TRADE4SD

Fostering the positive linkages between trade and sustainable development

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Deliverable 3.3: Report on modelling the environmental impact of trade and sustainability policies

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About TRADE4SD Project

Trade is a central factor in shaping not only global, but also regional and local development. Trade policy has an especially important part to play in achieving the UN Sustainable Development Goals (SDGs). The premise of the TRADE4SD project is that trade has the power to produce positive outcomes when the policies which define the rules of the game are framed and designed in a way to promote access to markets, fair prices and standards of living for farmers, as well as alleviating rural poverty and ensuring sustainable farming practices. Addressing the relation between trade and SDGs requires an integrated approach to policy-making and inclusive governance.

The main objective of the TRADE4SD project is to contribute to build new opportunities for fostering the positive sustainability impacts of trade supported by improved design and framing of trade policy at national, EU and global level, including WTO modernisation, increased policy coherence at different domains including agricultural, energy, climate, environmental and nutritional policies.

To meet this objective, the project will develop an integrated and systematic approach that combines quantitative models from different perspectives, and several qualitative methods recognising that SDGs and trade are highly context-related. On the one hand, a robust analysis of economic, social and environmental impacts is given by using diverse but integrated modelling techniques and qualitative case studies. On the other hand, a wide consultation process is implemented involving stakeholders both in the EU and in partner countries as well as those with a wide international scope of activity, providing opportunities for improved understanding, human capital building, knowledge transfer and dissemination of results. To this extent, the consortium involves, as co-producers of knowledge, a number of research and stakeholder participants with different backgrounds who will use their networks to facilitate the civil society dialogue and build consensus on the subject of gains from trade in view of sustainability.

Project Consortium

No.	Participant Organisation Name	Country
1	Corvinus University of Budapest (CORVINUS)	HU
2	University of Kent (UNIKENT)	UK
3	Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria (CREA)	IT
4	Johann Heinrich von Thünen-Institut, Bundesforschungsinstitut für ländliche Räume, Wald und Fischerei (THUENEN)	DE
5	The University of Sussex (UOS)	UK
6	University of Ghana (UG)	GH
7	Luonnonvarakeskus (LUKE)	FI
8	Centrum Analiz Społeczno-Ekonomicznych – Fundacja Naukowa (CASE)	PL
9	Food and Agriculture Organization of the United Nations (FAO)	IT
10	Institut national de recherche pour l'agriculture, l'alimentation et l'environnement (INRAE)	FR
11	Confederazione Generale Dell'Agricoltura Italiana (CONFAGRICOLTURA)	IT
12	Truong Dai Hoc Kinh Te Thanh Pho Ho Chi Minh (UEH)	VN
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1 Introduction

In the era of globalization, international trade policies play an important role in shaping the economic and environmental landscape of nations. As environmental concerns become more prominent, it is essential to understand how agri-food trade policies impact sustainable development and what approaches need to be taken to achieve a positive effect on the climate and environment.

The objective of this deliverable is to assess the impact of international agricultural trade on the achievement of selected climate and environmental goals, which are in line with particular SDGs (mainly Goal 13, but also elements of others related to the environment). Thus, the impact of specific trade agreements based on implications of current energy and climate policies were assessed utilising the modelling tools, with the analysed outcomes focusing on CO_2 and non-CO_2 emissions (i.e. N_2O, CH_4), as well as water pollution. This allows to understand the ways to mitigate GHG emissions through international trade globally and review methods to avoid relocation of pollution sources due to trade shifts. The utilised approach is grounded on global development scenarios within one of the Shared Socioeconomic Pathways (SSPs) - SSP1, which implies the implementation of sustainable approaches in the foreseen global development. The tool utilised to model the agri-food trade implications is a computable general equilibrium (CGE) model, resembling the global economy with specific sectors and countries.

The deliverable provides arguments for new/better policies for trade taking into account environmental measures as tools of climate change mitigation and reduction of water pollution. To verify the policy and modelling assumptions, scenarios and obtained results, it was crucial to investigate what stakeholders think about the agri-food trade policies and their impact on sustainable development. Stakeholders have different interests and unique perspectives on the matter. Therefore, within stakeholder consultations, we asked various groups of stakeholders - ranging from farmers, researchers, NGOs, to policymakers and the general public – on their opinions. Chapter 5 of this document sheds some light on those stakeholders' feedback regarding trade and environmental policies, offering a comprehensive view of their views and concerns. An online survey was conducted to assess stakeholders' views on trade and environment policies, with the aim of strengthening the positive links between trade and environment. The survey was divided into the following sections referring to various policy options:

1 **Trade Liberalisation Queries**: Focusing on the removal of tariffs between the EU and its trading partners.
2 **CO2-Based Import Tariff Queries**: Dealing with the imposition of import tariffs on sectors based on their emission intensity.
3 **CO2-Based Output Tax Queries**: Centered on imposing a production tax on sectors relative to their emission intensity.
4 **Mixed Policy Scenarios Queries**: Examining the combination of trade liberalisation policies with CO2-based tariffs and CO2-based output taxes in the agri-food sector.

The insights from the stakeholders can guide the formation of policies that are not only effective in achieving their objectives but also widely accepted and implemented without resistance. Hence some policy implications presented at the end of the Report are based also on the outcomes from the survey.

2 Policy background

Trade policies have traditionally been designed with economic growth as the primary objective, ensuring that nations can benefit from global markets and improve their GDP. However, with the increasing threat of climate change and environmental degradation, there's a pressing need to intertwine environmental considerations with trade decisions. This shift in focus has led to the emergence of policies which do not only look at economic benefits but also the environmental implications of trade.

The Kyoto protocol, followed by the Paris Agreement, have increasingly put the climate and environmental aspects in focus, leading to changes in policies of the developed and developing countries, while also having an effect on the remaining countries on the globe. In search of efficient climate mitigation measures, various policies are being modified or introduced, in order to utilise the existing reserves for reduction of the greenhouse gas emissions, as well as other types of environmental pollution.

To mitigate the negative effects of climate change and support transition to a more sustainable, low-carbon economy, the European Union (EU) is actively pursuing an ambitious climate and energy policy. The EU's climate and energy goals contained in the European Green Deal (European Commission, 2019)aim to make the EU carbon neutral by 2050.

A key aspect of EU climate policy is the commitment to reduce greenhouse gas emissions, with a particular focus on sectors such as energy, transport and agriculture. In the context of trade in agricultural products and foodstuffs, this commitment has a number of implications. Encouraging sustainable farming practices, promoting precision agriculture and investing in research and innovation to develop more climate-friendly farming techniques may be part of the EU's efforts to reduce emissions from agriculture. This could potentially have an impact on production methods and costs in EU agriculture, with implications for the competitiveness of EU agri-food products on the international market.

In addition, the EU has been working towards the integration of renewable energy sources into its energy mix. This shift to renewable energy will have an impact on the relatively energy-intensive agri-food industry. Measures to promote clean energy may have an impact on production costs, particularly for energy-intensive industries such as food processing. The transition to renewable energy may lead to changes in the cost structure of agricultural and food production, affecting their competitiveness on the global market.

Yet in terms of the global agri-food trade, the environmental aspects of production are still not being taken into account, thus leaving this aspect outside the regulatory framework. Moreover, the trade liberalization processes under the World Trade Organization (WTO) do not address sufficiently environmental aspects of trade, including those related to agri-food. While discussed, the environmental implications of agri-food trade and ways to lessen their negative impact are on primary stages in the global perspective.

At the same time, a “carbon leakage” effect is an obvious possibility, as restrictive approaches to agri-food production within particular countries or their unions (such as the EU) could lead to displacement of production associated with higher pollution to countries with less restrictive policies. Thus, with regard to the international trade in agricultural products and

foodstuffs, the EU's climate and energy policies will also have an impact on trade relations. To tackle such issues, among other, the EU recently explored the concept of a carbon border adjustment mechanism (CBAM), which aims to prevent carbon leakage by imposing a carbon price on certain imported products. Its transitional period is in force since 1st October 2023, as the European Union regulation on CBAM was adopted on 17 May 2023. The introduction of the CBAM has a significant impact on businesses importing goods into the EU. This mechanism could have an impact on trade in agri-food products through the imposition of additional costs on products that are not in compliance with EU environmental standards. Countries that export agri-food products to the EU may face new challenges in complying with these standards or in adapting their production processes to meet the EU's environmental criteria. Once the CBAM becomes fully operational in 2026, EU importers of these products will need to purchase carbon certificates corresponding to the carbon price that would have been paid to produce the goods in the EU, as free allocations are gradually reduced (Matthews, 2023). Yet the idea of including the agri-food sector under the CBAM is still being discussed, as applying it to these products is more difficult and could lead to adverse effects. Still, at this point, monitoring the displacement effect is crucial, as Europe strives to achieve goals of the European Green Deal, which is necessary to ensure avoiding the greenhouse gas leakage to other countries (e.g., Ghana, Vietnam).

The climate and energy policies of the EU have multiple implications for international agri-food trade. Changing agricultural methods and energy sources and introducing mechanisms such as carbon offsetting could change agricultural and food production and trade. To remain competitive in the EU market, actors in the global agri-food supply chain will need to adapt to new regulatory environments and sustainability standards as these policies evolve.

Given the multidimensional nature of trade and environmental challenges, the collective knowledge of the stakeholders is invaluable. Their diverse perspectives ensure that policies are comprehensive, inclusive, and geared towards a sustainable future for all.

For the purpose of a better understanding of the current policy implications, substantiation of potential agri-food trade development scenarios, as well as evaluating the modelling results, we approached the following groups of stakeholders:

NGOs: Non-Governmental Organizations, often at the forefront of social and environmental advocacy, provide a voice for underrepresented communities and ecological concerns. Their grassroots-level work offers a pulse on the ground realities, ensuring that policies are not only environmentally sound but also socially equitable.

Researchers: The academic and research community brings empirical evidence and data-driven insights to the table. Their rigorous analyses help in understanding the long-term consequences of policies, ensuring that decisions are based on robust evidence and scientific understanding.

Farmers: As primary producers and custodians of vast tracts of land, farmers are directly impacted by both trade and environmental policies. Their feedback sheds light on the practical implications of policies, offering insights into the challenges faced in implementation and the potential ripple effects on the agricultural ecosystem.

Advisors: These experts, often with interdisciplinary knowledge, bridge the gap between theory and practice. They provide strategic insights, foresee potential pitfalls, and suggest course corrections, ensuring that policies are both visionary and pragmatic.
Industry and private sector: provide insights into the practical implications of policies, ensuring that they are feasible and don't inadvertently hamper economic growth.
Policymakers: bridge the gap between economic growth and environmental protection, crafting policies that aim to strike a balance between the two. Their insights are crucial in understanding the broader strategic intent behind policies and the trade-offs considered during the formulation phase.

In light of this context, gathering and understanding feedback from stakeholders is essential. Their perspectives can help shape policies that are not only successful but also gain broad acceptance and face minimal opposition during implementation.

3. The modelling approach and modelling scenarios

3.1 General approach

We use a computable general equilibrium model to analyze the long-term effects of trade liberalization and introduction of carbon import taxes. We employ the CGEBox modelling framework (Britz and van der Mensbrugghe, 2018) an open-source set of models that originated from GTAP-in-GAMS (Lanz and Rutherford, 2016), a GAMS-based version of the GEMPACK-based GTAP model (Hertel, 1997), a standard tool in trade policy analysis. CGEBox framework includes several modules that implement the standard GTAP model with several extensions as well as derived models that include, inter alia, modified preference structure with respect to the original model.

We model trade with two selected FTAs (EU-Ghana and EU-Vietnam) as well as across-the board liberalization of EU trade with third countries. In the case of the latter, we also inquire into the effects of carbon-based tariff. We are interested in long-term results of those exercises – while tariff liberalization may be delayed and spread over several years (as is the case in EU-Ghana and EU-Vietnam) but also some effects, in particular, the capital accumulation from extra investment, can take years to materialize. Therefore, we use a recursive dynamic CGE model included with CGEBox, G-RDEM (Britz and Roson, 2019).

G-RDEM framework shares many features with the original GTAP model. The important differences include replacing the original CDE private demand system in GTAP with the AIDADS demand system which allows to capture non-linear Engel curves, which allow for changing shares for different commodities with the growth of per-capita income, therefore suitable for long-term scenarios of economic development, as "keeping constant marginal budget shares would lead to an overestimation of the demand for necessities, such as food, while demand in other sectors will hence be underestimated" (Britz and Roson, 2019). The parameters of this system of preferences are provided with the CGEBox package and discussed in Britz and Roson, 2019.

The CGEBox framework contains several tools that are employed in scenario building for our exercise. The baseline scenarios are automatically calibrated to the GDP and population growth scenarios in Shared Socioeconomic Pathways. When baseline is calibrated, GDP is fixed to the growth scenario and the labour supply is updated based on population changes (and the structure of the population of each country). Within the baseline run, sectoral productivity shifters are adjusted to account for the target growth. Differences in productivity growth across main sectors (agriculture, industry, services) are differentiated depending on annual growth rate (i.e., the industry is assumed to be more variable than the remaining sectors, in line with Britz and Rosson, 2019). Our simulations follow SSP1 as the baseline.

Our simulations are run with a default CGEBox closure similar to a standard GTAP closure. As far as the global bank closure is concerned, the allocation of foreign savings follows a rule that the returns on capital are equalized globally with endogenous trade balances (total global trade balances are equal to zero). The government expenditures are calculated based on

exogenous tax rates and the government expenditures are set based on the top-level regional household utility function, yielding the government savings endogenous.

For the baseline generation we also implement several additional assumptions. In particular, we allow for debt accumulation from foreign savings, i.e., a capital inflow in a particular period is reflected with increased debt payments over subsequent periods. Saving rates are chosen to depend on growth of income and age composition of each economy's population. We also enable adjustment of the sectoral shares in the government and investment demand to the income levels (reflecting the fact that high income countries may have a different composition of both of these aggregates, a feature of CGEBox based on an underlying econometric study, Britz and Roson, 2019). We also assume that besides the exogeneous population and labour force growth, endogenous capital accumulation, we allow limited elasticity in the supply of natural resources (0.15) to the change of its price and assume a fixed level of land available.

3.2 EU-Vietnam Free Trade Agreement (EVFTA) and EU-Ghana Economic Partnership Agreement (EU-Ghana EPA)

This section presents economic and environmental impacts of EU-Vietnam Free Trade Agreement (EVFTA) and EU-Ghana Economic Partnership Agreement. In order to simulate those trade agreements, we used the TASTE (Tariff Analytical and Simulation Tool for Economists) (Horridge, M., Laborde, D. 2008) software and CGEBox for simulations and analysis.

The EU-Vietnam Free Trade Agreement (EVFTA) is a comprehensive trade agreement that was officially signed on June 30, 2019, and entered into force on August 1, 2020. This agreement aims to eliminate up to 99% of tariffs on goods traded between the European Union and Vietnam over a specified period. Covering a broad array of areas such as trade in goods and services, investment, and intellectual property rights, the EVFTA is expected to have far-reaching implications for both parties involved. For Vietnam, the agreement promises significant economic benefits, particularly in sectors like textiles, footwear, and agricultural products, as it gains access to the EU's extensive market. On the other hand, the European Union sees this agreement as an opportunity to penetrate Vietnam's rapidly growing market, home to nearly 95 million consumers.

The EU-Ghana Economic Partnership Agreement is a wide-ranging trade agreement between the European Union and the Republic of Ghana. It was signed on 28 July 2016, under which the EU liberalized all trade in 2019, and Ghana is gradually liberalizing its trade between 2019 and 2029. This stepping stone Economic Partnership Agreement provides Ghana with duty-free and quota-free access to the EU market for all its products. Designed to foster trade and contribute to Ghana's sustainable development, the agreement aims to diversify the country's export basket and decrease its reliance on traditional commodities. From the EU's perspective, this agreement serves as a conduit for establishing deeper economic relations with the West African region. It also seeks to advance regional integration within the framework of the West African Economic and Monetary Union and to support the implementation of regional

Economic Community of West African States (ECOWAS) commitments. The EU-Ghana Economic Partnership Agreement also includes provisions to bolster cooperation in a variety of areas such as technical barriers to trade, sanitary and phytosanitary measures, and sustainable development. A significant aspect of this agreement is its focus on enhancing the political dialogue between the EU and Ghana. Both sides have agreed to use this platform to resolve any trade-related issues and to promote economic growth that leads to sustainable development. To facilitate the implementation of this agreement, the EU has committed to offering development cooperation support to Ghana. Consequently, Ghana views this partnership as an avenue to uplift its industries, stimulate innovation, and integrate more effectively into global markets. Overall, the EU-Ghana Economic Partnership Agreement is not just a trade deal but serves as a comprehensive platform for wider socio-economic cooperation between the two parties.

For the EVFTA, the liberalisation period stretches from 2020 to 2035, during which tariffs are progressively liberalised. In the EU-Ghana Economic Partnership Agreement, the European Union (EU) accomplished complete tariff liberalisation in 2019, while Ghana has adopted a phased strategy, committing to gradually liberalise tariffs between 2019 and 2029.

Based on the liberalisation schedules outlined in the agreements, specific tariffs for each year and for GTAP commodities were calculated as they gradually transitioned towards full liberalisation. Tariffs for liberalised products were determined using the TASTE software and were based on the HS6 product levels specified in the agreements. TASTE applies the shocks defined at the HS6 level of aggregation to aggregated GTAP sectors through included correspondence table and produces the scenario files.

Next, calculated tariffs for both agreements, each year and for all GTAP commodities, were used as simulation shocks to model the agreements with the use of the computable general equilibrium model - CGEBox. The results and analysis of these simulations are presented below.

3.3 Full-fledged EU trade liberalisation and CO2-based import tariff/production tax

We explore several hypothetical scenarios of large-scale EU trade liberalization. We also consider the imposition of CO2-related EU tariffs in agriculture and total trade, including potential retaliation responses and reciprocal tariffs from trading partners. Additionally, the analysis includes a CO2-based production tax to counterbalance the CO2-related tariffs. In scenarios related to the agrifood sector, the shock was applied as follows:
(for details, please see the appendix 8.1)

- Paddy rice
- Wheat
- Cereal grains nec
- Vegetables, fruit, nuts
- Oil seeds
- Sugar cane, sugar beet
- Plant-based fibers

- Crops nec
- Processed rice
- Cattle, sheep, goats, horses
- Animal products nec
- Raw milk
- Wool, silk-worm cocoons
- Bovine meat products
- Meat products nec
- Vegetable oils and fats
- Dairy products
- Sugar
- Food products nec
- Beverages and tobacco products

Starting from the baseline [0], the following scenarios were introduced (see **Błąd! Nie można odnaleźć źródła odwołania.**):

[0-1] (EU -> WORLD -> EU) agro-food Liberalisation:

This scenario involves reciprocal bilateral trade liberalization of agro-food sector between the EU and its trading partners worldwide.

[0-2] (EU -> WORLD -> EU) All Commodity Liberalisation:

Similar to scenario [0-1], this scenario involves bilateral trade liberalization, but it encompasses all commodities, not just agro-food products.

[0-2-1] (EU -> WORLD) agro-food CO2 based tariff + agro-food CO2 production tax in EU + (EU -> WORLD ->EU) liberalisation of other sectors:

In this scenario, the EU imposes CO2-based tariffs on agro-food products in its trade with the world. Additionally, the EU implements a CO2 production tax on agro-food products within its borders. Meanwhile, liberalization efforts apply to other sectors through bilateral agreements between the EU and its trading partners.

[0-2-2] (EU -> WORLD -> EU) agro-food CO2 based tariff + agro-food CO2 production tax + (EU -> WORLD ->EU) liberalisation of other sectors:

This scenario is similar to [0-2-1] but it also considers reciprocal actions applied by trading partners in response to introduction by EU CO2-related tariffs on agro-food commodities.

[0-3-1] (EU -> WORLD) agro-food CO2 based tariff + agro-food CO2 production tax in EU:

In this scenario, the EU imposes CO2-based tariffs on agro-food products in its trade with the world and implements a CO2 production tax on agro-food products within its borders. However, there is no liberalization of trade in other sectors.

[0-3-2] (EU -> WORLD -> EU) agro-food CO2 based tariff + agro-food CO2 production tax:

Similar to [0-3-1], this scenario combines the agro-food CO2-based tariff and CO2 production tax but also consider reciprocal actions applied by trading partners.

