of fuels such as coal which is burnt to reach high temperatures accounts for around 40% of emissions. According to the Vietnam Cement Association, the energy consumption rate/t of clinker in Vietnam is around 913kg/t clinker in which 525kg from raw materials (accounted for 57%), 336kg from fuel consumption (37%) and 52kg (6%) from electricity consumption.

12.4.1. Sectoral mitigation target in 2022 NDC

The targets and mitigation measures for the cement sector in the 2022 NDC is provided in below table:

Table 12-4 Mitigation measures for the cement sector in Vietnam's updated NDC 2022

Measures	Emission reduction potential (Million tCO_2eq)			Abatement cost	Financial need for 2021-2030	Assumption
	2025	2030	2021-2030	USD/ tCO_2e	million USD	
E7. Optimizing clinker burning process	0.18	0.38	2.05	-12.02	22.9	By 2030, optimizing clinker burning process measure will be applied for about 50% clinker production

Measures	Emission reduction potential (Million tCO_2eq)			Abatement cost	Financial need for 2021-2030	Assumption
	2025	2030	2021-2030	USD/ tCO_2e	million USD	
E8. Reducing clinker kiln heat losses	0.33	0.70	3.66	-14.49	4.2	By 2030, reducing clinker kiln heat losses will be applied for about 50% clinker production
E9. Recovering waste heat from cement production	0.42	0.89	4.81	0.36	77.8	By 2030, recovering waste heat from cement production measure will be applied for about 50% cement production
E10. Using vertical roller mills in cement production	0.54	1.38	6.89	2.68	734.1	By 2030, using vertical roller mills measure in cement production will be applied for 100% cement production
I1. Substituting clinker with natural minerals (limestone, pozzolana) in cement content	6.5	9	64.7	-50	247.1	By 2030, reduce the clinker content in cement to 65% with a cement production scenario of 1,348 kg/person/year. In which mineral content accounts for 19.5%
I2. Substituting clinker with industrial wastes (ground fly ash, ground granulated blast-furnace slag – GBFS) in cement content	12.07	16.6	120.2	-63	56.8	By 2030, reduce the clinker content in cement to 65% with a cement production scenario of 1,348 kg/person/year. In which waste from industry accounts for 10.5%

Notes to Table 12-4:

- Abatement cost: It is the additional cost (using 2020 value) to reduce emissions by 1 t-CO_2e compared to the case where no emission reduction measures are applied. If the economic

benefit from the emission reduction measure is greater than the cost, the abatement cost is negative. The above abatement costs are estimates, based on some assumptions that may not be exhaustive.

- Additional financial need: is the additional investment cost (using 2020 value) to implement emission reduction measures.

Source: Compiled from Vietnam's updated technical NDC 2022

The main options for emissions mitigation in cement sectors according to the Vietnam NDC report 2022 can be classified into 2 main categories: thermal energy efficiency of clinker production (E7, E8, E9, E10), and lowering the clinker content in cement (I1, I2). By implementing unconditional mitigation measures for the cement sector, Vietnam could reduce 202.31 million t-CO_2e for period 2025-2030. This requires an additional financial investment of 1,142.9 USD million, but it could also help the sector save 136.47 USD for each ton of CO_2e emission reduced.

12.4.2. Gap analysis

Even though there exist many policies which could be considered as supporting policies for the implementation of mitigation actions, namely Environmental Protection Law 2020 regulations on strengthening scientific research and development of pollution treatment, recycling, and enhancing waste treatment technologies; prioritizing advanced, environmental-friendly technologies and best existing techniques; improving human resources on environmental protection; Decision 1266/QD-TTg Approved The Strategy For Development Of Vietnam Building Materials For 2021 - 2030, with vision toward 2050 encouraging energy efficiency, alternative fuel, requirements of raw materials and emissions from cement production.

However, it can be noticed there is a lack of policy/legal documents facilitating the standard of alternative fuel as well as subsidy policies for the use of alternative fuels. Besides the amount of waste that does not meet the demand, the quality of the waste as alternative fuels (size and technical parameters) has not been standardised. We need appropriate policies that standardise the quality as well as prices of alternative fuels to support the implementation of alternative fuel technologies.

Moreover, when a cement plant uses industrial waste for alternatives fuel, they need to assess environmental impacts and hold an environmental license according to Decree 08/2022/ND-CP Elaboration Of Several Articles Of The Law On Environmental Protection, it makes the processes of implementing waste industrial projects as alternative fuels become difficult. Furthermore, Circular 02/2022/TT-BTNMT Detailing A Number Of Articles Of Law On Environmental Protection, regulate that the assessment time of the waste treatment work shall be at least 75 days for the trial operation and 7 days for the stable operation period is time-consuming and resources-wasting for the facilities.

The project of waste heat recovery for electricity generation will only be implemented when it is added to the local electricity development planning, however, the procedures related to local departments are often time-consuming and complicated, causing difficulties for cement facilities.

Since using industrial waste as an alternative fuel would require new technologies and cost for transporting, storing, and burning, the overall price to produce cement would increase. Without any subsidy, the cement products that originated from industrial waste as an alternative fuel cannot compete with the other cement products.

In cement production, the mill is the second most energy-consuming device after the clinker kiln. Using vertical roller mills (E10) instead of ball mills would save 20% of energy (INSEE Vietnam). However, using vertical roller mills requires the complete replacement of mill technology, which leads to a high investment cost at installing period (731.4 million USD according to NDC 2022).

Waste heat recovery is a technology that also requires a high investment cost (77.8 million USD according to NDC 2022). However, they can make a significant contribution to the utilisation of waste heat to dry raw materials.

The increase in coal prices internationally and nationally put pressure on Vietnam cement companies recently and after the effects of COVID-19, the sales volume of Vietnam's cement industry fell by 15% (Mirae Asset Securities). The scarcity and high price of coal also lead to the usage of unstable quality coal and cause bad effects on thermal efficiency.

The cement producer chains in Vietnam mostly have a lifespan of over 10 years, and some have a lifespan of 30 years or more (VICEM Song Thao, VICEM Hai Van, etc.) would affect the energy consumption and repair rate.

The chemical composition of raw materials (limestone, clay) is different and depends on the technologies of each cement producer chain, leading to uneven clinker quality and the clinker ratio in cement.

12.4.3. Recommendations

The Ministry of Construction, the Ministry of Industry and Trade, and the People's Committees of the provinces (where cement facilities implement waste heat power recovery for electricity generation located) must conduct guidance, support, and simplify the procedures for waste heat recovery projects.

Proposing to amend and supplement Clause 2, Article 27 of Decree No. 08/2022/ND-CP, simplify or remove environmental impact assessment report, apply for a re-issuance for the projects that have been put into operation using regulated conventional wastes to encourage the implementation of using industrial waste as alternative fuels...

Proposing to amend and supplement Clause 2, Article 70 of Decree No. 08/2022/ND-CP Cement production facilities are allowed to treat hazardous waste generated in their premises by using environmental protection technology and works and available equipment without having to re-approve the results of the appraisal of the EIA report or the environmental license.

Authorities should have supporting policies or subsidies in the implementation of GHG emission reduction technologies; holding training workshops to guide and share the technical regulations and standardised calculation tools for GHG inventory in cement facilities to ensure its accordance with regulations.

More R&D is needed to produce high-quality blended cement, achieve, and maintain consistent operational parameters, and desired particle size distribution, and use grinding aids.

Using alternative fuel have a high potential for emission reduction since 37% of emission from clinker production come from fuel consumption (coal, oil) for kiln heating, if we can completely replace them by using alternative fuels (tires, waste oil…) the emission from fuel must be zero.

Substituting clinker with natural minerals and industrial waste (I1, I2) has a high potential for emission reduction since they reduce the clinker ratio in cement. The reduction of clinker also brings financial benefits along with the high emission reduction potential. Substituting clinker with ground granulated blast-furnace slag – GBFS also creates a new kind of cement that is resistant to seawater. However, consumers don't want to use cement with less clinker ratio. Hence, the cement production facilities and concrete contractors must work closely together since cement is just part of the construction material in concrete, the concrete constructors hold important parts in deciding the clinker ratio in the type of cement they want to use depending on the characteristic of the construction site. If they can cooperate effectively, they can reduce the clinker ratio in cement depending on the requirements of the buyers (concrete contractors).

Optimizing clinker burning process (E7 and E8) and reducing clinker kiln heat losses are the easiest measures that can be applied but the emission reduction amount is not so high.

12.5. Conclusions

Among the CBAM sectors, steel and aluminium will be more impacted by CBAM than the other sectors, but overall impacts still remain limited. The mitigation potential would be the highest in the cement sector, following by steel sector and aluminium. It is also important to decarbonise the electricity sector by increasing solar and wind power penetration, given that the CBAM sectors use a significant quantity of electricity for production.

It is recommended that sectoral mitigation plans should be developed and integrated in the sectoral development plan and strategy for each sector. The development of the plan should consider the followings:

- Sectoral NDC targets;
- Identification of mitigation measures (may include those not identified in the NDC);
- Feasibility assessment of the mitigation measures;
- Marginal abatement costs of the measures;
- Identification of co-benefits;
- Prioritisation of the measures over the NDC implementation timeframe and beyond.

There is a high potential for reducing emission reductions in each sector by technology transfer and improvement of management practices. This should be further promoted through trainings, international cooperation on scientific and technological research and transfer. Capacity building for GHG accounting is important for the sectors to understand their emission profile and be more prepared for CBAM and the adoption of carbon pricing framework in Vietnam in the coming time. In addition, enterprises can also take advantage of low carbon innovation funds for enhancement of energy efficiency at facility-level. Table 12-5 gives a brief overview of existing low-carbon innovation funds:

Table 12-5 Descriptions of low-carbon innovation funds for enterprises in Vietnam

Low-carbon innovation funds	Budget size	Descriptions
MONRE - Environmental Protection Fund (EPF)	127.74 USD million	The EPF is a governmental financial institution that supports environmental protection and encourage enterprises, organisations, and individuals to establish environmental protection fund. (Environmental Protection Law 2020; Decree No. 08/2022/ND-CP)
Ministry of Science and Technology - National Technology Innovation Fund (NATIF)	85.1 USD million	The NTIF is a governmental financial institution that are non-profit and provides financial support for organisations, individuals, and businesses to conduct research, technology transfer and innovation. (Decision No. 04/2021/QD-TTg)
Global Environment Facility (GEF)	144.15 USD million	The GEF is a multilateral fund providing grants, blended financing, and policy support to assist developing countries focusing on their top environmental priorities and adhere to international environmental convention. The focal areas of GEF include biodiversity, climate change,

Low-carbon innovation funds	Budget size	Descriptions
		and land degradation. (Global Environmental Facility, 2023).
Climate Investment Fund (CIF) - Clean Technology Fund (CTF)	135.24 USD million	The CIF in Vietnam is invested through the CTF, striving to meet the country's growing energy demands while mitigating the climate change impact. It proves the commercial viability if energy efficiency and renewable energy investment and facilitates creation of an enabling environment for increased private sector investment and GHG emission reductions. The fund's core activities include supporting energy efficiency investment in enterprises in industry and energy service sector. (Climate Investment Fund, 2023).

Source: Compiled by the authors

13. RECOMMENDATIONS FOR NEGOTIATION POLICIES AND STRATEGIES

In this section, we analyse strengths, weaknesses, opportunities, and threats with respects to Vietnam's policy responses to CBAM. We then discuss response options, highlighting their pros and cons. This section concludes with recommendations for the Government of Vietnam and Vietnam-based enterprises.

13.1. Background insights

Strengths

Vietnam has sizable renewable energy potential to decarbonise its economy to reduce CBAM impacts. The country's potential for both solar and onshore wind power is massive, with technical potentials of 2847 GW and 311 GW respectively (Lee et al., 2020) . Moreover, Vietnam has 475 GW of offshore wind power technical potential within 200 kilometres of the coast (Do et al., 2022) . The combined potential of solar and wind power is about 47 times higher than the country's installed capacity in 2022. Studies suggest that Vietnam can achieve a penetration rate of solar and wind power exceeding 90%, along with off-river pumped hydro energy storage, at a competitive cost of 63–85 USD/MWh (Lu et al., 2021.

Vietnam has demonstrated relatively strong political interest in joining international efforts to address climate change. It actively participates in international climate treaties such as the Paris Agreement. Following the announcement to aim for net zero emissions by 2050 at COP 26, Vietnam has established a National Steering Commission on Realising the COP 26 Commitments, chaired by the Prime Minister, and coordinated by the Ministry of Natural Resources and Environment. The Prime Minister issued Decision 896/QD/TTg dated 26 July 2022 on National Strategy on Climate Change, which sets the targets of an emission peak by 2035 and net zero emissions by 2050.

Momentum for decarbonisation in Vietnam is high, with the country leading Southeast Asia in terms of solar and wind uptake since 2019 (Do et al., 2021) . Among recent climate commitments, Vietnam joined the Global Coal to Clean Power Transition Statement at COP 26 in 2021 pledging to phase out unabated coal power by the 2040s or as soon as possible thereafter. The Just Energy Transition Partnership (JET-P) also brings Vietnam into a pole position of countries embarking on a coal phaseout path. It aims to accelerate the decarbonisation of the electricity system from the current net-zero planning peak in 2035 to 2030 and reduce the emission peak from 240 $MtCO_2e$ to no more than 170 $MtCO_2e$ (about 30% reduction) from electricity generation sector, along with other objectives and just transition considerations.

Weaknesses

Vietnamese enterprises' awareness of CBAM remains limited. In addition, the Vietnamese private sector appears unwilling to share business- related data and this is unlikely to change in the future unless government exerts significant pressure. While financial data might be considered sensitive to competitiveness, energy consumption/carbon emission- related data may not be available or accessible within a short time.

Vietnam's legal framework for carbon pricing, phasing out fossil fuels, and developing renewable energy remains under-developed. There is a need for capacity building to improve emission monitoring, ratification, and verification processes, both for government agencies and enterprises (Do and Burke, 2021).

Vietnam's technical capacity for decarbonisation needs improvement. Grid transmission remains limited that has created curtailment of solar and wind power. Vietnam had almost zero energy storage

capacity as of 2022 (DEA and EREA, 2022). CBAM sectors are hard-to-decarbonize industries, and the Vietnamese enterprises are struggling to find technical solutions to reduce emissions.

Vietnam's energy transition also has encountered financial barriers. Solar PV and wind power purchase agreements face bankability problems due to reasons including that take-or-pay obligations currently do not exist for EVN (Do et al., 2020, 2021, 2022). State investment in solar and wind remains modest. State-owned enterprises accounted for only 4% and 1% of solar and wind power installed capacities respectively in 2021 (Do and Burke, 2023). In 2021, international investors accounted for only about 10% and 4% of the total investment in solar and wind power in Vietnam, respectively. Impediments include complex administrative procedures and policy uncertainty (Do et al., 2020, 2021, 2022).

Opportunities

There are significant opportunities for Vietnam to receive international support in continuing its climate efforts under the JET-P and the international carbon markets.

Solar and wind power are now cost-competitive options that can enable faster uptake of these renewables. In 2020, the globally weighted levelised costs of electricity (LCOE) for solar PV and onshore wind were about 57 USD/MWh and 39 USD/MWh, respectively (Lee et al., 2020). In contrast, those of coal- and gas-fire power were 88 and 71 USD/MWh respectively (T.N. Do, Burke, Hughes, & Ta, 2022). Importantly, the globally-weighted solar and wind LCOEs have been falling fast, by about 85% and 56% respectively, over 2010–2020.

Increasing energy demand in some neighbouring countries means that Vietnam can capitalise on exporting its massive offshore wind power potential. The agreement signed in February 2023 for exporting offshore wind power from Vietnam to Singapore sets an important example. Thailand and Malaysia could be other destinations for Vietnam's offshore wind power exports. Strong development of the renewables industry could generate significant impetus for decarbonisation.

EU has revealed willingness to negotiate over CBAM. It mentioned that the dialogue with third countries should continue, and there should be space for cooperation and solutions that could inform the specific choices on the details of the CBAM design and implementation. The EU also expressed that it stands ready to work with low and middle-income countries towards the de-carbonisation of their manufacturing industries. With high emission reduction potential and experience in participating in the international carbon market, Vietnam can negotiate with the EU to allow the use of carbon credits to offset for Vietnam-based exporters' emissions instead of buying CBAM certificates.

The energy transition away from fossil fuels may happen faster than expected even before CBAM. The EU has taken measures to accelerate renewable energy uptake, such as simplifying procedures for offshore wind power projects, to reduce its vulnerability to volatile fossil fuel imports. Recent energy price increases may incentivise countries to boost their transition to renewable energy.

Threats

EU's CBAM is evolving and involves uncertainties. Key uncertainties include: 1) when and to what extent the sector coverage will expand, 2) what are boundaries for determining product embedded emissions, 3) whether countries that already have a carbon price (although different from that of EU ETS) will receive special treatments; and 4) how CBAM revenues will be used.

It is also unclear whether non-EU ETS carbon credits can count toward CBAM exemption. In the case that these cannot and CBAM impacts and /or other co-benefits are significant, EU trade partners may consider developing domestic carbon pricing mechanisms with a carbon price approaching to EU ETS carbon price.

Uncertainty also lies in whether carbon decarbonisation policies other than carbon pricing would count towards CBAM special treatment. US issued the Inflation Reduction Act in August 2022 that

incentives clean and renewable energy uptake via subsidies. Australia enacted Climate Change Act in 2022. China has now the world's largest solar, wind, and hydropower installed capacities. As a member of the G7 group, Japan will likely claim its efforts to decarbonise electricity as complementary to strengthening carbon pricing. These large EU trade partners will hence likely negotiate with EU so that their products will fend off from CBAM, at least to some extent.

EU has revealed its determination to apply CBAM. EU has expanded the scope of CBAM to cover more sectors (now including hydrogen and emission scope 2). The US, Canada, and the UK have been considering imposing their own CBAMs (Jakob, 2023). Countries with relatively cleaner production technologies such as Japan and South Korea may support CBAM because they would gain more advantages over polluting economies when exporting to the EU (Do & Burke, 2021). Therefore, CBAM impacts on international trade may grow in the coming years.

Nevertheless, it remains largely uncertain how countries will engage in CBAM. Apart from adopting their own CBAM, countries may resist EU CBAM. The resistance may start from large trade partners such as the US. However, it is unclear if petitions against CBAM will ever happen. Legal actions against CBAM, if any, will occur from 2027 because a case can be put forward to WTO only when CBAM has already started.

While many developing countries would be negatively affected by CBAM, it is unclear whether they will lead in bringing up a case against CBAM to WTO because of their lack of legal expertise and limited resources. In addition, the risks of losing support from EU may make them reluctant to sue. To date, no official call for a collective action against CBAM has arisen.

A likely short-term global economic recession may worsen negative impacts of CBAM on Vietnam. Facing a potentially severe economic recession (WEF, 2023), EU may reduce its imports, putting more pressure on Vietnamese exporters even before CBAM officially starts. Surging energy prices may make it more difficult for the government to introduce a carbon price, as such a policy may create public resistance.

The timeframe for responding to CBAM is relatively short. Vietnam has less than 3 years to prepare before CBAM starts, and the preparation takes time and resources.

13.2. Response options

Response options can generally be classified into two broad groups: oppose or accept CBAM while seeking to reduce its negative impacts.

Oppose CBAM

One option for Vietnam is to join a case against CBAM at the WTO led by some other countries.

Pros

It is legally possible and would protect interest of Vietnam-based enterprises. This may also help to put pressure on the EU to negotiate a solution that is more favourable to Vietnam, or to reconsider the CBAM altogether.

Cons

The legal process could be lengthy and costly, and there is no guarantee that Vietnam would be successful. Additionally, taking legal action against the EU could harm the relationship with EU, and make it more difficult to negotiate mutually beneficial trade agreements in the future.

Whether or not Vietnam should join a WTO case against the EU over the CBAM is a complex question. The answer depends not only on the interests and priorities of the Vietnamese government but also on external factors such as how CBAM detailed mechanism evolves and how other countries react to CBAM.

Accept CBAM while seeking to reduce its negative impacts

This would involve several measures which can be taken concurrently.

First, the government can issue detailed guidelines for emission reporting that are compatible with CBAM requirements and provide training for enterprises. Enterprises would build their capacity and plan to comply with CBAM, including adjusting business strategy to reduce any potential impacts from CBAM.

Second, the government may negotiate with EU for favourable treatment. The treatment can include considerations of differences in socioeconomic development stages when determining CBAM payments. The discussion can also aim at acceptance of carbon credits in addition to the accounting of the domestic carbon price towards CBAM payments. It is worth noting that the negotiations may be fruitful only after Vietnam has introduced an explicit carbon price. Vietnam may benefit from joining other like-minded countries and lobbying interest groups within the EU that can influence the design of the CBAM.

Third, the government can consider the adoption of carbon pricing in the broad context of achieving energy transition, NDC and Net- zero targets, which will minimise the impacts of CBAM while obtaining other significant co-benefits.

With the significant potential impacts of carbon pricing shown by the modelling results, the carbon price at around 11 USD/tCO_2 based on the lowest marginal abatement cost to achieve the mitigation target in the NDC, may not be advisable for the initial phase of carbon pricing. Experiences from other countries show that a low start and gradual increase of the carbon price will be more effective in getting stakeholder buy-in and avoid their strong reaction as well as to reduce the negative impacts (International Renewable Energy Agency, 2021). The carbon price can be designed to be initially applied in some carbon- intensive sectors, for example, CBAM- most- impacted- sectors and electricity generation. A trial-error may be needed to determine the desirable carbon price. In any case, the carbon price would need to increase over time to approach the EU ETS allowance price.

Fourth, the government would strengthen non-carbon-price decarbonisation policies and incentives. Priority can be given to phasing out unabated coal power and promoting renewable energy as well as encouragement of energy efficiency measures, that will be implemented in line with the country energy transition and low carbon pathway.

Below, we discuss advantages and disadvantages of this approach. This approach presents a proactive way for Vietnam to prepare for CBAM. Importantly, it would contribute to Vietnam's achievement of NDC targets, facilitate the greening of its economy, and elevate the country's position in the international arena. Consequently, Vietnam may receive more international financial and technical support. Vietnamese products can become more competitive in markets where consumers demand green products.

On the other side, this approach may increase production costs initially, and domestic consumers may resist potentially increased energy prices. Improving technical and institutional capacity would also require resources.

13.3. Recommendations

Accept CBAM while seeking to reduce its negative impacts has emerged as a preferred option for Vietnam. This approach would help Vietnam prepare for the potential effects of CBAM while also achieving its sustainability goals.

It is recommended that the government:

- **Engage in constructive dialogues with EU**: This aims to seek clarification on the details of the CBAM and to negotiate a fair CBAM that considers Vietnam's concerns and efforts. This may involve seeking specific exemptions or compensation arrangements to mitigate the impacts

of the CBAM on Vietnamese exporters. A reasonable request would be the use of emissions credits instead of having to buy CBAM certificates.

Based on the CBAM, the EU is committed to continuing dialogue with third countries and finding solutions for cooperation that can inform specific choices made during the implementation of the measure, particularly during the transitional period. The Commission aims to engage with affected third countries in an impartial manner, and in compliance with the EU's international obligations, to explore possibilities for dialogue and cooperation in implementing specific elements of the Mechanism outlined in this Regulation and related implementing acts. The EU will also explore the potential to enter into agreements that consider their carbon pricing mechanisms. Given that the CBAM is intended to promote cleaner production processes, the EU is willing to work with low- and middle-income countries to support their efforts towards decarbonizing their manufacturing industries. Additionally, the EU intends to provide technical assistance to less developed countries to help them adapt to the new obligations introduced by this regulation[36].

- **Strengthen institutional and technical capacity for adapting CBAM:** This involves appointing a coordinating agency on CBAM, providing detailed guidelines for emission reporting that are compatible with the CBAM requirements, training for enterprises, and raising public awareness of CBAM.
- **Consider the adoption of carbon pricing in a broader context:** The adoption of carbon pricing supports energy transition, low- carbon development and generates other co-benefits (including environment and health). Carbon pricing will re-direct the development of carbon-intensive sectors in a more sustainable way and the revenue from carbon price can be used to incentivise green transformation process and to mitigate the negative impacts on vulnerable groups. If appropriately designed, carbon pricing can be an effective instrument for Vietnam to accelerate decarbonisation process toward the net-zero by 2050 target.
- **Improve national legal frameworks for decarbonisation**: The Vietnamese government could also consider updating its national legal frameworks to address the impacts of the CBAM. This could include the development of domestic carbon pricing mechanisms, or the implementation of other measures to support low-carbon production methods and reduce emissions in the country.

  This could include measures to increase energy efficiency, transition to cleaner forms of energy, and promote sustainable production methods, such as:

  (a) Develop domestic climate policies and measures to reduce carbon emissions and mitigate the impact of the CBAM.

  (b) Promote the development of a domestic carbon market to provide companies with a mechanism for generating emissions credits and reducing the impact of the CBAM.

  (c) Develop and implement domestic policies and programs to support the transition to low-carbon production processes, to promote sustainable production and consumption, including investment in renewable energy and energy efficiency measures.

  (d) Develop a sectoral mitigation plan that sets specific goals and targets for reducing emissions, and that outlines the policies, programs, and measures that will be implemented to achieve these goals

  (f) Encourage investment in research and development of new technologies and processes. Invest in clean technologies and research and development may reduce the carbon footprint of exports and increase competitiveness in the EU market

[36], Recital (53) (54) (55)

- **Enhance international cooperation:** This involves 1) strengthening cooperation with EU in other socioeconomic areas to consolidate mutual good will; 2) fostering cooperation with other countries that may be impacted by the CBAM to increase bargaining power with the EU, and 3) joining climate clubs similar to the JET-P to further gain international support.

It is recommended that Vietnam-based enterprises exporting to the EU:

- Start to plan for CBAM, including considering the costs of purchasing CBAM certificates as well as mitigation strategies, if active in sectors currently covered by CBAM. Among mitigation strategies, improving energy efficiency and employing good house-keeping practices to reduce material inputs should receive priority, given their relatively low costs.
- Watch for CBAM developments if active in a sector not yet covered by CBAM but by the EU ETS: Updates on CBAM can be found at the European Parliament webpage.
- Prepare for emission reporting requirements. Sharing emission related data with government agencies would contribute to the development of national emission database system that is needed to negotiate with EU for favourable CBAM conditions.
- Engage with the government in the context of decarbonisation policies such as carbon pricing and boosting renewable energy uptake. Enterprises can consider developing roof-top solar PV for their own consumption. They can also buy solar and wind power directly from renewable producers, once the under-consideration direct-power-purchase agreement policy takes effect.

13.4. Conclusions

The EU's CBAM is evolving very fast. Uncertainties persist regarding its eventual scope, how to do embedded emissions calculation, and how strong the reactions of EU-trade partners are. In its current form, the CBAM can generate impacts on individual enterprises exporting CBAM products to the EU; although its impacts on Vietnam's GDP are insignificant. If the CBAM is expanded to other trade-intensive sectors of Vietnam or other key trading partners of Vietnam such as the US, UK or Canada emulate it, the impacts may grow significantly. For example, it is possible, though not clear at this stage, that CBAM will be extended to ceramics and paper. Importantly, if the emission coverage reaches scope 3, enterprises exporting to the EU will need to report embedded emissions for the whole value chain of the exported products.

Vietnam should engage proactively and better prepared for mitigation of the impacts. One of the pro-active approaches is to consider the adoption of carbon pricing which will be beneficial for energy transition and achievement of the country's NDC and net-zero targets and would generate other co-benefits. It is also advisable for Vietnam to engage in constructive dialogues with EU to seek for clarification on the details and to negotiate for a fair implementation of CBAM that takes into account the country's concerns and efforts. A reasonable demand would be to allow Vietnamese exporters to submit internationally valid emissions credits instead of having to buy CBAM certificates.

REFERENCES

.

Decision 167/2007/QD-TTg on Approving the zoning plan for explore, mining, processing and use of bauxite ore in the 2007-2015 period with a vision to 2025, (2007).

ADB. (2017). *Pathways to low-carbon development for Vietnam*.

Ahmad, S., & Riker, D. (2020). *Updated Estimates of the Trade elasticity of Substitution*. Retrieved from Washinton DC:

Aldy, J. E., & Stavins, R. N. (2012). Promise and Problems of Pricing Carbon: Theory and Experience. *The journal of environment & development, 21*(2), 152-180. doi:10.1177/1070496512442508

Ambec, S. (2022). Impact and challenges of carbon border adjustments. Retrieved from https://www.tse-fr.eu/impact-and-challenges-carbon-border-adjustments

AMRO. (2022). Carbon Pricing in ASEAN+3 Economies: Progress and Challenges. Retrieved 01/02, 2023 from https://www.amro-asia.org/carbon-pricing-in-asean3-economies-progress-and-challenges/

Armington, P. S. (1969). *A Theory of Demand for Products Distinguished by Place of Production* (Vol. 16).

Asian Development Bank. (2018). *The Korea Emissions Trading Scheme: Challenges and Emerging Opportunities*: Asian Development Bank.

Australia Clean Energy Regulator. (2020). Emissions Reduction Fund achieves record 80 million tonnes in carbon abatement for Australia. Retrieved 01/01, 2023 from https://www.cleanenergyregulator.gov.au/ERF/Pages/News%20and%20updates/News-item.aspx?ListId=19b4efbb-6f5d-4637-94c4-121c1f96fcfe&ItemId=807

Bacchus, J. (2021). *Legal issues with the European carbon border adjustment mechanism*. Retrieved from

Bartlett, R., & Imadegawa. (2021). EU climate head says carbon border tax unlikely to hit Japan. Retrieved from https://asia.nikkei.com/Editor-s-Picks/Interview/EU-climate-head-says-carbon-border-tax-unlikely-to-hit-Japan

Benson, E., Majkut, J., Reinsch, W. A., & Steinberg, F. (2023). *Analyzing the European Union's Carbon Border Adjustment Mechanism*. Retrieved from https://www.csis.org/analysis/analyzing-european-unions-carbon-border-adjustment-mechanism

Berahab, R. (2022). *Is the EU's Carbon Border Adjustment Mechanism a Threat for Developing Countries?* Retrieved from https://www.policycenter.ma/opinion/eus-carbon-border-adjustment-mechanism-threat-developing-countries

Bergin, D., Cheng, T., Gilbert, V., & Meijer, W. (2021). *Perception of the Planned EU Carbon Border Adjustment Mechanism in Asia Pacific - An Expert Survey*. Retrieved from https://www.kas.de/documents/265079/265128/EU+Carbon+Border+Adjustment+Mechanism.pdf/fed1d5a4-4424-c450-a1b9-b7dbd3616179

Board and Wall. Is Gypsum Board Eco Friendly ? Retrieved from https://www.boardandwall.com/environment-friendly-gypsum-board/

Bray, S. (2022). Carbon Taxes in Europe. https://taxfoundation.org/carbon-taxes-in-europe-2022/

Bruyn, S. d., Juijn, D., & Schep, E. (2021). *Additional profits of sectors and firms from the EU ETS 2008-2019*. Retrieved from

BTNMT. (2019, March 07). Dự án permeate gas: Dự án nhỏ - Hiệu quả lớn. https://baotainguyenmoitruong.vn/du-an-permeate-gas-du-an-nho-hieu-qua-lon-251480.html

Busch, C., Min, H., & Meian, C. (2022). *China and the European Union's Carbon Border Adjustment Mechanism: Cultivating Mutual Benefits for the EU and China.* Retrieved from https://energyinnovation.org/wp-content/uploads/2022/04/China-and-the-EUs-Carbon-Border-Adjustment-Mechanism.pdf

CCIT. (2013). *"Strengthening Capacity on Climate Change Initiatives in the Industry and Trade Sectors"* Retrieved from

Chi, K. Nhôm Sông Hồng với 18 giải pháp sản xuất tiết kiệm năng lượng. Retrieved 01 March, 2023 from https://tietkiemnangluong.com.vn/tin-tuc/khoa-hoc-cong-nghe/t9409/nhom-song-hong-voi-18-giai-phap-san-xuat-tiet-kiem-nang-luong.html

Climate Transparency. (2020). Climate transparency report Vietnam's climate action and responses to the Covid-19 crisis.

ClimateWatch. (2022). Historical GHG Emissions. https://www.climatewatchdata.org

Cosbey, A., Droege, S., Fischer, C., & Munnings, C. (2019). Developing Guidance for Implementing Border Carbon Adjustments: Lessons, Cautions, and Research Needs from the Literature. *Review of Environmental Economics and Policy, 13*(1), 3-22. doi:https://doi.org/10.1093/reep/rey020

Council of the European Union. (2021). Fit for 55. Retrieved from https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/#what

Council of the European Union. (2022a). *CBAM: Commission proposal - Council general approach - Position of the EP*.

Council of the European Union. (2022b). *Draft regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism - General approach*. Retrieved from https://data.consilium.europa.eu/doc/document/ST-7226-2022-INIT/en/pdf

Council of the European Union. (2022c). EU climate action: provisional agreement reached on Carbon Border Adjustment Mechanism (CBAM) [Press release]. Retrieved from https://www.consilium.europa.eu/en/press/press-releases/2022/12/13/eu-climate-action-provisional-agreement-reached-on-carbon-border-adjustment-mechanism-cbam/

Council of the European Union. (2022d). EU climate action: provisional agreement reached on Carbon Border Adjustment Mechanism (CBAM). *European Council*. Retrieved from Europa: https://www.consilium.europa.eu/en/press/press-releases/2022/12/13/eu-climate-action-provisional-agreement-reached-on-carbon-border-adjustment-mechanism-cbam/

D'Arcangelo, F. M., Pisu, M., Raj, A., & Dender, K. v. (2022). Estimating the CO2 emission and revenue effects of carbon pricing. *OECD Economics Department Working Papers No. 1732*. doi:doi:https://doi.org/10.1787/39aa16d4-en

Dawkins, C., Srinivasan, T., & Whalley, J. (2001). Calibration. In J. H. James & L. Edward (Eds.), *Handbook of Econometrics* (pp. 3653-3603): Elsevier.

DCSVN. (2022, 16 May). Phát triển ngành thép cần có chính sách đặc thù. Retrieved 01 March, 2023 from https://dangcongsan.vn/kinh-te-va-hoi-nhap/phat-trien-nganh-thep-can-co-chinh-sach-dac-thu-610183.html

Do, T. N., & Burke, P. J. (2021). Carbon pricing in Vietnam: Options for adoption. *Energy and Climate Change, 2 (2021) 100058*. doi:https://doi.org/10.1016/j.egycc.2021.100058

Do, T. N., & Burke, P. J. (2023). Phasing out coal power in a developing country context: Insights from Vietnam. *Energy Policy, 176*(May 2023 113512). doi:https://doi.org/10.1016/j.enpol.2023.113512

Do, T. N., Burke, P. J., Hughes, L., & Ta, D. T. (2022). Policy options for offshore wind power in Vietnam. *Marine Policy, 141*(105080). doi:https://doi.org/10.1016/j.marpol.2022.105080

Do, T. N., Burke, P. J., Nguyen, H. N., Overland, I., Suryadi, B., Swandaru, A., & Yurnaidi, Z. (2021). Vietnam's solar and wind power success: Policy implications for the other ASEAN countries. *Energy for sustainable development, 65*, 1-11. doi:10.1016/j.esd.2021.09.002

Domeij, D., & Flodén, M. (2006). The labor-supply elasticity and borrowing constraints: Why estimates are biased. *Review of Economic Dynamics, 9*(2), 242-262. doi:10.1016/j.red.2005.11.001

Engström, G., Gars, J., Krishnamurthy, C., Spiro, D., Calel, R., Lindahl, T., & Narayanan, B. (2020). Carbon pricing and planetary boundaries. *Nature Communications, 11*(1), 4688. doi:10.1038/s41467-020-18342-7

Environmental Audit Committee of the UK. (2021). *Oral evidence: Carbon border adjustment mechanism*. UK Parliament Retrieved from https://committees.parliament.uk/oralevidence/3092/html/

Environmental Audit Committee of the UK. (2022a). *Greening imports: a UK carbon border approach*. UK Parliament Retrieved from https://publications.parliament.uk/pa/cm5802/cmselect/cmenvaud/737/report.html

Environmental Audit Committee of the UK. (2022b). *Greening imports: a UK carbon border approach: Government Response to the Committee's Fifth Report of Session 2021–22*. UK Parliament Retrieved from https://publications.parliament.uk/pa/cm5803/cmselect/cmenvaud/371/report.html

ERCST/WB. (2021). *Preliminary Study on the economic impact that EU CBAM could potentially impose on foreign exporters of products to the EU market - The case of Thailand, India, and Vietnam*: The World Bank.

EREA&DEA. (2022). *Vietnam Energy Outlook Report 2021*.

European Commission. (2019). *Communication from the commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee of the regions The European Green Deal*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN

European Commission. (2021a). Carbon Border Adjustment Mechanism: Questions and Answers. Retrieved 01/02, 2021 from https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_3661

European Commission. (2021b). *Impact Assessment Report Part 1/2*. Retrieved from

European Commission. (2021c). *Proposal for a Regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism*. Retrieved from EUR-Lex: https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:52021PC0564

European Commission. (2021d). *Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a Carbon Border Adjustment Mechanism*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0564

European Commission. (2021e). *Proposal for a Regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism*. Brussels: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021PC0564&rid=9

European Commission. (2022a). *EU - New Zealand Agreement*. Retrieved from https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/countries-and-regions/new-zealand/eu-new-zealand-agreement/text-agreement_en

European Commission. (2022b). European Green Deal: EU agrees to strengthen and expand emissions trading, and creates a Social Climate Fund to help people in the transition [Press release]. Retrieved from https://ec.europa.eu/commission/presscorner/detail/en/ip_22_7796

European Commission. (2022c). *Report from the Commission to the European Parliament and the Council on the Functioning of the European carbon market in 2021 pursuant to Articles 10(5) and 21(2) of Directive 2003/87/EC (as amended by Directive 2009/29/EC and Directive*

(EU) 2018/410). Retrieved from Brussels: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52022DC0516&from=EN

European Court of Auditors. (2020). *The EU's Emissions Trading System: free allocation of allowances needed better targeting*. Luxembourg: European Court of Auditors

European Economic and Social Committee. (2021). *Opinion on Carbon Border Adjustment Mechanism (CBAM)*. Retrieved from https://www.eesc.europa.eu/en/our-work/opinions-information-reports/opinions/carbon-border-adjustment-mechanism-cbam

European Parliament. (2021). *European Parliament resolution of 10 March 2021 towards a WTO-compatible EU carbon border adjustment mechanism*. Retrieved from https://www.europarl.europa.eu/doceo/document/TA-9-2021-0071_EN.html

European Parliament. (2022a). *Amendments adopted by the European Parliament on 22 June 2022 on the proposal for a regulation of the European Parliament and of the Council establishing a carbon border adjustment mechanism*. Retrieved from https://www.europarl.europa.eu/doceo/document/TA-9-2022-0248_EN.html

European Parliament. (2022b). Climate change: Deal on a more ambitious Emissions Trading System (ETS) [Press release]. Retrieved from https://www.europarl.europa.eu/news/en/press-room/20221212IPR64527/climate-change-deal-on-a-more-ambitious-emissions-trading-system-ets#:~:text=The%20free%20allowances%20to%20industries,%25%2C%202034%3A%20100%25.

European Parliament. (2022c). Deal reached on new carbon leakage instrument to raise global climate ambition [Press release]. Retrieved from https://www.europarl.europa.eu/news/en/press-room/20221212IPR64509/deal-reached-on-new-carbon-leakage-instrument-to-raise-global-climate-ambition

European Parliament. (2023). *Provisional agreement resulting from interinstitutional negotiations*. Retrieved from https://www.europarl.europa.eu/RegData/commissions/envi/inag/2023

EUROSTAT. (2022). International trade in goods - a statistical picture. Retrieved 21/01, 2023 from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=International_trade_in_goods_-_a_statistical_picture

Fally, T., & Sayre, J. (2018). *Commodity trade matters*. Retrieved from

FAO. (2023). FAOSTAT. https://www.fao.org/faostat/en/#data

Feng, X. (2022). As CBAM comes into sight: Direct impact on China's trade limited, yet a push for renewable power consumption. Retrieved from https://www.spglobal.com/commodityinsights/en/ci/research-analysis/as-cbam-comes-into-sight-direct-impact-on-chinas-trade-limited.html

Fernandez, V. (2018). Mineral commodity consumption and intensity of use re-assessed. *International Review of Financial Analysis, 59*, 1-18. doi:10.1016/j.irfa.2018.05.003

Gan, Y., & Griffin, W. M. (2018). Analysis of life-cycle GHG emissions for iron ore mining and processing in China—Uncertainty and trends. *Resources Policy, 58*(6). doi:10.1016/j.resourpol.2018.03.015

GATT. (1947). *The General Agreement on Tariffs and Trade*. Retrieved from https://www.wto.org/english/docs_e/legal_e/gatt47_01_e.htm#articleI

Gechert, S., Havranek, T., Irsova, Z., & Kolcunova, D. (2022). Measuring capital-labor substitution: The importance of method choices and publication bias. *Review of Economic Dynamics, 45*, 55-82. doi:https://doi.org/10.1016/j.red.2021.05.003

Gläser, A., & Caspar, O. (2021). *Less confrontation, more cooperation: Increasing acceptability of the EU Carbon Border Adjustment in key trade partners*. Retrieved from Berlin: https://www.germanwatch.org/en/20355

Global Tech Australia. (2022). Conversion tables. Retrieved from https://www.globaltechaustralia.com.au/conversion-tools/. https://www.globaltechaustralia.com.au/conversion-tools/

Gokhale, H. (2021). Japan's carbon tax policy: Limitations and policy suggestions. *Current Research in Environmental Sustainability, 3*, 100082.

Gore, T., Blot, E., Voituriez, T., Kelly, L., Cosbey, A., & Keane, J. (2021). *What can Least Developed Countries and other climate vulnerable countries expect from the EU Carbon Border Adjustment Mechanism (CBAM)?* Retrieved from https://ieep.eu/wp-content/uploads/2022/12/What-can-climate-vulnerable-countries-expect-from-the-EU-CBAM-IEEP-et-al-briefing-002.pdf

Government of Canada. (2023). Carbon pollution pricing systems across Canada. Retrieved 02/01, 2023 from https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work.html

Government of Vietnam. (2020). *Action Plan dated 02/10/2020 to implement Resolution No 55-NQ/TW on orientation of Vietnam's national energy development strategy to 2030, with a vision to 2045*.

Government of Vietnam. (2021). *Decision No 1658/QĐ-TTg dated 01/10/2021on National Green Growth Strategy 2021-2030 with a vision to 2050*

Government of Vietnam. (2022). *Dicision No 942/QĐ-TTg dated 05/08/2022 on the Methane Emission Reduction Action Plan to 2030*.

Grubb, M., Jordan, N. D., Hertwich, E., Neuhoff, K., Das, K., Bandyopadhyay, K. R., . . . Pizer, W. A. (2022). Carbon leakage, consumption, and trade. *Annual Review of Environment and Resources, 47*, 753-795.

GSO. (2022). *National Statistics*: General Statistics Office of Vietnam.

Ham, J. C., & Reilly, K. T. (2013). Implicit Contracts, Life Cycle Labor Supply, and Intertemporal Substitution. *International Economic Review, 54*(4), 1133-1158. doi:10.1111/iere.12031

Hanh, N. D. (2022, 08 30). Hàng trăm nghìn tỷ đồng dự kiến đổ vào các dự án phát triển công nghiệp nhôm ở Tây Nguyên. https://ndh.vn/doanh-nghiep/hang-tram-nghin-ty-dong-du-kien-do-vao-cac-du-an-phat-trien-cong-nghiep-nhom-o-tay-nguyen-1323023.html

Hon Gai Custom Branch. (2023). Import and Export Tax of Vietnam 2023. https://trungtamwto.vn/thong-ke/22620-bieu-thue-xuat-nhap-khau-viet-nam-nam-2023

Hoxha, A., & Christensen, B. (2018). *The carbon footprint of fertiliser production: regional reference values.* Paper presented at the Proceedings of the International Fertiliser Society Conference, Prague.

Hübner, C. (2021). *Perception of the Planned EU Carbon Border Adjustment Mechanism in Asia Pacific — An Expert Survey*. Retrieved from Hong Kong: https://www.kas.de/documents/265079/265128/EU+Carbon+Border+Adjustment+Mechanism.pdf/fed1d5a4-4424-c450-a1b9-b7dbd3616179?version=1.1&t=1615356593906

Hufbauer, G. C., Schott, J. J., Hogan, M., & Kim, J. (2022). *EU Carbon Border Adjustment Mechanism faces many challenges*. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4262951

ICAP. (2022). India establishes framework for voluntary carbon market and outlines pathway towards Cap-and-Trade System. Retrieved 03/01, 2023 from https://icapcarbonaction.com/en/news/india-establishes-framework-voluntary-carbon-market-and-outlines-pathway-towards-cap-and-trade

IEA. (2022). *Natural gas information: database documentation (2022 edition)*. Retrieved from http://wds.iea.org/wds/pdf/gas_documentation.pdf

International Aluminium Institute. (2022a). Greenhouse Gas Emissions Intensity- Primary Aluminium. https://international-aluminium.org/statistics/greenhouse-gas-emissions-intensity-primary-aluminium/

International Aluminium Institute. (2022b). Greenhouse gas emissions intensity- primary aluminium. *International Aluminium Institute*. Retrieved from https://international-aluminium.org/statistics/greenhouse-gas-emissions-intensity-primary-aluminium/

International Energy Agency. (2020). *Projected Costs of Generating Electricity 2020*. Retrieved from Paris: https://www.iea.org/reports/projected-costs-of-generating-electricity-2020

International Renewable Energy Agency. (2021). *Renewable Power Generation Costs in 2020*. Retrieved from

IPCC. (2006). *2006 IPCC Guidelines for National Greenhouse Gas Inventories. Institute for Global Environmental Strategies (IGES)*. Retrieved from

Jakob, M. (2023). The political economy of carbon border adjutment in the EU. *Oxford Review of Economic Policy, 2023* (39), 134-146. doi:https://doi.org/10.1093/oxrep/grac044

JICA. (2017). *Manual on GHG inventory for municipal level*. Retrieved from https://www.jica.go.jp/project/vietnamese/vietnam/036/activities/c8h0vm00009vi23p-att/activities_02_09.pdf

Kardish, C., Li, L., Hellmich, M., Duan, M., & Tao, Y. (2021). *The EU carbon border adjustment mechanism (CBAM) and China: unpacking options on policy design, potential responses, and possible impacts*. Retrieved from Berlin: https://www.adelphi.de/en/system/files/mediathek/bilder/20210610%20PolicyPaperCBAM%20China_Final.pdf

Kennedy, K., Kaufman, N., & Obeiter, M. (2015). *Putting a price on carbon: A handbook for US policymakers*: World Resources Institute.

Koch, N., & Mama, H. B. (2019). Does the EU Emissions Trading System induce investment leakage? Evidence from German multinational firms. *Energy Economics, 81*, 479-492.

Kotzampasakis, M., & Woerdman, E. (2020). Linking the EU ETS with California's Cap-and-Trade Program. *The Central European Review of Economics and Management, 4*(4), 9-45.

KPMG. (2022). *Fit for 55: Emissions Trading; Carbon Border Adjustments and Climate Funding*. Retrieved from https://assets.kpmg.com/content/dam/kpmg/us/pdf/2022/12/tnf-fit-55-dec22-2022.pdf

Le, D., & XuanHanh (Producer). (2022, 08 18). Dự án Nhà máy điện phân nhôm Đắk Nông dự kiến sẽ có sản phẩm vào năm 2024. *ĐÀI PHÁT THANH VÀ TRUYỀN HÌNH ĐẮK NÔNG*. Retrieved from https://truyenhinhdaknong.vn/news/du-an-nha-may-dien-phan-nhom-dak-nong-du-kien-se-co-san-pham-vao-nam-2024-13998.htm

Le, T. A. (2022). Ngành thép Việt Nam - Khó khăn trong tình hình mới. Retrieved 01 March, 2023 from https://vioit.org.vn/vn/chien-luoc-chinh-sach/nganh-thep-viet-nam----kho-khan-trong-tinh-hinh-moi-5017.4050.html

Lee, N., Flores-Espino, F., Oliveira, R., Roberts, B., Bowen, T., & Katz, J. (2020). *Exploring Renewable Energy Opportunities in select Southeast Asian Countries: A Geospatial Analysis of the Levelized Cost of Energy of Utility-Scale Wind and Solar Photovoltaics*. Retrieved from

Leonard, R. J., McArthur, C., & Hochuli, D. F. (2016). Particulate matter deposition on roadside plants and the importance of leaf trait combinations. *Urban forestry & urban greening, 20*, 249-253. doi:10.1016/j.ufug.2016.09.008

Li, M., Weng, Y., & Duan, M. (2019). Emissions, energy and economic impacts of linking China's national ETS with the EU ETS. *Applied energy, 235*, 1235-1244.

Liao, S., Wang, D., Xia, C., & Tang, J. (2022). China's provincial process CO2 emissions from cement production during 1993–2019. *Scientific Data, 9*(1), 1-14. doi:10.1038/s41597-022-01270-0

Lim, B., Hong, K., Yoon, J., Chang, J.-I., & Cheong, I. (2021). Pitfalls of the EU's Carbon Border Adjustment Mechanism. *Energies, 14*(21). doi:https://doi.org/10.3390/en14217303

Lin, Y.-W. Y., Yang, H. H., Ma, L. L., Li, Z. Z., & Ni, W. W. (2021). Low-Carbon Development for the Iron and Steel Industry in China and the World: Status Quo, Future Vision, and Key Actions. *Sustainability*, 12548.

Lowe, S. (2019). *Should the EU tax imported CO2?* Retrieved from https://www.cer.eu/insights/should-eu-tax-imported-co2

Lowe, S. (2021). *The EU's carbon border adjustment mechanism: How to make it work for developing countries*. Retrieved from https://www.cer.eu/publications/archive/policy-brief/2021/eus-carbon-border-adjustment-mechanism-how-make-it-work#section-5

Lu, B., Blakers, A., Stocks, M., & Do, T. N. (2021). Low-cost, low-emission 100% renewable electricity in Southeast Asia supported by pumped hydro storage. *Energy*. doi:10.1016/j.energy.2021.121387

Luyten, A.-E. (2021). The U.S. response to the EU CBAM: Past responses and future prospects. Retrieved from https://www.tradeexperettes.org/blog/articles/the-us-response-to-the-eu-cbam-past-responses-and-future-prospects

Magacho, G., Espagne, E., & Godin, A. (2022). *Impacts of CBAM on EU trade partners: consequences for developing countries*. Retrieved from https://www.afd.fr/en/ressources/impacts-cbam-eu-trade-partners-consequences-developing-countries

Marcu, A., Mehling, M., & Cosbey, A. (2020). *Border Carbon Adjustments in the EU: Issues and Options*. Retrieved from https://ercst.org/wp-content/uploads/2021/08/20200929-CBAM-Issues-and-Options-Paper-F-2.pdf

Mathiesen, L., & Maestad, O. (2004). Climate Policy and the Steel Industry: Achieving Global Emission Reductions by an Incomplete Climate Agreement. *The Energy Journal, 25*, 91-114. doi:10.2307/41323359

Ministry of Ecology and Environment of China. (2021). The Ministry of Ecology and Environment held a regular press conference in July 2021 [Press release]. Retrieved from https://www.mee.gov.cn/ywdt/zbft/202107/t20210726_851421.shtml

Ministry of Economy, T. a. I. o. J. (2022a). METI Minister Nishimura Attends the 2nd EU-Japan High Level Economic Dialogue [Press release]. Retrieved from https://www.meti.go.jp/english/press/2022/1025_001.html

Ministry of Economy, T. a. I. o. J. (2022b). Press Conference by Minister Nishimura (Excerpt) [Press release]. Retrieved from https://www.meti.go.jp/english/speeches/press_conferences/2022/1216001.html

Ministry of Justice. (2018). *Professional guidance book for policy impact assessment*.

Mishra, A. R. (2021). BRICS Summit Is Likely To Strongly Oppose Carbon Tax Proposed By EU. Retrieved from https://greenfiscalpolicy.org/brics-summit-is-likely-to-strongly-oppose-carbon-tax-proposed-by-eu/

MOIT. (2022). *Draft National Power Development Plan for the 2021-2030 period with a vision to 2045*: Ministry of Industry and Trade.

MONRE. (2022a). *Decision on Publishing the list of emissions factors for quantifying greenhouse gas emissions*. (Decision 2626/QD-BTNMT). Ministry of Natural Resources and Environment of Vietnam

MONRE. (2022b). *Publishing the results of the emission factor calculation for Vietnam's electricity grid in 2021*. (Document 1278/BDKH TTBVTOD). Hanoi: Ministry of Natural Resources and Environment Retrieved from http://www.dcc.gov.vn/van-ban-phap-luat/1101/He-so-phat-thai-luoi-dien-Viet-Nam-2021.html

Naegele, H., & Zaklan, A. (2019). Does the EU ETS cause carbon leakage in European manufacturing? *Journal of Environmental Economics and Management, 93*, 125-147.

National Environment Agency of Singapore. (2020). *Estimation of reckonable GHG emissions*. Retrieved from: https://www.nea.gov.sg/our-services/climate-change-energy-efficiency/climate-change/carbon-tax

Natter, A. (2021). Biden Exploring Border Adjustment Tax to Fight Climate Change. Retrieved from https://www.bloomberg.com/news/articles/2021-04-23/biden-exploring-border-adjustment-tax-to-fight-climate-change#xj4y7vzkg

NDC. (2022). *Viet Nam's Nationally Determined Contribution updated in 2022*.