[0-4-1] EU -> WORLD All Commodity CO2 based tariff + All Commodities CO2 production tax in EU:

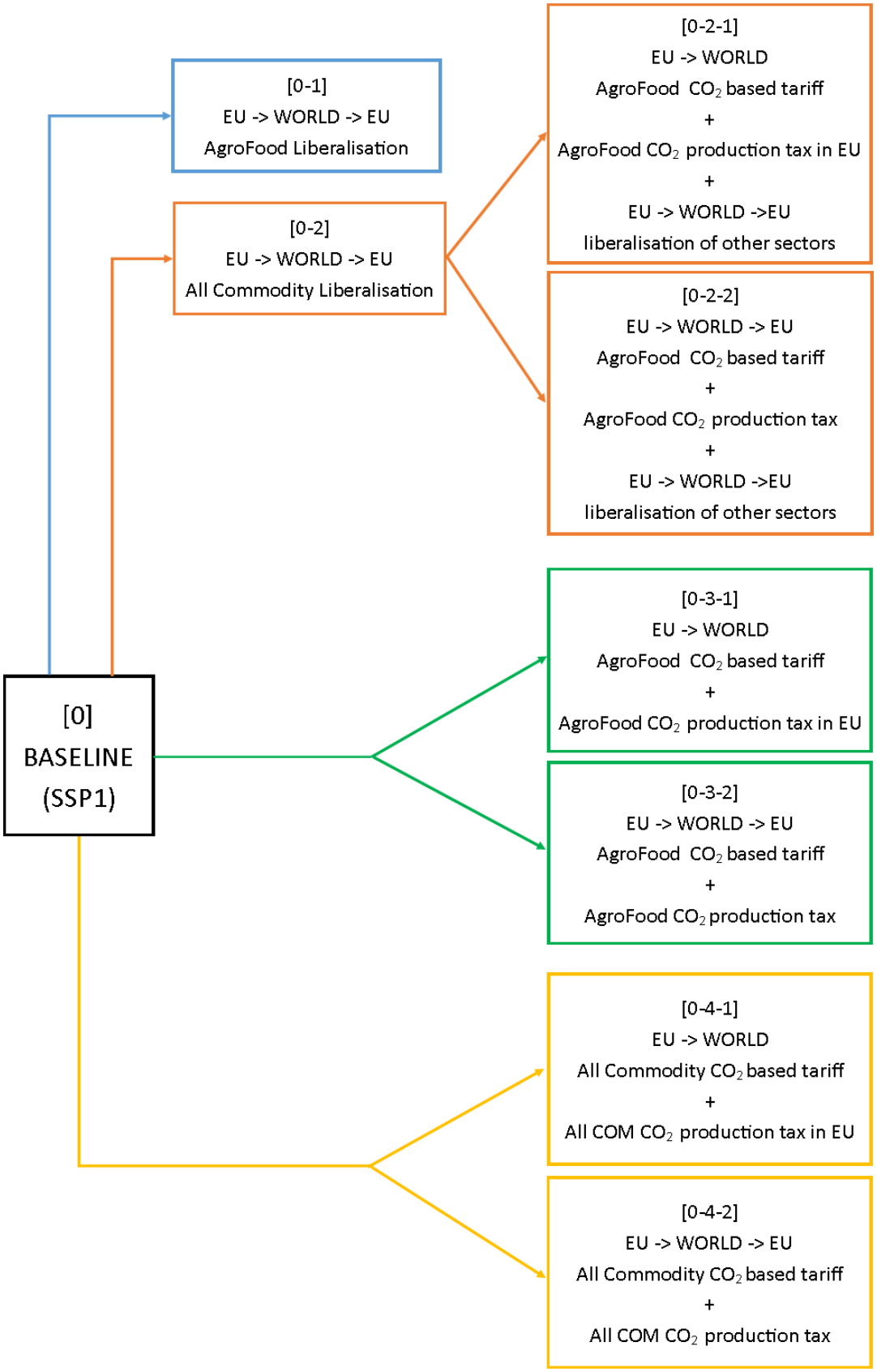
This scenario involves the EU imposing CO2-based tariffs on all commodities in its trade with the world while also implementing a CO2 production tax on all commodities within its borders.

[0-4-2] (EU -> WORLD -> EU) All Commodity CO2 based tariff + All Commodities CO2 production tax:

Similar to [0-4-1], this scenario combines the CO2-based tariffs and the CO2 production tax on all goods, but it also specifies that the EU's trading partners also apply CO2 tariffs to imports from the EU.

In scenarios involving carbon-rated tariffs and taxes, we apply a $100 USD tariff and a $100 USD production tax per 1 ton of emitted CO2 equivalent. The results of the simulations are presented in the following subsections.

Figure 1: Scenarios of trade liberalisation and CO2-based import tariff/production tax



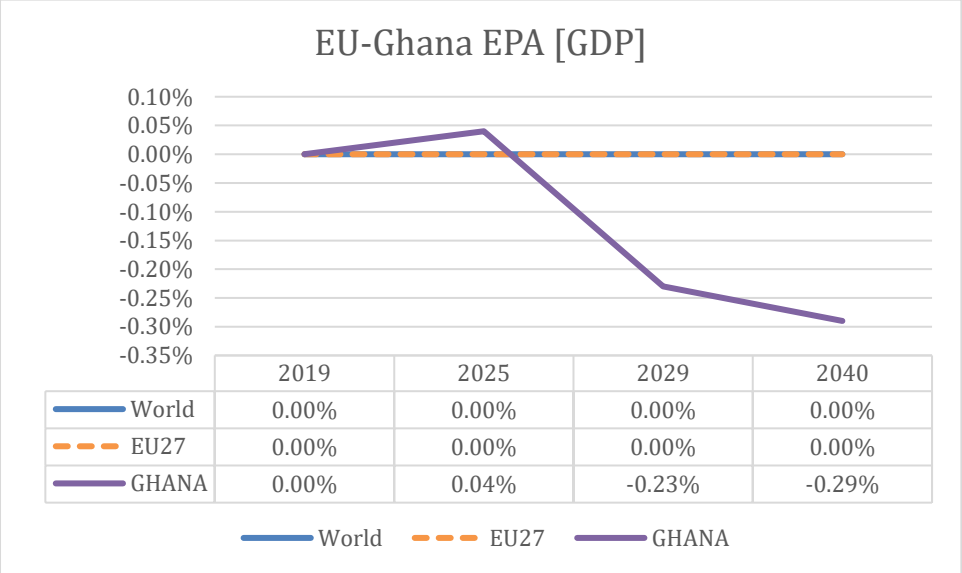
4 Simulation results

4.1 EU-Ghana Economic Partnership Agreement (EU-Ghana EPA) and EU-Vietnam Free Trade Agreement (EVFTA)

4.1.1 Economic impacts

When presenting macroeconomic impacts, we focus on levels of GDP and private consumption as the main indicators of economic activity. Figure 2 and Figure 3 present these results for the partners involved in the two analysed trade agreements and the global economy up to the year 2040 (see Figure 2 and Figure 3).

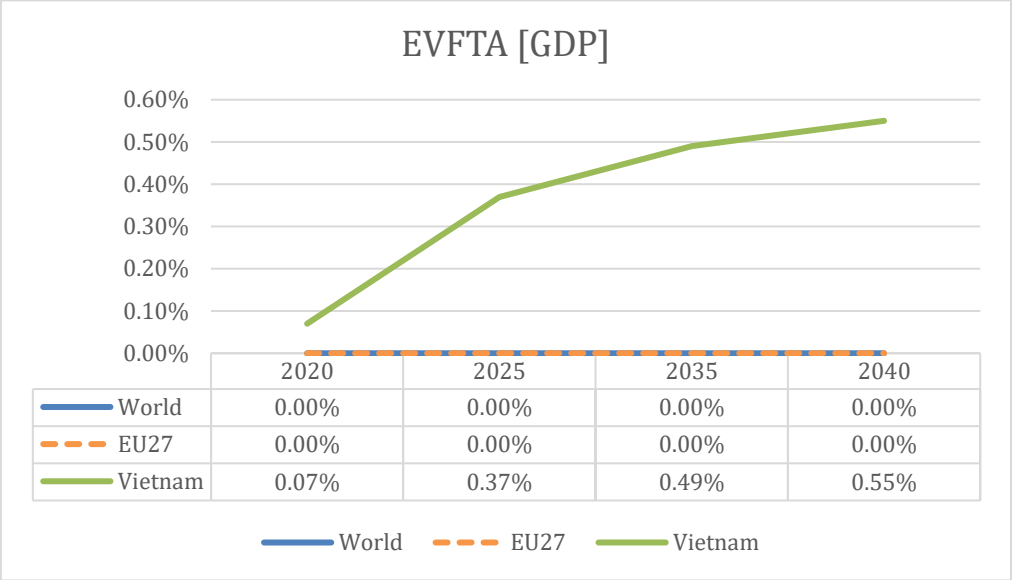
Figure 2: EU-Ghana EPA impacts on GDP



Source: own calculations

Under the EU-Ghana Economic Partnership Agreement, the global GDP remains unchanged at 0.00% across the listed years. Similar case is for the EU27 with no noticeable changes in GDP. Ghana, on the other hand, experienced a slight rise of 0.04% in 2025, but the subsequent years show a negative downward trend, reaching -0.23% in 2029 and -0.29% by 2040. This demonstrates that Ghana may experience some disturbances from the agreement, especially in the medium to long term.

Figure 3: EVFTA impacts on GDP

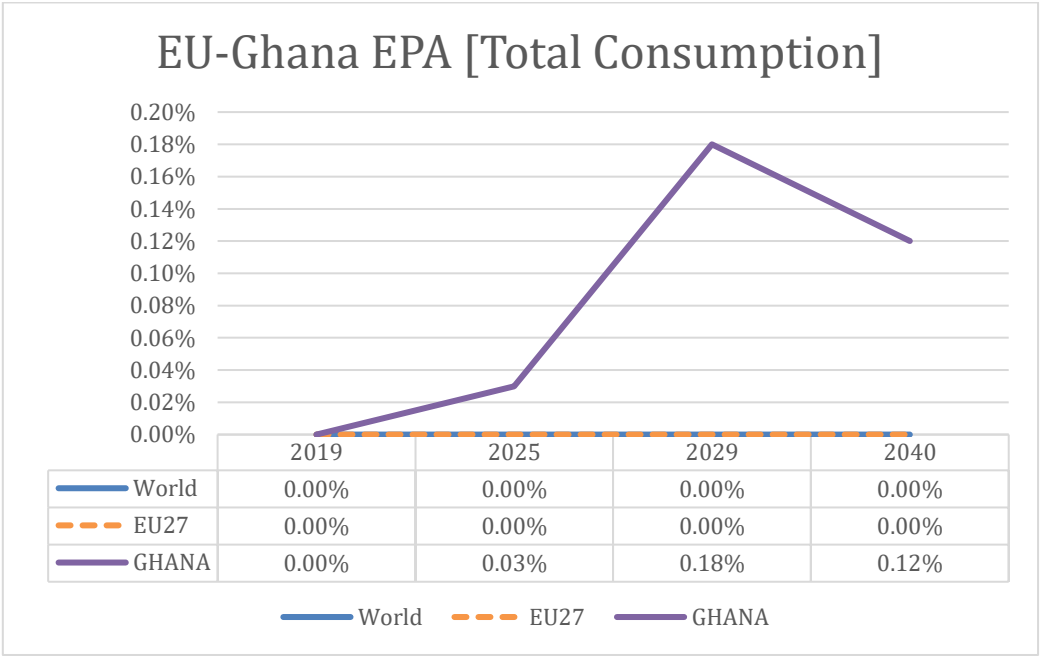


Source: own calculations

Regarding the EU-Vietnam Free Trade Agreement (EVFTA), as expected, the impact on global GDP is negligible. Similarly, for the EU27 the economic effects of the agreement are minimal. Oppositely to the case of Ghana, the benefits for Vietnam are much more positive. After an initial increase of 0.05% of GDP in 2020, Vietnam sees a consistent boost in GDP in comparison to the baseline, culminating at 0.55% by 2040. This indicates significant benefits for Vietnam as a result of the agreement with the EU.

Moving on to the analysis of the impact of the trade agreements on total consumption (see Figure 4 and Figure 5):

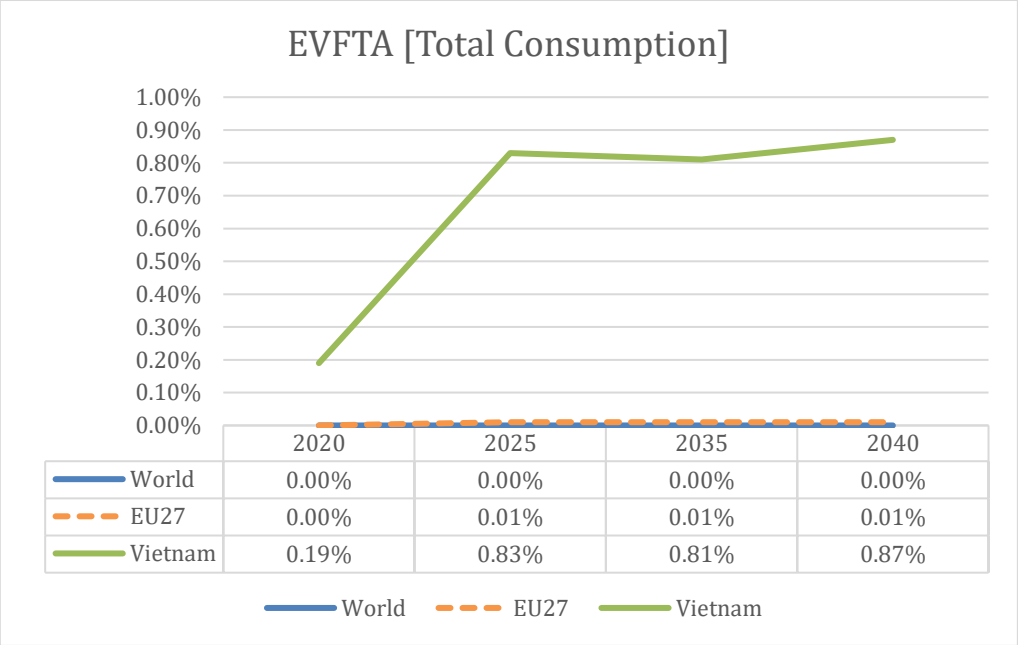
Figure 4: EU-Ghana EPA impacts on total consumption



Source: own calculations

As with the impact on global and EU27's GDP, the impact of the agreement is negligible. In contrast, Ghana's consumption data paints a more varied picture. The country shows a steady upward trend of 0.18% up to 2029, but by 2040 there's a surge to 0.12%. Nonetheless this trend indicates increasing demand in Ghana, on one hand resulting mainly from lower prices of imported products.

Figure 5: EVFTA impacts on total consumption

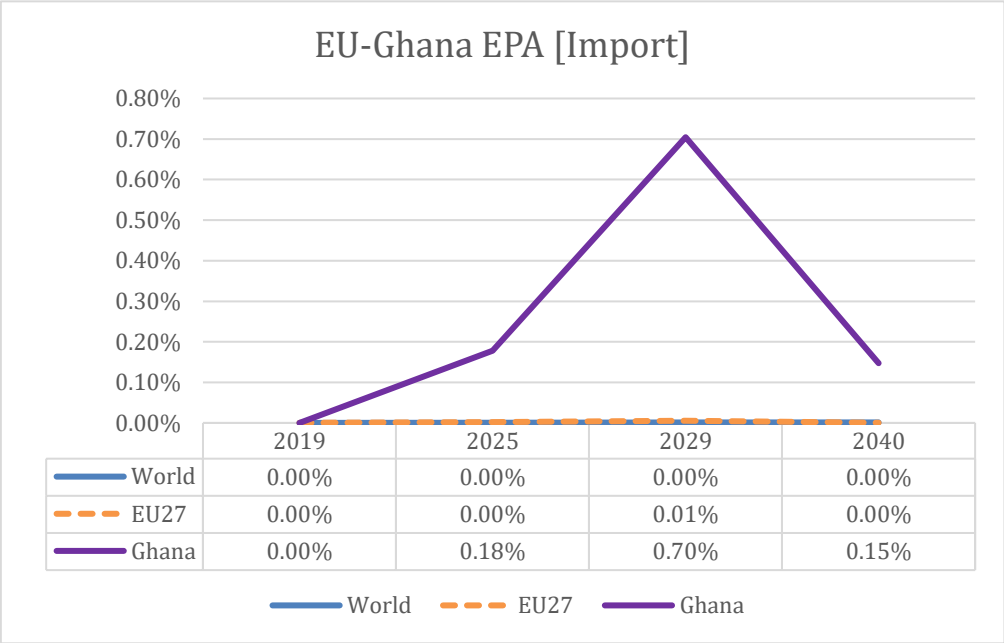


Source: own calculations

Considering the EU-Vietnam Free Trade Agreement (EVFTA), once more, the global consumption remains almost unaltered, reinforcing the notion that these bilateral agreements don't produce ripples in global demand. The EU27's consumption trends are also negatable across all reported years. Vietnam, however, shows a more pronounced positive trend. Beginning with a 0.19% rise in 2020, the growth accelerates to 0.83% in 2025, and despite small dip in 2023 continues its upward trajectory, reaching 0.87% by 2040. This reveals a substantial increase in Vietnam's consumption patterns, underscoring the country's expanding demand and potential economic growth in line with the trade agreement with the EU.

The next important aggregates that indicate changes brought about by trade agreements are global imports and exports, as well as those of the involved partners (see Figure 6, Figure 7, Figure 8 and Figure 9).

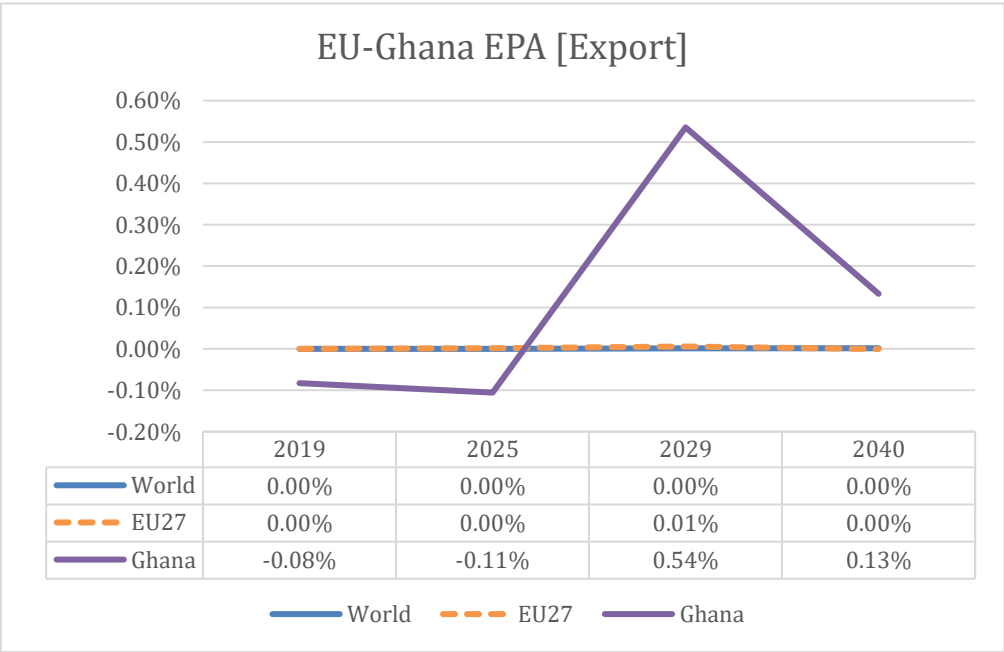
Figure 6: EU-Ghana EPA impacts on import



Source: own calculations

Given the asymmetry in the size of the trading partners, as expected the change in overall imports resulting from the agreement in EU27 is minimal. In Ghana one can observe significant leaps in imports, in particular by 2029, reaching 0.70%, though it moderates by 2040. This considerable jump might be due to Ghana leveraging the agreement to diversify its import portfolio or access essential goods at better rates.

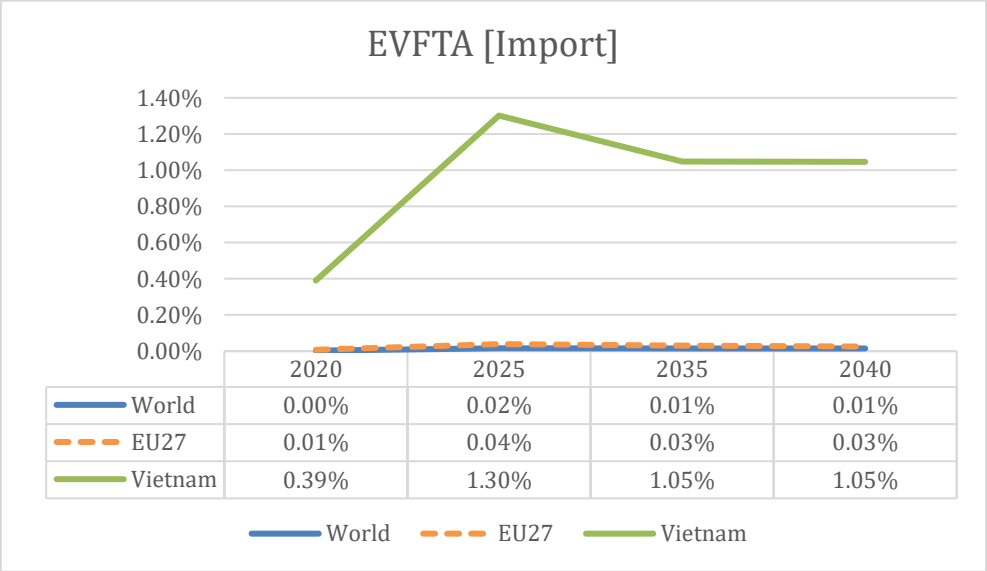
Figure 7: EU-Ghana EPA impacts on export



Source: own calculations

The EU27's export growth remains dormant until 2029, post which there is a slight uptrend, indicating a minimal increase in exports. Ghana initially showcases a decline in its exports, which might be due to adjusting to the new trade dynamics and to increased import competition. However, by 2029 and 2040, the figures rebound impressively.