Nedumpara, J. J., & Pradeep, S. (2020). Implementing Carbon Tax: From Rhetoric to Reality. *Social Science Research Network*. Retrieved from http://dx.doi.org/10.2139/ssrn.3698022

New Zealand Ministry for the Environment. (2023). Coverage of the New Zealand Emissions Trading Scheme. Retrieved 01/02, 2023 from https://environment.govt.nz/what-government-is-doing/areas-of-work/climate-change/ets/coverage-of-the-nz-ets/

Newman, N. S. (2022). The European Union opean Union's CBAM: Is It an E s CBAM: Is It an Effective Economic Climate conomic Climate Policy? . *Pepperdine Policy Review, 14*.

Nguyen, T. V. (2012). Foreign experience and the enhancement of the effectiveness of Viet Nam's participation in the dispute settlement mechanism at the World Trade Organization. *Science Journal of VNU, 28*(Jurisprudence), 117-133.

NLQT. (2015, April 20). Đạm Phú Mỹ - Sản xuất từ khí thiên nhiên như thế nào? Retrieved 02 March, 2023 from https://nangluongquocte.petrotimes.vn/dam-phu-my-san-xuat-tu-khi-thien-nhien-nhu-the-nao-274766.html

Notani, S. (2022). India: The EU Carbon Border Adjustment Mechanism – Implications For India. Retrieved from https://www.mondaq.com/india/international-trade-amp-investment/1166146/the-eu-carbon-border-adjustment-mechanism--implications-for-india

Nottage, H. (2009). *Developing countries in the WTO dispute settlement system*. GEG Working Paper, No. 2009/47. Oxford.

Office of the Minister of Finance and Office of the Minister of Revenue of New Zealand. (2022). *Emissions reduction plan: addressing emissions leakage*. Retrieved from https://www.taxpolicy.ird.govt.nz/-/media/project/ir/tp/publications/2022/2022-ir-cab-22-env-22-sub-0011/2022-ir-env-22-sub-0011-2-paper.pdf?modified=20220822233252

OurWorldInData. (2023a). CO_2 and Greenhouse Gas Emissions. https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions

OurWorldInData. (2023b). Energy. https://ourworldindata.org/energy

Pandit, J., Watson, M., & Qader, A. (2020). *Reduction of greenhouse gas emissions in steel production*. Retrieved from

Parliament of Vietnam. (2015). *Resolution No 1084/2015/UBTVQH13 dated 10/12/2015 on the issuance of Natural Resources Tax*.

Parliament of Vietnam. (2018). *Resolution No 579/2018/UBTVQH14 dated 26/09/2018 on the issuance of Environmental Protection Tax*.

Parliament of Vietnam. (2022). *Resolution No 30/2022/UBTVQH15 dated 26/09/2018 on the issuance of Environmental Protection Tax for Petrol, Oil and Grease in 2023*.

Parry, I., Dohlman, P., Hillier, C., Kaufman, M., Kwak, K., Misch, F., . . . Waerzeggers, C. (2021). *Carbon Pricing: What Role for Border Carbon Adjustments?* Retrieved from https://www.imf.org/en/Publications/staff-climate-notes/Issues/2021/09/24/Carbon-Pricing-What-Role-for-Border-Carbon-Adjustments-464805

Pauw, P., van Schaik, L., & Cretti, G. (2022). *The CBAM Effect: how the world is responding to the EU's new climate stick*. Retrieved from

Politburo. (2020). *Resolution No 55-NQ/TW dated 11/02/2020 on orientation of Vietnam's national energy development strategy to 2030, with a vision to 2045*.

Prime Minister of Vietnam. (2022). *Decision 896/QD-TTg 2022 approving the National strategy for climate change until 2050 in Vietnam*.

Ramizo, D. (2012). WTO dispute settlement: A right to a day in court for all. Retrieved from Asia Regional Intergration Center: https://aric.adb.org/blog/wto_dispute_settlement_a_right_to_a_day_in_court_for_all

REUTERS. (2023). Exclusive: India to bolster carbon trading market with stabilisation fund. Retrieved 01/02, 2023 from https://www.reuters.com/business/sustainable-business/india-bolster-carbon-trading-market-with-stabilisation-fund-2022-12-21/

Rosales, R. C., Bellino, P., Elnahass, M., Heubaum, H., Lim, P., Lemaistre, P., . . . Sjögersten, S. (2021). Voluntary Carbon Markets in ASEAN: Challenges and Opportunities for Scaling Up.

Royal Society. (2002). *Economic instruments for the reduction of carbon dioxide emissions*: Royal Society.

Rubio-Varas, M., & Muñoz-Delgado, B. (2019). The Energy Mix Concentration Index (EMCI): Methodological considerations for implementation. *MethodsX, 6*, 1228-1237. doi:https://doi.org/10.1016/j.mex.2019.05.023

Schaik, L. v., Pauw, P., & Cretti, G. (2022). *The CBAM Effect: how the world is responding to the EU's new climate stick*. Retrieved from www.clingendael.org/sites/default/files/2022-05/Alert_CBAM_effect.pdf

SFOE. (2022). Linking the Swiss and EU emissions trading systems. Retrieved 03/02, 2023 from Linking the Swiss and EU emissions trading systems (admin.ch)

Shen, Y., & Feng, J. (2017). Linking China's ETS with the EU ETS: Possibilities and institutional challenges. *Envtl. Pol'y & L., 47*, 127.

Simon, F. (2021). John Kerry: Carbon border tariffs are 'a legitimate idea to have on the table'. Retrieved from https://www.euractiv.com/section/emissions-trading-scheme/interview/john-kerry-carbon-border-tariffs-are-a-legitimate-idea-to-have-on-the-table/

Solar Bay. (2020). How Much Emissions Does a Solar Power System Prevent? Retrieved from https://solarbay.com.au/newsroom/how-much-emissions-does-solar-power-prevent/#:~:text=The%20US-based%20National%20Renewable,CO2%20equivalent%20per%20kilowatt-hour.

Spanish Slate Quarries. Sustainable slate for a more environmentally friendly future. Retrieved from https://www.ssqgroup.com/3-reasons-why-slate-roofs-are-a-great-choice-for-sustainable-projects#:~:text=This%20makes%20slate%20a%20great,kg%20of%20CO2%20per%20kilo.

Springer, C. (2018). Assessing energy intensity and retrofit opportunities for the aluminum industry: Lessons from Vietnam. *Resources, Conservation and Recycling, 131*, 235-246. doi:https://doi.org/10.1016/j.resconrec.2017.12.020

SRV. (2022). *National Determined Contribution (NDC) (Updated in 2022)*. Socialist Republic of Vietnam

Statista. (2023a). Production capacity of cement worldwide in 2022, by leading country. https://www.statista.com/statistics/1256776/production-capacity-of-cement-worldwide-by-country/

Statista. (2023b). Vietnam aluminium production. https://www.statista.com/statistics/1130165/vietnam-aluminum-production/

https://www.statista.com/statistics/1130149/vietnam-alumina-production/#:~:text=In%20Vietnam%2C%20alumina%20production%20amounted,million%20metric%20tons%20in%202021.

Stiglitz, J. E., Stern, N., Duan, M., Edenhofer, O., Giraud, G., Heal, G. M., . . . Pangestu, M. (2017). Report of the high-level commission on carbon prices.

Stone, R. (1954). Linear Expenditure Systems and Demand Analysis: An Application to the Pattern of British Demand. *The Economic Journal, 64*(255), 511-527. doi:10.2307/2227743

Sun, A. (2022). *East Meets West: Linking the China and EU ETS's*. Retrieved from East Meets West: Linking the China and EU ETS's - Kleinman Center for Energy Policy (upenn.edu)

Surf Cleaner. (2022). The European Carbon Taxes and Their Impact on Emissions What is a Carbon Tax? Retrieved 09/02, 2023 from https://surfcleaner.com/2022/03/01/an-overview-of-european-carbon-taxes-and-their-impact-on-emissions/#:~:text=Carbon%20Tax%20Rates%20in%20Europe,in%20Europe%20have%20carbon%20taxes.

Survey, U. S. G. (2023). *Mineral Commodity Summaries 2023*. Retrieved from Reston, VA:

Tanabe, Y. (2022). Japan should lead the global effort to decarbonise: Reflections on the EU's Carbon Border Adjustment Mechanism. Retrieved from https://cepr.org/voxeu/columns/japan-should-lead-global-effort-decarbonise-reflections-eus-carbon-border-adjustment

Taxation and Customs Union. (2022). Carbon Border Adjustment Mechanism. Retrieved from https://taxation-customs.ec.europa.eu/green-taxation-0/carbon-border-adjustment-mechanism_en

Taylor, K. (2021). US raises concerns over Europe's planned carbon 'border tax'. Retrieved from https://www.euractiv.com/section/energy-environment/news/us-raises-concerns-over-europes-planned-carbon-border-tax/

The Government of Viet Nam. (2022). *Decree No. 06/2022/ND-CP of the Government dated January 07, 2022 on mitigation of greenhouse gas (GHG) emissions and protection of ozone layer*. Retrieved from The Government of Socialist Republic of Viet Nam: https://vanban.chinhphu.vn/?pageid=27160&docid=205039

The Government of Viet Nam. (2023). *Resolution No. 01/NQ-CP of the Government dated 6 January 2023 on the main tasks and solutions to implement socio-economic development plan, state budget estimates and improvement of the business environment and national competitiveness*

in 2023. Retrieved from The Government of Socialist Republic of Viet Nam: https://vanban.chinhphu.vn/?pageid=27160&docid=207258&classid=509

The National Assembly of Viet Nam. (2015). *Law on Promulgation of Legal Normative Documents No. 80/2015/QH13 dated June 22, 2015*. Retrieved from National Assembly of the Socialist Republic of Vietnam: https://vanban.chinhphu.vn/?pageid=27160&docid=180583

The World Bank. (2022). The World Bank in Viet Nam - Overview. The World Bank: https://www.worldbank.org/en/country/vietnam/overview

The World Trade Organization. (n.d.). *Disputes by member*. Retrieved from The World Trade Organization: https://www.wto.org/english/tratop_e/dispu_e/dispu_by_country_e.htm

Thu, H. (Producer). (2022, April 15). "Cú sốc" Phân bón có thể thay đổi ngành nông nghiệp theo hướng tốt hơn? *Vneconomy*. Retrieved from https://vneconomy.vn/cu-soc-phan-bon-co-the-thay-doi-nganh-nong-nghiep-theo-huong-tot-hon.htm

TKNL. (2023, 22 February 2023). Công ty Cổ phần Nhôm Đô Thành giảm phát thải 56,8 tấn CO2 nhờ tiết kiệm năng lượng. Retrieved 01 March, 2023 from

UK Government. (2022). Guidance Participating in the UK ETS. Retrieved 02/02, 2023 from Participating in the UK ETS - GOV.UK (www.gov.uk)

UNCOMTRADE. (2023). UN Comtrade Database

UNCTAD. (2021). *A European Union Carbon Border Adjustment Mechanism: Implications for developing countries*. Retrieved from https://unctad.org/system/files/official-document/osginf2021d2_en.pdf

United Nations. (2015). *Paris Agreement*. Retrieved from United Nations: https://unfccc.int/sites/default/files/english_paris_agreement.pdf

United Nations Conference on Trade and Development. (2021). A European Union Carbon Border Adjustment Mechanism: Implications for developing countries. Retrieved from https://unctad.org/system/files/official-document/osginf2021d2_en.pdf

Van der Vorst, C., & Rousseau, S. (2022). Japan's Reaction to the Eu's Carbon Pricing Policy–an Economic-Environmental Analysis. *Available at SSRN 4291681*. doi:http://dx.doi.org/10.2139/ssrn.4291681

Verde, S. F. (2020). The impact of the EU emissions trading system on competitiveness and carbon leakage: the econometric evidence. *Journal of Economic Surveys, 34*(2), 320-343.

Verikios, G., Shridhar, T., & Liyanaarachchi, T. S. (2022). The Economic Benefits of COVIID-19 Vaccinations In Five Asian Countries. Retrieved from https://ssrn.com/abstract=4235893 or http://dx.doi.org/10.2139/ssrn.4235893

Viet Nam and EU. (2020). *EU-Vietnam: Texts of the agreements*. Retrieved from European Commission: https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/countries-and-regions/vietnam/eu-vietnam-agreement/texts-agreements_en

Vietnam's National Assembly. (2021). *National master plan for the period 2021-2030, vision to 2050*.

Vinson and Elkins. (2022). The Carbon Border Adjustment Mechanism ("CBAM") – the European Union's Next Climate Action Step. Retrieved from https://www.velaw.com/insights/the-carbon-border-adjustment-mechanism-cbam-the-european-unions-next-climate-action-step/

VNEEP. (2020). Vietnam Energy Statistics 2020.

Volek, D. (2017). SA Clay brick production – at the cutting edge of CO2 emissions reduction. Retrieved from http://www.sabuilder.co.za/2017/03/28/sa-clay-brick-production-at-the-cutting-edge-of-co2-emissions-reduction/

Vorst, C. V. d., & Rousseau, S. (2022). Japan's Reaction to the Eu's Carbon Pricing Policy – an Economic-Environmental Analysis. *SSRN*. doi:10.2139/ssrn.4291681

Wannan, O. (2021). The carbon border tax that could hit NZ exports. Retrieved from https://www.stuff.co.nz/environment/climate-news/125778344/the-carbon-border-tax-that-could-hit-nz-exports?rm=a

World Bank. (2020). *State and Trends of Carbon Pricing 2020*. Washington, DC: World Bank.

World Bank. (2022). *State and Trends of Carbon Pricing 2022*. Washington, DC: World Bank.
World Economic Forum. (2023). Recession in 2023? That depends on where you are in the world. Retrieved 27/2/2023, 2023 from https://www.weforum.org/agenda/2023/01/global-recession-economic-outlook-2023/
Worldsteel Assocation. (2023). December 2022 crude steel production and 2022 global crude steel production totals https://worldsteel.org/media-centre/press-releases/2023/december-2022-crude-steel-production-and-2022-global-totals/
WTO Committee of Trade and Environment. (2021). *Report of the meeting held on 16 and 20 November 2020*. Retrieved from https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/WT/CTE/M70.pdf&Open=True
WTO Committee on Market Access. (2020). *Minutes of the committee on market access 8 June 2020*. Retrieved from https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/G/MA/M72.pdf&Open=True
WTO Committee on Trade and Environment. (2021). *Report of the meeting held on 30 March 2021*. Retrieved from https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/WT/CTE/M71.pdf&Open=True
WTO Council for Trade in Goods. (2020). Goods Council considers EU plans for carbon taxes on certain imports. Retrieved from https://www.wto.org/english/news_e/news20_e/good_11jun20_e.htm
Xu, M., & Stanway, D. (2021). China says EU's planned carbon border tax violates trade principles. Retrieved from https://www.reuters.com/business/sustainable-business/china-says-ecs-carbon-border-tax-is-expanding-climate-issues-trade-2021-07-26/
Zachmann, G., & McWilliams, B. (2020). A European carbon border tax: much pain, little gain. *Policy Contribution,* (05/2020).

APPENDICES

Appendix 1: CBAM-targeted commodities

Iron and Steel

HS code	GHG
72 – Iron and steel **<u>Except:</u>** **7202 – Ferro-alloys** **7204 – Ferrous waste and scrap; remelting scrap ingots and steel**	CO_2
7301- Sheet piling of iron or steel, whether or not drilled, punched or made from assembled elements; welded angles, shapes and sections, of iron or steel	CO_2
7302 – Railway or tramway track construction material of iron or steel, the following: rails, check-rails and rack rails, switch blades, crossing frogs, point rods and other crossing pieces, sleepers (cross-ties), fish- plates, chairs, chair wedges, sole plates (base plates), rail clips, bedplates, ties and other material specialised for jointing or fixing rails	CO_2
730300 – Tubes, pipes and hollow profiles, of cast iron	CO_2
7304 – Tubes, pipes and hollow profiles, seamless, of iron (other than cast iron) or steel	CO_2
7305 – Other tubes and pipes (for example, welded, riveted or similarly closed), having circular cross-sections, the external diameter of which exceeds 406,4 mm, of iron or steel	CO_2
7306 – Other tubes, pipes and hollow profiles (for example, open seam or welded, riveted or similarly closed), of iron or steel	CO_2
7307 – Tube or pipe fittings (for example, couplings, elbows, sleeves), of iron or steel	CO_2
7308 – Structures (excluding prefabricated buildings of heading 9406) and parts of structures (for example, bridges and bridge-sections, lock- gates, towers, lattice masts, roofs, roofing frameworks, doors and windows and their frames and thresholds for doors, shutters, balustrades, pillars and columns), of iron or steel; plates, rods, angles, shapes, sections, tubes and the like, prepared for use in structures, of iron or steel	CO_2
7309 – Reservoirs, tanks, vats and similar containers for any material (other than compressed or liquefied gas), of iron or steel, of a capacity exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	CO_2
7310 – Tanks, casks, drums, cans, boxes and similar containers, for any material (other than compressed or liquefied gas), of iron or steel, of a capacity not exceeding 300 l, whether or not lined or heat-insulated, but not fitted with mechanical or thermal equipment	CO_2
7311 – Containers for compressed or liquefied gas, of iron or steel	CO_2

Aluminium

HS code	GHG
7601 – Unwrought aluminium	CO_2 and PFCs
7603 – Aluminium powders and flakes	CO_2 and PFCs
7604 – Aluminium bars, rods and profiles	CO_2 and PFCs
7605 – Aluminium wire	CO_2 and PFCs
7606 – Aluminium plates, sheets and strip, of a thickness exceeding 0,2 mm	CO_2 and PFCs
7607 – Aluminium foil (whether or not printed or backed with paper, paper-board, plastics or similar backing materials) of a thickness (excluding any backing) not exceeding 0.2 mm	CO_2 and PFCs
7608 – Aluminium tubes and pipes	CO_2 and PFCs
760900 – Aluminium tube or pipe fittings (for example, couplings, elbows, sleeves)	CO_2 and PFCs

Cement

HS code	GHG
252310 – Cement clinkers	CO_2
252321 – White Portland cement, whether or not artificially coloured	CO_2
252329 – Other Portland cement	CO_2
252390 – Other hydraulic cements	CO_2

Fertilisers

HS code	GHG
280800 – Nitric acid; sulphonitric acids	CO_2 and N_2O
2814 – Ammonia, anhydrous or in aqueous solution	CO_2
283421 - Nitrates of potassium	CO_2 and N_2O
3102 – Mineral or chemical fertilisers, nitrogenous	CO_2 and N_2O
3105 – Mineral or chemical fertilisers containing two or three of the fertilising elements nitrogen, phosphorus and potassium; other fertilisers; goods of this chapter in tablets or similar forms or in packages of a gross weight not exceeding 10 kg **Except: 310560 – Mineral or chemical fertilisers containing the two fertilising elements phosphorus and potassium**	CO_2 and N_2O

Electricity

HS code	GHG
271600 – Electrical energy	CO_2

Hydrogen

HS code	GHG
280410 – Hydrogen	CO_2

Sources: European Commission (2020) and European Parliament (2023)

Appendix 2: Sectoral trade and production data

Sources: Ministry of Industry and Trade, UN COMTRADE, and mentions in newspaper articles

Appendix Table 1. Trade and production data in iron-steel sector

	2017	2018	2019	2020	2021
Total export value (million USD)	4,246	5,973	5,848	6,695	13,622
Total export quantity (million tonnes)	5.5	6.1	6.9	9.6	13.4
Export value to EU (million USD)	396	529	471	479	2,971
Export quantity to EU (million tonnes)	0.50	0.50	0.40	0.40	2.50
Total import value (million USD)	10,172	11,252	11,038	9,579	13,226
Total import quantity (million tonnes)	15.6	11.6	12.6	11.7	11.1
Import value from EU (million USD)	178	233	283	197	164
Import quantity from EU (million tonnes)	0.1	0.1	0.2	0.1	0.1
Domestic production (million tonnes)	7.7	12.8	18.3	23.9	26.2

Appendix Table 2. Trade and production data in aluminium sector

	2017	2018	2019	2020	2021
Total export value (million USD)	400	577	604	720	1,177
Total export quantity (million tonnes)	0.1	0.2	0.2	0.3	0.4
Export value to EU (million USD)	35	31	15	18	139
Export quantity to EU (million tonnes)	-	-	-	-	0.10
Total import value (million USD)	2,504	3,390	2,458	2,278	3,179
Total import quantity (million tonnes)	0.8	1.0	0.9	0.9	1.0
Import value from EU (million USD)	29	30	24	26	28
Import quantity from EU (million tonnes)	-	-	-	-	-
Domestic production (million tonnes)	0.5	1.3	1.4	1.4	1.4

Appendix Table 3. Trade and production data in fertiliser sector

	2017	2018	2019	2020	2021
Total export value (million USD)	235	244	220	282	488
Total export quantity (million tonnes)	0.8	0.5	0.6	0.9	1.1
Export value to EU (million USD)	1	-	-	-	-
Export quantity to EU (million tonnes)	-	-	-	-	-
Total import value (million USD)	986	930	760	641	1,020
Total import quantity (million tonnes)	3.6	2.6	2.7	2.5	3.0
Import value from EU (million USD)	74	39	29	28	29
Import quantity from EU (million tonnes)	0.2	-	0.1	0.1	-
Domestic production (million tonnes)	6.9	7.4	7.4	7.7	7.9

Appendix Table 4. Trade and production data in cement sector

	2017	2018	2019	2020	2021
Total export value (million USD)	707	1,159	1,301	1,350	1,646
Total export quantity (million tonnes)	18.6	28.2	31.7	36.0	41.8
Export value to EU (million USD)	8	4	9	13	21
Export quantity to EU (million tonnes)	0.20	0.10	0.20	0.40	0.50
Total import value (million USD)	44	25	24	25	12
Total import quantity (million tonnes)	0.7	0.3	0.4	0.4	0.2
Import value from EU (million USD)	-	-	-	-	-
Import quantity from EU (million tonnes)	-	-	-	-	-
Domestic production (million tonnes)	81.5	89.1	105.5	112.3	114.7

Appendix 3: Partial equilibrium specification for sectoral analysis

This section describes the specification of the partial equilibrium framework which is used in the quantitative analysis for CBAM-targeted sectors. The partial equilibrium framework is constructed to match data availability. Key modules of the partial equilibrium framework include (i) consumption and import substitution, (ii) domestic production, (iii) export, (iv) market clearing, i.e., equilibrium conditions. This section also describes how the partial equilibrium framework is repeatedly calibrated with multiple sets of hyper-parameters to generate confidence intervals of estimated economic outcomes.

Consumption, import substitution, and consumption price

Consumers can consume domestic and imported products. Imported products can be purchased from M trading partners, indexed by a superscript $tp = [1,2 \ldots . M]$. The domestic product is indexed by a Greek letter ϑ. The demand for each type of products is formalised in (a series of) equation (1) and equation (2). The average consumer price can be calculated in equation (3). In these equations, $q^{im:x}$ is the quantity imported from trading partner $x \in tp$, and q^{ϑ} is the quantity of domestic product; $p^{im:x}$ is the pre-tax price of products imported from trading partner x, and p^{ϑ} is the pre-tax price of domestic products; $t^{im:x}$ is the import tax rate (including any margin) imported from trading partner x, and t^{ϑ} is the margin of domestic products (if any); $b^{im:x} \geq$ is the price-shift parameter of category-x product, $b^{\vartheta} \geq$ is the price-shift parameter of domestic products; $\sigma \geq 0$ is the CES between consumption products; and $Y \geq 0$ is the 'purchasing power'.

$$q^{im:x} = Y^{\sigma} b^{im:x} \left[p^{im:x}\left(1 + t^{im:x}\right)\right]^{-\sigma} \quad \text{(Eq 1)}$$

$$q^{\vartheta} = Y^{\sigma} b^{\vartheta} \left[p^{\vartheta}\left(1 + t^{\vartheta}\right)\right]^{-\sigma} \quad \text{(Eq 2)}$$

$$p^{cons} = \frac{q^{\vartheta} p^{\vartheta}\left(1+t^{\vartheta}\right) + \sum_{x \in tp} q^{im:x} p^{im:x}\left(1+t^{im:x}\right)}{q^{\vartheta} + \sum_{x \in tp} q^{im:x}} \quad \text{(Eq 3)}$$

The total consumption quantity is defined equation (4) where Q^{cons} is the total consumption, $\epsilon^{cons} \leq 0$ is the price elasticity of demand, and A^{cons} is the price-shift parameter of the demand function.

$$Q^{cons} = Y^{cons} A^{cons} (p^{cons})^{\epsilon^{cons}} \quad \text{(Eq 4)}$$

Production

The production output of domestic producers is formalised in equation (5). In this equation, Q^{prod} is the total production quantity; $\epsilon^{prod} \geq 0$ is the price elasticity of production supply; and A^{prod} is the price-shift parameter of the supply function.

$$Q^{prod} = Y^{prod} A^{prod} \left(p^{prod}\right)^{\epsilon^{prod}} \quad \text{(Eq 5)}$$

Exports

The domestically produced products can be exported to the trading partners as formalised in equation (6). In this equation, $q^{ex:x}$ is the export quantity to trading partner $x \in tp$; $t^{ex:x}$ is the tax rate imposed on export products; $A^{ex:x}$ is the price shift parameter on category-x product, and $\epsilon^{ex:x} \leq 0$ is the elasticity of demand for export.

$$q^{ex:x} = Y^{ex:x} A^{ex:x} \left(p^{prod}(1 + t^{ex:x}) + CBAM^{ex:x}\right)^{\epsilon^{ex:x}} \quad \text{(Eq 6)}$$

Equilibrium and market-clearing conditions

The equilibrium and market clearing conditions are formalised in equations (7) and (8). Equation (7) specifies that domestic production output can be either consumed domestically or exported to one of trading partners. Equation (8) specifies that domestic consumption can be met by domestic production and imports for all trading partners.

$$Q^{prod} = q^{\vartheta} + \sum_{x \in tp} q^{ex:x} \quad \text{(Eq 7)}$$

$$Q^{cons} = q^{\vartheta} + \sum_{x \in tp} q^{im:x} \quad \text{(Eq 8)}$$

Calibration and sensitivity analysis

Calibration of the partial equilibrium models follow the procedure specified by Hübner (2021). Sensitivity analyses are undertaken by repeating the quantitative analysis with multiple sets of hyper parameters.

Appendix Table 5. Hyper-parameters of the data-driven partial equilibrium models

Hyper-parameters	Notations	Distribution	Sources / Justifications
Elasticity of substitution between domestic and imported products	σ	U [0,10]	(Van der Vorst & Rousseau, 2022)
(Short run) price elasticity of consumption	ϵ^{cons}	U [-1,0]	(World Economic Forum, 2023) (; Thang Nam Do & Burke, 2021; European Commission, 2021d) (European Parliament, 2022a) (Dawkins, Srinivasan, & Whalley, 2001)
(Short run) price elasticity of supply	ϵ^{prod}	U [0,5]	(Ahmad & Riker, 2020) (Bruyn, Juijn, & Schep, 2021; Fally & Sayre, 2018) (Bruyn et al., 2021) (Mathiesen & Maestad, 2004)
(Short run) price elasticity of export quantity	ϵ^{exx}	U [-10, -1]	(Fernandez, 2018) (Bruyn et al., 2021; Fally & Sayre, 2018) (Bruyn et al., 2021) (Mathiesen & Maestad, 2004)

Appendix 4: General equilibrium specification

This section describes the specification of the general equilibrium framework which is used in the quantitative analysis for economy-wide indicators. The general equilibrium framework is constructed to match data availability, particular Vietnam's most-detailed-most-recent Input/Output (I/O) table which covers 164 commodities. In other words, our model specification strictly follows the structure of Vietnam's 2019 I/O table (i.e., our model specification focuses on components whose actual data can be reliably obtained or estimated). Key components of the general equilibrium framework include various group of equations representing (i) 164 production sectors, (ii) a private representative consumer, (iii) the government sector, (iv) investment, and (v) international trade, and (vi) equilibrium conditions. This section also describes how the general equilibrium framework is repeatedly calibrated with multiple sets of hyper-parameters to generate confidence intervals of estimated economic outcomes.

Production sectors

There are 164 production sectors corresponding to the 164 commodities in the IO Table of Vietnam. We use s to index these sectors, i.e., $s \in [1,2 \dots 164]$. Each sector uses production factors, i.e., capital (K) and labour (L), and intermediate inputs (i.e., the output of its own and the output of other sectors) to produce output. Assuming a 2-layer production function combining a CES layer and Leontief Layer, the demand for capital, labour, and for immediate inputs in production are specified in equations (9)-(11). In these equations, $K^D_{t,s}(.)$ and $L^D_{t,s}$ are the demand for capital and labour, respectively, by sector s at time t; $Input_{t,j,s}$ is the output of sector j to be used as input of sector s at time t; $Q^{prod}_{t,s}$ is the output of sector s at time t; $A^{Prod}_{t,s}$ is the total factor productivity of sector s at time t; $w_{t,f}$ is the price of production factor $f \in [K,L]$ at time t; σ_s is the elasticity of substitution between production factors; $w_{t,f}$ is the price of factor f at time t; $\alpha_{s,f}$ is the weight of factor f in sector s; $IO_{t,j,s}$ is the required unit of the output of sector j to be used to produce one unit of output of sector s at time t.

$$K^D_{t,s} = Q^{prod}_{t,s}\left(A^{Prod}_{t,s}\right)^{-1}\left(\frac{\alpha_{s,K}}{w_{t,K}}\right)^{\sigma_s}\left(\sum_{f\in[K,L]} w_{t,f}\left(\frac{\alpha_{s,f}}{w_{t,f}}\right)^{\sigma_s}\right)^{\frac{\sigma_s}{1-\sigma_s}} \text{ with } \forall s \in [1..164] \quad \text{(Eq 9)}$$

$$L^D_{t,s} = Q^{prod}_{t,s}\left(A^{Prod}_{t,s}\right)^{-1}\left(\frac{\alpha_{s,L}}{w_{t,L}}\right)^{\sigma_s}\left(\sum_{f\in[K,L]} w_{t,f}\left(\frac{\alpha_{s,f}}{w_{t,f}}\right)^{\sigma_s}\right)^{\frac{\sigma_s}{1-\sigma_s}} \text{ with } \forall s \in [1..164] \quad \text{(Eq 10)}$$

$$Q^{input}_{t,j,s} = Q^{prod}_{t,s} \times IO_{t,j,s} \quad \text{with } \forall s \in [1..164] \text{ and } \forall j \in [1..164] \quad \text{(Eq 11)}$$

Consumption

The quantity of each commodity demanded for consumption is specified as a linear expenditure system (Fernandez, 2018) in equation (12). In this equation, $w_{t,s}$ is the (after-tax) price of commodity s at time t; and $C^{sub}_{t,s}$ is the subsistence level of consumption of commodity s at time t; and γ^{Cons} is the marginal propensity to consume.

$$Q^{Cons}_{t,s} = \frac{\gamma^{Cons}\left(w_{t,L}\sum_s L^D_{t,s} + w_{t,K}\sum_s K^D_{t,s}\right) - \sum_s w_{t,s}C^{sub}_{t,s}}{w_{t,s}} + C^{sub}_{t,s} \text{ with } \forall s \in [1..164] \text{ and } \forall j \in [1..164] \text{ (Eq 12)}$$

Government expenditure, VAT, and carbon tax revenue

The government consumption of commodity s grows at a rate of $g^{gov}_{t,s}$ as specified in equation (13) where $Gov_{t,s}$ is the government consumption (if any) of commodity s at time t.

$$Q^{gov}_{t,s} = Q^{gov}_{t-1,s}(1 + g^{gov}_{t,s}) \text{ with } \forall s \in [1..164] \quad \text{(Eq 13)}$$

The value-added tax is formalised in equation (14) and the carbon tax is formalised in equation (15). In these equations, $\gamma^{VA}_{t,s}$ is the rate of value-added tax imposed on sector s at time t, and $\gamma^{Carbon}_{t,s}$ is the carbon tax rate (per unit of output) imposed on sector s at time t.

$$VA_{t,s} = \gamma_{t,s}^{VA}\left(w_{t,L}L_{t,s}^{D} + w_{t,K}K_{t,s}^{D}\right) \quad \text{with } \forall s \in [1..164] \quad \text{(Eq 14)}$$

$$T^{carbon}{}_{t,s} = \gamma_{t,s}^{Carbon}Q_{t,s} \quad \text{with } \forall s \in [1..164] \quad \text{(Eq 15)}$$

Export and Import

Export quantity is formalised in equation (16). In this equation, $Q_{t,s}^{ex}$ is the export quantity of commodity s at time t; $A_{t,s}^{ex}$ is (calibrated) price-shift parameters; $\alpha_{t,s}$ is the share of CBAM-subject commodity in sector s at time t; $\gamma_{t,s}^{CBAM}$ is the CBAM tax rate (if any) imposed on commodity s; and $-\epsilon_{t,s}^{ex}$ is the price elasticity of export quantity. Import quantity is presented in equation (17) using the Armington formalisation (Fally & Sayre, 2018) that products traded internationally are differentiated by country of origin. In equation (17), $Q_{t,s}^{im}$ is the import quantity (if any) of commodity s at time t; $p_{t,s}^{world}$ is a world price, and $\epsilon_{t,s}^{im}$ is the elasticity of substitution.

$$Q_{t,s}^{ex} = A_{t,s}^{ex}\left(w_{t,s} + \alpha_{t,s} \times \gamma_{t,s}^{CBAM}\right)^{-\epsilon_{t,s}^{ex}} \quad \text{with } \forall s \in [1..164] \quad \text{(Eq 16)}$$

$$Q_{t,s}^{im} = Q_{t,s}^{prod}\left(\frac{p_{t,s}^{world}}{w_{t,s}}\right)^{-\epsilon_{t,s}^{im}} \quad \text{with } \forall s \in [1..164] \quad \text{(Eq 17)}$$

Investment

The quantity of each commodity used for investment (if any) is formalised in equation (18). In this equation γ_t^{inv} is the propensity to invest, α_{ts}^{inv} is the share of each commodity in the total investment spending.

$$Q_{t,s}^{inv} = \frac{\gamma_t^{inv}\alpha_{ts}^{inv}\left(\left(w_{t,L}\sum_s L_{t,s}^{D} + w_{t,K}\sum_s K_{t,s}^{D}\right) + \sum_s VA_{t,s} + \sum_s T^{carbon}{}_{t,s}\right)}{w_{t,s}} \quad \text{with } \forall s \in [1..164] \quad \text{(Eq 18)}$$

Market clearing conditions (equilibrium conditions - closure)

The market clearing conditions of the model are formalised in equations (19)-(22). Equation (19) specifies that the total supply of each commodity (i.e., domestic production and import) equal to the total demand (for immediate inputs, for private consumption, for government consumption, for investment, and for export). Equation (20) specifies that the revenue of each sector will be allocated to an economic actor in the economy (i.e., zero-profit conditions). Equation (21) states that the total capital used in all sectors must be equal to the total capital available. Finally, equation (22) states that the total labour used in all sectors must be equal to the supply of labour, with a price elasticity ϵ_t^{lab} and a shift parameter A_t^{lab}.

$$Q_{t,s}^{prod} + Q_{t,s}^{im} = \sum_j Q_{t,j,s}^{input} + Q_{t,s}^{cons} + Q_{t,s}^{gov} + Q_{t,s}^{ex} + Q_{t,s}^{inv} \quad \text{with } \forall s \in [1..164] \quad \text{(Eq 19)}$$

$$w_{t,s}Q_{t,s}^{prod} = \sum_j w_{t,j}Q_{t,j,s}^{input} + \left(w_{t,L}\sum_s L_{t,s}^{D} + w_{t,K}\sum_s K_{t,s}^{D}\right) + \sum_s VA_{t,s} + \sum_s T^{carbon}{}_{t,s} \quad \text{with } \forall s \in [1..164] \quad \text{(Eq 20)}$$

$$\sum_s K_{t,s}^{D} = \overline{K_t} \quad \text{(Eq 21)}$$

$$\sum_s L_{t,s}^{D} = A_t^{lab}w_{t,L}^{\epsilon_t^{lab}} \quad \text{(Eq 22)}$$

Calibration and hyper-parameter ranges

The calibration of the general equilibrium model follows the procedure set out by Bruyn et al. (2021). In particular, we combine Vietnam's 2019 I/O table with a set of hyper-parameter values for the calibrated parameters. Sensitivity analyses are undertaken by repeating the calibration process with multiple sets of hyper parameters.

Appendix Table 6. Hyper-parameters of the data-driven general equilibrium model

Hyper-parameters	Notations	Distribution	Sources/ Justifications
Elasticity of substitution in production	σ_s	U [0,2]	(Bruyn et al., 2021)
The (short run) price elasticity of labour supply	ϵ_t^{lab}	U [0,1]	(Bruyn et al., 2021), (Mathiesen & Maestad, 2004), (Armington, 1969); Fernandez (2018); (Stone, 1954)
The (short run) price elasticity of export demand	$\epsilon_{t.s}^{ex}$	U [-5, -0.5]	GTAP database (v9.0)
The elasticity of substitution between import and domestic products	$\epsilon_{t,s}^{im}$	U [0, 5]	(Dawkins et al., 2001)

Dynamics and tuning to match BAU assumptions

The dynamics of economic indicators are formalised in equations (23)-(25). Equation (23) specifies that the change in capital stock is the difference between investment and depreciation. In this equation, the depreciation rate δ is specified at 0.1, and the estimated capital stock in the base year (i.e., 2019) is calculated from the I/O table and the fact that the average real interest in Vietnam during 2012-2021 was 5.3% (as extracted from the World Bank's World-Development-Indicator Database). In equation (24) g_t^{lab} is the growth rate of labour force and is specified at 0.94%/year, the demographic growth rate. In equation (25) g_t^{sub} is the growth rate of subsistence (minimum) consumption level, and this parameter is also set at the average demographic growth rate of 0.94%/year.

$$\overline{K}_t = (1-\delta)\overline{K}_{t-1} + \sum_s \frac{\gamma_t^{inv}\alpha_{ts}^{inv}\left((w_{t,L}\sum_s L_{t,s}^D + w_{t,K}\sum_s K_{t,s}^D) + \sum_s VA_{t,s} + \sum_s T^{carbon}{}_{t,s}\right)}{w_{t,s}} \quad \text{(Eq 23)}$$

$$A_t^{lab} = A_{t-1}^{lab}(1+g_t^{lab}) \quad \text{(Eq 24)}$$

$$C_{t,s}^{sub} = C_{t-1,s}^{sub}(1+g_t^{sub}) \quad \text{(Eq 25)}$$

The total factor productivity parameters $A_{t,s}^{Prod}$ in BAU scenarios are tune to reflect the assumption that increases in labour, capital and total factor productivity would generate an annual GDP growth rate of 6.5%, a conservative target set by Vietnam's master plan for 2021-2030 with vision to 2050 (Gechert, Havranek, Irsova, & Kolcunova, 2022: p. 4).

Economy-wide emissions from fossil fuel

Economy-wide emissions from fossil fuel is estimated using IEA data about Vietnam emissions in 2019 (the base year of the CGE model)

Appendix Table 7. Fossil fuel emissions in the reference year 2019

	Emissions 2019 (Million tCO_2e)	Sector indices in I/O 2019 table
Oil	63.71	60
Coal	158.95	28,59
Gas	17.76	30

Sources: International Energy Association (Ham & Reilly)

Appendix 5: Enterprise Survey

Appendix Table 8. Questionnaire templates for 4 sectors

Page 1 of (9)

QUESTIONNAIRE FOR ENTERPRISE - ALUMINUM		
For impact assessment study of the European's Carbon Border Adjustment Mechanism applied to products exported to the EU. ***(The collected data will only be used for research purpose. The name of the responder and the enterprise will be confidential.)***		
A1	ENTERPRISE'S INFORMATION *(*This section is to provide information on enterprise's features to provide recommendation relevant to each group of enterprises in a sector)*	
A1.1	**Name of enterprise:**	
A1.2	**Address**	
	Province/Municipality	
	District (town, provincial city):	
	Commune/ward/town:	
	Village/ Hamlet (building number, stree	
A1.3	**Phone:**	
A1.4	**Email :**	

A1.5 Type of enterprise *(Choose the most suitable option)*

01 Single-member LLC with 100% state capital under central government contr
02 Single-member LLC with 100% state capital under local government control
03 JSCo, LLC with >50% state capital
% capital under central government control ☐
% capital under local government control ☐
04 Cooperative/ Union of Cooperative
4.1. Cooperative
4.2. Union of Cooperative
4.3. People's credit fund
05 Sole proprietorship
06 Partnership
07 Private LLC, LLC with≤ 50% state capital
% state capital ☐
08 JSCo without state capital
09 JSCo with <50% state capital
% state capital ☐
Does state have control? Yes ☐ No ☐
10 Enterprise with 100% foreign capital
11 Joint Venture between foreign parties and State-owned enterprise
% foreign capital ☐
12 Joint Venture between foreign parties and domestic enterprise
% foreign capital ☐

A1.6 Business type of enterprise *(Choose the most suitable option)*

01 Production company
02 Manufacturing and processing company
03 Trading and servicing company

A1.7 Production technology *(Only applicable to production company)*

01 Søderberg technology
02 Prebake technology

A1.8 Has your business exported in the last 5 years?

1 No
2 Yes, export to the EU market
3 Yes, export to markets outside the EU *(please specify)*

QUESTIONNAIRE FOR ENTERPRISE - FERTILIZER

For impact assessment study of the European's Carbon Border Adjustment Mechanism applied to products exported to the EU.
(The collected data will only be used for research purpose. The name of the responder and the enterprise will be confidential.)

A1 ENTERPRISE'S INFORMATION
*(*This section is to provide information on enterprise's features to provide recommendation relevant to each group of enterprises in a sector)*

A1.1	**Name of enterprise:**	
A1.2	**Address**	
	Province/Municipality	
	District (town, provincial city):	
	Commune/ward/town:	
	Village/ Hamlet (building number, stree	
A1.3	**Phone:**	
A1.4	**Email :**	

A1.5 Type of enterprise *(Choose the most suitable option)*

01 Single-member LLC with 100% state capital under central government contr
02 Single-member LLC with 100% state capital under local government control
03 JSCo, LLC with >50% state capital
% capital under central government control ☐
% capital under local government control ☐
04 Cooperative/ Union of Cooperative
4.1. Cooperative
4.2. Union of Cooperative
4.3. People's credit fund
05 Sole proprietorship
06 Partnership
07 Private LLC, LLC with≤ 50% state capital
% state capital ☐
08 JSCo without state capital
09 JSCo with <50% state capital
% state capital ☐
Does state have control? Yes ☐ No ☐
10 Enterprise with 100% foreign capital
11 Joint Venture between foreign parties and State-owned enterprise
% foreign capital ☐
12 Joint Venture between foreign parties and domestic enterprise
% foreign capital ☐

A1.6 Business type of enterprise *(Choose the most suitable option)*

01 Production company
02 Manufacturing and processing company
03 Trading and servicing company

A1.7 Production technology *(Only applicable to production company)*

01 Plant with Non-Selective Catalytic Reduction (NSCR)
02 Plant with process-intergrated or tailgas N2O destruction
03 Atmospheric pressure plants (low pressure)
04 Medium pressure combustion plant
05 High pressure plant

QUESTIONNAIRE FOR ENTERPRISE - IRON AND STEEL

For impact assessment study of the European's Carbon Border Adjustment Mechanism applied to products exported to the EU.
(The collected data will only be used for research purpose. The name of the responder and the enterprise will be confidential.)

A1 ENTERPRISE'S INFORMATION
*(*This section is to provide information on enterprise's features to provide recommendation relevant to each group of enterprises in a sector)*

A1.1	**Name of enterprise:**	
A1.2	**Address**	
	Province/Municipality	
	District (town, provincial city):	
	Commune/ward/town:	
	Village/ Hamlet (building number, stree	
A1.3	**Phone:**	
A1.4	**Email :**	

A1.5 Type of enterprise *(Choose the most suitable option)*

01 Single-member LLC with 100% state capital under central government contr
02 Single-member LLC with 100% state capital under local government control
03 JSCo, LLC with >50% state capital
% capital under central government control ☐
% capital under local government control ☐
04 Cooperative/ Union of Cooperative
4.1. Cooperative
4.2. Union of Cooperative
4.3. People's credit fund
05 Sole proprietorship
06 Partnership
07 Private LLC, LLC with≤ 50% state capital
% state capital ☐
08 JSCo without state capital
09 JSCo with <50% state capital
% state capital ☐
Does state have control? Yes ☐ No ☐
10 Enterprise with 100% foreign capital
11 Joint Venture between foreign parties and State-owned enterprise
% foreign capital ☐
12 Joint Venture between foreign parties and domestic enterprise
% foreign capital ☐

A1.6 Business type of enterprise *(Choose the most suitable option)*

01 Production company
02 Manufacturing and processing company
03 Trading and servicing company

A1.7 Production technology *(Only applicable to production company)*

01 Basic Oxygen Furnace- BOF
02 Electric Arc Furnace-EAF

A1.8 Has your business exported in the last 5 years?

1 No
2 Yes, export to the EU market
3 Yes, export to markets outside the EU *(please specify)*

QUESTIONNAIRE FOR ENTERPRISE - CEMENT

For impact assessment study of the European's Carbon Border Adjustment Mechanism applied to products exported to the EU.
(The collected data will only be used for research purpose. The name of the responder and the enterprise will be confidential.)

A1 ENTERPRISE'S INFORMATION
*(*This section is to provide information on enterprise's features to provide recommendation relevant to each group of enterprises in a sector)*

A1.1	**Name of enterprise:**	
A1.2	**Address**	
	Province/Municipality	
	District (town, provincial city):	
	Commune/ward/town:	
	Village/ Hamlet (building number, stree	
A1.3	**Phone:**	
A1.4	**Email :**	

A1.5 Type of enterprise *(Choose the most suitable option)*

01 Single-member LLC with 100% state capital under central government contr
02 Single-member LLC with 100% state capital under local government control
03 JSCo, LLC with >50% state capital
% capital under central government control ☐
% capital under local government control ☐
04 Cooperative/ Union of Cooperative
4.1. Cooperative
4.2. Union of Cooperative
4.3. People's credit fund
05 Sole proprietorship
06 Partnership
07 Private LLC, LLC with≤ 50% state capital
% state capital ☐
08 JSCo without state capital
09 JSCo with <50% state capital
% state capital ☐
Does state have control? Yes ☐ No ☐
10 Enterprise with 100% foreign capital
11 Joint Venture between foreign parties and State-owned enterprise
% foreign capital ☐
12 Joint Venture between foreign parties and domestic enterprise
% foreign capital ☐

A1.6 Business type of enterprise *(Choose the most suitable option)*

01 Production company
02 Manufacturing and processing company
03 Trading and servicing company

A1.8 Has your business exported in the last 5 years?

1 No
2 Yes, export to the EU market
3 Yes, export to markets outside the EU *(please specify)*

A2	**ENTERPRISE'S RESPONSE TO THE EU'S CARBON BORDER ADJUSTMENT MECHANISM** *(*This section is to understand enterprise's approach to information and opinions regarding CBAM)*
A2.1	**Have you heard that the European Union plans to apply a carbon tax (EU carbon border adjustment mechanism - CBAM) on products importeed to the EU?**
	1 Yes 2 No
A2.2	**How well do you know about the EU CBAM?**
	1 Totally unaware 2 Aware but do not know in detail 3 Know general information 4 Know relatively well 5 Know very well
A2.3	**Does your enterprise have any plan to respond to the EU CBAM?**
	1 Yes 2 No
A2.4	**If not, when will your enterprise develop a plan to respond to EU CBAM?**
	1 2023 2 2024 3 2025 4 After 2025 5 Not know yet
A2.5	**In your opinion, how will EU CBAM affect on your enterprise?**
	1 No impact 2 Small impact 3 Moderate impact 4 Heavy impact 5 Severe impact 6 Do not know/ No opinion
A2.6	**In your opinion, which of the following plan is the most important for Vietnamese enterprises in order to respond to EU CBAM?** *(Choose 1 option)*
	1 No action 2 Complying with EU CBAM regulation 3 Supporting and complying with implementation of domestic carbon tax 4 Supporting and complying with establishment of domestic carbon market 5 Exporting to other markets outside the EU 6 Opposing to EU CBAM 7 Do not know/ No opinion

8 Other plans *(please specify)*:

A2.7 Do you have any other opinions on EU CBAM?

1 No
2 Yes *(please specify)*:

A2.8 Is your enterprise subject to pay any taxes, fees, charges related to emission or environmental protection?

1 No
2 Yes *(please specify)*:

A2.9 Does your enterprise encounter any difficulty in paying those taxes, fees, and charges?

1 No
2 Yes *(please specify)*:

A2.10 Does your enterprise develop or implement any plans, policies, or regulations to resolve difficulties in paying the above taxes, fees and charges? If so, did the implementation of those solutions work?

1 No
2 Yes, but not effective
3 Yes, and effective
Please specify plans, policies, and regulations that your enterprise has developed or implemented (if applicable):

A2.11 Is your enterprise interested in joining carbon market?

1 Yes
2 No

A3 INFORMATION ON ENERGY AND RAW MATERIAL CONSUMPTION OF ENTERPRISE

*(*This section is to study the current state of raw material, energy and electricity consumption of enterprise to conduct GHG emission inventory for enterprise)*

Type of raw material and energy	Code	Unit	2017		2018		2019		2020		2021	
			Consumption amount	Consumption value *(mil. đồng)*	Consumption amount	Consumption value *(mil. đồng)*	Consumption amount	Consumption value *(mil. đồng)*	Consumption amount	Consumption value *(mil. đồng)*	Consumption amount	Consumption value *(mil. đồng)*
A	B	C	1	2	3	4	5	6	7	8	9	10
Electricity	01	1000 kWh										
Coal	02	Ton										
Crude oil	03	1000 tons										
Petrol	04	1000 litre										
Fuel oil	05	1000 litre										
LPG	06	Ton										
Gas	07	1000 m3										
Other material or energy type (please specify):	08											

A4 INFORMATION ON BUSINESS AND PRODUCTION ACTIVITY OF ENTERPRISE

*(*This section is to quantify CBAM impact on production and business activities of enterprises, analyse costs and benefits and provide recommendation)*

A4.1 Information on products (goods and services) of enterprise

Description of goods and services	Product code VCPA 2018 - fifth level	Unit	2017							2018						
			Amount				Country exporting to	Sales revenue *(mil. Dong)*		Amount				Country exporting to	Sales revenue *(mil. Dong)*	
			Inventory	Produced	Sold in domestic market	Export		Domestic	Export	Inventory	Produced	Sold in domestic market	Export		Domestic	Export
A	B	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14

Description of goods and services	Product code VCPA 2018 - fifth level	Unit	2019							2020						
			Amount				Country exporting to	Sales revenue (mil. Dong)		Amount				Country exporting to	Sales revenue (mil. Dong)	
			Inventory	Produced	Sold in domestic market	Export		Domestic	Export	Inventory	Produced	Sold in domestic market	Export		Domestic	Export
A	B	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14

Description of goods and services	Product code VCPA 2018 - fifth level	Unit	2021						
			Amount				Country exporting to	Sales revenue (mil. Dong)	
			Inventory	Produced	Sold in domestic market	Export		Domestic	Export
A	B	C	1	2	3	4	5	6	7

A4.2	Costs (mil. đồng)		2017	2018	2019	2020	2021
a	Labour costs (including direct and indirect labor, wages, insurance, bonuses, etc.) and related expenses						
b	Energy costs						
c	Other input costs (including material input costs, transportation,…)						
d	Financial expenses (including interest expenses)						
e	Land rental costs (if applicable)						
f	Other taxes and fees						
	In which:	Environmental protection tax					
		Environmental fees					
g	Depreciation of fixed assets						
h	Other expenses						

A4.3	Revenues and profits (mil. dong)	2017	2018	2019	2020	2021
a	Net revenues from sales and services rendered					
b	Gross revenues from sales and services rendered					
c	Financial income					
d	Financial expenses					
	Including: Interest expenses					
e	General administration expense (including sales expense, administrative expenses)					
f	Net profit from operating activities					

A5	INFORMATION OF QUESTIONNAIRE'S RESPONDER *(*The responder is not necessarily the company owner)*	
A5.1	Full name of responder	
A5.2	Title/position	
A5.3	Phone:	
A5.4	Email:	

THANK YOU FOR PARTICIPATING IN THE SURVEY

Anh chị vui lòng quét mã QR để tải về bản mềm của khảo sát.
Phản hồi xin gửi về địa chỉ email pnhung3@monre.gov.vn. Xin trân trọng cảm ơn!