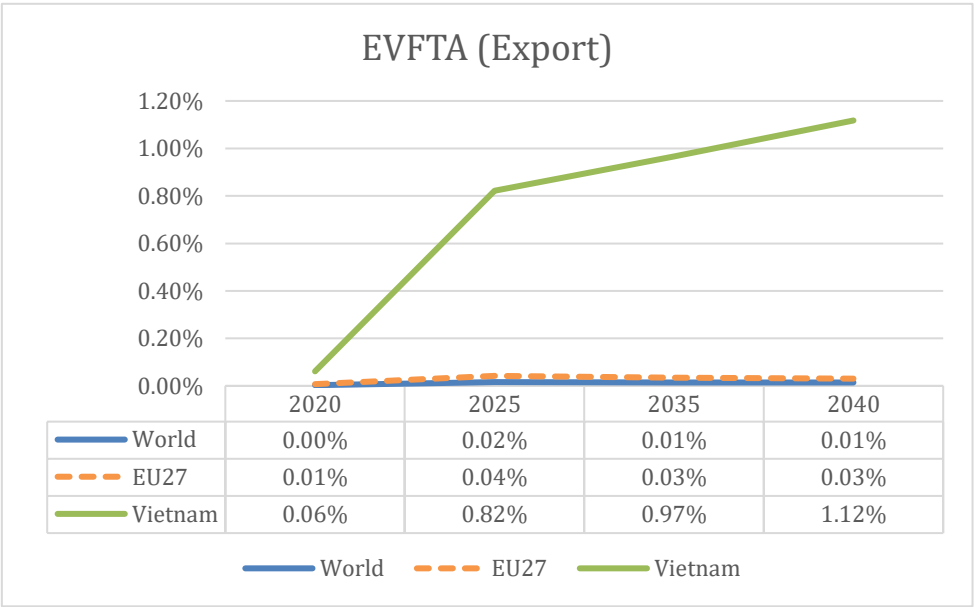
Figure 8: EVFTA impacts on import



Source: own calculations

For the EU-Vietnam Free Trade Agreement (EVFTA) concerning imports, the world figures do display a minor uptick by 2025, which moderates by 2040. The EU27 shows a modest rise throughout, reflecting an increase in Vietnamese imports, potentially due to the favourable trade terms. Vietnam's import numbers stand out, showing a substantial rise, especially in 2025 at 1.3%, though slightly moderating in subsequent years.

Figure 9: EVFTA impacts on export



Source: own calculations

Regarding the EVFTA's export patterns, the global numbers are consistent with prior observations, with only a minor increase by 2040. The EU27 sees gradual export growth relative to the baseline, with Vietnam becoming a more significant trading partner over time. Vietnam's exports, in relation to baseline, starts with an initial rise of 0.06% in 2020 to reach significant 1.12% growth by 2040. This sharp rise indicates Vietnam's capability to penetrate the EU's market effectively, thanks to the reduced barriers under the EVFTA.

Under both the EU-Ghana Economic Partnership Agreement and the EU-Vietnam Free Trade Agreement (EVFTA), global GDP and total consumption remained largely unchanged, suggesting that these bilateral agreements don't drastically influence the global economy or consumption patterns. For GDP growth, Ghana suffers from some small drops in rate of growth, on the other hand, Vietnam benefitted in the medium to long term. The EU showed more subtle or no noticeable changes. In terms of total consumption, Ghana and Vietnam displayed significant positive shifts, reflecting evolving economies and consumption behaviours, whereas the EU experienced moderate positive shifts. Regarding imports, both Ghana and Vietnam, over time, showed increased reliance on imports, with Vietnam in particular leveraging the EVFTA significantly by 2025. The EU's import pattern remained consistently positive with Vietnam, indicating growing trade relations. In exports, Ghana initially faced challenges, but rebounded with notable growth rates by the end of the observed period. Vietnam's export showed positive upward trend from the effective date of the trade agreement. This suggests that, post-adjustment in case of Ghana, these nations found effective ways to penetrate the EU market. The EU's export trends highlighted a steady, positive relationship with both partner countries.

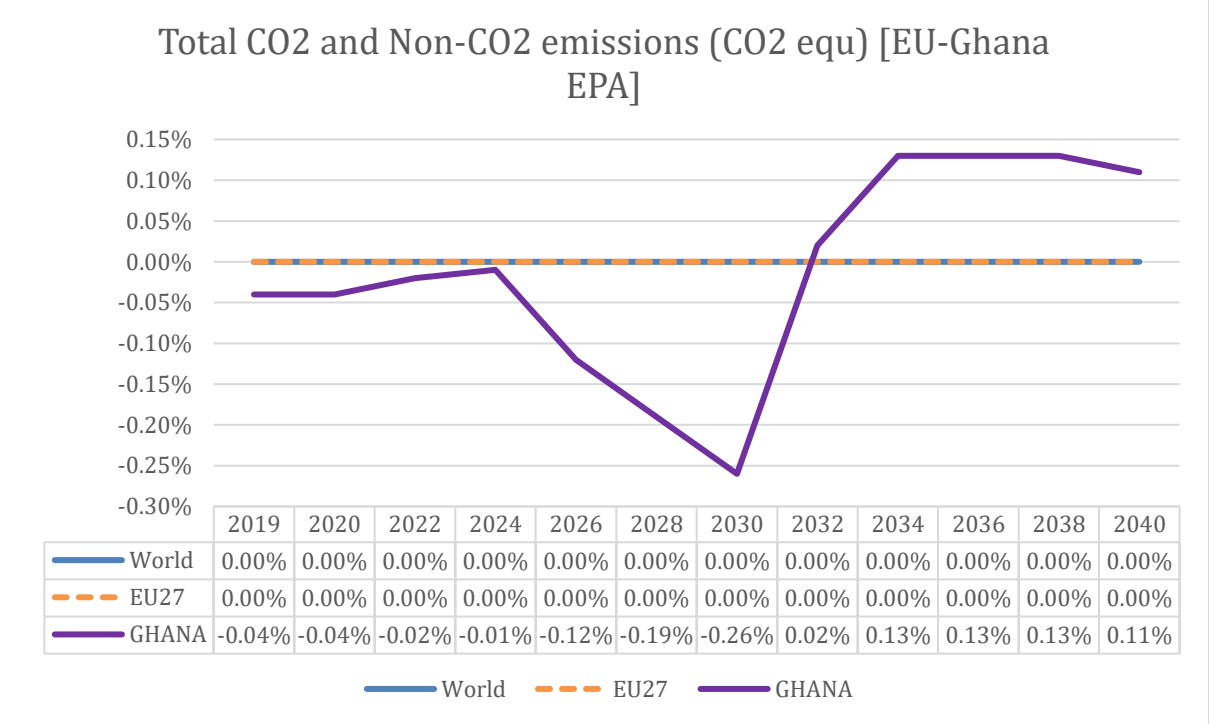
In conclusion, although the global impact of both agreements was minimal, the direct participants experienced notable changes in their economic indicators. Particularly, Ghana witnessed a slight but negative growth in GDP compared to the baseline, but witnessed positive changes in consumption, imports, and exports. On the other hand, Vietnam, experienced significant positive shifts in GDP, consumption, imports, and exports. This emphasizes the importance of these trade agreements in shaping their economic trajectories.

4.1.2 Impact on emissions

4.1.2.1 EU-Ghana EPA

From 2019 to 2040, worldwide and EU's emissions influenced by EU-Ghana agreement displayed no noticeable growth relative to the baseline. Ghana experienced a minor decrease in CO2 and Non-CO2 emissions, between 2019 and 2024 with reductions mostly under -0.05%. This trend intensified with larger reductions from 2026 to 2030, reaching up to -0.26% in 2029. However, from 2032 to 2040, there was a positive shift, with emissions gradually increasing up to 0.11% (see Figure 10**Błąd! Nie można odnaleźć źródła odwołania.**).

Figure 10: EU-Ghana EPA impact on Total CO2 and Non-CO2 emissions (CO2-equ) [% change to baseline]



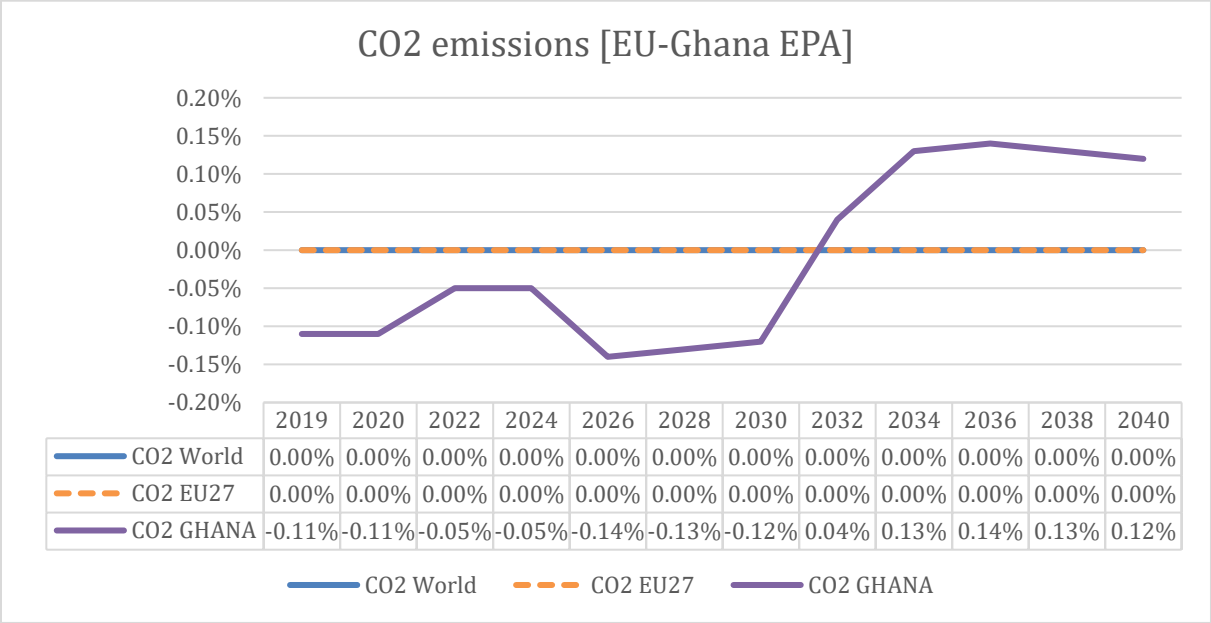
	2019	2020	2022	2024	2026	2028	2030	2032	2034	2036	2038	2040
World	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
EU27	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
GHANA	-0.04%	-0.04%	-0.02%	-0.01%	-0.12%	-0.19%	-0.26%	0.02%	0.13%	0.13%	0.13%	0.11%

Source: own calculations

Ghana's rise suggests an expanding industrial sector and increasing energy demands, potentially without the implementation of sustainable practices (carbon leakage).

Worldwide and EU's CO2 emissions rates are similar to total emissions (CO2 and Non-CO2) with no noticeable changes in comparison to the baseline. In contrast, Ghana's emissions declined slightly from 2019 to 2025, with reductions hovering around -0.05% to -0.11%. The trend of decreasing emissions intensified between 2026 and 2030. Starting from 2032 and continuing through 2040, there was an upward shift with CO2 emissions increasing, peaking at 0.14% in 2036. (See Figure 11).

Figure 11: EU-Ghana EPA impact on CO2 emissions [% change to baseline]

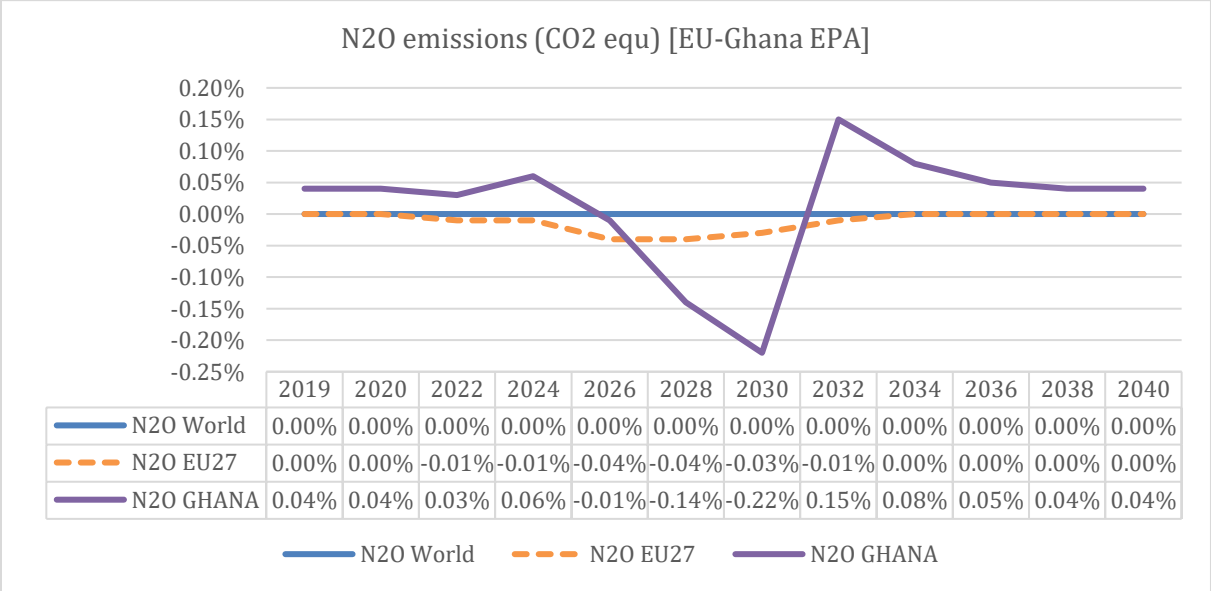


	2019	2020	2022	2024	2026	2028	2030	2032	2034	2036	2038	2040
CO2 World	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
CO2 EU27	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
CO2 GHANA	-0.11%	-0.11%	-0.05%	-0.05%	-0.14%	-0.13%	-0.12%	0.04%	0.13%	0.14%	0.13%	0.12%

Source: own calculations

Similarly to previously presented emission there is no noticeable change in rate of N2O emission in case of the World and EU27. For Ghana, between 2019 and 2025, there was a gradual increase, starting from 0.04% in 2019 and peaking at 0.06% in 2024. A sharp decline was then observed from 2026 to 2030, with rate of emissions dropping to as low as -0.22% in 2030. Post-2030, the trend reversed, with emissions steadily rising to 0.15% in 2032 and then stabilizing around 0.04% to 0.05% from 2035 to 2040 (see Figure 12).

Figure 12: EU-Ghana EPA impact on NO2 emissions (CO2-equ) [% change to baseline]

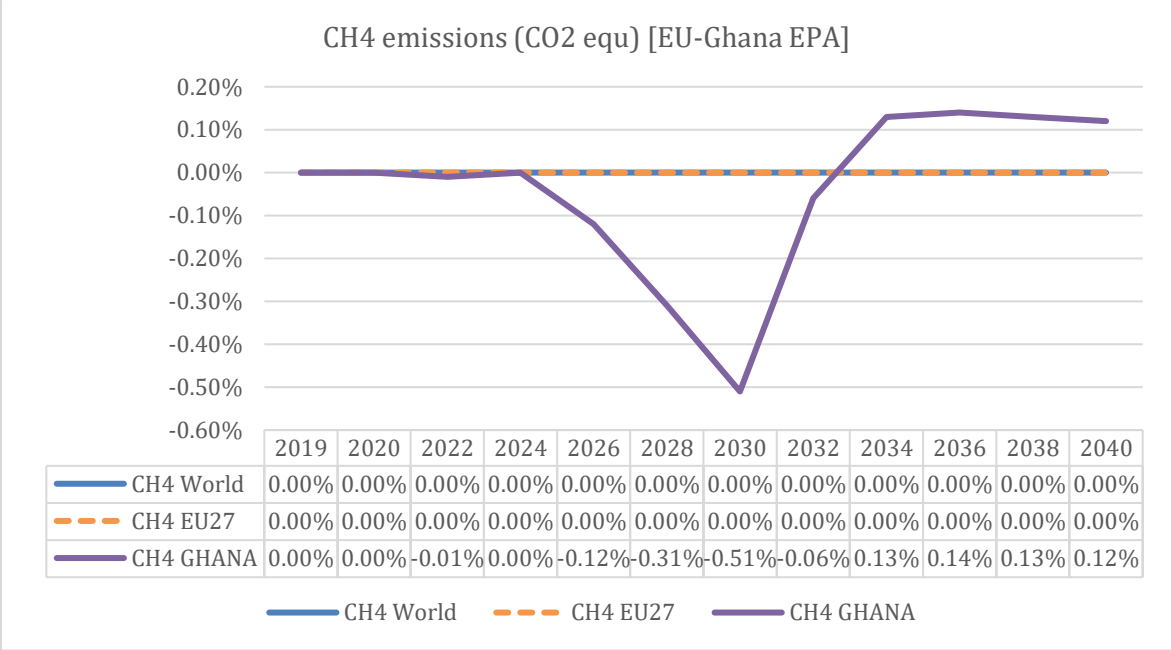


	2019	2020	2022	2024	2026	2028	2030	2032	2034	2036	2038	2040
N2O World	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
N2O EU27	0.00%	0.00%	-0.01%	-0.01%	-0.04%	-0.04%	-0.03%	-0.01%	0.00%	0.00%	0.00%	0.00%
N2O GHANA	0.04%	0.04%	0.03%	0.06%	-0.01%	-0.14%	-0.22%	0.15%	0.08%	0.05%	0.04%	0.04%

Source: own calculations

From 2019 to 2040, worldwide and EU's CH4 rate of emissions did not show noteworthy changes. For Ghana, CH4 emissions remained stable at 0.00% in 2019 and 2020. A minor decrease was observed between 2021 and 2023, with emissions dropping to -0.01%. The year 2024 saw stabilization, but a significant decline began from 2026, reaching its lowest at -0.51% in 2030. Following this, there was a notable recovery from 2031 onwards. Emissions climbed back to positive figures by 2033, stabilizing at around 0.12% to 0.14% from 2034 to 2040 (see Figure 13**Błąd! Nie można odnaleźć źródła odwołania.**).

Figure 13: EU-Ghana EPA impact on CH4 emissions (CO2-equ) [% change to baseline]



	2019	2020	2022	2024	2026	2028	2030	2032	2034	2036	2038	2040
CH4 World	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
CH4 EU27	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
CH4 GHANA	0.00%	0.00%	-0.01%	0.00%	-0.12%	-0.31%	-0.51%	-0.06%	0.13%	0.14%	0.13%	0.12%

Source: own calculations

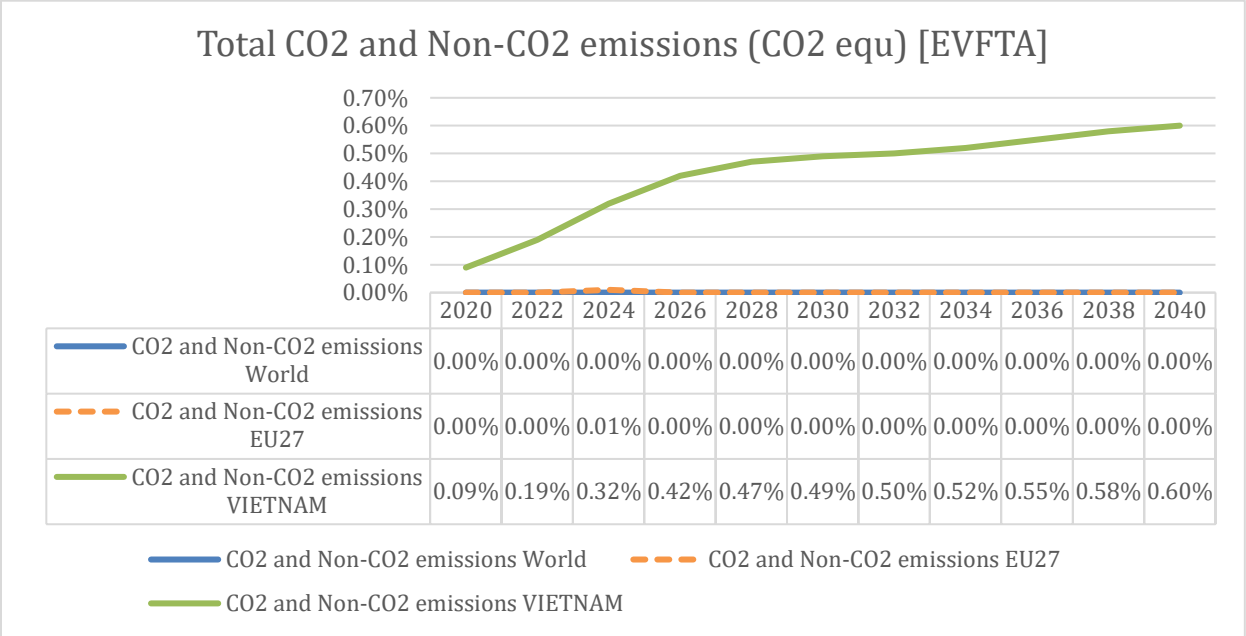
Ghana's rising CH4 emissions might be attributed to its expanding livestock sectors without the incorporation of mitigation measures.

In conclusion, the EU-Ghana agreement did not lead to significant changes in worldwide and EU emissions, but it did influence Ghana's emission trends. Although there was a period of reduction in various emissions in Ghana, the country experienced an upward shift in emissions post-2030, indicating challenges in maintaining sustainable practices amidst industrial growth and increasing energy demands.