Appendix Table 9. List of surveyed enterprises

Notes to Appendix Table 9: The enterprises in red text are the enterprises responded to the survey

No.	Enterprise	Group		No.	Enterprise	Group
Aluminium sector						
1	CÔNG TY CP NHÔM ĐÔ THÀNH	Public company or other		86	CÔNG TY TNHH LONG VÂN - NTV	Public company or other
2	CÔNG TY TNHH ALMINE VIỆT NAM	Exporter, Decision 01's subject		87	CÔNG TY TNHH LUXSHARE - ICT (VÂN TRUNG)	Exporter, Decision 01's subject
3	CÔNG TY TNHH ANAM ELECTRONICS VIỆT NAM	Exporter, Decision 01's subject		88	CÔNG TY TNHH M&C ELECTRONICS VINA	Exporter, Decision 01's subject
4	CÔNG TY TNHH CÔNG NGHIỆP STRONG WAY VĨNH PHÚC	Exporter		89	CÔNG TY TNHH MẮT KÍNH VIỆT	Exporter
5	CÔNG TY CP TỔ HỢP CÔNG NGHIỆP XÂY DỰNG NAM HẢI	Public company or other		90	CÔNG TY TNHH MODERN SOURCING VIỆT NAM	Exporter
6	CÔNG TY TNHH FABTEK VIỆT NAM	Exporter		91	CÔNG TY TNHH MỘT THÀNH VIÊN ÂU SA VI NA	Exporter
7	CÔNG TY TNHH MTV ASG TOÀN CẦU	Exporter		92	CÔNG TY TNHH MỘT THÀNH VIÊN B.I.L.Y	Exporter
8	CÔNG TY TNHH NHÔM TOÀN CẦU VIỆT NAM	Exporter, Decision 01's subject		93	CÔNG TY TNHH MỘT THÀNH VIÊN CƠ KHÍ XÂY DỰNG AUSABACO	Exporter
9	CÔNG TY TNHH VIỆT NAM TOP VISION INDUSTRIES	Exporter		94	CÔNG TY TNHH MỘT THÀNH VIÊN DANH THẠNH	Exporter
10	CÔNG TY TNHH HỢP VŨ (VIỆT NAM)	Exporter		95	CÔNG TY TNHH MỘT THÀNH VIÊN DỊCH VỤ THƯƠNG MẠI CHÌA KHÓA HẢI NGOẠI	Exporter
11	CÔNG TY CP TẬP ĐOÀN NHÔM SÔNG HỒNG SHALUMI	Decision 01's subject, Public company or other		96	CÔNG TY TNHH MỘT THÀNH VIÊN MV INVESTMENT	Exporter

12	CÔNG TY CP ALK VINA	Exporter		97	CÔNG TY TNHH MỘT THÀNH VIÊN SJ TECH VIỆT NAM	Exporter, Decision 01's subject
13	CÔNG TY CP BAO BÌ NHỰA TÂN TIẾN	Exporter, Decision 01's subject		98	CÔNG TY TNHH MỘT THÀNH VIÊN YS VINA	Exporter
14	CÔNG TY CP CNC HOLDINGS VIỆT NAM	Exporter		99	CÔNG TY TNHH MOUNTECH	Exporter
15	CÔNG TY CP CƠ KHÍ NHÔM XINGFAWINDOW - NHÀ MÁY NHÔM XINGFA	Public company or other		100	CÔNG TY TNHH MTV PPTD - ASIA	Public company or other
16	CÔNG TY CP CÔNG NGHỆ CAO CNC	Exporter		101	CÔNG TY TNHH NAM SUNG	Public company or other
17	CÔNG TY CP CÔNG NGHIỆP KIM SEN	Public company or other		102	CÔNG TY TNHH NGÀNH NHÔM YONGXING VTR	Exporter
18	CÔNG TY CP CÔNG NGHIỆP TUNG KUANG	Public company or other		103	CÔNG TY TNHH NHÔM ALANMI	Public company or other
19	CÔNG TY CP CÔNG NGHIỆP VÀ NĂNG LƯỢNG VIMETCO	Public company or other		104	CÔNG TY TNHH NHÔM ASEAN	Decision 01's subject
20	CÔNG TY CP ĐẦU TƯ HOÀNG ĐẠO	Exporter		105	CÔNG TY TNHH NHÔM BÌNH NAM	Public company or other
21	CÔNG TY CP ĐẦU TƯ SXKD PHÚ THIÊN LONG	Public company or other		106	CÔNG TY TNHH NHÔM ĐỊNH HÌNH SAPA BẾN THÀNH	Exporter
22	CÔNG TY CP DST HÀ NỘI	Public company or other		107	CÔNG TY TNHH NHÔM ĐÔNG Á	Exporter, Decision 01's subject
23	CÔNG TY CP ELMICH	Exporter		108	CÔNG TY TNHH NHÔM ĐÔNG PHONG	Public company or other
24	CÔNG TY CP EUROHOUSE VIỆT NAM	Public company or other		109	CÔNG TY TNHH NHÔM MAL VIỆT NAM	Public company or other
25	CÔNG TY CP GOLDSUN VIỆT NAM	Exporter		110	CÔNG TY TNHH NHÔM THÉP QUANG MINH	Public company or other
26	CÔNG TY CP HYUNDAI ALUMINUM VINA	Exporter, Decision 01's subject		111	CÔNG TY TNHH NHÔM THỦ QUÂN	Public company or other

27	CÔNG TY CP NHÔM KHANG MINH	Public company or other		112	CÔNG TY TNHH NHÔM TIẾN ĐẠT	Decision 01's subject, Public company or other
28	CÔNG TY CP NHÔM NGỌC DIỆP	Public company or other		113	CÔNG TY TNHH NHÔM VIỆT Ý	Public company or other
29	CÔNG TY CP NHÔM VÀ CƠ KHÍ XÂY LẮP VIỆT PHÁP	Public company or other		114	CÔNG TY TNHH NHÔM VĨNH HƯNG VIỆT NAM	Public company or other
30	CÔNG TY CP NHÔM VIỆT PHÁP - NHÀ MÁY NHÔM VIỆT PHÁP	Public company or other		115	CÔNG TY TNHH NHÔM ZHENG XING VIỆT NAM	Public company or other
31	CÔNG TY CP NHÔM YANGLI VIỆT NAM	Public company or other		116	CÔNG TY TNHH PALFINGER MARINE VIỆT NAM	Exporter
32	CÔNG TY CP PRAMAC	Public company or other		117	CÔNG TY TNHH PHÚ AN	Exporter
33	CÔNG TY CP QUỐC TẾ ALUK	Public company or other		118	CÔNG TY TNHH PIING HEH	Exporter
34	CÔNG TY CP SẢN XUẤT VẬT LIỆU CÁCH ÂM - CÁCH NHIỆT CÁT TƯỜNG	Exporter		119	CÔNG TY TNHH PMAS	Exporter
35	CÔNG TY CP TẬP ĐOÀN AUSTDOOR	Public company or other		120	CÔNG TY TNHH POLIFILM VIỆT NAM	Exporter
36	CÔNG TY CP TẬP ĐOÀN EUROVIEW	Public company or other		121	CÔNG TY TNHH PREMO VIỆT NAM	Exporter
37	CÔNG TY CP TẬP ĐOÀN FRAVI VIỆT NAM	Public company or other		122	CÔNG TY TNHH PRINCEMATE VN	Exporter, Decision 01's subject
38	CÔNG TY CP TẬP ĐOÀN SINGHAL	Public company or other		123	CÔNG TY TNHH QUỐC TẾ DI HƯNG	Exporter, Decision 01's subject
39	CÔNG TY CP THƯƠNG MẠI THÀNH HIỀN	Public company or other		124	CÔNG TY TNHH REINTECHNIK VIỆT NAM	Exporter
40	CÔNG TY CP ỨNG DỤNG CÔNG NGHỆ & CNC VIỆT NAM	Exporter		125	CÔNG TY TNHH ROEDERS VIỆT NAM	Exporter
41	CÔNG TY CP VẬN TẢI XUYÊN ĐẠI DƯƠNG - CHI NHÁNH THÀNH PHỐ HỒ CHÍ MINH	Exporter		126	CÔNG TY TNHH S&HV	Exporter

42	CÔNG TY CP XÂY LẮP DẦU KHÍ MIỀN NAM	Exporter		127	CÔNG TY TNHH SAMSUNG ELECTRONICS VIỆT NAM THÁI NGUYÊN	Exporter, Decision 01's subject, Public company or other
43	CÔNG TY CP XNK & XÂY DỰNG TÂN TRƯỜNG SƠN	Public company or other		128	CÔNG TY TNHH SẢN XUẤT KINH DOANH MỸ NGHỆ XUẤT KHẨU	Exporter
44	CÔNG TY GIÀY RIEKER VIỆT NAM	Exporter, Decision 01's subject		129	CÔNG TY TNHH SẢN XUẤT PHỤ TÙNG ÔTÔ XE MÁY - HƯNG YÊN	Exporter, Decision 01's subject
45	CÔNG TY TNHH ALWAYS	Exporter		130	CÔNG TY TNHH SẢN XUẤT THƯƠNG MẠI ĐỨC HỢP	Exporter
46	CÔNG TY TNHH AN CHI	Exporter		131	CÔNG TY TNHH SẢN XUẤT TOÀN CẦU LIXIL VIỆT NAM	Public company or other
47	CÔNG TY TNHH AN VIỆT LONG	Exporter		132	CÔNG TY TNHH SẢN XUẤT VÀ THƯƠNG MẠI ATC VIỆT NAM (NHÔM PMA)	Public company or other
48	CÔNG TY TNHH B.BRAUN VIỆT NAM	Exporter		133	CÔNG TY TNHH SCANCOM VIỆT NAM	Exporter, Decision 01's subject
49	CÔNG TY TNHH BORAMTEK VIỆT NAM	Exporter, Decision 01's subject		134	CÔNG TY TNHH SED (VIỆT NAM)	Exporter
50	CÔNG TY TNHH C&K METAL PRESSING	Exporter		135	CÔNG TY TNHH SEOJIN AUTO	Exporter
51	CÔNG TY TNHH CHANG XIN VN	Decision 01's subject, Public company or other		136	CÔNG TY TNHH SEOJIN SYSTEM VINA	Exporter, Decision 01's subject
52	CÔNG TY TNHH CHENG TAI	Exporter		137	CÔNG TY TNHH SIN CHI VIỆT NAM	Exporter
53	CÔNG TY TNHH CƠ KHÍ CHÍNH XÁC MIEN HUA	Exporter, Decision 01's subject		138	CÔNG TY TNHH SSAB VIỆT NAM	Exporter
54	CÔNG TY TNHH CƠ KHÍ CHÍNH XÁC, DỊCH VỤ VÀ THƯƠNG MẠI VIỆT NAM	Exporter		139	CÔNG TY TNHH SUMIDEN INTERNATIONAL TRADING VIỆT NAM	Exporter

55	CÔNG TY TNHH CƠ KHÍ DUY KHANH	Exporter		140	CÔNG TY TNHH SX NHÔM TRƯỜNG THÀNH	Public company or other
56	CÔNG TY TNHH CƠ KHÍ MIAN LAN	Exporter, Decision 01's subject		141	CÔNG TY TNHH TẦM NHÌN QUỐC TẾ VIỆT NAM	Exporter
57	CÔNG TY TNHH CÔNG NGHIỆP CHÍNH XÁC VIỆT NAM 1	Exporter, Decision 01's subject		142	CÔNG TY TNHH TÂN MỸ	Decision 01's subject, Public company or other
58	CÔNG TY TNHH CÔNG NGHIỆP GREEN FIELD	Exporter		143	CÔNG TY TNHH TẤN TÀI	Exporter
59	CÔNG TY TNHH CÔNG NGHIỆP NHÔM VIỆT PHÁP	Public company or other		144	CÔNG TY TNHH TÂN VĨNH HƯNG	Exporter, Decision 01's subject
60	CÔNG TY TNHH CÔNG NGHIỆP TBD NHƠN TRẠCH (CHINCHU)	Public company or other		145	CÔNG TY TNHH TELLBE VIỆT NAM	Exporter
61	CÔNG TY TNHH CÔNG NGHIỆP TUNG SHIN	Exporter, Decision 01's subject		146	CÔNG TY TNHH THƯƠNG MẠI - SẢN XUẤT THIÊN THƯƠNG	Exporter
62	CÔNG TY TNHH CORE M - TECH VINA	Exporter		147	CÔNG TY TNHH THƯƠNG MẠI CÔNG NGHIỆP NHÔM VIỆT PHÁP	Public company or other
63	CÔNG TY TNHH CỰ THÀNH	Exporter, Decision 01's subject		148	CÔNG TY TNHH THƯƠNG MẠI DỊCH VỤ DU LỊCH XUẤT NHẬP KHẨU MINH TRUNG	Exporter
64	CÔNG TY TNHH ĐÀI PHÁT	Exporter		149	CÔNG TY TNHH THƯƠNG MẠI DỊCH VỤ KỸ THUẬT RỒNG VIỆT	Exporter
65	CÔNG TY TNHH DATALOGIC VIỆT NAM	Exporter		150	CÔNG TY TNHH THƯƠNG MẠI MENGLA	Exporter
66	CÔNG TY TNHH ĐẦU TƯ VÀ PHÁT TRIỂN LINH AN	Exporter		151	CÔNG TY TNHH THƯƠNG MẠI SX NHÔM TIẾN THỊNH	Public company or other
67	CÔNG TY TNHH DS OUT DOOR VN	Exporter		152	CÔNG TY TNHH THÚY MỸ TƯ VIỆT NAM	Exporter
68	CÔNG TY TNHH ENTIRE COUPLING	Exporter		153	CÔNG TY TNHH TIGER ALWIN	Public company or other
69	CÔNG TY TNHH FISCHER ASIA	Exporter		154	CÔNG TY TNHH TM & DV ĐÔNG HOA	Public company or other

70	CÔNG TY TNHH FRIWO VIỆT NAM	Exporter		155	CÔNG TY TNHH TMDV ĐẠI TÂN THÀNH	Public company or other
71	CÔNG TY TNHH GANG VIỆT NAM	Exporter		156	CÔNG TY TNHH TRUMPF VIỆT NAM - CHI NHÁNH HÀ NỘI	Exporter
72	CÔNG TY TNHH GATTNER VIỆT NAM	Exporter		157	CÔNG TY TNHH TUNGYANG	Decision 01's subject, Public company or other
73	CÔNG TY TNHH GETAC PRECISION TECHNOLOGY VIỆT NAM	Exporter, Decision 01's subject		158	CÔNG TY TNHH UNIVERSAL ALLOY CORPORATION VIETNAM	Exporter
74	CÔNG TY TNHH GIA CÔNG CƠ KHÍ GOLDWIN	Exporter		159	CÔNG TY TNHH VẬT LIỆU TẦM NHÌN VIỆT	Exporter
75	CÔNG TY TNHH GTR VIỆT NAM	Exporter		160	CÔNG TY TNHH VIET HSIANG	Exporter
76	CÔNG TY TNHH HANWHA TECHWIN SECURITY VIỆT NAM	Exporter		161	CÔNG TY TNHH VINA DUKE	Exporter
77	CÔNG TY TNHH HH POWER TECHNOLOGY	Exporter		162	CÔNG TY TNHH WASHIN ALUMINIUM VIỆT NAM	Public company or other
78	CÔNG TY TNHH HYDRA VIỆT NAM	Exporter		163	CÔNG TY TNHH WEIPO INDUSTRIAL	Exporter
79	CÔNG TY TNHH KER VIỆT NAM	Exporter		164	CÔNG TY TNHH WERNER VIỆT NAM	Exporter
80	CÔNG TY TNHH KHUÔN ĐÚC TSUKUBA VIỆT NAM	Exporter, Decision 01's subject		165	CÔNG TY TNHH WINEL VIỆT NAM	Exporter
81	CÔNG TY TNHH KHUÔN MẪU THUẦN HOA	Exporter		166	CÔNG TY TNHH XÂY DỰNG VÀ THƯƠNG MẠI PHONG CÁCH MỚI (QUEENVIET)	Public company or other
82	CÔNG TY TNHH KIM LOẠI SHINYANG METAL VIỆT NAM	Public company or other		167	CÔNG TY TNHH XINGFA VIET NAM	Public company or other
83	CÔNG TY TNHH KỸ NGHỆ SÓI	Exporter		168	CÔNG TY TNHH YNG SHUN VIỆT NAM	Exporter
84	CÔNG TY TNHH LG ELECTRONICS VIỆT NAM HẢI PHÒNG	Exporter, Decision 01's subject		169	NHÀ MÁY NHÔM ĐÔNG ANH - CTY CP CƠ KHÍ ĐÔNG ANH LICOGI	Public company or other

85	CÔNG TY TNHH LMAT VINA	Exporter, Decision 01's subject		170	TRUNG TÂM KHAI THÁC NỘI BÀI	Exporter
Aluminium, Iron and Steel sector						
171	CÔNG TY TNHH GONZALES VIỆT NAM	Exporter		173	CÔNG TY TNHH HỆ THỐNG CƠ ĐIỆN TỬ XANH	Exporter, Public company or other
172	CÔNG TY CP CƠ KHÍ ĐIỆN TỬ PHÚ THỌ HÒA	Exporter		174	CÔNG TY TNHH KỸ THUẬT THÀNH NGHĨA	Exporter
Fertiliser sector						
175	CÔNG TY CP PHÂN BÓN DẦU KHÍ CÀ MAU	Decision 01's subject, Public company or other		183	CÔNG TY CP PHÂN LÂN NINH BÌNH	Decision 01's subject, Public company or other
176	CÔNG TY CP SUPE PHỐT PHÁT VÀ HÓA CHẤT LÂM THAO	Decision 01's subject, Public company or other		184	CÔNG TY TNHH BACONCO CHI NHÁNH PHÚ MỸ	Decision 01's subject
177	CÔNG TY CP PHÂN BÓN MIỀN NAM	Decision 01's subject		185	CÔNG TY CP PHÂN BÓN BÌNH ĐIỀN	Decision 01's subject
178	CÔNG TY CP PHÂN ĐẠM VÀ HÓA CHẤT HÀ BẮC	Decision 01's subject		186	CÔNG TY CP PHÂN LÂN NUNG CHẢY VĂN ĐIỂN	Decision 01's subject
179	TỔNG CÔNG TY PHÂN BÓN VÀ HÓA CHẤT DẦU KHÍ - CTCP (PVFCCO)	Decision 01's subject		187	CÔNG TY CP TẬP ĐOÀN HÓA CHẤT ĐỨC GIANG	Decision 01's subject
180	CÔNG TY CP BÌNH ĐIỀN LÂM ĐỒNG	Decision 01's subject		188	CÔNG TY CP VẬT TƯ KỸ THUẬT NÔNG NGHIỆP CẦN THƠ	Decision 01's subject
181	CÔNG TY CP HỮU HẠN VEDAN VIỆT NAM	Exporter, Decision 01's subject		189	CÔNG TY CP VẬT TƯ TỔNG HỢP VÀ PHÂN BÓN HÓA SINH	Decision 01's subject
182	CÔNG TY CP NINH QUANG GROUP	Exporter		190	TỔNG CÔNG TY PHÂN BÓN VÀ HÓA CHẤT DẦU KHÍ - CÔNG TY CP - NHÀ MÁY ĐẠM PHÚ MỸ	Decision 01's subject

Iron and Steel Sector						
191	CÔNG TY CP DÂY LƯỚI THÉP NAM ĐỊNH	Decision 01's subject		258	CÔNG TY TNHH GANG THÉP TUYÊN QUANG	Decision 01's subject
192	CÔNG TY CP LUYỆN KIM ĐEN THÁI NGUYÊN	Decision 01's subject		259	CÔNG TY TNHH GIA CÔNG VÀ DỊCH VỤ THÉP SÀI GÒN	Exporter
193	CÔNG TY CP MARUICHI SUNSTEEL	Decision 01's subject		260	CÔNG TY TNHH GROZ-BECKERT VIỆT NAM	Exporter, Decision 01's subject
194	CÔNG TY CP THÉP THỦ ĐỨC - VNSTEEL	Decision 01's subject, Public company or other		261	CÔNG TY TNHH HIROTA PRECISION VN	Exporter
195	CÔNG TY LIÊN DOANH SẢN XUẤT THÉP VINAUSTEEL	Decision 01's subject		262	CÔNG TY TNHH HI-TECH WIRES ASIA	Exporter
196	CÔNG TY TNHH GANG THÉP FORMOSA HÀ TĨNH	Exporter, Decision 01's subject		263	CÔNG TY TNHH HOMN REEN (VIETNAM)	Exporter, Decision 01's subject
197	CÔNG TY TNHH HYOSUNG VIỆT NAM	Exporter, Decision 01's subject		264	CÔNG TY TNHH HƯƠNG ĐÔNG	Decision 01's subject
198	CÔNG TY TNHH KUANG TAI (VIỆT NAM)	Exporter		265	CÔNG TY TNHH HYUNDAI WELDING VINA	Exporter
199	CÔNG TY TNHH THÉP MIỀN NAM - VNSTEEL	Decision 01's subject		266	CÔNG TY TNHH KẾT CẤU THÉP 568	Exporter, Decision 01's subject
200	CÔNG TY TNHH MTV THÉP TẤM LÁ PHÚ MỸ	Decision 01's subject		267	CÔNG TY TNHH KHOÁNG SẢN VÀ LUYỆN KIM VIỆT TRUNG	Decision 01's subject
201	CÔNG TY TNHH PERSTIMA VIỆT NAM	Exporter, Decision 01's subject		268	CÔNG TY TNHH KISWIRE VIỆT NAM	Decision 01's subject
202	CÔNG TY CP THÉP POSCO YAMATO VINA	Decision 01's subject		269	CÔNG TY TNHH LIÊN DOANH ỐNG THÉP SENDO	Decision 01's subject
203	CÔNG TY TNHH SỢI THÉP TINH PHẨM TENG YUAN VIỆT NAM	Decision 01's subject		270	CÔNG TY TNHH LUYỆN CÁN THÉP HÙNG CƯỜNG	Decision 01's subject
204	CÔNG TY TNHH THÉP KOS VIỆT NAM	Exporter		271	CÔNG TY TNHH LUYỆN CÁN THÉP VIỆT SINH	Decision 01's subject

205	CÔNG TY TNHH THÉP KYOEI VIỆT NAM	Decision 01's subject		272	CÔNG TY TNHH MANGALAM THÉP VÀ HỢP KIM	Exporter
206	CÔNG TY TNHH TÔN HÒA PHÁT	Exporter, Decision 01's subject, Public company or other		273	CÔNG TY TNHH MỘT THÀNH VIÊN 28	Decision 01's subject
207	CÔNG TY CP GROUP BẮC VIỆT	Decision 01's subject		274	CÔNG TY TNHH MỘT THÀNH VIÊN THÉP ĐẠI THIÊN LỘC	Exporter, Decision 01's subject
208	CÔNG TY CỔ PHẦN THÉP HÒA PHÁT HẢI DƯƠNG	Decision 01's subject		275	CÔNG TY TNHH MTV THÉP ĐỨC TÍN	Decision 01's subject
209	CÔNG TY CP CÁN THÉP THÁI TRUNG	Decision 01's subject, Public company or other		276	CÔNG TY TNHH MTV THÉP VAS VIỆT MỸ	Decision 01's subject
210	CÔNG TY CP CHINA STEEL & NIPPON STEEL VIỆT NAM	Exporter		277	CÔNG TY TNHH MTV THUẬN PHÁT HẢI DƯƠNG	Decision 01's subject
211	CÔNG TY CP CÔNG NGHIỆP VIỆT NAM	Decision 01's subject		278	CÔNG TY TNHH NS BLUESCOPE VIỆT NAM	Exporter, Decision 01's subject
212	CÔNG TY CP ĐẦU TƯ THƯƠNG MẠI THÉP ĐẠI VIỆT	Decision 01's subject		279	CÔNG TY TNHH ỐNG THÉP VINAPIPE	Decision 01's subject
213	CÔNG TY CP ĐẦU TƯ VÀ THƯƠNG MẠI HIỆP LINH	Decision 01's subject		280	CÔNG TY TNHH POL SHENG FASTENER (VIỆT NAM)	Exporter, Decision 01's subject
214	CÔNG TY CP ĐẦU TƯ VÀ XÂY DỰNG HỢP LỰC	Decision 01's subject		281	CÔNG TY TNHH POSCO - VIỆT NAM	Decision 01's subject
215	CÔNG TY CP DELTA SEIKAN	Exporter		282	CÔNG TY TNHH POSCO VST	Exporter, Decision 01's subject
216	CÔNG TY CP GANG THÉP CAO BẰNG	Decision 01's subject		283	CÔNG TY TNHH SAM HWAN VINA	Exporter
217	CÔNG TY CP GANG THÉP THÁI NGUYÊN	Decision 01's subject, Public company or other		284	CÔNG TY TNHH SẢN XUẤT VÀ THƯƠNG MẠI THÉP VIỆT NGA	Decision 01's subject
218	CÔNG TY CP INNOTEK	Exporter		285	CÔNG TY TNHH SONION VIỆT NAM	Exporter, Decision 01's subject
219	CÔNG TY CP LAM KHANG	Exporter		286	CÔNG TY TNHH SX & TM THÉP TÂY NAM	Exporter

220	CÔNG TY CP LUYỆN THÉP VIỆT Ý	Decision 01's subject		287	CÔNG TY TNHH SX TM ĐẠI LONG AN	Decision 01's subject
221	CÔNG TY CP MEINFA	Exporter, Decision 01's subject		288	CÔNG TY TNHH SX TM THÉP VIỆT TRUNG L.A	Decision 01's subject
222	CÔNG TY CP QUỐC TẾ INOX HÒA BÌNH	Decision 01's subject		289	CÔNG TY TNHH SX VÀ TM THÉP PHƯƠNG VŨ	Decision 01's subject
223	CÔNG TY CP SẢN XUẤT THÉP VINA ONE	Decision 01's subject		290	CÔNG TY TNHH THẮNG LỢI	Decision 01's subject
224	CÔNG TY CP SẢN XUẤT THƯƠNG MẠI KỲ PHÁT	Decision 01's subject		291	CÔNG TY TNHH THÉP AN KHÁNH	Decision 01's subject
225	CÔNG TY CP TẬP ĐOÀN HANAKA	Exporter		292	CÔNG TY TNHH THÉP CÔNG NGHỆ CAO SINO VIỆT NAM	Exporter
226	CÔNG TY CP TẬP ĐOÀN HOA SEN	Exporter, Decision 01's subject, Public company or other		293	CÔNG TY TNHH THÉP KHÔNG GỈ HÀ ANH	Exporter
227	CÔNG TY CP TẬP ĐOÀN THÉP NGUYỄN MINH	Decision 01's subject		294	CÔNG TY TNHH THÉP KHÔNG GỈ QUẢNG THƯỢNG VIỆT NAM	Decision 01's subject
228	CÔNG TY CP THÉP Á CHÂU	Decision 01's subject		295	CÔNG TY TNHH THÉP NHẬT QUANG	Decision 01's subject
229	CÔNG TY CP THÉP BÌNH DƯƠNG	Decision 01's subject		296	CÔNG TY TNHH THÉP QUANG THẮNG	Decision 01's subject
230	CÔNG TY CP THÉP ĐÀ NẴNG	Decision 01's subject		297	CÔNG TY TNHH THÉP QUYỀN QUYÊN	Decision 01's subject
231	CÔNG TY CP THÉP ĐÔNG NAM Á	Decision 01's subject		298	CÔNG TY TNHH THÉP SAMINA	Decision 01's subject
232	CÔNG TY CP THÉP MIỀN TÂY	Decision 01's subject		299	CÔNG TY TNHH THÉP SEAH VIỆT NAM	Decision 01's subject
233	CÔNG TY CP THÉP MINH PHÚ - HẢI DƯƠNG	Decision 01's subject		300	CÔNG TY TNHH THÉP SMC	Decision 01's subject, Public company or other
234	CÔNG TY CP THÉP NAM KIM	Exporter, Decision 01's subject, Public company or other		301	CÔNG TY TNHH THÉP TÂN THÀNH PHÁT	Decision 01's subject