4.1.2.2 EVFTA

From 2020 to 2040, global emissions influenced by EVFTA remained stable and not noteworthy. During this period, EU27 maintained its emissions levels, fluctuating slightly but ultimately remaining at 0% by 2040. On the other hand, Vietnam experienced a steady increase in emissions, starting at 0.09% in 2020 and gradually rising to 0.60% by 2040 (see Figure 14).

Figure 14: EVFTA impact on Total CO2 and Non-CO2 emissions (CO2-equ) [% change to baseline]

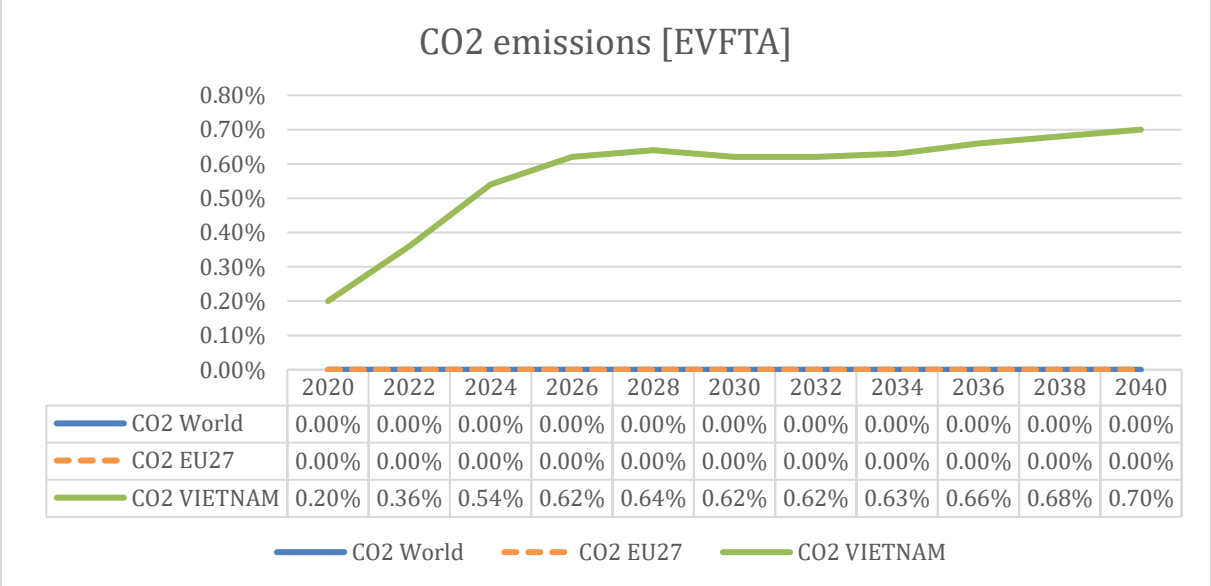


Source: own calculations

The increase in Vietnam's emissions could be associated with its growing industrial sector and increasing energy demands. However, it is important to note that the increase is gradual, suggesting some level of engagement with sustainable practices and eco-friendly measures.

Worldwide and EU's CO2 emissions remained constant and does not vary from the baseline. In contrast, Vietnam experienced a gradual increase in CO2 emissions, starting at 0.20% in 2020 and rising to 0.70% by 2040 (see Figure 15).

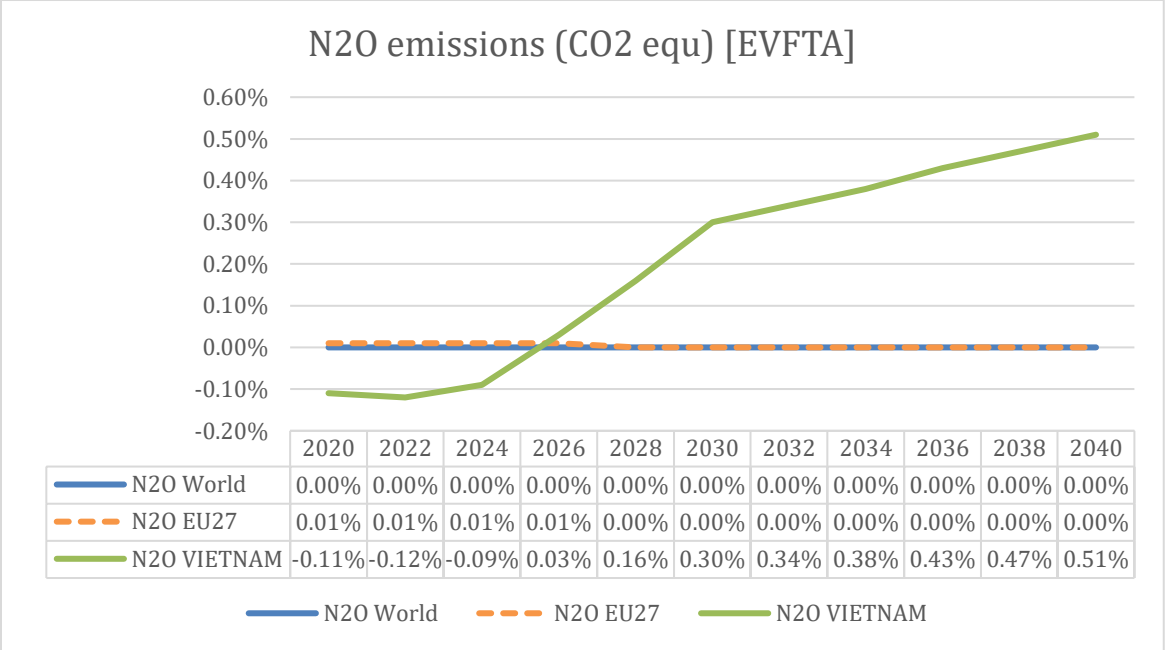
Figure 15: EVFTA impact on CO2 emissions [% change to baseline]



Source: own calculations

Global N2O emissions remained virtually unaffected by EVFTA which displayed slight positive emissions, hovering around 0.01%. On the contrary, Vietnam experienced a significant turnaround in its N2O emissions trajectory, starting at -0.11% in 2020, transitioning to positive values (more emissions in comparison to baseline) from 2026 onwards, and reaching 0.51% by 2040 (see Figure 16).

Figure 16: EVFTA impact on NO2 emissions (CO2-equ) [% change to baseline]



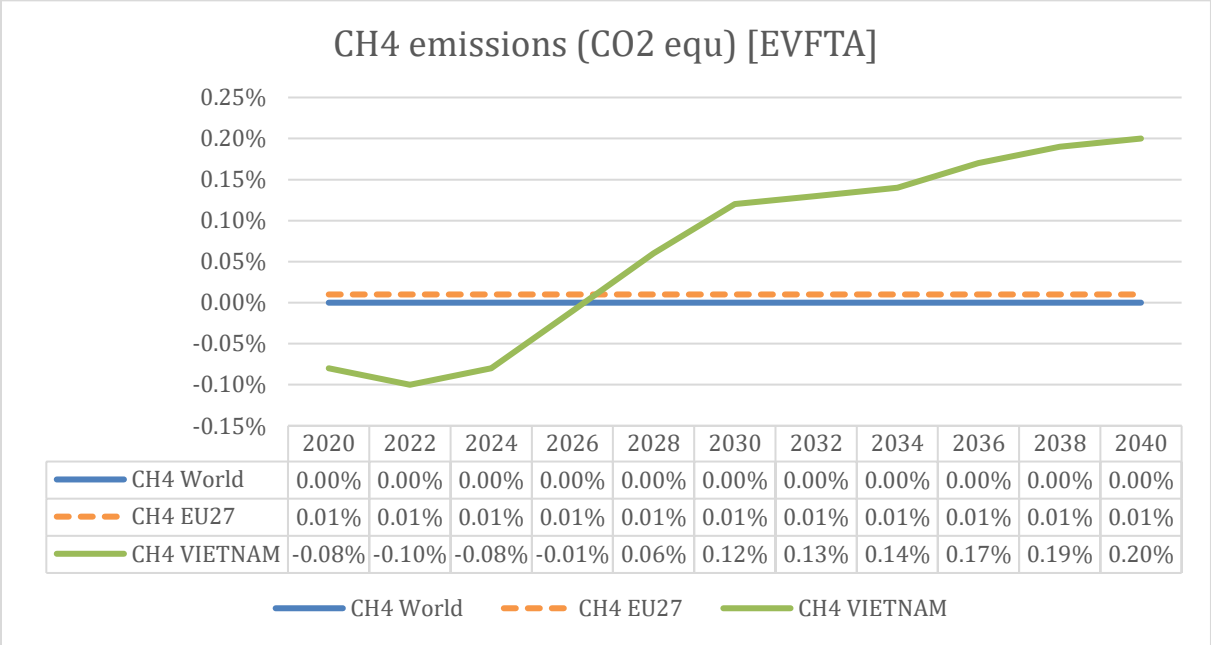
	2020	2022	2024	2026	2028	2030	2032	2034	2036	2038	2040
N2O World	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
N2O EU27	0.01%	0.01%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
N2O VIETNAM	-0.11%	-0.12%	-0.09%	0.03%	0.16%	0.30%	0.34%	0.38%	0.43%	0.47%	0.51%

Source: own calculations

Vietnam's shift from negative to positive emissions highlights a transformative journey in its agricultural and industrial sectors. The results may suggest initial increased agricultural activity or changes in land use.

Between 2020 and 2040, global CH4 emissions remain by this trade agreement. The European Union (EU27) consistently exhibited slight positive CH4 emissions, maintaining around 0.01% throughout the period. Vietnam's CH4 emissions rose from -0.08% in 2020 to 0.20% in 2040 (see Figure 17). Vietnam's transition from negative to positive CH4 emissions suggests a change in methane management, possibly due to increased agricultural activities or changes in waste handling practices.

Figure 17: EVFTA impact on CH4 emissions (CO2-equ) [% change to baseline]



	2020	2022	2024	2026	2028	2030	2032	2034	2036	2038	2040
CH4 World	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
CH4 EU27	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
CH4 VIETNAM	-0.08%	-0.10%	-0.08%	-0.01%	0.06%	0.12%	0.13%	0.14%	0.17%	0.19%	0.20%

Source: own calculations

In conclusion, while EVFTA did not markedly affect global emission trends, it played a role in altering emission patterns in Vietnam, showcasing a steady increase across various types of emissions, indicative of industrial growth and higher energy demands, yet also hinting at a slow and steady adoption of sustainable practices.

4.2 Full-fledged EU trade liberalisation and CO2-based import tariff/production tax

4.2.1 Economic impacts

4.2.1.1 GDP

In scenario [0-1], which explores the agri-food liberalization between the EU27 and the rest of the world, the changes in GDP across different regions and income groups are minimal. In 2025, the global GDP experiences a negligible impact, indicating that agri-food liberalization alone does not substantially alter the economic landscape. This trend continues up to 2040, showing that the impact of agri-food liberalization remains limited over time (see Table 1).

Scenario [0-2] illustrates the liberalization of all goods between the EU27 and the rest of the world, leading to a small growth in global GDP, with a 0.04% increase relative to the baseline of no liberalization in 2025, and a 0.07% increase by 2040. The EU27 benefits significantly from this scenario, with a GDP increase of 0.23% in 2025, and an even more significant increase of 0.66% by 2040.

In scenario [0-2-1], the world GDP shows a slight positive trend, increasing by 0.03% in 2025 and 0.07% by 2040. The EU27 again benefits substantially, with an increase of 0.22% in GDP in 2025, which nearly triples to a 0.58% increase by 2040. This suggests that the EU27 would gain from a combination of a CO2-based tariff on agri-food products and the liberalization of other sectors.

Scenario [0-2-2] introduces reciprocal actions from the EU's trading partners to the CO2-related tariff and production tax. The global GDP increases modestly by 0.03% in 2025 and by 0.07% in 2040. The EU27 witnesses growth under this scenario, with a 0.22% increase in GDP in 2025 and a 0.58% increase by 2040.

Scenario [0-3-1] involves the introduction of CO2-based tariffs between the EU27 and the rest of the world, without any trade liberalization. The global economy remains unaffected in terms of GDP for both 2025 and 2040. The EU27 experiences a slight positive impact in the short term with a 0.01% increase in GDP in 2025, but this turns into a -0.04% decrease by 2040.

In scenario [0-3-2], the introduction of a CO2-based tariff and production tax is followed by reciprocal actions from EU's trading partners. The global GDP shows a slight positive impact in the short term, with a 0.01% increase in 2025, which remain stable by 2040. The EU27 observes a short-term positive impact with a 0.05% increase in GDP in 2025, but this shifts to a -0.03% decrease by 2040.

Scenario [0-4-1] sees the imposition of CO2-based tariffs on all goods traded between the EU27 and the rest of the world. This results in a significant negative impact on the global GDP, with a -0.07% change in 2025 and a more substantial -0.22% by 2040. The EU27 faces severe challenges, with a -0.44% decrease in GDP in 2025, deepening to a -0.87% decrease by 2040.

In the final scenario [0-4-2], CO2-based tariffs are imposed on all goods, followed by reciprocal tariffs from the rest of the world. This scenario leads to a significant decrease in

world GDP, showing a -0.07% change in 2025 and a -0.23% by 2040. The EU27 experiences a significant fall, with a -0.40% decrease in GDP in 2025, worsening to -1.08% by 2040.

Overall, these scenarios depict varied impacts of different trade liberalization and tariff imposition policies on the global economy and the EU27. The EU27 tends to benefit from liberalization policies, but faces significant challenges when CO2-based tariffs are imposed, in particular when reciprocated by trading partners."

Table 1: GDP, real %-change between baseline and scenarios.

	[0-1] EU->WORLD->EU agro-food liberalisation		[0-2] EU->WORLD->EU All COM liberalisation		[0-2-1] EU->WORLD agro-food CO2 based tariff + liberalisation of other sectors		[0-2-2] EU->WORLD->EU agro-food CO2 based tariff + liberalisation of other sectors		[0-3-1] EU->WORLD agro-food CO2 based tariff		[0-3-2] EU->WORLD->EU agro-food CO2 based tariff		[0-4-1] EU->WORLD All COM CO2 based tariff		[0-4-2] EU->WORLD->EU All COM CO2 based tariff	
Income groups/regions	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040
World	0.01%	0.01%	0.04%	0.07%	0.03%	0.07%	0.03%	0.07%	0.00%	0.00%	0.01%	0.01%	-0.07%	-0.22%	-0.07%	-0.23%
Upper middle income	0.00%	0.02%	0.02%	0.00%	0.02%	0.00%	0.02%	0.00%	0.00%	0.01%	0.00%	0.03%	-0.02%	-0.13%	-0.01%	-0.03%
High income	0.00%	-0.01%	0.00%	-0.07%	-0.01%	-0.07%	-0.01%	-0.07%	0.00%	0.00%	0.00%	0.00%	0.02%	0.07%	0.02%	0.08%
Low income	0.01%	-0.04%	-0.03%	0.07%	-0.04%	0.11%	-0.04%	0.10%	0.01%	0.07%	0.00%	-0.01%	0.00%	-0.19%	-0.03%	-0.57%
EU27	0.06%	0.05%	0.23%	0.66%	0.22%	0.58%	0.22%	0.58%	0.01%	-0.04%	0.05%	-0.03%	-0.44%	-0.87%	-0.40%	-1.08%
Lower middle income	0.01%	0.01%	-0.02%	0.14%	-0.03%	0.18%	-0.03%	0.17%	0.00%	0.06%	0.00%	0.04%	-0.01%	-0.51%	-0.02%	-0.63%
ROW	-0.01%	-0.10%	-0.05%	-0.36%	-0.07%	-0.42%	-0.07%	-0.41%	-0.02%	-0.16%	-0.03%	-0.16%	-0.07%	-0.34%	-0.10%	-0.42%

Source: own calculations

In the scenario focusing on agri-food liberalisation alone, changes in GDP remained minimal, suggesting that such policies don't dramatically reshape the economic landscape. However, comprehensive liberalisation between the EU and the rest of the world showed potential for growth, especially in the EU27, with mixed results across regions and income groups. The integration of CO2-based tariffs with other liberalisation measures presented a complex picture, highlighting the importance of balancing both short- and long-term effects as well as distributional impacts across different sectors and regions.

In scenarios that emphasised reciprocal measures to CO2-based tariffs, the results showed a combination of modest positive effects in the short term, followed by more pronounced negative effects in the long term, in particular for the EU. When tariffs were imposed only on agri-food products without accompanying liberalisation, the impact on global GDP remained neutral, but low-income regions showed potential long-term positive effects. The introduction of CO2-based tariffs on all goods led to a significant negative impact on global GDP, especially in scenarios with reciprocal tariffs by trading partners. In particular, these tariffs posed serious economic challenges for the EU, with drastic reductions in GDP. In conclusion, these simulations underline the complexity of trade policy implementation and emphasise the need to consider both global and region-specific impacts.

4.2.1.2 Consumption

In Scenario [0-1], there is a minimal increase in worldwide consumption, showing a 0.04% rise in 2025 and tapering to a 0.02% growth by 2040. For the EU-27, consumption rises moderately by 0.12% in 2025, maintaining a positive trend with a slight increase to 0.14% in 2040 (see Table 2)

Scenario [0-2] presents a small, stable uplift in global consumption of 0.15% from 2015 to 2040. The EU-27 experiences a substantial benefit, with consumption increasing by 0.83% in 2025 and escalating further to 1.35% in 2040.

In Scenario [0-2-1], total world consumption sees a moderate rise from 0.14% in 2015 to 0.16% by 2040. The EU-27 gains significantly, with a 0.80% increase in 2025, which further amplifies to 1.29% in 2040.

Scenario [0-2-2] exhibits a slight enhancement in global consumption levels, with a 0.14% increase in 2025 and a minor improvement to 0.15% by 2040. The EU-27 again benefits noticeably, with consumption growing from 0.77% in 2025 to 1.27% in 2040.

In Scenario [0-3-1], most regions and income groups, including the global level, experience negligible changes in consumption. However, the EU-27 sees a minor fluctuation, with a -0.01% decrease in 2025 followed by a 0.02% increase in 2040.

Scenario [0-3-2] results in modest changes across various regions and income groups. On a global scale, consumption slightly increases by 0.03%, remaining constant until 2040. The EU-27 observes a moderate boost in consumption, starting at 0.06% in 2025 and slightly diminishing to 0.05% in 2040.

In Scenario [0-4-1], the global consumption level faces a negative trend, decreasing from -0.04% in 2025 to -0.22% by 2040. Contrastingly, the EU-27 experiences a significant downturn, with consumption plummeting from -0.39% in 2025 to -0.74% in 2040.

Scenario [0-4-2] showcases a gradual decline in global consumption, starting from a slight -0.01% in 2025 and deepening to -0.24% by 2040. The EU-27, however, faces contrasting fortunes, observing a positive change in consumption, starting at 0.03% in 2025 and enhancing to 0.04% in 2040.

Looking more closely at the different scenarios for the impact on global consumption by 2040, it's hard to miss the pattern: the EU-27 often emerges as the main beneficiary. Different scenarios predict different outcomes. Scenarios such as [0-2] and [0-2-1] show a relatively modest increase in global consumption. In particular, the EU-27 enjoys the lion's share of these benefits. On the other hand, scenarios such as [0-4-1], in which carbon-based tariffs and taxes are applied to all goods, present a more worrying outlook. There's a significant drop in consumption, with the brunt of the impact falling on lower-middle-income regions. But it's not all negative. The results suggest that low-income regions could benefit under certain scenarios. However, as we extend the time horizon, the challenges for these regions become more pronounced.

In summary, the position of the EU-27 looks relatively stable and often positive, while the results for the other regions are mixed.

Table 2: Total Consumption, %-change between baseline and scenarios.

	[0-1] EU->WORLD->EU agro-food liberalisation		[0-2] EU->WORLD->EU All COM liberalisation		[0-2-1] EU->WORLD agro-food CO2 based tariff + liberalisation of other sectors		[0-2-2] EU->WORLD->EU agro-food CO2 based tariff + liberalisation of other sectors		[0-3-1] EU->WORLD agro-food CO2 based tariff		[0-3-2] EU->WORLD->EU agro-food CO2 based tariff		[0-4-1] EU->WORLD All COM CO2 based tariff		[0-4-2] EU->WORLD->EU All COM CO2 based tariff	
Income groups/regions	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040
World	0.04%	0.02%	0.15%	0.15%	0.14%	0.16%	0.14%	0.15%	0.00%	0.00%	0.03%	0.03%	-0.04%	-0.22%	-0.01%	-0.24%
Upper middle income	0.03%	0.04%	0.11%	-0.03%	0.10%	-0.01%	0.11%	-0.01%	0.00%	0.00%	0.03%	0.06%	0.06%	-0.08%	0.14%	0.10%
High income	0.01%	-0.01%	-0.07%	-0.15%	-0.07%	-0.14%	-0.07%	-0.14%	0.00%	0.00%	0.01%	0.01%	0.01%	0.13%	0.03%	0.15%
Low income	0.05%	-0.16%	0.11%	-0.04%	0.04%	0.00%	0.07%	0.00%	-0.03%	0.00%	0.01%	-0.11%	0.25%	0.48%	0.22%	-0.12%
EU27	0.12%	0.14%	0.83%	1.35%	0.80%	1.29%	0.77%	1.27%	-0.01%	0.02%	0.06%	0.05%	-0.39%	-0.74%	-0.42%	-1.08%
Lower middle income	0.06%	-0.07%	0.04%	0.16%	0.00%	0.22%	0.01%	0.23%	0.01%	0.02%	0.03%	-0.01%	-0.02%	-0.82%	-0.02%	-1.01%
ROW	0.01%	-0.01%	-0.01%	-0.15%	-0.06%	-0.20%	-0.06%	-0.20%	-0.05%	-0.09%	-0.04%	-0.07%	0.04%	-0.34%	-0.05%	-0.45%

Source: own calculations

4.2.1.3 Import

In scenario [0-1], the world imports observe a slight increase of 0.26% in 2025, and the trend continues to 2040 with a 0.15% increase, reflecting a positive yet diminishing impact on global trade. The EU27 experiences a noteworthy growth in imports, with a 0.63% increase in 2025 and a 0.65% increase in 2040, signifying the considerable positive effects of agri-food liberalisation in this region.