235	CÔNG TY CP THÉP NHÀ BÈ - VNSTEEL	Decision 01's subject, Public company or other		302	CÔNG TY TNHH THÉP TÚ SƠN	Decision 01's subject
236	CÔNG TY CP THÉP POMINA	Decision 01's subject, Public company or other		303	CÔNG TY TNHH THÉP TUNG HO VIỆT NAM	Decision 01's subject
237	CÔNG TY CP THÉP TẤM LÁ THỐNG NHẤT	Decision 01's subject, Public company or other		304	CÔNG TY TNHH THÉP VAS AN HƯNG TƯỜNG	Decision 01's subject
238	CÔNG TY CP THÉP TOÀN THẮNG	Decision 01's subject		305	CÔNG TY TNHH THIÊN THAI	Decision 01's subject
239	CÔNG TY CP THÉP TOP PRO	Exporter, Decision 01's subject		306	CÔNG TY TNHH THỤ NGỌC HẰNG	Decision 01's subject
240	CÔNG TY CP THÉP TRƯỜNG BIỆN	Decision 01's subject		307	CÔNG TY TNHH THƯƠNG MẠI DƯƠNG TIẾN	Decision 01's subject
241	CÔNG TY CP THÉP TVP	Exporter, Decision 01's subject		308	CÔNG TY TNHH THƯƠNG MẠI SẢN XUẤT CÔNG NGHIỆP NGUYỄN TÍNH	Decision 01's subject
242	CÔNG TY CP THÉP VICASA - VIỆT NAM STEEL	Decision 01's subject, Public company or other		309	CÔNG TY TNHH THƯƠNG MẠI THẠCH DƯƠNG	Decision 01's subject
243	CÔNG TY CP THÉP VIỆT - Ý	Decision 01's subject		310	CÔNG TY TNHH TIẾN BỘ	Decision 01's subject
244	CÔNG TY CP THÉP VIỆT THÀNH LONG AN	Decision 01's subject		311	CÔNG TY TNHH TRUNG HÀ	Decision 01's subject
245	CÔNG TY CP THƯƠNG MẠI VÀ SẢN XUẤT TÔN TÂN PHƯỚC KHANH	Decision 01's subject		312	CÔNG TY TÔN PHƯƠNG NAM	Exporter, Decision 01's subject
246	CÔNG TY CP TÔN ĐÔNG Á	Exporter, Decision 01's subject		313	CÔNG TY CP CHẾ TẠO KẾT CẤU THÉP VNECO.SSM	Decision 01's subject
247	CÔNG TY CP TUẤN CƯỜNG	Decision 01's subject		314	CÔNG TY CP ĐẦU TƯ VÀ XÂY DỰNG ĐIỆN MÊCA VNECO	Decision 01's subject
248	CÔNG TY CP TVL	Exporter		315	CÔNG TY CP HỮU LIÊN Á CHÂU	Decision 01's subject

249	CÔNG TY THÉP TÂY ĐÔ	Decision 01's subject		316	CÔNG TY CP KIM KHÍ MIỀN TRUNG	Decision 01's subject
250	CÔNG TY TNHH BẢO CHI	Exporter		317	CÔNG TY CP KIM KHÍ THÀNH PHỐ HỒ CHÍ MINH - VNSTEEL	Decision 01's subject
251	CÔNG TY TNHH BAOSTEEL CAN MAKING VN	Decision 01's subject		318	CÔNG TY CP LƯỚI THÉP BÌNH TÂY	Decision 01's subject
252	CÔNG TY TNHH BOSCH VIỆT NAM	Exporter		319	CÔNG TY CP ỐNG THÉP VIỆT ĐỨC VG PIPE	Decision 01's subject
253	CÔNG TY TNHH CHẾ XUẤT SỢI THÉP DUSCO VINA	Exporter, Decision 01's subject		320	CÔNG TY CP TẬP ĐOÀN THÀNH THÁI	Public company or other
254	CÔNG TY TNHH CƠ KHÍ VIỆT NHẬT	Decision 01's subject		321	CÔNG TY CP TẬP ĐOÀN THÉP TIẾN LÊN	Decision 01's subject
255	CÔNG TY TNHH CÔNG NGHIỆP CHÍNH ĐẠI	Decision 01's subject		322	HỢP TÁC XÃ THÉP TOÀN LỰC	Decision 01's subject
256	CÔNG TY TNHH COSCOR	Exporter		323	TỔNG CÔNG TY THÉP VIỆT NAM - CTCP	Decision 01's subject
257	CÔNG TY TNHH ĐẦU TƯ PHÁT TRIỂN NAM THUẬN	Decision 01's subject				
Cement Sector						
324	CÔNG TY CP XI MĂNG BỈM SƠN	Decision 01's subject, Public company or other		352	CÔNG TY CP XI MĂNG VICEM HẢI VÂN	Decision 01's subject, Public company or other
325	CÔNG TY CP XI MĂNG VICEM SÔNG THAO	Decision 01's subject		353	CÔNG TY CP XI MĂNG X18	Decision 01's subject
326	CÔNG TY CP XI MĂNG VICEM HOÀNG MAI	Decision 01's subject, Public company or other		354	CÔNG TY CP XI MĂNG YÊN BÌNH	Decision 01's subject
327	CÔNG TY TNHH MTV XI MĂNG XUÂN THÀNH QUẢNG NAM	Decision 01's subject		355	CÔNG TY HỮU HẠN XI MĂNG LUKS (VIỆT NAM)	Decision 01's subject
328	CÔNG TY TNHH XI MĂNG VĨNH SƠN	Decision 01's subject		356	CÔNG TY TNHH ĐẦU TƯ VAWAZ VIỆT NAM	Exporter

329	CÔNG TY XI MĂNG CHINFON	Decision 01's subject		357	CÔNG TY TNHH HOÀNG YẾN HD	Exporter
330	CÔNG TY XI MĂNG NGHI SƠN	Decision 01's subject		358	CÔNG TY TNHH LONG SƠN	Decision 01's subject
331	CÔNG TY CP XI MĂNG LA HIÊN VVMI	Decision 01's subject		359	CÔNG TY TNHH MTV VICEM HẢI PHÒNG	Decision 01's subject
332	CÔNG TY CP XI MĂNG QUÁN TRIỀU VVMI	Decision 01's subject		360	CÔNG TY TNHH MTV XI MĂNG QUANG SƠN	Decision 01's subject
333	CÔNG TY CP XI MĂNG SÔNG ĐÀ YALY	Decision 01's subject		361	CÔNG TY TNHH MTV XI MĂNG SÔNG GIANH - CÔNG TY TNHH VLXD XI MĂNG VCM	Decision 01's subject
334	CÔNG TY CP VISSAI NINH BÌNH	Decision 01's subject		362	CÔNG TY TNHH NGUYÊN LIỆU OMANCO VIỆT NAM	Exporter
335	CÔNG TY CP COSEVCO6	Decision 01's subject		363	CÔNG TY TNHH PHÚ TÂN	Decision 01's subject
336	CÔNG TY CP XI MĂNG BẮC GIANG	Decision 01's subject		364	CÔNG TY TNHH SẢN XUẤT VẬT LIỆU XÂY DỰNG THÀNH CÔNG	Decision 01's subject
337	CÔNG TY CP XI MĂNG CẨM PHẢ - TẬP ĐOÀN VIỄN THÔNG QUÂN ĐỘI (VIETTEL)	Decision 01's subject		365	CÔNG TY TNHH SIAM CITY CEMENT (VIỆT NAM)	Decision 01's subject
338	CÔNG TY CP XI MĂNG ĐIỆN BIÊN	Decision 01's subject		366	CÔNG TY XI MĂNG PHÚC SƠN	Decision 01's subject
339	CÔNG TY CP XI MĂNG ĐỒNG LÂM	Decision 01's subject		367	CÔNG TY XI MĂNG TÂN THẮNG	Decision 01's subject
340	CÔNG TY CP XI MĂNG FICO TÂY NINH - TỔNG CÔNG TY VLXD SỐ 1	Decision 01's subject		368	CÔNG TY XI MĂNG VICEM HOÀNG THẠCH	Decision 01's subject
341	CÔNG TY CP XI MĂNG HOÀNG LONG	Decision 01's subject		369	CP XI MĂNG TÂN QUANG - VVMI TỔNG CÔNG TY CÔNG NGHIỆP MỎ VIỆT BẮC TKV	Decision 01's subject
342	CÔNG TY CP XI MĂNG HỒNG PHONG	Decision 01's subject, Public company or other		370	CÔNG TY CP KHOÁNG SẢN VÀ XI MĂNG CẦN THƠ	Decision 01's subject
343	CÔNG TY CP XI MĂNG LA HIÊN	Decision 01's subject		371	CÔNG TY CP VICEM THẠCH CAO XI MĂNG	Decision 01's subject

344	CÔNG TY CP XI MĂNG PHÚ THỌ	Decision 01's subject, Public company or other		372	CÔNG TY CP VICEM THƯƠNG MẠI XI MĂNG	Decision 01's subject
345	CÔNG TY CP XI MĂNG QUÁN TRIỀU	Decision 01's subject		373	CÔNG TY CP XI MĂNG SÀI SƠN	Decision 01's subject
346	CÔNG TY CP XI MĂNG THẠNH MỸ - THAIGROUP	Decision 01's subject		374	CÔNG TY CP XI MĂNG SÔNG LAM 2	Decision 01's subject
347	CÔNG TY CP XI MĂNG THÀNH THẮNG GROUP	Exporter, Decision 01's subject		375	CÔNG TY CP XI MĂNG THÁI BÌNH	Decision 01's subject
348	CÔNG TY CP XI MĂNG VÀ KHOÁNG SẢN YÊN BÁI	Decision 01's subject		376	NHÀ MÁY XI MĂNG SƠN LA, CÔNG TY CP XI MĂNG MAI SƠN	Decision 01's subject
349	CÔNG TY CP XI MĂNG VÀ XÂY DỰNG QUẢNG NINH	Decision 01's subject, Public company or other		377	NHÀ MÁY XI MĂNG TRUNG SƠN, CÔNG TY CP XÂY DỰNG VÀ DU LỊCH BÌNH MINH	Decision 01's subject
350	CÔNG TY CP XI MĂNG VICEM BÚT SƠN	Decision 01's subject, Public company or other		378	NHÀ MÁY XI MĂNG VĂN HÓA, CÔNG TY CP VẬT LIỆU XÂY DỰNG VN	Decision 01's subject
351	CÔNG TY CP XI MĂNG VICEM HÀ TIÊN 1	Decision 01's subject, Public company or other		379	TẬP ĐOÀN CÔNG THÀNH	Decision 01's subject

Appendix 6: Calculation of sectoral emission intensity

Based on our enterprise survey findings, there are a total of 23 materials and energy sources used in the productions process of 89 enterprises, spanning across four sectors: Aluminium, Cement, Fertiliser and Iron and Steel. (See column (1) in Appendix Table 10)

The sectoral emissions intensity is calculated as follows:

Step 1: Calculate the emission intensity of enterprise *k* for a specific year *t*:

$$Emission\ intensity_k^t\ (tCO_2\ per\ ton\ of output) = \frac{\Sigma_{i=1}^{23}\ CO_2\ emission\ factor_i\ (tCO_2\ per\ unit\ of\ input) \times consumption\ of\ input_i^t}{\text{Total outputs}_k^t\ (\text{tonnes})}$$

where *i = [1:23]* denotes the materials/energy sources used; and the units of input consumption depend on the types of material/energy used and reported (See column (2) in Appendix Table 10)

The CO_2 emission factors for each material/energy source and the calculation methods are presented in column (3) - (5) in Appendix Table 10, noted that:

The CO_2 emission factor for electricity is estimated at 0.7221 tonne CO_2/MWh by the Ministry of Natural Resources and Environment of Vietnam (2006)

For Materials/energy sources numbered 3 through 12, we have converted the CO_2 emission factors provided by the Ministry of Natural Resources and Environment of Vietnam (Verikios, Shridhar, & Liyanaarachchi, 2022) from *$KgCO_2/TJ$* to *tCO_2 per unit of input consumption*, using the conversion factors obtained from various sources.

For materials/energy sources numbered 14 through 23, CO_2 emission factors are obtained from different international sources as we did not sufficient information to conduct our own calculations.

Step 2: Calculate the sectoral emissions intensity

$$Sectoral\ emission\ intensity\ (tCO_2\ per\ tonne\ of output) = \frac{\Sigma_{k=1}^{N}\Sigma_{t=1}^{T_k}\ Emission\ intensity_k^t (tCO_2\ per\ tonne\ of output)}{\Sigma_{k=1}^{N} T_k}$$

Where T_k = [1:5] is the total number of reported years of enterprise *k*; *N* is the total number of enterprises in each sectors (i.e., *N = 0* for Aluminium, *25* for Fertiliser, *25* for Cement and *29* for Iron and Steel)

Appendix Table 10: CO2 emission factors for the material/energy of surveyed enterprises

No.	Materials/ energy sources	Consumption unit	CO_2 factor | unit		Calculation method	References
	(1)	(2)	(3)	(4)	(5)	(6)
1	Electricity	MWh	0.722	tCO_2/MWh	Estimated by MONRE	Verikios et al. (2022)
2	Clinker	tonne	0.525	tCO_2/tonne	Estimated by MONRE	Verikios et al. (2022)
3	Coal	tonne	2.625	tCO_2/tonne	98300 $kgCO_2$/tj × 0.0267 tj/ton × 10e-3	(Ahmad & Riker, 2020; Vietnam's National Assembly, 2021)
4	LPG	tonne	2.985	tCO_2/tonne	63100 $kgCO_2$/tj × 0.0473 tj/ton × 10e-3	
5	Biomass	tonne	1.160	tCO_2/tonne	1000 $kgCO_2$/tj × 0.0116tj/ton × 10e-3	IEA (2022)
6	Crude oil	1000 tonne	3100	tCO_2/1000 tonne	73300 $kgCO_2$/tj × 0.0423tj/ton	MONRE (2022b)
7	Diesel	1000 litre	2.676	tCO_2/1000 l	74100 $kgCO_2$/tj × 0.043 tj/ton × 0.84 ton/1000 liter × 10e-3	(MONRE, 2022a, 2022b)
8	Gasoline	1000 litre	2.241	tCO_2/1000 l	69300 $kgCO_2$/tj × 0. 443 tj/ton × 0.73 ton/1000 liter × 10e-3	
9	Fuel oil	1000 litre	3.064	tCO_2/1000l	77400 $kgCO_2$/tj × 0.0404tj/ton × 0.98 ton/1000 liter × 10e-3	
10	Gas	1000 m3	2.917	tCO_2/1000m3	74100 $kgCO_2$/tj × 0.039367636 tj/1000m3× 10e-3	(MONRE, 2022a; National Environment Agency of Singapore, 2020)
11	CN Gas	1000 m3	2.209	tCO_2/1000m3	56100 $kgCO_2$/tj × 0.039367636 tj/1000m3× 10e-3	
12	Natural gas	mmBTU	0.059	tCO_2/mmBTU	56100 $kgCO_2$/tj × 0.001055053 tj/mmBTU × 10e-3	(MONRE, 2022a)
13	Solar	MWh	0.040	tCO_2/ MWh	Use secondary data	MONRE (2022a)
14	Limestone	tonne	0.750	tCO_2/tonne	Use secondary data	National Environment Agency of Singapore (2020)
15	Clay	tonne	0.270	tCO_2/tonne	Use secondary data	JICA (2017)

16	Iron ore	tonne	0.270	tCO_2/tonne	Use secondary data	MONRE (2022a)
17	Slate	tonne	0.030	tCO_2/tonne	Use secondary data	(Global Tech Australia)
18	Plaster	tonne	0.168	tCO_2/tonne	Use secondary data	(MONRE)
19	Slag	tonne	0.550	tCO_2/tonne	Use secondary data	IEA (2022)
20	Fly ash	tonne	0.000	tCO_2/tonne	Use secondary data	Solar Bay (2020)
21	Permeate gas	1000 m3	2.209	tCO_2/1000m3	equivalent to natural gas	
22	Diatomite	tonne	0.000	tCO_2/tonne	Equivalent to fly ash	
23	Black limestone	tonne	0.750	tCO_2/tonne	equivalent to limestone	

Appendix 7: CBAM 'Opponent' Index

Appendix Table 11. CBAM "Opponent Index"

No	Name	Index		No	Name	Index
1	Japan	1		22	Thailand	64
2	Rep. of Korea	12		23	Vietnam	66
3	Singapore	28		24	Algeria	67
4	Chile	33		25	Bangladesh	68
5	Peru	34		26	Morocco	69
6	Colombia	36		27	Jordan	70
7	Israel	38		28	Serbia	70
8	New Zealand	38		29	Tunisia	71
9	Argentina	45		30	Kuwait	73
10	Australia	45		31	South Africa	73
11	Mexico	47		32	Indonesia	74
12	Senegal	48		33	Saudi Arabia	80
13	Philippines	49		34	Belarus	82
14	Canada	50		35	Russian Federation	82
15	Lebanon	50		36	India	86
16	Brazil	53		37	Kazakhstan	86
17	Nigeria	55		38	China	88
18	Malaysia	58		39	Egypt	89
19	Turkey	58		40	United Arab Emirates	94
20	Azerbaijan	62		41	USA	96
21	Pakistan	64		42	Ukraine	99

Source: Overland (2022)

Appendix 8: Pathway for energy transition

Appendix Table 12. Emissions from electricity generation 2019 and 2030, Vietnam

Technology	Output 2019* (GWh)	Emission 2019 (tonnes CO_2e)	Output 2030** (GWh)	Emission 2030 (tonnes CO_2e)
Hydroelectric	66,117	1,586,808	104,510	2,508,246
Coal-fired	120,157	98,528,740	217,655	178,477,305
FO fired	1,239	908,187		
Diesel	974	713,942		
Gas fired	42,507	20,828,430	158,701	77,763,368
Renewable			94,685	3,282,712
Solar PV	4,818	231,264		
On-shore wind	724	7,964		
Biomass	350	15,750		
Total	236,886	122,821,085	575,551	262,031,630
Average emission (tonnes CO_2e/GWh)	518		455	

Source: * IPCC (2006), ** estimated based on Volek (2017) and Gan and Griffin (2018). The emission is calculated using emissions factor of electricity generation technologies by Spanish Slate Quarries

Appendix Table 13. Electricity share in emissions in Vietnam CBAM-target sectors

Sectors	Electricity share in emissions	Sources
Iron-steel	53.9%	Estimated for the enterprise survey
Fertiliser	19.2%	Estimated for the enterprise survey
Cement	9.78%	Estimated for the enterprise survey
Aluminium	85%	(Board and Wall)

Appendix 9: Minutes of consultation meetings and consultation workshop

Consultation meeting with Vietnam Cement Association (VNCA)

Time: 09:00 – 10:00, 29/12/2022
Location: VNCA's office, 4th Floor, 37 Le Dai Hanh street, Hai Ba Trung, Ha Noi.

General information

The purpose of the meeting was to consult the Vietnam Cement Association (VNCA) on the state of Vietnam cement production and export, the industry's development strategy as well as the reaction and awareness of enterprises in the cement industry about CBAM, and the content of the enterprise survey on CBAM.

Participants

- GreenCIC: Nguyen Hong Loan, Nguyen Viet Can, Pham Phuong Linh
- NHQuang&Associates: Đinh Thi Thu Trang, Nguyen Thi Kieu Trinh
- VNCA: Dr. Luong Duc Long – Vice President, Secretary General

Agenda

- Introduction of the project and purpose of consultation
- Consultation

Content of consultation

Current state of the cement industry In Vietnam

Vietnam mainly exports cement to Asian and South American countries. Vietnam has exports to Europe but in low quantity. This year exports may decrease due to economic impacts from China and from Covid, but domestic consumption will not decrease and may increase slightly.

Enterprises exporting to Europe besides cement production enterprises, there are also subsidiaries of cement production enterprises and trading service companies that do not produce cement. Members of VNCA include cement manufacturers and some other cement-related enterprises. Some private cement manufacturers, such as Thanh Thang (1 enterprise exporting cement to Europe) are not members of the Association.

The Association has a website (ximang.vn), but the content of the website is mainly managed and operated by Gamma company, so the above information is only for website maintenance purposes, so it is not Association official communication channel. The association still communicates with members via email and official documents.

Industrial development plans

The development strategy of the cement industry is defined in the Strategy for the development of building materials in Vietnam for the period of 2021 - 2030, with a vision to 2050, approved by the Prime Minister in Decision No. 1266/QD-TTg dated 18 08/2020. However, in the near future if the Government does not develop the industry strategy anymore, VNCA will develop a strategy to develop the cement industry. The general direction of industry is still for domestic consumption, export is not the main direction.

Current practices on GHG inventory and GHG mitigation

Enterprises' understanding of GHG inventory ends at knowing preliminary information through legal documents. VNCA also regularly shares information related to GHG inventory and also includes GHG inventory-related contents in the association's work plan.

Vietnam Institute for Building Materials has a project to develop a CO2 emission scenario to 2030, with a vision to 2050, including emission data from enterprises, including the construction of calculations for three industries: cement, brick, cladding, however, the project has just been submitted, not implemented, and approved. Scenarios include high, low and medium scenarios and will be piloted at factories.

Some enterprises have conducted inventory and reported on CO2 emissions, but they are not consistent because Vietnam has no specific standards, as well as no regulations on emission coefficients for the cement industry.

Comments on CBAM's awareness and questionnaire

The general information and information on the production of enterprises can be answered, but information related to costs will be hard to collect. The consultant team should use other methods to evaluate the cost-related part, e.g. based on statistics instead of surveys because the data of enterprises themselves are also complex. Currently, cement manufacturing enterprises are subject to taxes such as export tax, value-added tax, environmental protection tax/fee and resource tax.

If Vietnam imposes a carbon tax on cement to reduce the carbon tax when exporting to Europe, it should be cautious and reasonable. Because enterprises exporting to Europe account for a very small proportion, the imposition of a carbon tax on all cement enterprises in Vietnam may cause a strong reaction if the tax rate is not reasonable. Factors such as GDP per capita, GHG emissions and economic situation can be assessed to calculate the appropriate tax rate. According to Decree 06, the Government will set emission limits based on actual emissions. This initiative from the government is a good sign. Currently, the business has not reacted. The government will listen to the opinions of agencies and scientists to make reasonable policies.

Currently, the Government is planning to increase the export tax for clinker from 5-10%, creating difficulties for businesses. VNCA sent a written objection and requested a postponement but received no response.

In fact, the cement industry has no drastic emission reduction measures. Cement production currently does not have effective alternative fuels and raw materials. Electricity saving measure is not significant. Europe is the largest user of clinker in the world.

The association cannot collect data for the survey because lack of capacity, time and funding. The association represents businesses, regularly exchanges with businesses about difficulties and problems, and makes recommendations.

The EU categorize cement, concrete and artificial stone in the same commodity group (commodity group 6810 "Articles of cement, of concrete or of artificial stone, whether or not reinforced"). But the HS code between cement and concrete is different, concrete is not affected by CBAM. The concrete industry has its own concrete association.

Consultation meeting with Vietnam Aluminium Association (VAA)

Time: 08:30 – 09:30, 30/12/2022

Location: VAA office, 4th Floor, Viet Phap Aluminium Factory, CN 9, Tu Liem Industrial Park, Ha Noi

General information

The purpose of the meeting was to consult the Vietnam Aluminium Association (VAA) on the status of Vietnam aluminium production and export, the industry's development strategy as well as the reaction and awareness of enterprises in the aluminium industry about CBAM, and the content of the enterprise survey on CBAM.

Participants

- GreenCIC: Nguyen Hong Loan, Nguyen Viet Can, Pham Phuong Linh
- NHQuang&Associates: Nguyen Anh Minh
- VAA:
    - Nguyen Minh Ke – President
    - Vu Van Phung – Vise president, General Secretary
    - Nguyen Hong Thang – Vise president
    - Ly Thi Ngan – Chief of staff
    - Tran Cong Hau – Head of international sale department, Austdoor Group JSC. (ADG)

Agenda

- Introduction of the project and purpose of consultation
- Consultation

Contents

Current status and development orientation of the aluminium profile industry in Vietnam

VAA includes 22 official members, with nearly 100 factories related to aluminium production, not including foreign-invested enterprise.

Vietnam aluminium production does not include the full value chain from mining aluminium ore to finished products. Vietnam only produces processed and semi-processed aluminium. Vietnam has exploited bauxite ore for export but not for aluminium production.

Exports only account for about 10% of production, European exports account for less than 1%, mainly foreign enterprises. Members of the association mainly export to the US, Canada, and Japan.

Enterprises exporting to Europe are mainly foreign enterprises, not under the management of the association.

Currently, there is no national development plan for the aluminium industry, and the Association has just been established since 2019, so there is no current orientation. The aluminium industry management also overlaps, but currently the VAA is working with the Industry Department of the Ministry of Industry and Trade to develop the aluminium industry plan. The industry development plan is necessary and important because currently, the aluminium industry is growing rapidly, averaging 10% per year because there are many private enterprises and investment from China, but the supply tends to surpass the demand. The association wants the development plan to balance supply and demand, attract investment, and be export oriented.

Current practices on GHG inventory, GHG mitigation and awareness about CBAM

The VAA has 7 aluminium enterprises listed in Decision 01/2022/QD-TTg, of which 1 is public company.

In the past 10 years, enterprises have become aware of the environment, wastewater, and have installed relatively good-scale emission monitoring stations. The association said that the environment is a very “hot topic”, especially recently when the Government has also committed to net-zero. However, the state of environmental protection in Vietnam is far from that of Europe. Members of the association have not yet calculated their GHG emissions, they only done preliminary studies. Because aluminium production in Vietnam is mainly processed and semi-processed, if assessing the emissions of aluminium production, it is necessary to pay attention to the scope. It is necessary to develop a mechanism, for example, to identify which material is used in each production stage and to estimate emissions. The Association recommends that there should be a set of samples guidelines for assessing GHG emissions according to the standards. The Association also has not participated in any workshops and has not received any support from ministries and sectors in GHG inventory and emission reduction guidelines. Thus, the Association also wishes to receive more support in this matter.

Members in the association regularly update new technologies to save costs, increase efficiency and save energy, while also reducing emissions. However, the aluminium industry’s technology changes constantly, so it is difficult to update in time.

Comments on CBAM’s awareness and questionnaire

Regarding CBAM, enterprises have heard of it, but most of them have not exported to Europe, so they are not interested. The reaction of enterprise (specifically ADG) to CBAM is that they still want to export in the long-term, so they will find ways to cooperate and improve competitiveness. However, the association does not see the need to pioneer. They will comply when it is mandatory, with advance preparation.

Regarding environmental issues, in general, enterprise's responses are quite positive. The obligations of GHG inventory and GHG emission reduction and the application of a carbon tax must be gradual, if it is applied too fast, enterprise will react strongly. In general, the company affected by the policy will be interested, but it is necessary to take action first for them to be aware and cooperate.

Aluminium companies must pay environmental fees. Environmental fee of new enterprises is determined according to investment level, while the fee for old enterprises is determined according to reality, based on EIA assessment. Companies have a positive spirit and accept to pay the applicable environmental taxes/fees and have no difficulty in paying them. Regarding other policy issues, VAA has sent many suggestions to the competent ministries and agencies, you can contact the Chief of the Association's Office to learn more.

According to preliminary assessment, enterprises may cooperate to provide data, but some sensitive information such as data on costs, revenue may not be shared. incorrect. However, the consultant can send the questionnaire as it is, so that there can be preliminary data for evaluation.

The Association will support distribution of questionnaires to members and some enterprise in the industry. The consultant team shall send questionnaires to the Association, and the Association will give feedback and help distribute the questionnaire as well as official letters to its members to gain cooperation.

Consultation meeting with Fertilizer Association of Vietnam (VFA)

Time: 08:30 – 09:30, 30/12/2022
Location: FAV's office, Room 496, 16 Tran Quoc Vuong, Dich Vong Hau, Cau Giay, Ha Noi

General information

The purpose of the meeting was to consult the Fertilizer Association of Vietnam (FAV) on the state of Vietnam fertilizer production and export, the industry's development strategy as well as the reaction and awareness of enterprises in the fertilizer industry about CBAM, and the content of the enterprise survey on CBAM.

Participants

- GreenCIC: Nguyen Hong Loan, Nguyen Viet Can, Pham Phuong Linh
- NHQuang&Associates: Nguyen Anh Minh
- FAV: Dr. Phung Ha, Vice President, Secretary General

Agenda

- Introduction of the project and purpose of consultation
- Consultation

Contents

Current state and development orientation of the fertilizer industry

This year exports reached a record, about 1.7 million tons, but only accounted for about 25% of production, and mainly exported to countries in the surrounding region (Myanmar, Cambodia, Thailand) and South America. The development orientation is to produce to ensure domestic demand.

Vedan exports organic fertilizer to the EU, but it is only a by-product from the production process. Vedan is a member of the association. In the fertilizer industry, chemical fertilizers accounts for 85-90% of total fertilizer, organic fertilizers account for a small proportion.

Currently, the Law on Planning abolishes the development plan of the fertilizer industry, so there is no longer a sectoral plan. In the fertilizer industry, the state plays a key role, for example, the Vietnam Oil and Gas Group.

Current practices on GHG Inventory and awareness about CBAM

Some enterprises already have a good understanding of GHG inventory and can carry out the GHG inventory (Vietnam Oil and Gas Group, Vedan, Viet Nhat, Viet Han). But FAV and small businesses have not yet informed. There are currently no formal studies on the energy consumption and GHG emissions of the industry.

The Association are not aware of CBAM, in the near future FAV will participate in the workshop of Committee 4, Central Economic Committee to update relevant information.

Currently, FAV knows that GIZ is conducting a pilot survey using hydrogen for production, so it is proposed that the consultant team can connect with GIZ to conduct the survey.

Taxes and fees related to the environment that businesses have to pay are discharge fees, wastewater fees, etc.

Consultation meeting with Vietnam Steel Association (VSA)

Time: 09:00 – 10:30, 10 January 2023
Venue: Vietnam Steel Association, 51 Lang Ha, Ba Dinh, Hanoi

General Information

The main purpose of this meeting is to present about the project and to gather information from Vietnam Steel Association (VSA) on situation of the association and enterprises in the sector, import/export, production and development of steel sector in Vietnam, enterprises in the sector and their opinions and understanding about CBAM and to set the foundation for more cooperation in conducting the survey with the enterprises in the sector in the coming time.

Participants

- GreenCIC: Nguyen Hong Loan, Nguyen Viet Can
- NHQuang&Associates: Dinh Thu Trang, Nguyen Thi Thanh Mai
- VSA:
    - Dinh Quoc Thai, General Secretary of the association
    - Trang Thu Ha – Chief of staff of the association

Agenda

- Introduction of the project and purpose of the consultation
- Consultation on the situation of the steel sector and its enterprises in production, import/export, emissions, opinions on CBAM and interests
- Discussion on the opportunities to cooperate in surveying enterprises in the sector

Contents

Ms. Nguyen Hong Loan made an introduction on:

- Overview of the project (reasons, purposes, targets, main components and expected results)
- Partners involving in implementation of the project
- Initial responses of countries and Vietnam to CBAM
- The purposes of the consultation meeting

Mr. Dinh Quoc Thai made a brief introduction about the association and the iron and steel sector in Vietnam.

- VSA is the representative association of enterprises with activities related to iron and steel in Vietnam. It has more than 120 members with participation of almost all big players in the sector.
- On the production and performance of the sector in 2021. There were a total of 24 – 25 million tons of crude steel and 30 – 35 million tons of finished steel produced by Vietnam steel producers. This made Vietnam ranked 13th in the world in terms of steel production. 2021 is a very good year for steel sector. Vietnam exported more than 12 million tons of steel with a revenue of more than USD 12 billion. Steel became one of the 10 products with highest exporting value of Vietnam. Vietnam steel is being exported to more than 30 markets with the EU as one of the main markets, after ASEAN and the USA markets.
- Activity data of 2022 had not been consolidated. However, initial review showed that it slightly decreased in both production and export. The EU remains one of the main export markets for Vietnam's steel.
- On the development orientation of the sector, Mr. Thai said that Vietnam steel sector gears towards supplying the high demand domestically for construction steels and a rising demand for manufacturing steels. However, 70 – 80% of the input materials of steel sector is from importation from other countries, so it is critical to have exports for balancing foreign currency.
- In the coming year, domestic demand was projected to be at 21 – 22 million tons while the capacity of the sector now was 30 – 35 million tons, so export is required to solve the surplus of steel.

About question on the opinions and understanding of enterprises in the sector on CBAM:

- CBAM is a new policy in the EU. Enterprises may hear about it already, but the response to it is not yet. Most of them are still not clear about CBAM and it actually has not implemented yet, so it is difficult for enterprise to have any actions.

About the question on opinion of the association about the questionnaire survey:

- VSA thinks this is a very detailed and in-depth survey questionnaire. It covers not only opinion of enterprises on CBAM but also business confidential information such as cost structures and revenue and energy consumption information. General information can be provided but sensitive information is a challenge.

About the question on practices and actual status of enterprises of the sector on GHG inventory and responding to reporting obligation under Decree 06/2022/ND-CP:

- GHG inventory is always the weakness of Vietnamese enterprises. Recently, Ministry of Industry and Trade had a workshop to support steel enterprises in complying with the reporting deadline of 31 March 2023.
- Small instruction workshop is a good approach to reach enterprises and have them respond to the questionnaire survey.

- Until now, there are no guidelines or legal documents instructing the enterprises in the sector on conducting GHG inventory. In other countries, they use ISO14404 to guide enterprises in conducting GHG inventory. In Vietnam, some companies have applied this but it not officially recognized by the Government.

About the question on how to improve the reach to enterprises in the survey:

- To provide initial impact assessment of CBAM to enterprises to make them understand the important of the project in forecasting the impacts for them and the benefits they can get when providing their business information.
- To conduct workshops guiding enterprises on GHG inventory. This at the same time tell them how to prepare for the data the survey needs. Currently, VSA is also collecting opinions from enterprises in their needs for guidance for compliance of Decision 01/2022/QD-TTg.
- VSA proposed to consult Energy Efficiency and Sustainable Development Department, MOIT to get their support in providing data on energy consumption from steel enterprises.
- VSA can also support in reach enterprises and guide them the respond to the questionnaires.
- VSA wants to get more export information on CBAM to publish on internal as well as public media among members of VSA. More information on CBAM can raise awareness on the need to respond to the questionnaires.

VSA is willing and would support the Consultant team in reaching enterprises and responding to the questionnaires.

About the question to share the report of MOIT to the prime minister on Steel sector development strategy until 2030, vision to 2050.

- VSA knows about this report but details of the report is still confidential. We still don't know when the decision on selecting the authority to develop this strategy will be settled. When we have the information, we are happy to share.

Consultation meeting with Department of Multilateral Trade Policy – Ministry of Industry and Trade

Time: 16:00 – 17:00, 12/01/2023
Venue: MOIT headquarter, 54 Hai Ba Trung, Hoan Kiem, Hanoi

General Information

The main purpose of this meeting is to present about the project and to have more insight into the approach and opinions of the Department of Multilateral Trade Policy (DMTP) and MOIT about CBAM and to set the foundation for more in-depth consultation regarding the project results and opportunities for future cooperation.

Participants

- GreenCIC: Nguyen Hong Loan, Nguyen Viet Can, Pham Phuong Linh
- NHQuang&Associates: Nguyen Anh Minh
- DMTP:
    - Ngo Chung Khanh, Deputy General Director of DMTP
    - Nguyen Thi Lan Phuong – Deputy Director of the Division of WTO and trade negotiations, DMTP
    - Le Huyen Nga – Officer of the Division of WTO trade negotiation, DMTP

Agenda

- Introduction of the project and purpose of the consultation
- Consultation

Contents

According to Mr. Khanh, the DMTP is assigned to conduct a study on CBAM focusing more on the aspects of trade and import/export, initially the Department needs to identify and approach the stakeholders who are involved. Therefore, the Department wants the Consultant team to introduce: 1. What is the expected outcome of the CBAM project, and how can it help the Government of Vietnam in studying and assessing the impacts of CBAM; and 2. The roles of the parties to participate in the consultation today in this project.

The project has 4 main products, in which the first product is a survey of enterprises exporting to the EU in 4 main sectors affected by CBAM including iron and steel, aluminum, cement and fertilizers. The survey would be also related to CBAM awareness, activity data for calculating emissions, data related to production, export and business activities. The output of this activity will be used as input data to run model and evaluate the impact of CBAM. Mr. Khanh also asked about the number of surveyed enterprises. Currently, the Consultant has surveyed all enterprises in 4 sectors and some manufacturing enterprises are the subjects of Decision 01, which is very good. He proposed to expand the survey to all manufacturing and exporting enterprises.

According to MONRE, the results of this project will be sent to the stakeholders for comments. For example, in MOIT, it is DMTP and in the Ministry of Finance, there is the Department of Tax Policy. However, according to Mr. Khanh, that MONRE consults MOIT on the project results related to the impact of CBAM on import and export is not reasonable because under the direction of the Government, impacts on import/export are under the responsibility of MOIT, while MONRE is in charge of assessing the impact on the domestic socio-economic. DMTP highly appreciates the effort of MONRE and the Consultant team to conduct the study because this is the first study of its kind and helps future studies. However, there should be a close coordination among ministries to avoid overlapping between sections in charge of MOIT and MONRE.

Mr. Khanh said that the DMTP can request some organizations such as ARISE+ to fund and implement CBAM-related studies and would like to have cooperation from the Consultant team. For example, after the end of the current project, if the Consultant has unfinished issues due to the limitation of the project framework, the Consultant can coordinate with the DMTP to continue implementing and focus on the export aspect. Mr. Khanh believes that if the Consultant team can handle an important study like this, it can be a potential partner of MOIT.

Mr. Minh, representative of NHQuang&Associates shared about his company's roles in the project, including research and advice on international and national policies. He also shared about the concerns of countries in general and Vietnam in particular that CBAM is compatible with WTO or not. The EU has argued that CBAM is not a tax and aims to protect the environment to avoid conflicts with WTO principles. Mr. Khanh shared that Vietnam was considering CBAM within the WTO framework, he commented that CBAM would be difficult to apply smoothly, although Vietnam could not force the EU to change, it also raised questions. He said that the Consultant should provide information from a practical perspective, while the DMTP will look at the macro perspective with other international commitments, and from business perspective, if combined, it has a more accurate perspective. An assessment is needed for the Government to take a holistic look and then make a decision.

He thought that it would be a good idea to make recommendations from a Vietnamese perspective, offering flexible policies, e.g by sector. The DMTP hoped that the Consultant team can make recommendations so that MOIT will have a basis for negotiation, for example, within the framework of WTO or EVFTA. He also thought that CBAM could be a good opportunity for Vietnamese businesses to change their minds, think in the direction of cleaner and greener development, and spend the initial cost for sustainable development in the future. He emphasized that he found the work of the Consultant very meaningful, not only for businesses but also for the government and national development orientation.

Consultation meeting with Legal Department – VCCI

Time: 14:00 – 15:30, 12/04/2023
Venue: VCCI Building, 9 Dao Duy Anh, Dong Da, Ha Noi

General Information

The aim of this meeting was to present policy implications and recommendations of the CBAM impact assessment and consult on the recommendations on legal aspects from enterprises' perspectives.

Participants

- GreenCIC: Nguyen Hong Loan, Pham Phuong Linh
- NHQuang&Associates: Nguyen Anh Minh, Dinh Thi Thu Trang
- AEMDA: Do Nam Thang, Chu Hoang Long
- VCCI: Pham Van Hung, Officer of Regulation development group, Legal Department

Agenda

- Purpose of consultation and short presentation on key results of the CBAM project
- Consultation

Contents

Dr. Do Nam Thang introduced CBAM and presented responses of other countries to CBAM and policy recommendations proposed in the CBAM Impact Assessment Report. After reviewing the report and listening to Dr. Thang, Mr. Pham Van Hung recommended that the Consultant could propose different approaches to the policy recommendation. In fact, the EU is not the most potential market of Vietnam (both import and export), if so, is the EU market attractive enough for Vietnam to develop a policy mechanism for transformation? If the market is large enough, we could propose mandatory policy instruments. If it is not large enough, we could suggest providing supporting policies and programs such as tax incentives and technology transformation support for enterprises exporting to the EU. We should be more careful with carbon tax because enterprises would react negatively, and this should give rise to reform environmental tax and fees first.

Ms. Nguyen Hong Loan shared that CBAM is not the decisive factor for policymaking, but in the overall context, CBAM is the driving factor for all policies related to low-carbon development. The consultant felt that it was possible to include Mr. Hung's proposed approach in the presentation on points for consideration for the CBAM response plan at the CBAM Consultation Workshop.

Dr. Chu Hoang Long asked questions and shared about issues related to the Certificate of Origin, concerned that this could become a barrier right from the reporting phase to the EU. Because, under the current design, the EU is likely to apply CBAM to the entire product value chain. In the production of the four CBAM-target sectors of iron and steel, aluminium, fertiliser and cement, Vietnam currently still depends on the import of raw materials in some production processes, such as the production of aluminium or some fertilisers. Thus, issues related to the traceability of input materials for emission calculation and emission reporting, as well as negotiation on indirect emission costs for Vietnam are still left unopened and potentially cause a significant impact. Therefore, although the quantitative impact on the economy in the Report may be insignificant, the overall impact of CBAM may be considerable, especially on aspects other than the economy.

Mr. Hung gave an example of compliance law in Germany, that businesses in Germany must ensure that their partners in Vietnam comply with a number of relevant regulations in Germany. The same will apply to CBAM, importers in Europe must also ensure that businesses exporting to them in Vietnam comply with CBAM regulations. Currently, VCCI is building a centre to support businesses to raise awareness about such regulations and laws. Once CBAM comes into effect, it will be useful and necessary to develop similar programs. In addition, Vietnam and the EU have a multilateral mechanism to exchange information related to trade and emission reduction activities, it is necessary to monitor and take advantage of these information channels to timely update information, prepare to respond, and negotiate with the EU. With regard to VCCI's perspective, the prioritised approaches are (i) Let the market self-adjust; (ii) Propose supporting and encouraging policies; (iii) As a last resort, apply compulsory measures such as tax.

Consultation meeting with Department of Multilateral Trade Policy – Ministry of Industry and Trade

Time: 09:00 – 10:30, 13 April 2023
Venue: MOIT headquarter, 54 Hai Ba Trung, Hoan Kiem, Hanoi

General Information

The main purpose of this meeting is to present about results and findings of the CBAM impact assessment, creditability of the approach and methodology of modeling and data used. Besides, the Consultant team also wants to consult the Department of Multilateral Trade Policy (DMTP) and MOIT on the results to get their comments and acceptance. Finally, the Consultant team seek further opportunities for future cooperation with DMTP and MOIT in CBAM impact assessment in later phase and other studies on CBAM.

Participants

- GreenCIC: Nguyen Hong Loan, Nguyen Viet Can
- NHQuang&Associates: Nguyen Anh Minh, Dinh Thu Trang, Nguyen Thanh Mai
- AEMDA: Dr. Chu Hoang Long, Dr. Do Nam Thang
- DMTP:
    - Ngo Chung Khanh, Deputy General Director of DMTP
    - Nguyen Thi Lan Phuong – Deputy Director of the Division of WTO and trade negotiations, DMTP
    - Le Huyen Nga – Officer of the Division of WTO trade negotiation, DMTP

Agenda

- Briefing of the results of CBAM impact assessment and points for consultation
- Discussion on the results and future cooperation in CBAM impact assessment

Contents

Dr. Chu Hoang Long presented the results of the study on CBAM impacts, collected data and data processing, modeling methodologies. The draft report and slide presentation of the CBAM impact assessment report had been sent to DMTP in advance.

For the conclusion of the presentation, the focus was that CBAM at the beginning may have small impacts on Vietnam, but it is still very open and potential to have greater impacts when CBAM is fully implemented. The implication for carbon pricing was raised and discussed.

The following are the comments of DMTP for the draft report:

- To separate the study into 2 components CBAM impacts on import/export and CBAM impacts on socio-economic.
- This report is comprehensive, but it can be not detailed, so the next phase we should go more into some details. Specifically, impacts on import/export, GDP, jobs, FDI attraction and other indicators.
- CBAM is very open and may have the potential to extend to other sectors. Vietnam's concern is about the impacts on export competitiveness, the extension of CBAM to agricultural products and other main exporting products of Vietnam. The study should extend to have these scenarios to have better meaning in terms of warning, giving the Government a holistic advice.
- CBAM should be seen in combination with other initiatives and international framework that Vietnam joins and makes commitments on emission reduction and green economy.

- Future studies should have reach and have wider participation of enterprises, covering higher percentage of enterprises.

The advice from DMTP is to be careful when concluding the message in the CBAM impact assessment report. If the impacts are interpreted as being small, enterprises won't pay sufficient attention to CBAM as they should, hence the warning effects will be weak. The message should reflect potential impacts, get the interest of the public and attract more resources to have more detailed studies on CBAM.

In summary, DMTP have the following recommendations for Consultant team and the report:

The Department was impressed with the Report and the vast amount of information the Consultant team provided. The report is very comprehensive and has covered the most important issues surrounding CBAM. CBAM is an interdisciplinary issue and under the current direction of the Government, the Ministry of Industry and Trade (MOIT) is in charge of implementing a number of activities in parallel with the Ministry of Natural Resources and Environment (MONRE). Specifically, MONRE assesses the impact of CBAM on the socio-economic situation and MOIT evaluates the impact of CBAM on import and export. The Department found that some of the report's conclusions with a relatively large volume covered this content. However, the Department believes that if we separate the two issues of import-export and socio-economics into separate reports, we can further analyze of each aspect in the next session of the research.

Secondly, regarding the scenarios and proposals the Consultant set out in the report, the Department proposes to add more industries that the Government of Vietnam is very interested in because currently steel, aluminium, cement and fertilizer are not main industry groups that export to the EU, but those that export in bulk to the EU are agricultural and fishery products. If the report can include analysis of warnings and potential impacts of these sectors, it will be more valuable in terms of warnings for relevant ministries. Particularly, the potential administrative costs including tracking and reporting of embedded emissions for the whole value chains of production inputs could be significant, creating burdens for government agencies and exporting enterprises.

Third, when building an impact assessment model of CBAM, we need to take into account other Vietnam's commitments in multilateral environmental frameworks such as COP 26 for CBAM's impact assessment to have a more accurate view about the value of CBAM's damage to the economy. Because, besides COP26, we would already have a lot of commitments to comply with in the environmental field. If we combine the commitments of COP26 with the other commitments, including CBAM to build the model, the results of the model will better reflect the reality and more accurate impacts of CBAM.

In addition, regarding the survey sample, the Department also hopes to get more responses from businesses. The Department was also honoured to have been consulted by a group of experts during the preparation of the report and also provided some suggestions. The Department is pleased that the comments have been incorporated in this report. The Ministry of Industry and Trade hopes to have the opportunity to continue working with the whole group of experts to conduct further research on the impact of CBAM so that we can effectively deploy our role assigned by the Government regarding the study and development of CBAM response plans.

Consultation meeting with Department of Climate Change – Ministry of Natural Resources and Environment

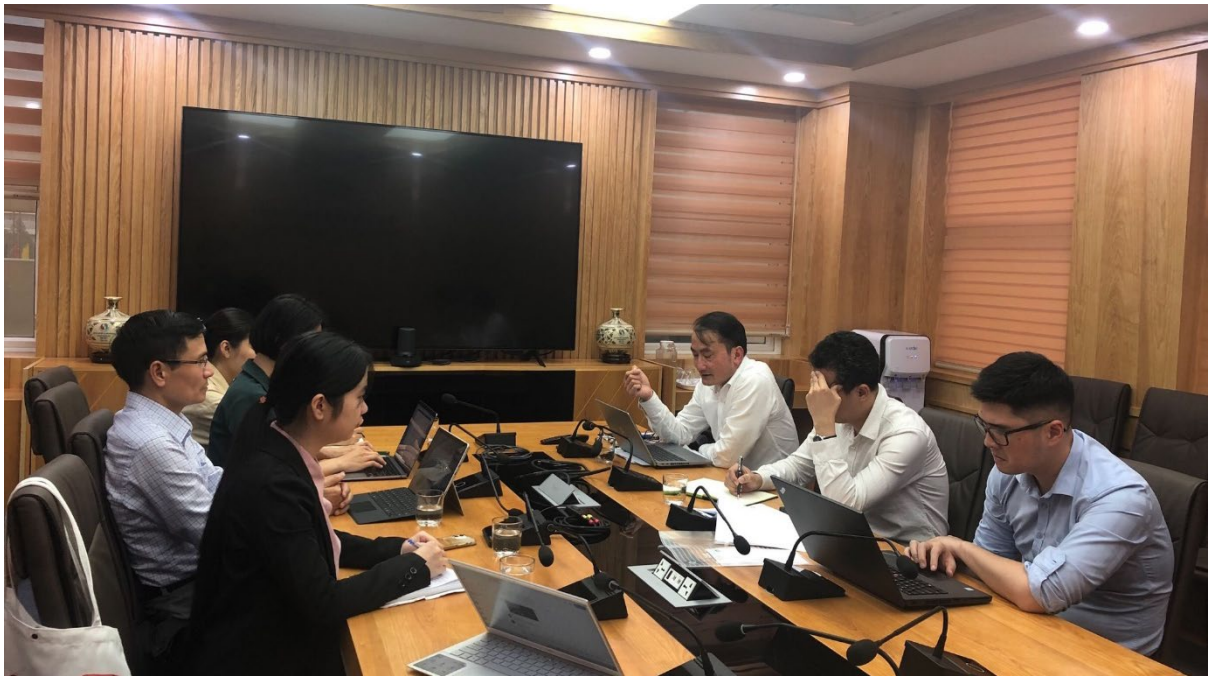
Time: 13:30 – 15:00, 13/04/2023
Venue: Department of Climate Change, 10 Ton That Thuyet, Cau Giay, Ha Noi

General Information

The aim of the meeting was to present a summary of the CBAM impact assessment results, their policy implications and points of consideration for Vietnam in responding to CBAM. Another aim was to consult the Economics and Climate Change Information Division on the results and findings to seek approval and finalise the report, as well as potential recommendations for the next phase of the project.

Participants

- GreenCIC: Nguyen Hong Loan, Pham Phuong Linh
- NHQuang&Associates: Dinh Thi Thu Trang, Nguyen Thi Kieu Trinh
- AEMDA: Do Nam Thang, Chu Hoang Long
- Department of Climate Change – Economics and Climate Change Information Division
    - Nguyen Van Minh, Director
    - Nguyen Thanh Cong, Deputy Director



Agenda

- Purpose of consultation and presentation on key results and findings of the CBAM project
- Consultation on the results and findings

Contents

Dr. Chu Hoang Long presented the data collection and modelling methodologies for the quantification of CBAM impact assessment, results and implications of the impacts. Dr. Do Nam Thang presented the reactions of other countries to CBAM and points for consideration for Vietnam proposed in the CBAM Impact Assessment Report. The draft report and summary slides of the CBAM impact assessment report had been sent to DCC in advance.

For the conclusion of the presentation, the focus was that CBAM at the beginning may have small impacts on Vietnam's entire economy, but it can reduce competitiveness of exporting firms. CBAM is still very open and potentially have greater impacts when CBAM is fully implemented. The implications and drivers for carbon pricing instruments were raised and discussed.

Mr. Nguyen Van Minh expressed that DCC appreciated the Consultant's effort in conducting the study and the achieved results. DCC has been looking forward to the study results as the CBAM impact assessment is a task assigned to the Ministry of Natural Resources and Environment by the Government. Mr. Minh agreed with the Consultant's recommendations and said that they need to be considerate of the geopolitical context of Vietnam. DCC has received other independent studies on CBAM and they said that there were still several uncertainties about the EU's CBAM so there existed opportunities to negotiate to maximise the benefits for all parties. DCC would consult the higher governmental bodies that we should show acceptance to CBAM but we need to negotiate to maximise our benefits and express our relevant commitments.

Mr. Minh also made the following comments and questions about the study, followed by responses from the consultant team:

- Whether the average emission in comparison with the calculated average emission in the study is the EU average or the world average and whether the data collected from the survey include data from all industrial technologies.

Ms. Loan answered that regarding the average emission, the revised report clarifies that the average emission intensity in the report is the world average and the average of Vietnam's products as calculated using data from our enterprise surveys. Regarding the industrial technologies covered in the survey data, their relevance to the study depends on the sector. In the steel sector, there are only two available technologies (BOF and EAF) and the enterprises that responded to our survey have both technologies. In the cement sector, there are only two types of rotation kiln and vertical kiln, which were also covered in our survey data. Regarding aluminium, Vietnam does not produce primary aluminium (aluminium electrolysis) so the production technology issues are not relevant here. The fertiliser sector is very complex and VN does not export chemical fertilisers to the EU, which is targeted by CBAM, so the production technology issue is also not relevant here.

- The report should at least mention the impact of CBAM from a value-chain perspective because Vietnam imports materials from other countries, e.g., China. This impact could be much more significant than the economic impact.