In Scenario [0-2], the world imports significantly rise by 1.14% in 2025, continuing to 2040 at a slightly reduced rate of 1.08%. The EU27 benefits greatly, with imports increasing by 3.49% in 2025 and further to 4.25% in 2040, highlighting the substantial gains from full liberalisation in this region.

Scenario [0-2-1] leads to a 1.15% increase in world imports in 2025, and a 1.11% increase in 2040. The EU27 stands out with a remarkable 3.52% increase in imports in 2025, which escalates to 4.36% in 2040, demonstrating the significant positive impact of agro-food CO2-based tariffs and sectoral liberalisation on the region.

In Scenario [0-2-2], the world imports experience a 1.12% increase in 2025 and a 1.10% increase in 2040. The EU27 sees a substantial increase of 3.44% in imports in 2025, which further rises to 4.27% in 2040, underscoring the positive effects of the policy measures on the region.

Scenario [0-3-1] results in a small 0.07% increase in world imports in 2025, slowing down to a 0.06% increase in 2040. For the EU27, imports increase by 0.14% in 2025, and improve to a 0.33% increase in 2040, reflecting a steady positive trend.

In Scenario [0-3-2], world imports see a 0.24% increase in 2025, and a 0.17% increase in 2040. The EU27 experiences a growth in imports of 0.58% in 2025, remaining fairly consistent at 0.66% in 2040, indicating a continuous benefit from the implemented policies.

Scenario [0-4-1] shows a modest 0.10% increase in world imports in 2025, but a significant -0.35% decline by 2040. The EU27 sees a slight increase of 0.08% in imports in 2025, but faces a downturn with a -0.29% decline in 2040, signifying a shift from initial gains to long-term challenges.

In scenario [0-4-2], world imports grow by 0.27% in 2025, yet face a notable -0.42% decline in 2040. The EU27 experiences a minor increase of 0.25% in imports in 2025, but this reverses to a significant decline by 2040 (percentage missing due to text cut-off), showcasing a complex impact over time.

The different scenarios show both positive and negative trends for world imports between 2025 and 2040. Scenario [0-1] shows an increase in world imports, but at declining rates, with a gradually positive but decreasing impact over time. In particular, the EU27 benefits throughout from the liberalisation of the agri-food sector, with significant increases in imports. Scenario [0-2] and similar variants reflect a significant increase in world imports, highlighting a significant and persistent impact on world imports, especially for the EU27. High-income regions, however, face challenges with initial declines in imports, but show signs of recovery

by 2040. For low-income regions, most scenarios predict favourable long-term impacts on import levels, although there are some exceptions. Lower middle-income regions generally see an increase in imports in 2025, with a possible decline by 2040. The rest of the world (ROW) experiences mixed impacts, often facing challenges as 2040 approaches. Finally, scenarios such as [0-4-1] and [0-4-2] predict sharp reversals from positive trends in 2025 to significant declines in imports by 2040, signalling overarching negative impacts of carbon related tariffs and taxes for several regions.

Table 3: Import, %-change between baseline and scenarios.

	[0-1] EU->WORLD->EU agro-food liberalisation		[0-2] EU->WORLD->EU All COM liberalisation		[0-2-1] EU->WORLD agro-food CO2 based tariff + liberalisation of other sectors		[0-2-2] EU->WORLD->EU agro-food CO2 based tariff + liberalisation of other sectors		[0-3-1] EU->WORLD agro-food CO2 based tariff		[0-3-2] EU->WORLD->EU agro-food CO2 based tariff		[0-4-1] EU->WORLD All COM CO2 based tariff		[0-4-2] EU->WORLD->EU All COM CO2 based tariff	
Income groups/regions	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040
World	0.26%	0.15%	1.14%	1.08%	1.15%	1.11%	1.12%	1.10%	0.07%	0.06%	0.24%	0.17%	0.10%	-0.35%	0.27%	-0.42%
Upper middle income	0.24%	0.16%	1.35%	1.18%	1.41%	1.19%	1.41%	1.19%	0.06%	-0.01%	0.29%	0.17%	0.52%	-0.43%	1.18%	-0.14%
High income	0.06%	0.01%	-0.31%	-0.13%	-0.30%	-0.14%	-0.31%	-0.15%	0.03%	-0.02%	0.05%	0.00%	-0.15%	0.10%	-0.14%	0.03%
Low income	0.15%	-0.17%	0.61%	0.27%	0.66%	0.38%	0.61%	0.35%	0.20%	0.08%	0.12%	-0.10%	2.03%	1.81%	1.56%	0.73%
EU27	0.63%	0.65%	3.49%	4.25%	3.52%	4.36%	3.44%	4.27%	0.14%	0.33%	0.58%	0.66%	0.08%	-0.29%	0.25%	-0.48%
Lower middle income	0.25%	-0.02%	0.57%	0.81%	0.49%	0.86%	0.48%	0.86%	0.14%	0.06%	0.14%	0.03%	0.00%	-1.46%	-0.24%	-1.90%
ROW	0.06%	-0.12%	0.15%	-0.31%	0.00%	-0.19%	-0.01%	-0.18%	-0.14%	-0.05%	-0.12%	0.01%	0.06%	-1.04%	-0.36%	-1.21%

Source: own calculations

4.2.1.4 Exports

In Scenario [0-1], the world sees a modest increase in exports, 0.26% in 2025, dropping to a 0.15% increase by 2040, illustrating a declining global trend. The EU27 experiences a growth in exports from 0.43% in 2025 to 0.44% in 2040, showcasing a stable and positive impact of agri-food liberalization on exports.

In Scenario [0-2], world exports rise significantly by 1.14% in 2025, with a slight decrease to 1.08% by 2040, indicating a robust and somewhat stable global impact. The EU27 witnesses a surge in exports from 1.36% in 2025 to a stronger 2.33% in 2040, denoting a consistent and substantial positive effect from all commodity liberalization.

Scenario [0-2-1] presents a world export growth of 1.15% in 2025, slightly diminishing to 1.11% in 2040, reflecting a significant and stable global influence. For the EU27, exports escalate from 1.62% in 2025 to an even higher 2.39% in 2040, demonstrating a steady and noteworthy positive response to the policy.

In Scenario [0-2-2], there is a notable increase in world exports by 1.12% in 2025, with a slight dip to 1.10% by 2040, indicating a considerable and fairly constant global benefit. The EU27 sees a boost in exports from 1.53% in 2025 to 2.30% in 2040, highlighting a sustained and remarkable positive impact.

Scenario [0-3-1] leads to a slight increase in world exports of 0.07% in 2025, decreasing marginally to 0.06% by 2040, showing a limited global effect. The EU27 experiences a minimal increase in exports, growing from 0.01% in 2025 to 0.06% in 2040, depicting a small yet gradually increasing positive impact.

In Scenario [0-3-2], world exports moderately increase by 0.24% in 2025, declining to 0.17% in 2040, indicating a positive but decreasing global trend. The EU27 observes a significant increase in exports from 0.59% in 2025 to 0.41% in 2040, suggesting a substantial but slightly diminishing positive effect.

Scenario [0-4-1] leads to a slight increase in world exports of 0.10% in 2025, turning significantly negative to -0.35% by 2040, showing a shift in global trends. The EU27, however, faces challenges, with exports dropping from -0.22% in 2025 to -1.28% in 2040, indicating growing difficulties over time.

In Scenario [0-4-2], there is a moderate increase in world exports of 0.27% in 2025, but by 2040, the situation worsens with a -0.42% decrease, illustrating a negative shift in global trends. Despite this, upper middle-income regions experience a growth from 0.92% in 2025 to 1.27% in 2040, showing a contrary positive trend. However, the EU27 faces a tough situation, with exports decreasing from a -0.15% decrease in 2025 to a -0.35% decrease in 2040, highlighting a challenging environment.

Across the different scenarios presented, there is a consistent theme regarding the dynamics of world trade. Scenario [0-1] shows a decline in the positive impact on world exports over time, with different income regions experiencing fluctuating trade dynamics. Upper-middle-income regions showed steady but moderate positive effects on exports, while low-income regions benefited initially but struggled in the long run. The EU27 consistently

benefited from agri-food liberalisation. In contrast, Scenario [0-2] and its variants showed significant boosts to world exports, with most regions experiencing substantial positive effects. Upper middle-income and low-income regions in particular benefited in the long run. However, high-income regions faced challenges over time. Scenarios [0-3-1] and [0-3-2] both show minimal increases in global exports, with impacts declining or stabilising over time. In the case of scenarios [0-4-1] and [0-4-2], there was a notable shift from short-term benefits to long-term challenges, with significant declines in exports by 2040. Interestingly, while the global trend often turned negative, some specific regions, especially upper middle-income regions, seemed to buck the trend, showing resilience or even growth. In essence, while general trends can be inferred from global data, region-specific nuances often play a crucial role in understanding the full impact of trade dynamics.

Table 4: Export, %-change between baseline and scenarios.

	[0-1] EU->WORLD->EU agro-food liberalisation		[0-2] EU->WORLD->EU All COM liberalisation		[0-2-1] EU->WORLD agro-food CO2 based tariff + liberalisation of other sectors		[0-2-2] EU->WORLD->EU agro-food CO2 based tariff + liberalisation of other sectors		[0-3-1] EU->WORLD agro-food CO2 based tariff		[0-3-2] EU->WORLD->EU agro-food CO2 based tariff		[0-4-1] EU->WORLD All COM CO2 based tariff		[0-4-2] EU->WORLD->EU All COM CO2 based tariff	
Income groups/regions	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040
World	0.26%	0.15%	1.14%	1.08%	1.15%	1.11%	1.12%	1.10%	0.07%	0.06%	0.24%	0.17%	0.10%	-0.35%	0.27%	-0.42%
Upper middle income	0.18%	0.14%	1.85%	1.07%	1.81%	1.12%	1.80%	1.13%	0.07%	0.05%	0.12%	0.20%	0.89%	0.80%	0.92%	1.27%
High income	0.15%	0.04%	0.43%	-0.41%	0.36%	-0.41%	0.35%	-0.41%	0.05%	0.05%	0.07%	0.03%	-0.50%	-0.22%	-0.50%	-0.15%
Low income	0.32%	-0.10%	1.26%	0.76%	1.08%	0.74%	1.13%	0.77%	0.12%	-0.04%	0.17%	-0.10%	1.64%	1.71%	1.64%	1.20%
EU27	0.43%	0.44%	1.36%	2.33%	1.62%	2.39%	1.53%	2.30%	0.01%	0.06%	0.59%	0.41%	-0.22%	-1.28%	0.43%	-1.91%
Lower middle income	0.35%	-0.01%	1.00%	0.90%	0.85%	0.92%	0.85%	0.94%	0.18%	0.06%	0.20%	0.03%	0.42%	-1.13%	0.39%	-1.39%
ROW	0.38%	0.04%	0.93%	0.35%	0.89%	0.33%	0.87%	0.32%	0.31%	0.01%	0.33%	0.01%	0.64%	0.42%	0.51%	0.08%

Source: own calculations

4.2.2 Environmental impacts

4.2.2.1 Emissions

4.2.2.1.1 Total emissions (CO2 and Non-CO2 emissions [CO2 equ])

In the year 2025 under scenario [0-1], there was no noticeable change in global emissions due to the implementation of agro-food liberalisation policies between the EU and its global trading partners. Upper middle-income countries saw a slight decrease in emissions, while low-income countries experienced an increase. The EU-27 observed an increase in emissions, while the other income groups remained relatively stable. By 2040, the global emissions experienced a minor decrease, mainly influenced by the decrease in emissions in low-income countries and the EU-27. Upper middle-income countries and high-income countries also saw slight changes in their emissions.

Scenario [0-2], which involved the introduction of a full commodity liberalisation policy, led to a reduction in global emissions by 0.07% in 2025 and 0.12% in 2040. The upper middle-income countries benefited the most initially, with a significant decrease in emissions. High-income countries initially saw a slight increase in emissions, but this trend reversed by 2040. Low-income countries experienced an increase in emissions, while the EU-27 saw a significant decrease in 2025, followed by a substantial increase in 2040. Lower middle-income countries experienced a decrease in emissions in both years.

Under scenario [0-2-1], involving the CO2-based tariff and production tax, there was a downward trend in global emissions, with a decrease of 0.09% in 2025 and 0.11% in 2040. Upper middle-income regions and the EU-27 showed a favorable response with a decrease in emissions, while high-income regions showed a mixed response. Low-income regions experienced an increase in emissions, and lower middle-income countries saw a decrease in 2025 and a stabilization by 2040.

In scenario [0-2-2], there was a general decreasing trend in emissions, with a 0.09% reduction in 2025 and a 0.11% reduction by 2040 at the global level. Upper middle-income countries and the EU-27 saw a significant decrease in emissions, while high-income countries initially saw an increase, later reversing the trend. Low-income countries experienced an increase in emissions, and lower middle-income regions saw a decrease in 2025, stabilizing by 2040.

Scenario [0-3-1] showed varied impacts across regions, with negligible changes in global emissions. Upper middle-income and high-income regions experienced slight increases, while low-income regions saw a more significant increase. The EU-27 experienced a decrease in emissions, and lower middle-income countries saw a moderate increase. The impact of the CO2-based tariff on the agro-food sector led to different results across regions.

In scenario [0-3-2], there was a modest reduction in global emissions in 2025, neutralized by 2040. Upper middle-income countries showed an initial reduction, while high-income regions experienced a steady increase. Low-income countries saw a significant increase

in 2025, reversing by 2040. The EU-27 experienced a significant reduction in emissions, and lower middle-income countries saw a stabilization by 2040.

Scenario [0-4-1] presented dramatic differences across regions, with a steady increase in global emissions. Upper middle-income and high-income countries experienced significant increases, while low-income regions saw a dramatic increase. The EU-27 experienced a significant decrease in emissions, and lower middle-income countries saw growth. The unilateral imposition of a CO2-based tariff led primarily to a significant reduction in EU-27 emissions, with increases in other regions.

In scenario [0-4-2], there were consistent increases in global emissions, with upper middle-income and high-income regions experiencing significant increases. Low-income countries saw a notable increase, while the EU-27 experienced a drastic drop in emissions. Lower middle-income countries experienced growth in 2025, followed by a marginal decline in 2040. The bilateral CO2-based mechanism led to a significant reduction in EU-27 emissions, with varying degrees of emissions growth in other sectors.

Table 5: Total emissions, %-change between baseline and scenarios.

	[0-1] EU->WORLD->EU agro-food liberalisation		[0-2] EU->WORLD->EU All COM liberalisation		[0-2-1] EU->WORLD agro-food CO2 based tariff + liberalisation of other sectors		[0-2-2] EU->WORLD->EU agro-food CO2 based tariff + liberalisation of other sectors		[0-3-1] EU->WORLD agro-food CO2 based tariff		[0-3-2] EU->WORLD->EU agro-food CO2 based tariff		[0-4-1] EU->WORLD All COM CO2 based tariff		[0-4-2] EU->WORLD->EU All COM CO2 based tariff	
Income groups/regions	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040
World	0.00%	-0.01%	-0.07%	-0.12%	-0.09%	-0.11%	-0.09%	-0.11%	0.00%	0.00%	-0.02%	0.00%	0.12%	0.13%	0.12%	0.12%
Upper middle income	-0.03%	0.01%	-0.08%	-0.19%	-0.08%	-0.17%	-0.08%	-0.18%	0.01%	0.00%	-0.03%	0.02%	0.63%	0.83%	0.74%	1.20%
High income	0.00%	-0.01%	0.03%	-0.12%	0.05%	-0.10%	0.05%	-0.11%	0.01%	0.01%	0.02%	0.01%	1.32%	1.67%	1.24%	1.66%
Low income	0.20%	-0.24%	0.22%	0.45%	0.11%	0.61%	0.13%	0.52%	0.04%	0.16%	0.10%	-0.17%	1.18%	3.92%	0.91%	3.10%
EU27	0.18%	0.10%	-0.24%	0.46%	-0.81%	0.07%	-0.71%	0.12%	-0.37%	-0.22%	-0.31%	-0.26%	-9.81%	-13.80%	-9.93%	-14.63%
Lower middle income	0.00%	-0.05%	-0.15%	-0.07%	-0.11%	-0.01%	-0.12%	-0.02%	0.02%	0.03%	0.03%	0.00%	0.54%	0.33%	0.50%	-0.04%
ROW	0.09%	-0.02%	-0.12%	-0.22%	-0.14%	-0.30%	-0.14%	-0.30%	0.08%	-0.09%	0.07%	-0.10%	1.41%	3.30%	1.31%	3.20%

Source: own calculations

4.2.2.1.2 CO2 emissions

The bilateral agri-food liberalisation policies between the EU and the world exhibit varied impacts on CO2 emissions across different economic sectors. Globally, emissions stayed relatively constant in 2025 and decreased slightly by 0.01% by 2040. The EU-27, specifically, witnessed a consistent increase in emissions, growing by 0.07% in both 2025 and 2040. Upper-middle-income, high-income, low-income, and lower middle-income countries all experienced fluctuations in their emission levels, with increases and decreases ranging from 0.01% to 0.20%. However, these changes were not substantial, given the small percentage points involved.

The full liberalisation of trade in goods between the EU and its global trading partners resulted in a slight decline in global CO2 emissions, with a decrease of 0.01% in 2025 and 0.02% in 2040. The EU-27 observed a robust upward trend, with emissions increasing by 0.49% in 2025 and 1.45% in 2040. Low-income regions saw a continuous and significant increase in their emissions, while upper middle-income regions experienced a pronounced decline. High-income regions and lower middle-income regions also saw changes in their emission levels, but these were relatively moderate.

Under the [0-2-1] scenario, there was a minimal downward trend in global emissions, with a reduction of 0.02% in 2025 and 0.01% in 2040. The EU-27 displayed a marked increase in CO2 emissions, growing by 0.34% in 2025 and 1.29% in 2040. Low-income areas also showed a robust growth pattern in emissions, while upper middle-income regions experienced a decrease. High-income and lower middle-income regions witnessed fluctuations in their emission levels.

In the [0-2-2] scenario, a slight reduction in global emissions was noted, with upper middle-income regions experiencing a relatively large decrease. The EU-27 followed a growth path in emissions, with an increase of 0.36% in 2025 and 1.31% in 2040. Low-income regions showed resilience and growth in emissions, while high-income regions and lower middle-income regions experienced changes in their emission levels.

The [0-3-1] scenario produced a spectrum of mild emissions effects globally, with upper middle-income and high-income regions showing stability in their emission levels. The EU-27 experienced a reduction in emissions, while low-income regions showed a subtle shift over the years. Lower middle-income regions saw a small increase in emissions.

In the [0-3-2] scenario, the world's emissions decreased slightly in 2025 but stabilized by 2040. The EU-27 saw a prolonged decline in emissions, reflecting a commitment to reducing CO2 emissions and promoting greener trade practices. Upper middle-income countries and low-income regions experienced fluctuations in their emission levels, while high-income regions showed resilience.

The [0-4-1] scenario led to an increase in global CO2 emissions, with the world experiencing an initial spike followed by a gradual adjustment. The EU27 saw a significant reduction in emissions, while upper middle-income, high-income, and low-income regions all experienced increases in their emission levels. Lower middle-income countries saw a dramatic shift in their emissions over time.

In the [0-4-2] scenario, there was a moderate increase in global emissions, with the EU27 continuing to reduce its emissions significantly. Upper middle-income and high-income countries saw relentless rises in their emissions, while low-income regions experienced dramatic increases. Lower middle-income regions initially increased their emissions but later showed a decrease, suggesting a potential recalibration towards greener strategies.

Table 6: CO2 emissions, %-change between baseline and scenarios.