Dr. Long thought that Mr. Minh mentioned an important point on the impact from a value-chain perspective. Dr. Long agreed that there are possibly a number of significant costs caused by CBAM in relation to reporting system and GHG accounting across the value chain of a product which is not quantifiable at this stage. The Consultant has clarified this point in the revised report.

- Does the report assess the ratio of the emissions of CBAM-target commodities to the national emissions? These values may also contribute to the impact assessment on the economy-wide.

The Consultant also did some calculations regarding how much the surveyed emission accounted for the national emissions. However, they are only guesstimations and do not reflect the sectoral emissions because the survey only focused on exporting enterprises and major emitters in four CBAM-target sectors.

- If Vietnam applies carbon pricing, then a part of CBAM revenues will go to the Vietnamese Government instead of the EU. This issue is worth noticing, so please explain further: does this measure also focus on carbon tax or ETS? To be specific, are there any differences between ETS and carbon tax in keeping CBAM revenues in Vietnam?

Mr. Thang replied that carbon tax would generate tax revenue. Whether ETS would generate tax revenue depends on the design. For example, ETS may generate revenue when emission quotas are auctioned. This has been clarified in the revised report.

- In accordance with the Law of Environment Protection and Decree 06, Vietnam's ETS will be officially launched from 2026-2030 so the priority in this phase is the ETS, not the carbon tax. Most countries in the world only apply ETS or carbon tax – if both are applied, their scopes must be clearly defined. As a result, the report should not use the term 'carbon tax' in scenarios with a price of 11 USD/tCO2e. In the project's next phase, the research team can provide insights into the appropriateness of ETS and carbon tax.

Following Mr. Minh's opinions, Mr. Nguyen Thanh Cong also made some comments and questions below, followed by the Consultant response:

- How was the carbon price of 11 USD/tCO2 calculated? Was the carbon price of 11 USD/tCO2 which was calculated based on the NDC and used in the impact assessment of the emission and GDP double counted with the emission reduction costs in the NDC?

Dr. Long and Dr. Thang explained that it was not double-counted. It was calculated based on the estimates of the quantity emission reductions and associated cost in the NDC and supplemented any existing environmental non-carbon pricing costs.

- What was the scenario of "Reduced emission intensity" based on?

Dr. Long clarified that the source of the assumption of a reduction in emission intensity by 1-1.5%. This is mentioned in Vietnam's National Strategy for Green Growth in the Prime Minister's Decision 1658/QD-TTg 2021.

- Please clarify whether the report mentioned energy transition so were there any details of JET-P considered when analysing the energy transition scenarios?

The details relevant to JET-P was not covered in the report.

- Please avoid using the term "carbon tax" in the CBAM Impact Assessment Report.

Ms. Loan also agreed with Mr. Cong suggestion on the avoidance of the term "tax" and shared with DCC about the consultation with MOIT and VCCI. According to the advice from MOIT, the workshop should focus on raising awareness for enterprises and highlight that the economic impacts of CBAM may be small but non-economic impacts may be significant as well as other non-economic risk such as traceability in the raw materials used in manufacturing of CBAM-target goods. Also, MOIT showed interest in conducting in-depth study on CBAM with the Consultant team so the messages and findings delivered from both MOIT and MONRE to the Government regarding CBAM are consistent and have similar approach.

Consultation Workshop on the Results of the Impact Assessment of the EU's Carbon Border Adjustment Mechanism and Implications for Vietnam

Time: 08:30 – 12:00, 14/04/2023

Venue: Online via Zoom and offline at Hanoi Grand Plaza Hotel, 117 Tran Duy Hung Rd., Trung Hoa, Cau Giay, Ha Noi

General Information

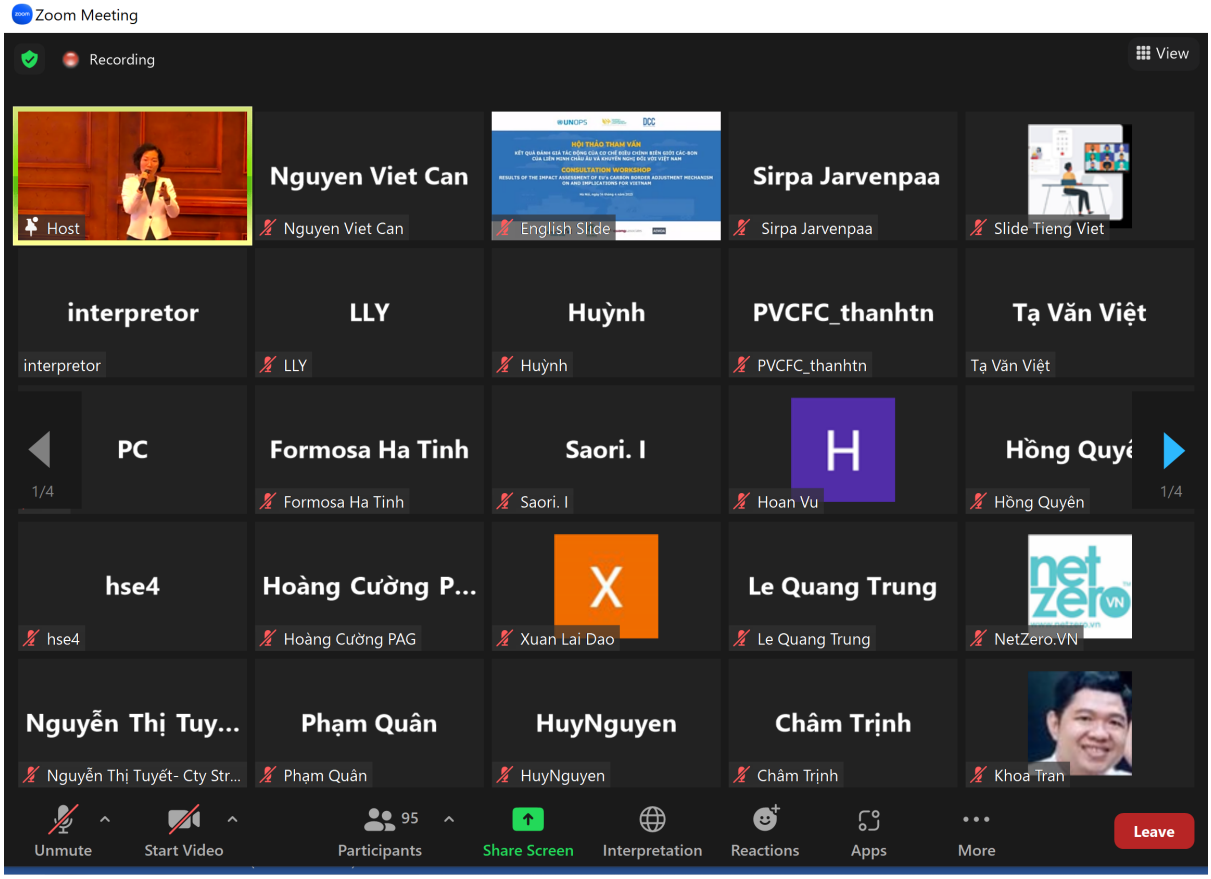
The Consultation Workshop on the Results of the Impact Assessment of the EU's Carbon Border Adjustment Mechanism on and Implications for Vietnam was organized by the Southeast Asian Energy Transition Partnership and consultant team of the Technical Assistant Project, in close collaboration with the Department of Climate Change, Ministry of Natural Resources and Environment. The aims of the Workshop were to:

- To update the project progress, latest regulations on CBAM and to inform and consult with stakeholders on the impacts of the EU's Carbon Border Adjustment Mechanism (CBAM) on export products, energy transition, the economy, and the implementation of the NDC in Vietnam;
- To receive comments and opinions of the wide stakeholders on the results of the study;
- To discuss the next steps on design and roadmap for application of the carbon tax system in Vietnam.

Participants

- Consultant team:
    - **GreenCIC:** Nguyen Hong Loan, Pham Kim Cuc, Nguyen Viet Can, Duong Anh Dung**,** Pham Phuong Linh**,** Pham Thuy Linh
    - **PCG:** Dario Brescia (Online participation)
    - **NHQuang&Associates:** Nguyen Hung Quang, Dinh Thu Trang, Pham Thi Kieu Trinh, Nguyen Thi Thanh Mai
    - **AEMDA:** Dr. Chu Hoang Long, Dr. Do Nam Thang
- Onsite participants: **74** (42 female and 32 male)
- Online participants: **108**
- Important stakeholders includes participants from ETP-UNOPS, DCC – MONRE, Vietnam Environment Protection Fund (VEPF), Legal Department – Ministry of Finance (MOF), General Statistics Office of Vietnam (GSO), General Department of Taxation – MOF, Vietnam WTO Center – Ministry of Industry and Trade (MOIT), Multilateral Trade Policy Department – MOIT, Department of International Cooperation – MONRE, Ministry of Construction, Department of European and American markets – MOIT, Vietnam Steel Association, Vietnam National Cement Association, Vietnam Aluminium Association, Ministry of Foreign Affairs, News Agencies (Vietnam Government portal, Hanoi times, VnEconomy, Vietnam News, etc), JICA, World Bank, CBAM-impacted companies (Hoa Phat, POSCO, Fomosa, etc.) and other relevant stakeholders.


UNOPS
DCC


Zoom Meeting
Recording
View
Host
Nguyen Viet Can
Nguyen Viet Can
English Slide
Sirpa Jarvenpaa
Sirpa Jarvenpaa
Slide Tieng Viet
interpretor
interpretor
LLY
LLY
Huỳnh
Huỳnh
PVCFC_thanhtn
PVCFC_thanhtn
Tạ Văn Việt
Tạ Văn Việt
PC
1/4
Formosa Ha Tinh
Formosa Ha Tinh
Saori. I
Saori. I
H
Hoan Vu
Hồng Quyé
Hồng Quyên
1/4
hse4
hse4
Hoàng Cường P...
Hoàng Cường PAG
X
Xuan Lai Dao
Le Quang Trung
Le Quang Trung
NetZero.VN
Nguyễn Thị Tuy...
Nguyễn Thị Tuyết- Cty Str...
Phạm Quân
Phạm Quân
HuyNguyen
HuyNguyen
Châm Trịnh
Châm Trịnh
Khoa Tran
Unmute
Start Video
95
Participants
Share Screen
Interpretation
Reactions
Apps
More
Leave

Agenda

Time	Agenda Items
08:00	**Registration**
08:30	**Opening remarks** *Ms. Sirpa Jarvenpaa, Director of Southeast Asia Energy Transition Partnership (ETP)*
08:40	**Roles of Carbon Border Adjustment Impact Assessment towards climate policies of Vietnam** *Mr. Nguyen Van Minh, Director of Economics and Climate Change Information Division, Department of Climate Change (DCC)*
Session 1: Overview of the EU's Carbon Border Adjustment Mechanisms (CBAM) and CBAM-covered sectors in Vietnam	
08:50	**Updates on the latest implementation plan of the EU's CBAM and the project implementation progress** *The Consultant*
09:00	**Status and development policies of CBAM-covered sectors in Vietnam (iron and steel/ aluminium/cement/fertiliser)** *Associations (iron & steel, aluminium, cement, fertiliser) and the Consultant*
09:40	**Photo session and Tea Break**
Session 2: Results of the Impact Assessment of the EU's CBAM on and Implications for Vietnam	
10:00	**Results of the impact assessment of the EU's CBAM on sectors, economy, energy transition, and NDC implementation and implications for Vietnam** *The Consultant*
10:45	**Reactions from other countries and recommendations for negotiation strategies and policies for Vietnam** *The Consultant*
11:15	**Discussion**
11:45	**Closing remarks** *DCC/ ETP*
12:00	**Lunch**

Contents

1. Opening remark

Ms. Sirpa Jarvenpaa, Director of Southeast Asia Energy Transition Partnership (ETP) made an opening remark by introducing ETP and its activities in Vietnam. The remark also includes briefing about CBAM and its impacts on Vietnam, providing the reasonings for the consultation workshop.

Mr. Nguyen Van Minh, DCC made an opening remark. He emphasized the important task of CBAm impact assessment as it is the role of both MONRE and MOIT. ETP valuable support has brought about an initial results of the impact assessment. He welcomed all comments and feedbacks that will be valuable for the consultant team to improve the study.

2. Presentations

Ms. Nguyen Hong Loan – Updates on the latest implementation plan of the EU's CBAM and the project implementation progress

The presentation focused on two main points:

- Timeline of the projects: what have been done, and what will be implemented next.
- Update on latest CBAM regulation according to the Provisional Agreement reached between legislative bodies of the EU on 13 December 2022 and the published text on 08 February 2023.

Mr. Dinh Quoc Thai – Vietnam Steel Association: Status and development of the iron and steel sector in Vietnam

The presentation focused on three main points:

- Overview of the iron and steel sector in Vietnam, including production, import, export and emissions by the sector
- Decarbonization trend on the steel sector: potential and actual implementation in Vietnam
- CBAM impacts on the steel sector and intended measures and recommendations for the association

Ms. Ly Thi Nga – Vietnam Aluminium Association: Status and development of aluminium production in Vietnam

The presentation focused on three main points:

- Overview of the sector, including production, import, export and revenuw from aluminium production in Vietnam
- GHG emissions by the sector and mitigation measures
- Recommendation for GHG emission reduction and CBAM impact reduction

She stressed out the challenges and gaps of the aluminium industry in Vietnam to meet decarbonization targets.

Mr. Luong Duc Long – Vietnam national Cement Association: Status and development of cement sector in Vietnam

The main contents of the presentation include:

- Overview of the industry, capacity, and development orientation of the sector
- Emissions and challeges in emission reduction
- Vietnam building material development strategy 2021 – 2030, with a vision towards 2050 and the ability to achieve that goal

Mr. Duong Anh Dung – the Consultant's expert: Status and development of the fertilizer sector in Vietnam

Mr. Dung's presentation focused on 3 main points:

- The overview of the sector
- The sector's GHG emission status and mitigation measures
- Sectoral development strategy and how the element of GHG emission reduction is addressed

Dr. Chu Hoang Long – AEMDA: CBAM Economic Impact Assessment and Implications

The presentation outlined the following:

- Profile of CBAM-targeted sectors
- Challenges in quantitative analysis and solutions
- Economy-wide impacts: General-equilibrium modelling
- Estimated economic impacts of CBAM on macroeconomic indicators in 2030
- Sectoral impact assessment: Modelling individual sector
- Carbon pricing: Why matters in CBAM context
- Estimated price-change sectoral impacts in 2030: without and with carbon pricing
- Estimated impacts on Vietnam's NDC in 2030
- Impact on energy transition and other impacts

Dr. Do Nam Thang – AEMDA: possible reactions from other countries and points for consideration for Vietnam

The presentation outlined the following:

- Possible and initial reactions from other countries
- Vietnam responding to CBAM under a swot analysis
- Response options to CBAM
- Recommendation for the government and for enterprises

3. Discussion

Name	Question/comment	Initial response from the Consultant team
Getac company	Will the exporter have to send the carbon emissions report to the exporter by shipment or by period (month, quarter, year)? My company has certified ISO14064-1 GHG inventory, does CBAM require to carry out a carbon emission inventory for each product (ISO14067-1 carbon footprint)?	@GreenCIC: As far as we understand, the exporter shall have to send the carbon emissions report to the exporter by shipment. It is very good that your company has been certified for ISO 14064-1. However from our point of view, CBAM will be based on the product emission intensity and will be closer to ISO 14067-1 carbon footprint. Anyway there are just a few calculation steps to convert the GHG inventory results to the GHG intensity values.
Nguyen Minh Hien	The speaker just raised the issue of using Hydrogen to produce green steel in Vietnam. However, the current reality shows that the production of green hydrogen is still very limited and experimental.	@GreenCIC In the presentation by Vietnam Steel Asociation, the speaker mentioned the utilization of green hydrogen for steel production. We see that this is a breakthrough technology only applied in few countries like Sweden and not commercially available yet in Vietnam . Vietnam's updated NDC 2022 also mentions breakthrough technologies like this

		will only feasiable after 2030. It is mentioned for the purpose of informing the development plan of the steel sector.
Department of Multilateral Trade Policy, Ministry of Industry and Trade **Ms. Le Huyen Nga**	The Department was impressed with the Report and the vast amount of information the Consultant team provided. The report is very comprehensive and has covered the most important issues surrounding CBAM. CBAM is an interdisciplinary issue and under the current direction of the Government, the Ministry of Industry and Trade (MOIT) is in charge of implementing a number of activities in parallel with the Ministry of Natural Resources and Environment (MONRE). Specifically, MONRE assesses the impact of CBAM on the socio-economic situation and MOIT evaluates the impact of CBAM on import and export. The Department found that some of the report's conclusions with a relatively large volume covered this content. However, the Department believes that if we separate the two issues of import-export and socio-economics into separate reports, we can further analyze of each aspect in the next session of the research. Secondly, regarding the scenarios and proposals the Consultant set out in the report, the Department proposes to add more industries that the Government of Vietnam is very interested in because currently steel, aluminum, cement and fertilizer are not main industry groups that export to the EU, but those that export in bulk to the EU are agricultural and fishery products. If the report can include analysis of warnings and potential impacts of these sectors, it will be more valuable in terms of warnings for relevant ministries. Third, when building an impact assessment model of CBAM, we need to take into account other Vietnam's commitments in multilateral environmental frameworks such as	Mr. Toan-ETP: Through the comment of the representative from MOIT, I saw an opportunity to expand the cooperation between ETP and MOIT in implementing a deeper assessment of the potential impact of CBAM on import/ export markets and other key export goods of Vietnam. I will report back to ETP director to discuss more potential cooperation activities with MOIT.

	COP 26 for CBAM's impact assessment to have an more accurate view about the value of CBAM's damage to the economy. Because, besides COP26, we would already have a lot of commitments to comply with in the environmental field. If we combine the commitments of COP26 with the other commitments, including CBAM to build the model, the results of the model will better reflect the reality and more accurate impacts of CBAM. In addition, regarding the survey sample, the Department also hopes to get more responses from businesses. The Department was also honored to have been consulted by a group of experts during the preparation of the report and also provided some suggestions. The Department is pleased that the comments have been incorporated in this report. The Ministry of Industry and Trade hopes to have the opportunity to continue working with the whole group of experts to conduct further research on the impact of CBAM so that we can effectively deploy our role assigned by the Government regarding the study and development of CBAM response plans.	
Pham Quan	Can the consultant clarify more about CBAM free quota allocation? Quotas are calculated according to the total of the whole EU or only for import quotas…	@GreenCIC We would like to correct here that CBAM certificates are not freely allocated to entities. Importers who import goods into the EU have to pay for the embedded emmissions in the goods they import. The price of CBAM certificates mirror the price of EU ETS allowance. Maybe you misunderstand CBAM certificates with EU ETS allowances which are now still freely allocated to some entities in the EU.
Perstima	According to CBAM, they only mention the importer in declaring the GHG included in the total imports and will buy carbon credits if it exceeds the quotas. They do not mention exporters. But the speakers said that we will pay a carbon tax when exporting if we exceed the quotas. Can	@AEMDA While CBAM regulations specify that importers are responsible for paying for carbon credits, importers may seek to offset the economic cost by negotiating with exporters to minimise the cost they carry. It is difficult to track on each specific business negotiation how

	the organizers clarify the relationship between these two issues?	Vietnam's exporters and EU's importers share the CBAM cost. However, according to economic principles, it is certain that there is a larger difference between the production cost in Vietnam and the market price paid by EU consumers when CBAM is applied, and that reduces the competitiveness of Vietnam's product if other factors remain equal. This is the principle we use in our economic assessment.
Truong Tu Long, GreenIN	The report is talking about the impact on the overall output of the industry, so what is the impact on the profits of businesses that export goods? How much revenue that will be reduced when CBAM is applied?	@AEMDA Thank you for your question. We are not able to collect profit data which are considered sensitive from a business perspective. The challenge is whether businesses share their profit information or not, moreover, profits vary from business to business. Our assessments are industry-focused. We have not had the opportunity to go into each business in depth because we need to collect a lot of data of each business (sensitive information). If they are not in the stock market, they have no obligation to provide data.
Truong An Ha, VIETSE	Which party bears the cost of CBAM? Importers have many options to reduce costs, the problem for Vietnam is how to make the product competitive for decision-making. Therefore, the assumption is being placed in favor of exporters paying the CBAM fee, which is not very close to CBAM. The Consultant may focus on a number of topics, e.g. how to conduct GHG inventory, how to report data to Europe.	@AEMDA Thank you for your questions and comments. You have raised an important point. We agree that there are possibly a number of significant costs caused by CBAM in relation to reporting system and GHG accounting which is not quantifiable at this stage. On who actually bears the cost of CBAM in practice, it is difficult to evaluate in each specific business negotiation how Vietnam's exporters and EU's importers share the CBAM cost. However, it is certain that there is a larger difference between the production cost in Vietnam and the market price paid by EU consumers when CBAM is applied, and that reduce the competitiveness of Vietnam's product if other factors remain. For example, in the steel industry, each ton of steel emits 2 tons of CO2, compared to the current price, CBAM price is roughly equivalent to

		10% of steel price. The steel price will increase further under CBAM, reducing our competitiveness.
Nguyen Ngoc Lam, Hanoi Times	CBAM will be applied from 2026. Do ministries and the authorities have plans to support enterprises in implementing CBAM impact reduction?	Mr. Minh-DCC: The results of the study are the basis for proposing the Government to have a plan to assign relevant ministries, including the Ministry of Foreign Affairs, to negotiate for CBAM. In Vietnam, some policy measures are being implemented such as Decree 06, companies in these 4 sectors must report GHG inventory results. The roadmap for GHG inventory and domestic carbon market development is a suitable roadmap for CBAM implementation. DCC is organizing training for businesses to understand the GHG inventory regulations and comply with it.
Phung Thi Nguyet Anh, Ngan Ha Media	Could you explain more about what the term CI in slide 12 means, and can you elaborate on the impact on GDP.	@AEMDA CI is the model's confidence interval, the impact is calculated on the USD exchange rate in 2019. According to this report, the confidence level is in the range of 95%. If we have energy transition to RE, it can increase to USD 248 million (electricity sector).
Pham Lan Huong, Independent Consultant	Very good report, elaborated, rigorous methodology, a great quantity of data, good and applicable recommendations. My opinion is that the carbon price at 11 USD is not enough, we should come up with more options. In the presentations, the authors repeatedly emphasized that CBAM is open. If there are any changes, they need to be updated for the enterprises to follow closely.	@AEMDA Thank you for your positive feedback on our work. In the next period when we study the carbon tax for Vietnam, we will delve deeper into the experiences of other countries to add to the scenario of carbon pricing that is appropriate for Vietnam.
No name	Can the Consultant team analyze further, assuming that it is the carbon market of the country whose goods are exported to the EU and subject to CBAM, then they can set a high carbon price (asymptotic to the price of the ETS EU allowance) to retain the fee, can Vietnam apply this tax to reduce the CBAM cost?	@AEMDA Thank you for your question. In theory, if Vietnam's carbon price could be set close to the EU's, the quantity that would be paid to the EU would be lower. However, it is important to note that if applied in Vietnam, carbon pricing will apply to all economic sectors, not just CBAM sectors. As a result, the design of carbon pricing must be considered in a broader context, rather than a

		measure to reduce the impact of CBAM.
Le Phuong Thao, Ministry of Foreign Affairs	We are interested in recommended measures for VN. When negotiating with the EU, what measures should be taken immediately, we think they should be comparable to other countries, what problems they raise and what conditions they negotiate. We need to learn to apply the negotiation strategy to Vietnam. It is recommended that the Consultant team focus on the experiences of other countries. Set up a domestic carbon market: there is now a development roadmap, CBAM is ongoing, and officially applied in 2026, but it changes quickly and may have an impact on Vietnamese businesses. Whether the roadmap 2025-2028 will be slow to response to CBAM, will it reduce the competitiveness of the economy. Is it possible to accelerate that plan?	@AEMDA In short, the new CBAM was temporarily approved in December 2022, so the reaction of other countries as well as Vietnam is not yet available because it is too new. International experts still doubt whether it can be applied in Europe or not => no international experience in negotiation, we must rely on the available negotiating experience of the Ministry of Foreign Affairs and the Ministry of Industry and Trade. According to the roadmap, by 2028, we officially has a carbon market, but it depends on many good factors, especially data. Data is the basis for quota allocation. From now to 2025, our duty is providing data and conducting GHG inventory => difficult to push the development ò the market because it depends on many factors. Experts also emphasize that the use of carbon credits is not clear.
Tran Hung Cuong, MONRE retired officer	Very good workshop. Where has CBAM been tested? Regarding renewable energy, is hydroelectricity renewable or not?	@GreenCIC CBAM has not been tested anywhere, but there are already many mitigation activities and research on carbon pricing in Vietnam. The potential for hydroelectricity in Vietnam is now limited. By 2030, we need 130 GW while hydropower potential now is around 1 or 2 GW=> contribution of hydropower is not much.
Phung Thu Hang STAMEQ	The problem is that when calculating emissions per enterprise, enterprises have different factories, different technologies, for example, newly built factories with new technology emit less, this leads to differences in emissions. So CBAM requires that the product embedded emissions should be calculated as the sum of the factories divided equally or only for the shipment and the place of production of that shipment? How do businesses solve this problem?	@AEMDA Thank you for your comment. We have revised the report to clarify that our estimates of average emission intensity take into account the weights of reported shares of technologies and factories in overall production levels. In other words, technologies or factories that contribute more to the total production of CBAM products would have more weight in the average emission intensity.

4. Closing remarks

Closing remark by Mr. Nguyen Van Minh, DCC

He appreciated the results of the research by the Consultant team. This result will be used for negotiation with the EU on CBAM. In the coming time, ministries and authorities will continue to issue new guidelines and legal documents for GHG inventories of enterprises. The results should be communicated and spread out to other potentially impacted enterprises. Finally, the Consultant team should make use of comment and feedbacks in today workshop to improve and reflect them into the report.

Closing remark by Mr. Do Manh Toan, ETP

Vietnam, as an active participant in the global trading system, should actively engage with the European Union and other stakeholders to address concerns or issues related to CBAM implementation. Vietnam also needs to properly recognize the importance of improving domestic production capacity to minimize the impact of CBAM, focusing on investing in clean and low-carbon technologies, enhancing the use efficiency energy, the use of renewable energy in production, and the enhancement of monitoring, reporting and verification (MRV) systems to accurately measure and report the carbon footprint of products and commodities. Along with that is the research and development of regulations, legal frameworks and carbon pricing instruments.

ETP in coordination with DCC will continue the consultation process with stakeholders after this workshop to finalize the assessment report and implement the next steps of the project. The report after consultation and adjustment will be sent back to the colleagues of DCC and related parties to advise the Government of Vietnam.

He appreciated the opportunity to expand the cooperation between ETP and MOIT in implementing a deeper assessment of the potential impact of CBAM on import/ export markets and other key export goods of Vietnam