	[0-1] EU->WORLD->EU agro-food liberalisation		[0-2] EU->WORLD->EU All COM liberalisation		[0-2-1] EU->WORLD agro-food CO2 based tariff + liberalisation of other sectors		[0-2-2] EU->WORLD->EU agro-food CO2 based tariff + liberalisation of other sectors		[0-3-1] EU->WORLD agro-food CO2 based tariff		[0-3-2] EU->WORLD->EU agro-food CO2 based tariff		[0-4-1] EU->WORLD All COM CO2 based tariff		[0-4-2] EU->WORLD->EU All COM CO2 based tariff	
Income groups/regions	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040
World	0.00%	-0.01%	-0.01%	-0.02%	-0.02%	-0.01%	-0.02%	-0.01%	0.00%	0.00%	-0.01%	0.00%	0.18%	0.10%	0.15%	0.09%
Upper middle income	-0.02%	0.01%	-0.08%	-0.21%	-0.09%	-0.20%	-0.09%	-0.20%	0.00%	0.00%	-0.03%	0.02%	0.58%	0.77%	0.55%	0.92%
High income	0.01%	-0.01%	0.02%	-0.10%	0.02%	-0.09%	0.02%	-0.09%	0.00%	0.00%	0.01%	0.00%	1.22%	1.57%	1.10%	1.55%
Low income	0.20%	-0.07%	0.87%	0.89%	0.69%	0.91%	0.75%	0.90%	-0.04%	0.03%	0.07%	-0.06%	4.52%	8.65%	4.26%	7.78%
EU27	0.07%	0.07%	0.49%	1.45%	0.34%	1.29%	0.36%	1.31%	-0.06%	-0.03%	-0.06%	-0.09%	-7.71%	-12.15%	-7.34%	-12.49%
Lower middle income	0.01%	-0.06%	-0.09%	-0.02%	-0.07%	0.04%	-0.08%	0.03%	0.02%	0.03%	0.02%	0.00%	0.63%	0.07%	0.62%	-0.09%
ROW	0.05%	-0.03%	0.03%	0.01%	0.01%	-0.06%	0.01%	-0.06%	0.03%	-0.09%	0.03%	-0.10%	1.60%	3.52%	1.40%	3.32%

Source: own calculations

4.2.2.1.3 N2O emissions [CO2equ])

In the [0-1] scenario, global N2O emissions exhibited a marginal increase of 0.05% in 2025, shifting to a slight decrease of 0.06% by 2040. The EU-27 region experienced an initial increase of 0.52% in 2025, before reversing to a decrease of 0.24% in 2040. The upward trend of the upper middle-income group, with an increase from 0.43% in 2025 to 0.67% in 2040, and the continuous decrease in high-income regions, from a 0.21% decrease in 2025 to 0.31% in 2040, were notable. Low-income countries and lower middle-income countries also followed a decreasing trend in emissions.

In the [0-2] scenario, the global N2O emissions showed a small increase of 0.06% in 2025, stabilizing to no change by 2040. The EU-27 displayed a significant decrease of 0.54% in 2025, followed by an unexpected increase of 0.67% in 2040. The upper middle-income regions saw an increase in emissions from 0.57% in 2025 to 0.64% in 2040, while high-income areas and low-income countries experienced reductions in emissions.

Under the [0-2-1] scenario, global N2O emissions increased from 0.05% in 2025 to 0.27% in 2040. The EU-27 faced a dramatic decrease in emissions, dropping by 12.47% in 2025 and 11.55% in 2040. Upper middle-income and high-income regions, as well as low-income areas, all saw increases in emissions, with upper middle-income regions experiencing a significant increase from 1.36% in 2025 to 1.57% in 2040.

In the [0-2-2] scenario, global N2O emissions rose from 0.04% in 2025 to 0.23% in 2040. The EU-27 experienced substantial reductions, with a decrease of 11.11% in 2025 and 10.54% in 2040. Both upper middle-income and high-income regions experienced increases in emissions, although the high-income regions showed a notable slowdown from 1.13% in 2025 to 0.27% in 2040.

In the [0-3-1] scenario, global N2O emissions shifted from a reduction of 0.16% in 2025 to an increase of 0.14% by 2040. The EU-27 showcased significant reductions, decreasing by 8.16% in 2025 and 9.29% in 2040. Upper middle-income and high-income regions, along with low-income regions, all exhibited increases in emissions.

The [0-3-2] scenario revealed a moderate upward trajectory in global N2O emissions, increasing from 0.03% in 2025 to 0.17% in 2040. The EU27 displayed a compelling downward trend, with a decrease of 10.31% in 2025 intensifying to 11.73% in 2040. Upper middle-income regions, high-income regions, and low-income regions all experienced increases in emissions.

In the [0-4-1] scenario, global N2O emissions significantly decreased by 0.30% in 2025, with a smaller decrease of 0.05% in 2040. The EU-27 showed a pronounced decline, with emissions falling by 11.84% in 2025 and further to 14.34% in 2040. Upper middle-income regions, high-income regions, and low-income regions saw increases in emissions.

Finally, in the [0-4-2] scenario, there was a small decrease in global N2O emissions, from 0.12% in 2025 to 0.04% in 2040. The EU27 again displayed a strong downward trend, with a -14.41% decrease in 2025 and an -18.07% decrease in 2040. Upper middle-income regions, high-income regions, and low-income regions exhibited increases in emissions, while lower middle-income regions saw a slight increase in 2025 and a decrease by 2040.

Table 7: N2O emissions, %-change between baseline and scenarios.

	[0-1] EU->WORLD->EU agro-food liberalisation		[0-2] EU->WORLD->EU All COM liberalisation		[0-2-1] EU->WORLD agro-food CO2 based tariff + liberalisation of other sectors		[0-2-2] EU->WORLD->EU agro-food CO2 based tariff + liberalisation of other sectors		[0-3-1] EU->WORLD agro-food CO2 based tariff		[0-3-2] EU->WORLD->EU agro-food CO2 based tariff		[0-4-1] EU->WORLD All COM CO2 based tariff		[0-4-2] EU->WORLD->EU All COM CO2 based tariff	
Income groups/regions	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040
World	0.05%	-0.06%	0.06%	0.00%	0.05%	0.27%	0.04%	0.23%	-0.16%	0.14%	0.03%	0.17%	-0.30%	-0.05%	-0.12%	-0.04%
Upper middle income	0.43%	0.67%	0.57%	0.64%	1.36%	1.57%	1.30%	1.55%	0.33%	0.43%	1.17%	1.59%	0.55%	0.67%	1.41%	1.99%
High income	-0.21%	-0.31%	-0.05%	-0.41%	1.49%	0.52%	1.13%	0.27%	0.82%	0.58%	0.99%	0.39%	0.96%	0.92%	1.16%	0.83%
Low income	-0.33%	-0.67%	-0.51%	-0.56%	0.33%	0.75%	0.30%	0.60%	0.60%	1.23%	0.49%	0.50%	0.35%	1.05%	0.10%	0.18%
EU27	0.52%	-0.24%	-0.54%	0.67%	-12.47%	-11.55%	-11.11%	-10.54%	-8.16%	-9.29%	-10.31%	-11.73%	-11.84%	-14.34%	-14.41%	-18.07%
Lower middle income	-0.38%	-0.62%	-0.39%	-0.55%	0.20%	0.31%	0.10%	0.18%	0.21%	0.78%	0.12%	0.12%	0.22%	0.57%	0.16%	-0.12%
ROW	-0.17%	-0.07%	-0.14%	-0.04%	0.77%	0.81%	0.74%	0.80%	0.74%	0.79%	0.73%	0.79%	0.77%	1.08%	0.76%	1.10%

Source: own calculations

4.2.2.1.4 CH4 emissions [CO2equ])

In scenario [0-1], which focused on the liberalization of agro-food trade between the EU and global partners, CH4 emissions saw varied responses across different regions. Globally, the impact was minimal initially, with no change in 2025, but by 2040, there was a modest reduction in emissions. Within the EU27, a significant reduction was observed with a 1.18% decrease in 2025, though this reduced to a 0.33% decrease by 2040. Upper middle income and high-income regions, however, experienced increases in emissions, particularly upper middle-income regions which saw a 0.26% increase in 2025, growing to a 0.42% increase by 2040. Low-income and lower middle-income countries both followed a downward trend throughout the period, contributing to the global reduction in emissions.

Under the scenario [0-2], which expanded the liberalization to all goods traded between the EU and global partners, the global CH4 emissions saw a consistent decrease, though slight, with a 0.04% reduction in 2025 and a 0.05% reduction by 2040. The EU27 region experienced a pronounced downward trend, with emissions decreasing by 2.03% in 2025, though this moderated to a 0.60% decrease in 2040. Upper middle-income regions, on the other hand, saw a consistent increase in emissions, and low-income regions experienced a steady decline, helping contribute to the global reduction.

In scenario [0-2-1], there was a varied impact on CH4 emissions, with a global decrease of 0.08% in 2025, reversing to an increase of 0.08% by 2040. The EU27 experienced a dramatic decrease in emissions, with a 10.75% reduction in 2025 and a 10.30% reduction by 2040. Upper middle income and low-income regions, however, saw significant increases in emissions, particularly upper middle-income regions which experienced a 0.72% increase in 2025, growing to a 1.00% increase by 2040.

Scenario [0-2-2] also saw varied responses, with a global decrease of 0.08% in 2025, turning into a 0.06% increase by 2040. The EU27 again experienced a significant reduction in emissions, while upper middle income and low-income regions saw increases. High-income regions experienced an increase in 2025 but saw a significant slowdown in emission growth by 2040.

In scenario [0-3-1], the global response initially was a decrease of 0.11% in 2025, shifting to a 0.10% increase by 2040. The EU27 saw a significant and consistent decrease in emissions, while upper middle income, low-income, and lower middle-income countries all experienced increases in emissions.

The [0-3-2] scenario resulted in a slight global decrease of 0.04% in 2025, shifting to a 0.07% increase by 2040. The EU27 saw a deep and consistent reduction in emissions, while upper middle income and low-income countries experienced increases in emissions. High-income countries saw an increase in 2025 but a significant slowdown in emission growth by 2040.

In scenario [0-4-1], there was a slight global decrease of 0.11% in 2025, turning into a 0.03% increase by 2040. The EU27 experienced a sharp decline in emissions, while upper middle-income, low-income, and lower middle-income countries all saw increases in emissions.

Similar to the previous scenario [0-4-2], there was a global decrease of 0.07% in 2025 and a slight decrease of 0.02% by 2040. The EU27 experienced a significant decrease in emissions, while upper middle income, low-income, and lower middle-income countries saw increases in emissions, though lower middle-income countries showed a drop to 0.00% increase by 2040.

Throughout these scenarios, it is evident that the EU27 consistently experienced significant reductions in CH4 emissions, aligning with its liberalization and environmental policies. Upper middle income and low-income regions generally saw increases in emissions, though there were variations and complexities in the trends, indicating the multifaceted nature of global emissions and the impact of trade and economic policies.

Table 8: CH4 emissions, %-change between baseline and scenarios.

	[0-1] EU->WORLD->EU agro-food liberalisation		[0-2] EU->WORLD->EU All COM liberalisation		[0-2-1] EU->WORLD agro-food CO2 based tariff + liberalisation of other sectors		[0-2-2] EU->WORLD->EU agro-food CO2 based tariff + liberalisation of other sectors		[0-3-1] EU->WORLD agro-food CO2 based tariff		[0-3-2] EU->WORLD->EU agro-food CO2 based tariff		[0-4-1] EU->WORLD All COM CO2 based tariff		[0-4-2] EU->WORLD->EU All COM CO2 based tariff	
Income groups/regions	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040
World	0.00%	-0.05%	-0.04%	-0.05%	-0.08%	0.08%	-0.08%	0.06%	-0.11%	0.10%	-0.04%	0.07%	-0.11%	0.03%	-0.07%	-0.02%
Upper middle income	0.26%	0.42%	0.30%	0.42%	0.72%	1.00%	0.73%	1.01%	0.23%	0.32%	0.69%	1.01%	0.40%	0.46%	0.85%	1.21%
High income	0.05%	-0.08%	0.10%	-0.15%	0.66%	0.15%	0.53%	0.07%	0.35%	0.20%	0.50%	0.14%	0.71%	0.54%	0.84%	0.50%
Low income	-0.22%	-0.42%	-0.35%	-0.20%	0.32%	1.08%	0.30%	0.99%	0.52%	1.26%	0.45%	0.78%	0.49%	1.29%	0.19%	0.51%
EU27	-1.18%	-0.33%	-2.03%	-0.60%	-10.75%	-10.30%	-10.32%	-9.99%	-7.12%	-8.15%	-9.69%	-9.95%	-10.78%	-12.51%	-13.25%	-14.56%
Lower middle income	-0.16%	-0.49%	-0.24%	-0.45%	-0.01%	0.18%	-0.02%	0.11%	0.15%	0.68%	0.07%	0.09%	0.24%	0.66%	0.12%	0.00%
ROW	-0.06%	-0.04%	-0.08%	-0.05%	0.42%	0.47%	0.41%	0.47%	0.45%	0.50%	0.45%	0.50%	0.64%	0.78%	0.63%	0.78%

Source: own calculations

4.2.2.1.5 Fluorinated gases emissions [CO2equ])

In the context of agro-food liberalisation between the EU and the world market (scenario [0-1]), a global decrease in fluorinated gas (F-gas) emissions was observed, with a reduction of 0.02% in 2025, deepening slightly to 0.03% in 2040. The EU-27 experienced notable reductions, with emissions falling by 0.28% in 2025 and continuing to decrease to 0.13% in 2040. This reduction was influenced by decreases in upper middle-income countries, with a fall of 0.16% in 2025 and a slight recovery to a decrease of 0.06% in 2040. However, this global trend was counteracted by increases in high-income and low-income regions, with the latter showing a significant increase of 0.92% in 2025, though slowing to 0.22% by 2040.

In the comprehensive liberalisation policy scenario ([0-2]), F-gas emissions globally fell significantly, with a 0.20% reduction in 2025 and a further decrease to 0.44% in 2040. The EU-27 showed a substantial decrease in emissions of 1.96% in 2025, but this trend reversed, resulting in an increase of 0.57% in 2040. Upper middle-income regions and high-income regions also contributed to the global decrease, though low-income countries displayed a consistent increase in emissions.

Scenario [0-2-1] revealed a global decline in F-gas emissions, with a 0.22% reduction in 2025 and 0.44% in 2040. The EU-27 experienced a sharp decline of 0.69% in 2025, but a dramatic shift occurred, leading to a 1.31% increase in 2040. Upper middle-income and high-income regions mirrored the global trend with substantial decreases, while low-income countries displayed a growing trend in emissions.

In the [0-2-2] scenario, a global reduction of F-gas emissions was noted, with a 0.22% decrease in 2025 and a 0.44% decrease in 2040. The EU-27 followed this trend with a significant decrease of 0.78% in 2025, though this was reversed to a 1.25% increase in 2040. Upper middle-income countries and high-income countries experienced marked declines, while low-income countries saw increases in emissions.

The [0-3-1] scenario presented a slight global increase in F-gas emissions, with the EU-27 experiencing significant reductions, though at a diminishing rate from 0.22% in 2025 to 0.05% in 2040. Upper middle-income and high-income countries displayed minor increases, while low-income countries saw reductions in emissions.

In scenario [0-3-2], a global decrease in F-gas emissions was observed, with the EU-27 showing a significant increase of 0.98% in 2025, slowing to 0.58% in 2040. Upper middle-income countries displayed the largest decrease, while high-income countries and low-income countries experienced increases in emissions.

Scenario [0-4-1] resulted in a slight global increase in F-gas emissions in 2025, transitioning to a decrease in 2040. The EU-27 showed continuous and substantial decreases in emissions. Upper middle-income countries faced significant increases, while high-income countries and low-income countries experienced a mix of increases and decreases.

In the [0-4-2] scenario, a global increase in F-gas emissions was observed, with the EU-27 experiencing significant reductions. Upper middle-income and high-income regions saw increases in emissions, while low-income countries displayed significant reductions.

Across these scenarios, the EU-27 consistently worked towards reducing F-gas emissions, contributing significantly to global trends. The impact of these policies varied across different income groups, with upper middle-income and high-income regions generally showing decreases, while low-income regions displayed increases in emissions.

Table 9: Fluorinated gases emissions, %-change between baseline and scenarios.

	[0-1] EU->WORLD->EU agro-food liberalisation		[0-2] EU->WORLD->EU All COM liberalisation		[0-2-1] EU->WORLD agro-food CO2 based tariff + liberalisation of other sectors		[0-2-2] EU->WORLD->EU agro-food CO2 based tariff + liberalisation of other sectors		[0-3-1] EU->WORLD agro-food CO2 based tariff		[0-3-2] EU->WORLD->EU agro-food CO2 based tariff		[0-4-1] EU->WORLD All COM CO2 based tariff		[0-4-2] EU->WORLD->EU All COM CO2 based tariff	
Income groups/regions	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040	2025	2040
World	-0.02%	-0.03%	-0.20%	-0.44%	-0.22%	-0.44%	-0.22%	-0.44%	0.02%	0.01%	-0.04%	-0.02%	0.06%	-0.06%	0.23%	0.20%
Upper middle income	-0.16%	-0.06%	-0.04%	-0.43%	-0.19%	-0.48%	-0.18%	-0.48%	0.04%	0.02%	-0.30%	-0.12%	0.88%	0.78%	0.66%	1.12%
High income	0.26%	0.13%	-0.04%	-1.05%	-0.15%	-1.08%	-0.13%	-1.07%	0.02%	0.03%	0.17%	0.11%	-0.23%	-0.01%	0.25%	0.59%
Low income	0.92%	0.22%	1.03%	1.05%	0.41%	0.94%	0.65%	0.96%	-0.09%	-0.04%	0.53%	0.13%	-2.52%	0.08%	-1.22%	-0.13%
EU27	-0.28%	-0.13%	-1.96%	0.57%	-0.69%	1.31%	-0.78%	1.25%	-0.22%	-0.05%	0.98%	0.58%	-5.61%	-6.49%	-3.67%	-6.99%
Lower middle income	0.25%	0.07%	-0.12%	-0.59%	-0.28%	-0.68%	-0.25%	-0.65%	0.08%	0.00%	0.13%	0.01%	0.49%	-1.27%	0.81%	-1.38%
ROW	0.61%	0.10%	-0.21%	-1.06%	-0.29%	-1.25%	-0.28%	-1.24%	0.49%	-0.09%	0.53%	-0.09%	0.64%	0.69%	1.10%	0.94%

4.2.2.2 Water Pollution

Post-modelling calculations have been done to tackle the issue of water quality affected by trade liberalization, as presented in section 3.3. The process and calculations described below align closely with the United Nations' Sustainable Development Goals (SDGs), specifically with Goal 6, which is dedicated to ensuring the availability and sustainable management of water and sanitation for all. More precisely, they align with SDG Target 6.3. This target aims to improve water quality by reducing pollution, eliminating dumping, and minimizing the release of hazardous chemicals and materials. The calculation of pollution presented below directly relates to assessing and managing water pollution, which is relevant to the following indicators:

- **SDG Indicator 6.3.1:** "*Proportion of domestic and industrial wastewater flows safely treated"*
- **SDG Indicator 6.3.2:** "*Proportion of bodies of water with good ambient water quality"*

Post-modeling calculations for the evaluation of changes in water quality started with the acquisition of raw data. The most diverse and global database, which contains scientifically-sound data and information on the state and trend of global inland water quality, is The Global Freshwater Quality Database GEMStat (United Nations Environment Programme, 2018). The requested data contained over 10 million records from 17,268 stations located across 87 different countries. The data consisted of measurements related to 70 unique parameters for five types of water bodies (Rivers, Reservoirs, Lakes, Groundwater, and Wetlands). The time span of these collected records ranged from 1906 to 2023, with variations between different countries. At this stage, the data was extensive, capturing a wide range of measurements and geographical locations, which allowed for a broad and diversified analysis of water conditions around the world.

Once the raw data was collected, the next step involved data cleaning and aggregation. This process was aimed at eliminating potential errors or inaccuracies and condensing the data into a more manageable form. During this phase, only the most recent data available for a given country and parameter was retained. This cleaning and aggregation process was applied across the same parameters as in the raw data – 87 countries, 70 unique parameters, five water body types, and within the year span of 1972-2023. This step ensured that the data was reliable and ready for in-depth analysis.

Following data cleaning and aggregation, the parameters that occurred most frequently and had the greatest potential for indicating water quality (showing the impact of diverse pollutants, such as agriculture, manufacturing, and wastewater treatment) across the 72 GTAP regions in the database were selected for further consideration. This choice was made based on the newest data available for each country, parameter, and water body type. The parameters selected for further analysis are presented in Table 10.

Table 10: Chosen water quality parameters

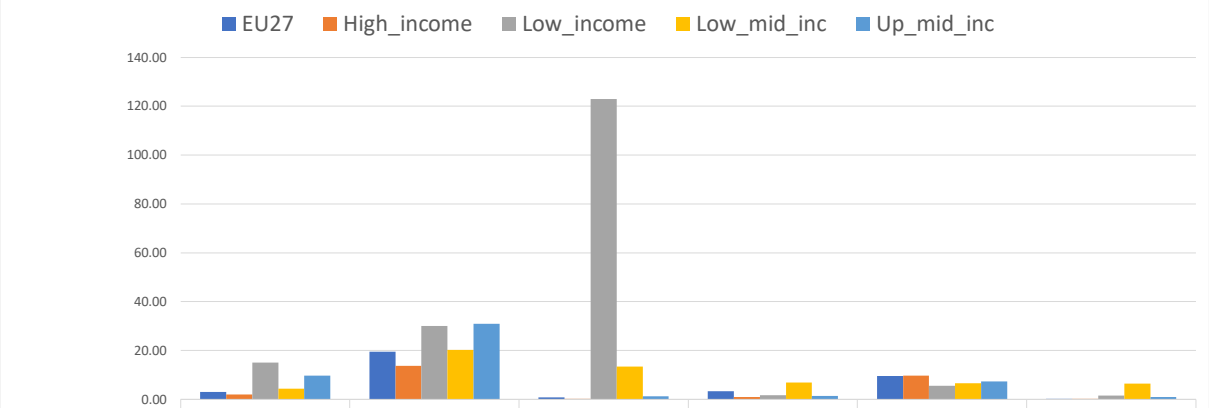
Short name	Long name	Description
BOD	Biochemical Oxygen Demand	Represents oxygen needed for organic matter decomposition. High levels indicate pollution.
COD	Chemical Oxygen Demand	Indicates the amount of organic pollutants. High levels suggest substantial water contamination.
NH3N	Free Ammonia Nitrogen	Affects taste and smell and may suggest organic matter decay (preliminary from manure management).
NO3N	Nitrate	Elevated levels suggest contamination from fertilizers and can cause methemoglobinemia in infants.
O2-Dis	Dissolved Oxygen	Essential for aquatic life survival. Low levels indicate pollution and can harm the ecosystem.
TP: Total	Total Phosphorus	High levels can cause algae growth, which can lead to oxygen depletion in the water.

Going back to the chosen SDG indicators, the parameters presented in Table 10 can be used to indicate the following:

- **SDG Indicator 6.3.1**: As this indicator focuses on the proportion of wastewater safely treated, the assessment of water quality through parameters like Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD) provides valuable insights into the level of organic pollutants in water, which can be linked to wastewater treatment efficiency.
- **SDG Indicator 6.3.2:** This indicator emphasizes the proportion of bodies of water with good ambient water quality. The evaluation of water quality through parameters like Free Ammonia Nitrogen (NH3N), Nitrate (NO3N), Dissolved Oxygen (O2-Dis), and Total Phosphorus (TP) corresponds with this indicator by providing data on the contamination and overall quality of different water bodies.

The cleaned and sorted data was then broken down into different income groups following the scenarios presented in section 3.3. These groups include EU27, High income, Upper middle income (Up_mid_inc), Lower middle income (Low_mid_inc), and Low income. The group ROW (the Rest of the World) was not included in these calculations, as there was too little data on water pollution in the countries that constituted this region. In this step, the average value for each parameter within these income groups was calculated.

Figure 18: Average value for chosen water quality parameters in given income groups



	BOD	COD	NH3N	NO3N	O2-Dis	TP
EU27	3.05	19.54	0.77	3.29	9.51	0.22
High_income	1.95	13.69	0.18	0.90	9.75	0.11
Low_income	15.08	30.10	122.99	1.74	5.51	1.51
Low_mid_inc	4.40	20.25	13.39	6.93	6.58	6.47
Up_mid_inc	9.72	30.89	1.28	1.32	7.37	0.93

Source: own calculations based on (United Nations Environment Programme, 2018).

Once the average parameter values were determined, the next step involved calculating pollution coefficients. Each parameter value was divided by the baseline Gross Domestic Product (GDP) for 2025 (2025_baseline_gdp) to obtain these coefficients. For the Dissolved Oxygen (O2-Dis) parameter, its reciprocal was used instead.

- BOD coefficient = BOD / 2025_baseline_gdp
- COD coefficient = COD / 2025_baseline_gdp
- NH3N coefficient = NH3N / 2025_baseline_gdp
- NO3N coefficient = NO3N / 2025_baseline_gdp
- O2-Dis coefficient = (1/O2-Dis) / 2025_baseline_gdp
- TP coefficient = TP / 2025_baseline_gdp

This method was developed in response to the absence of sectoral pollution data, with the study depending on average sectoral parameters and the GDP of different income groups. These coefficients give a standardized measure of water pollution, adjusting for the economic status of each income group.

Following the calculation of pollution coefficients, the next stage involved the calculation of pollution levels for each income group based on GDP. This was achieved by multiplying the GDP of each income group by the corresponding pollution coefficients.

$$\textbf{\textit{Income group water polution}} = BOD\ coefficient * GDP\ + COD\ coefficient * GDP + NH3N\ coefficient * GDP + NO3N\ coefficient * GDP + \text{O2-Dis coefficient} * \text{GDP} + \text{TP coefficient} * \text{GDP}$$

This process generated a more nuanced understanding of how water pollution correlates with the economic output of different income groups.

Finally, the process calculated the percentage change in world water pollution based on the GDP changes between the baseline and trade liberalization scenarios for the year 2040 (for details about scenarios, see chapter 3.3). The percentage changes were calculated for each income group and globally (Table 11). This allows for an assessment of how different economic scenarios could influence water pollution rates across the world, offering vital insights for policy-making and future research.

Table 11: Water pollution percentage-change for year 2040.

	Upper middle income	High income	Low income	EU27	Lower middle income	**WORLD**
[0-1] EU->WORLD->EU agro-food liberalisation	0.02%	-0.01%	-0.05%	-0.01%	-0.01%	**-0.04%**
[0-2] EU->WORLD->EU All COM liberalisation	-0.03%	-0.07%	0.10%	0.43%	0.16%	**0.11%**
[0-2-1] EU->WORLD agro-food CO2 based tariff + liberalisation of other sectors	-0.02%	-0.06%	0.15%	0.35%	0.21%	**0.15%**
[0-2-2] EU->WORLD->EU agro-food CO2 based tariff + liberalisation of other sectors	-0.02%	-0.06%	0.14%	0.36%	0.20%	**0.14%**
[0-3-1] EU->WORLD agro-food CO2 based tariff	0.01%	0.00%	0.06%	-0.05%	0.05%	**0.05%**
[0-3-2] EU->WORLD->EU agro-food CO2 based tariff	0.03%	0.00%	-0.01%	-0.08%	0.03%	**-0.01%**
[0-4-1] EU->WORLD All COM CO2 based tariff	-0.10%	0.05%	-0.19%	-0.43%	-0.50%	**-0.23%**
[0-4-2] EU->WORLD->EU All COM CO2 based tariff	-0.02%	0.06%	-0.54%	-0.68%	-0.61%	**-0.49%**

Source: own calculations

Scenario [0-1] shows a slight increase in water pollution in the upper-middle-income group, while other groups demonstrate marginal decreases. Globally, this scenario led to a decrease of 0.04% in water pollution.

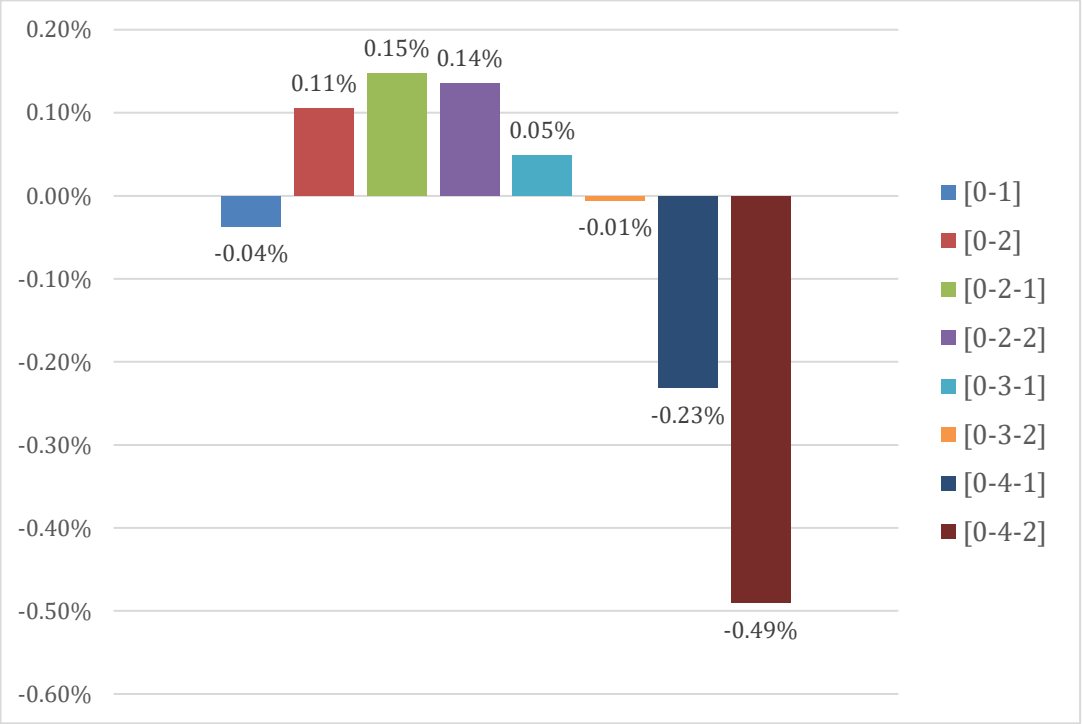
Scenario [0-2] yielded mixed results. In some income groups, pollution decreased, while in others it increased. Particularly intriguing is the substantial increase in water pollution in the EU27 group. Globally, this scenario increased water pollution by 0.11%.

Scenarios [0-2-1] and [0-2-2] show varied results, but generally indicate that the liberalization of other sectors may lead to an increase in water pollution. The global impact for these scenarios resulted in a 0.15% and 0.14% increase, respectively.

Scenarios [0-3-1] and [0-3-2] show moderate changes in both directions, increasing and decreasing pollution. The global impact for these scenarios was an increase of 0.05% and a decrease of 0.01%, respectively.

The last two scenarios, [0-4-1] and [0-4-2], reveal a significant decrease in world water pollution, especially in lower-income countries and the EU27. The global impact for these scenarios was a decrease of 0.23% and 0.49%, respectively.

Figure 19: World water pollution percentage-change for year 2040.



Source: own calculations

The result suggests that different trade liberalization strategies, as depicted in the various scenarios, may have diverse impacts on water pollution in various regions of the world. It appears that trade liberalization in certain sectors, such as food, may lead to an increase in water pollution, particularly in developed regions like the EU27. For scenarios involving CO2 tariffs, the results are more varied, suggesting that the implementation of such tariffs might have different effects depending on how they are constructed and in which sectors they are applied. The introduction of CO2 tariffs on all commercial commodities (production and consumption), as seen in the last two scenarios, seems to lead to a substantial decrease in world water pollution, suggesting that such an approach might be an effective tool in pursuing sustainable development.

Overall, these findings underscore the complexity of the relationship between trade liberalization and water pollution and point to the need for further research that takes into consideration the diversity of scenarios and their potential impacts on various regions and income groups.

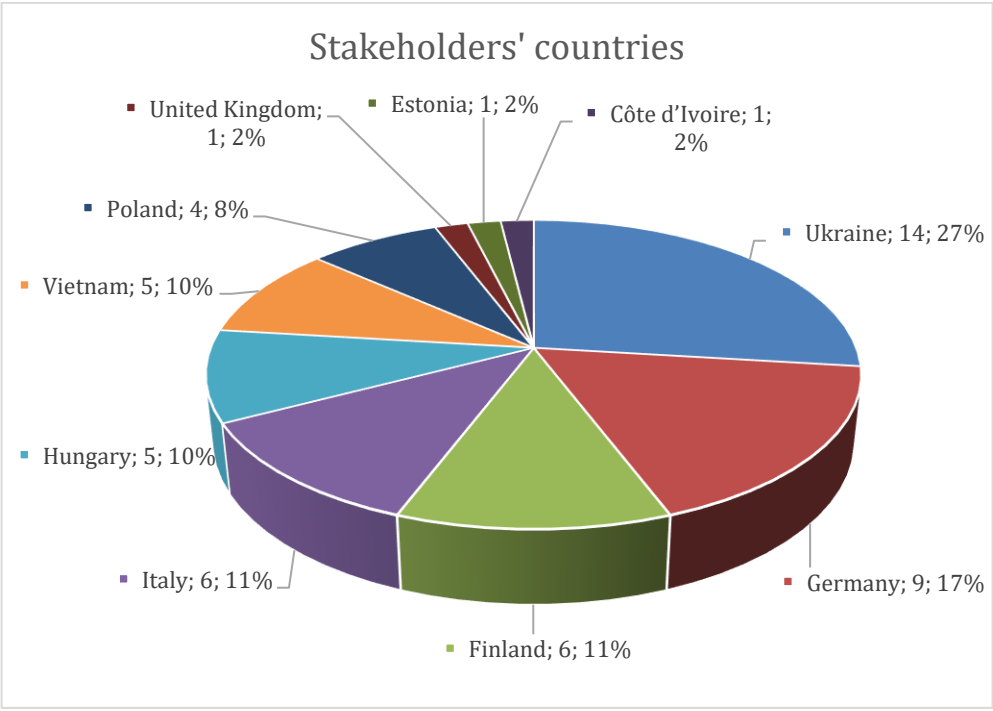
5 Stakeholder feedback

In order to assess stakeholders' views on trade and environment policies that could potentially strengthen the positive links between trade and sustainable development, an online survey was conducted. the survey was divided into the following five sections:

1. Trade Liberalisation Queries:
   This section focuses on the removal of tariffs between the EU and its trading partners.
2. CO2-Based Import Tariff Queries:
   This section deals with the imposition of import tariffs on sectors according to their emission intensity.
3. CO2-Based Output Tax Queries:
   This section centers on imposing a production tax on sectors relative to their emission intensity.
4. Mixed Policy Scenarios Queries:
   This section examines the combination of trade liberalisation policies with CO2-based tariffs and CO2-based output taxes in the agri-food sector.
5. Policy effectiveness and trade-offs
   This section focuses on the effectiveness and trade-offs of different policies.

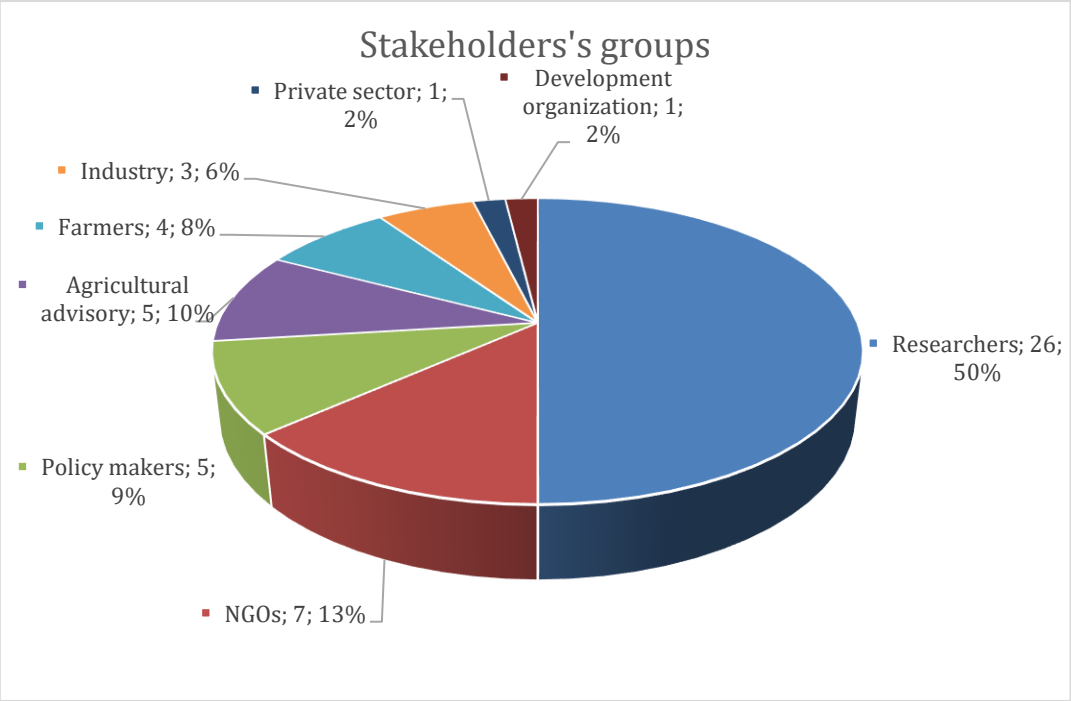
This structure aims to provide a comprehensive insight into the interaction between trade policy and environmental considerations from the perspective of different stakeholders. The survey was completed by 52 respondents from the EU, Ghana, Vietnam and Côte d'Ivoire. A detailed overview of stakeholder locations is shown in Figure 20.

Figure 20: Stakeholder countries (stakeholder survey)



The stakeholders who completed the survey represented 8 interest groups. The detailed representation is shown in Figure 21.

Figure 21: Stakeholder groups (stakeholder survey)



5.1 Trade Liberalisation Queries

Regarding the implementation of trade liberalisation, the political feasibility of such move is seen as moderately feasible by 38% of respondents, somewhat feasible by 29% and fully feasible by 29%, while only 4% see it as completely feasible (see Figure 22).

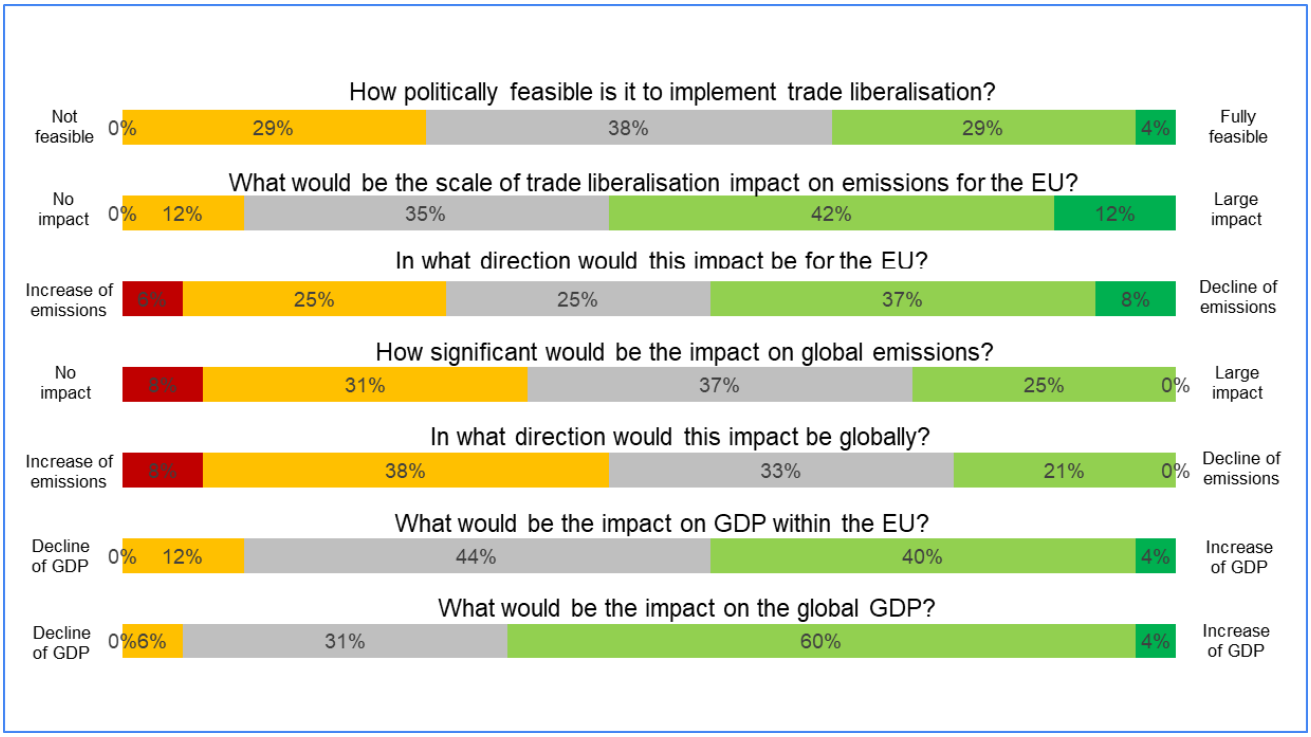
In terms of its impact on emissions within the EU, a significant number of respondents (42%) believe it would have a major impact, while 35% expect a moderate impact and 12% a negligible impact. Furthermore, the direction of this impact within the EU is seen as likely to be a decrease in emissions by 37% of respondents, while 25% see no change and 25% expect an increase in emissions.

Globally, the perceived impact on emissions is significant, with 37% expecting a moderate impact and 25% expecting a large impact, but no participants expect a significant reduction in global emissions. The majority of respondents, 38%, predict an increase in global emissions, while 33% see no change in the direction of emissions.

On the economic side, the impact on GDP within the EU is largely seen as positive, with 44% predicting a moderate increase in GDP and 40% predicting a large increase. Similarly, global GDP is expected to increase significantly as a result of trade liberalisation, with 60% of respondents expecting a significant increase and 31% expecting a moderate increase in global GDP.

In conclusion, there seems to be a moderate consensus that the implementation of trade liberalisation is politically feasible to some extent and that its impact on both EU and world GDP is expected to be positive. However, opinions on its impact on emissions are mixed, with a significant number of participants predicting a decrease in emissions within the EU, but an increase in emissions at the global level.

Figure 22: Trade Liberalisation Queries (stakeholder survey)



In conclusion, there seems to be a moderate consensus that the implementation of trade liberalisation is politically feasible to some extent and that its impact on both EU and world GDP is expected to be positive. However, opinions on its impact on emissions are mixed, with a significant number of participants predicting a decrease in emissions within the EU, but an increase in emissions at the global level.

In the comments section, there is a consensus on the complexity of the issue due to the various influencing factors and the complex interactions between them. The EU's declining role in world trade is attributed to its dependence on food exports and imports of raw materials. The difficulty of answering the question of trade liberalisation is recognised, due to the different status of tariffs and levels of liberalisation, and the different impacts depending on trading partners and their fossil fuel policies. The perspective that the EU could potentially reduce its greenhouse gas (GHG) emissions by engaging in trade liberalisation with less developed countries is discussed, as this would transfer emissions to countries with less stringent policies, potentially increasing global emissions.

The consequences of avoiding carbon border adjustment measures and allowing carbon leakage are considered. If trade liberalisation includes these measures, it may mitigate negative

environmental impacts, although some may still persist. The discourse on emissions focuses on whether direct or consumption-based emissions are taken into account, as the latter entail smaller differences due to less stringent climate policies in third countries and transport emissions. There is ambiguity about the scope of emissions considered, whether embedded carbon or only production impacts are examined.

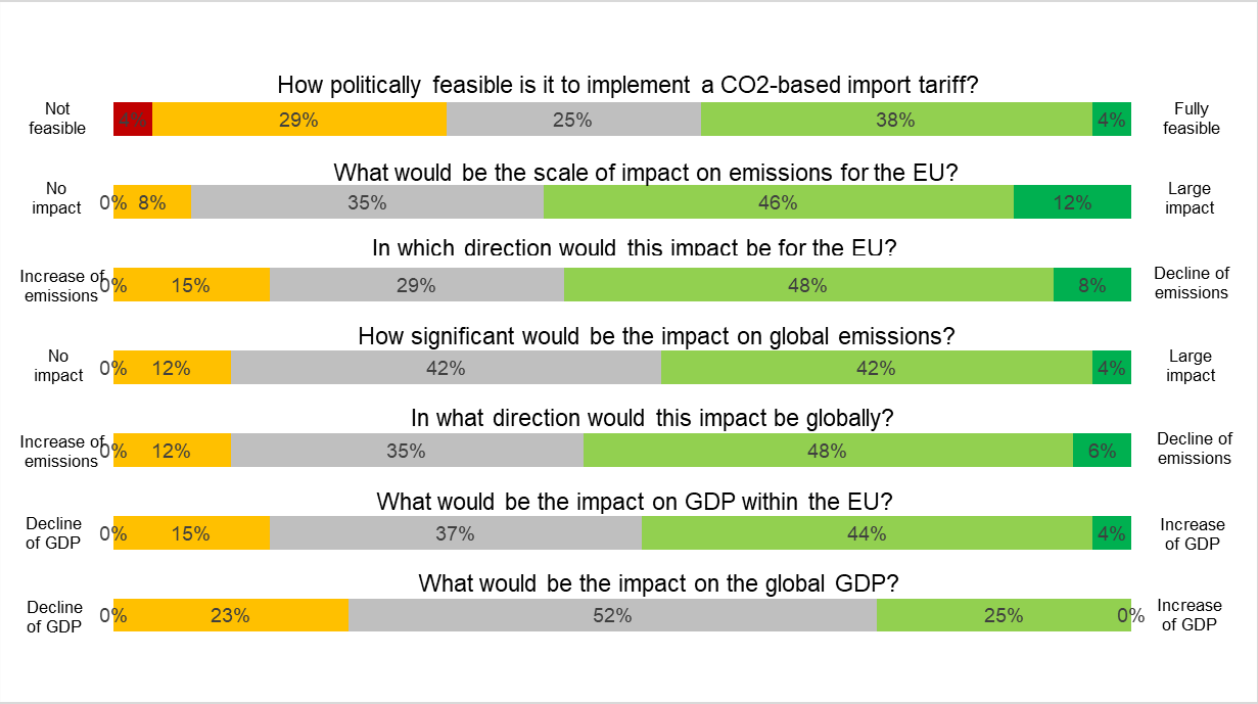
The feasibility of liberalisation is seen as highly dependent on trading partners and there is also a focus on the increasing trend towards de-risking of supply chains. The environmental impact is seen as highly dependent on addressing the externalities of specific commodities and dealing with emissions from logistics and increased production of high carbon footprint goods, such as beef in a potential Mercosur-EU trade deal. Without appropriate efforts, these emissions could overshadow any efficiency gains from trade liberalisation.

The discussion on GDP and trade liberalisation overlooks distributional issues, namely that the trade-off between GDP gains and redistribution burdens becomes more difficult as tariff rates fall. This leads to disproportionately little gain and a lot of pain, especially in a world of relatively low tariffs. In addition, there are concerns about greater centralisation of industries in a few countries and reduced pathways to industrialisation, with the result that growth miracle countries such as South Korea are less able to protect their industries.

Assessing the impact of EU emissions on global GDP is seen as challenging due to the different economic structures of different countries and their varying ability to implement appropriate emission reduction policies. Finally, the increase in production and consumption resulting from trade liberalisation can potentially increase GDP and emissions in general, but strong and clear EU policies and regulations can help reduce emissions on a global scale.

5.2 CO2-Based Import Tariff Queries

Figure 23: CO2-Based Import Tariff Queries (stakeholder survey)



In summary, there is widespread agreement that a CO2-based import tariff is realistically achievable and has the potential to significantly reduce emissions both within the EU and globally. At the same time, this could boost GDP growth within the EU. However, the outlook for global GDP remains mixed, with a range of views on the various possibilities.

In the comments sections, stakeholders mention that the introduction of a Carbon Border Adjustment Mechanism (CBAM), a tool designed to equalise the price of carbon between imported and domestically produced goods, is a creative idea, although concerns are raised about its practical implementation. At the WTO level, it's emphasised that many issues need to be resolved for dispute settlement, and there is a consensus that the likely revenues and collection costs of CBAM have probably been inaccurately estimated in the preparatory stages, with revenues overestimated and costs underestimated.

The feasibility of CBAMs is also linked to potential political reactions, with countries such as India already considering the establishment of their own CBAMs. These reactive measures can complicate the initial implementation of such mechanisms. The structure and implementation of the tariff system is crucial, as it has to comply with trade rules, which affects the overall impact of CBAM.

Stakeholders also consider the dynamic nature of technological developments, emphasising that the situation isn't static and that advances in technology may bring new opportunities or solutions. It is theorised that a CO2-based import tariff might mainly affect less developed countries due to their less restrictive policies. In such a case, the European Union might have to increase production to make up for the lack of imports, potentially leading to an increase in GHG emissions within the EU but a decrease in global emissions. Sectoral coverage and different time horizons for examining impacts are also key factors in determining the results of implementing CBAM.

Short-term effects may differ from long-term effects; for example, global emissions may increase in the short term as a result of import tariffs, but in the long term they are expected to be lower than in a world without EU import tariffs. The success and impact of the mechanism will depend on many factors, including the availability of cleaner production capacity.

Stakeholders also mentioned that the European Parliament has recently adopted legislation aimed at reducing net greenhouse gas emissions by around 55%, the results of which will be visible by 2030. A CO2-based import tariff is seen as a more quantitative, measurable and effective tool to reduce emissions. However, this could come at the cost of reduced GDP and may be less feasible due to the challenges of implementing accurate CO2 methodologies and reporting.

5.3 CO2-Based Output Tax Queries

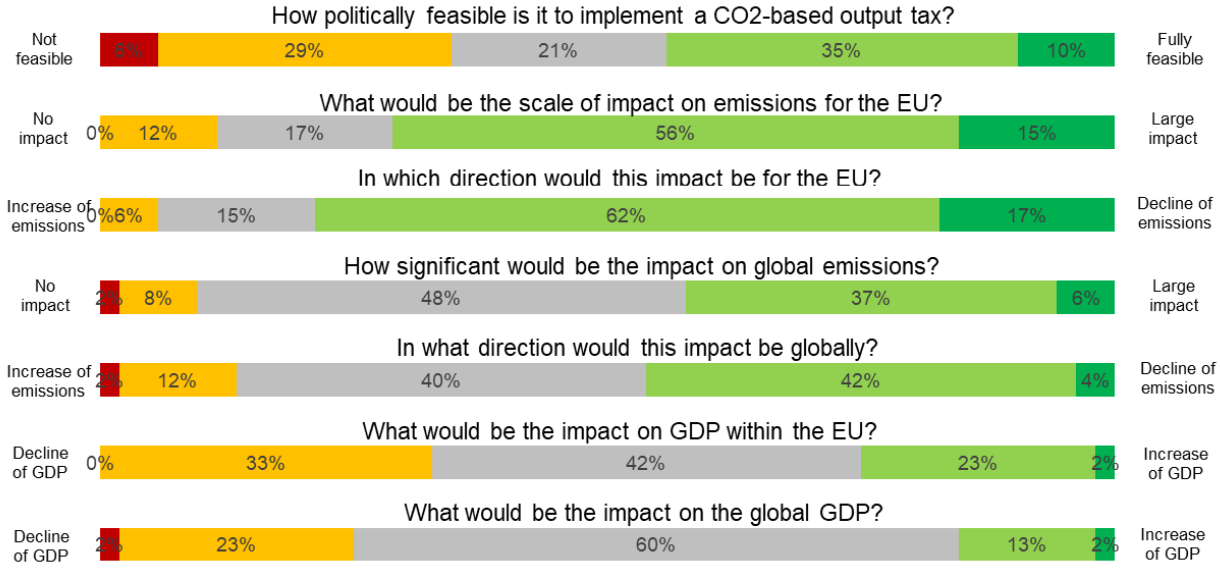
The proposal to introduce a CO2-based output tax appears to be moderately to highly politically feasible, with 35% of respondents seeing it as very feasible and 10% as completely feasible, compared to 6% who see it as not feasible (see Figure 24).

When assessing the impact on emissions within the EU, a significant 56% predict a major impact, with 15% believing the impact would be even greater. The prevailing view, held by 62%, is that it would lead to a decrease in EU emissions, with only a small minority, 6%, predicting an increase.

In terms of the impact on global emissions, a split of 48% think it will be significant and 6% expect it to be large, with 42% expecting global emissions to fall and 12% expecting them to rise.

In terms of economic impact, opinions are mixed on the impact on EU GDP, with 42% expecting a neutral impact, 33% a decrease and 23% an increase. Views on the impact on global GDP are similarly mixed, with a majority of 60% expecting a neutral impact, 23% a decrease and 13% an increase.

Figure 24: CO2-Based Output Tax Queries (stakeholder survey)



In conclusion, there is a broad consensus that the introduction of a CO2-based output tax is generally politically feasible and has the potential to achieve significant emission reductions in the EU and globally. However, opinions diverge on the economic consequences, with different expectations on the impact on GDP both in the EU and globally.

Comments from stakeholders suggest different perspectives on the impact of a potential CO2-based output tax. One view is that high-tech and innovative sectors are likely to benefit from such a tax. There is concern that the impact of this tax would largely depend on its design and implementation. Some commentators have raised questions about the sectors it would cover, in particular questioning its impact on the financial and services sectors. There is also speculation that the tax, if applied only within the EU, could potentially harm EU producers.

Several commentators emphasise that the impact of this tax would also depend on whether there are parallel measures to tax imports in conjunction with the production (output)

tax. If import and domestic taxes are synergised and balanced with acceptable social security expenditure, this could result in a more coherent approach. There are also concerns about the potential challenges of implementing a CO2-based output tax, such as the accuracy of CO2 calculation methods and reporting, and how this tax would fit in with existing mechanisms such as the Emissions Trading Scheme.

Some stakeholders point out that a CO2-based output tax, similar to a CO2-based import tariff, could be a more quantitative, measurable and effective tool to reduce emissions, although it could lead to a reduction in GDP due to increased production costs in the sectors concerned.

5.4 Mixed Policy Scenarios Queries

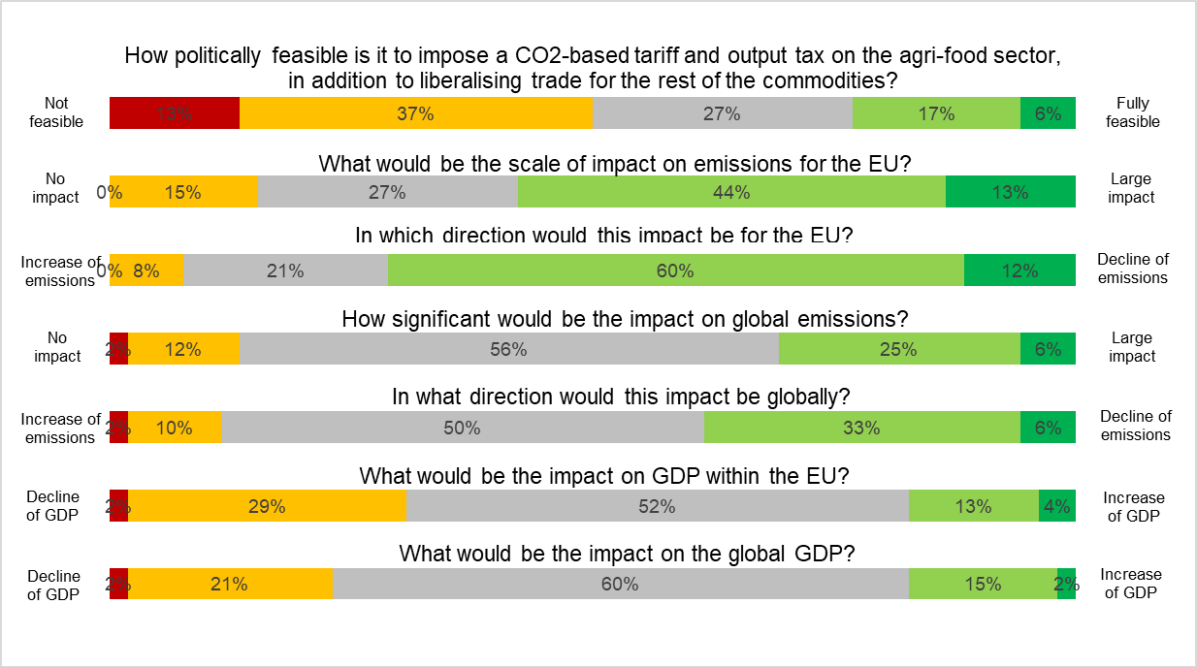
The introduction of a CO2-based tariff and output tax on the agri-food sector, while liberalising trade in other commodities, appears to be moderately politically feasible according to respondents. With 37% seeing it as somewhat unfeasible and 27% as neutral, only 6% see it as fully feasible, while 13% see it as not feasible at all (see Figure 25).

Regarding the potential impact on emissions within the EU, 44% of respondents expect a large impact and a further 13% expect an even larger impact. The predominant expectation is that the measure would lead to a decrease in emissions within the EU, with 60% of respondents expecting an increase, compared to 8% who expect an increase.

Opinions are more mixed when it comes to global emissions, with 56% of respondents saying the impact would be significant and 6% saying it would be large. A majority, 50%, predict a decrease in global emissions, while 10% predict an increase.

On the economic front, the majority, 52%, predict a neutral impact on EU GDP, with 29% expecting a decrease and 13% an increase. Expectations for global GDP follow a similar pattern, with 60% expecting a neutral impact, 21% a decrease and 15% an increase.

Figure 25: Mixed Policy Scenarios Queries (stakeholder survey)



In summary, the imposition of a CO2-based tariff and output tax on the agri-food sector, coupled with trade liberalisation for other commodities, is seen as moderately politically feasible. It is widely expected to lead to a significant reduction in emissions both in the EU and globally, although opinions on its economic impact vary, with the majority predicting a neutral effect on GDP both in the EU and globally.

Stakeholders point out that there is considerable concern about the policy's focus on the agri-food sector, given the significant contribution of the industrial and energy sectors to greenhouse gas emissions, and due to the interconnectedness of global trade regimes, some believe that the policy's focus appears somewhat limited and potentially ineffective. Stakeholders also recognise that the EU's approach to reducing emissions does not necessarily have to be in line with global action, and emphasise the autonomy of different regions or countries in their approach to climate change.

A proposal is made to highlight the potential effectiveness of combining trade liberalisation with CO2-based tariffs and output taxes on the agri-food sector in reducing emissions. Such a combination is perceived as not jeopardising the economic health, in particular the gross domestic product, of the EU or the world, making it a seemingly balanced approach. However, the actual implementation of such a combined policy is expected to be challenging, although it is seen as potentially more equitable, transparent and clear in its intent and application. Overall, the discussions reflect a diversity of views and considerations on the development and implementation of equitable and effective emission reduction policies.

In this section, stakeholders were also asked for suggestions and perspectives on other possible scenarios regarding the impact of international trade and environmental policies on reducing emissions.

Several comments highlight the importance of promoting circularity in nutrient management and bioenergy production within the food industry, noting that this approach requires substantial criteria and standardisation work before it can be supported in terms of actual policy. Some comments address the impact of increased EU sustainability measures, some of which are unilateral, such as those targeting deforestation-free practices, and some of which focus on Technical Barriers to Trade (TBT) chapters. It's mentioned that the indicators are satisfactory and that there is a need for global implementation of such measures, taking into account the different levels of adoption by different countries or trading blocs.

A number of comments propose regulations, bans and quotas as alternatives, recommending that measures that reduce emissions should be combined with those that increase emissions, and emphasising shorter trade routes and closer trading partners to minimise transport emissions. Suggestions include the application of a common minimum price and the implementation of technical assistance programmes outside the EU to promote lower greenhouse gas emission production techniques. Within the EU, increased investment and efficient transfer of information from research to producers are recommended. Several respondents discuss compensation through payments for ecosystem services to the agri-food sector and reflect on the environmental and labour market advantages of local production over free trade if externalities are not internalised. They also suggest direct bans on highly polluting activities and command and control type interventions.

Some stakeholders draw attention to policies in single or joint carbon markets around the world, particularly in China and the US. There's concern that the benefits of trade liberalisation are diminishing, and the costs are becoming more apparent, necessitating a change in the World Trade Organisation (WTO) agreement systems to focus on sustainable, environmentally sound economic development rather than increasing gross domestic product (GDP).

The role of technological improvement in agriculture and the development of Agriculture 4.0 is noted. Several comments suggest policies to support lifestyle changes, such as reducing meat consumption, which would have an impact on traded goods. Other suggestions include increasing the use of environmentally friendly technologies, particularly for soil conservation, and reducing the amount of irrigated land. A critical perspective warns that the scenarios presented, especially if implemented simultaneously, could lead to Europe's economic and social decline due to high inflation, increased prices, lower living standards and possible emigration.

The stakeholders also call for action to address emissions from aircraft, ships, cars and the energy sector, and emphasise the importance of addressing CO2 emissions from different activities. They advocate tax incentives for climate-smart food production systems, and stress that trade agreements with relevant conditions and rules can significantly manage and influence emissions in production prior to export.

5.5 Policy effectiveness and trade-offs

The responses show that a substantial majority, 69%, agree that international trade policy can have a significant impact on emissions, with 31% strongly agreeing. There is a notable

divergence of opinion on whether a trade policy in the European Union is justified if it increases the GDP of member countries but also leads to increased greenhouse gas emissions, with 64% tending to disagree and only 21% agreeing (see Figure 26).

Conversely, a substantial 52% of respondents agree that a trade policy in the European Union is justified if it leads to a decrease in GDP but at the same time reduces emissions in Europe, with 17% strongly agreeing. However, opinions are more divided on a trade policy that leads to a reduction in both GDP and GHG emissions in the EU without having a significant impact on global emissions, with 21% disagreeing and 21% agreeing or strongly agreeing.

An overwhelming 81% believe that balancing environmental protection and economic growth should be the main consideration in international trade policy, with 46% strongly agreeing. In addition, 70% agree that trade liberalisation in the European Union should be balanced with stricter environmental regulations to offset potential increases in emissions.

Opinions on whether prioritising environmental goals over economic growth in trade policy could be effective in reducing global emissions are fairly positive, with 64% agreeing. However, views are more divided on whether such a policy could be effective in promoting regional trade cooperation, with 49% agreeing and 25% disagreeing.

Figure 26: Policy effectiveness and trade-offs (stakeholder survey)

In essence, there's a broad agreement on the important role of international trade policy in influencing emissions and the need to balance environmental protection and economic growth in formulating these policies. While there's a consensus on the integration of stricter environmental regulations with trade liberalisation, views are more divided on the effectiveness

of prioritising environmental objectives in promoting regional trade cooperation and on the justification of policies that lead to different impacts on GDP and emissions.

Stakeholder comments reflect different perspectives on the impact of international trade policy on emissions and environmental protection. The justifiability of economic costs in relation to environmental benefits is seen as crucial. It is argued that costs are justified in high-income countries as a fair transition to carbon neutrality, but are unacceptable if they fall on low-income countries and threaten human rights, including the right to food and nutrition.

While there is a consensus that international trade policy can have an impact on emissions, there is scepticism about the extent of this impact, with a suggestion to consider the influence of hidden factors that may affect outcomes. The need for a balanced approach is emphasised, where international trade policy should balance different objectives, gradually giving priority to environmental objectives. Strict environmental policies, such as CO2-based import tariffs, should be phased in gradually and integrated with other supporting instruments, such as project support, training and guidelines, to ensure a holistic approach to environmental protection and international trade.

6 Policy recommendations

Future trade agreements would require incorporating environmental protection measures, and we propose the following:

1. **Cross-compliance in global trade agreements:** Conditioning market access on the achievement of Sustainable Development Goals (SDGs), especially those calling for technological advancements in environmental protection, solidifies cross-compliance as a fundamental criterion in global trade agreements. This approach not only incentivizes nations to pursue ecological goals but also ensures that global trade serves as a vector for sustainable development. Furthermore, embedding such compliance within the trade framework elevates environmental standards and propels industries towards greener practices, potentially sparking a wave of innovation in sustainable technologies.

2. **WTO reform suggestions:** WTO reforms should pivot towards incorporating trade policies that actively reduce environmental pressure and combat carbon leakage. This would entail a paradigm shift in how trade regulations are perceived, with sustainability becoming a cornerstone of international trade laws. Additionally, it would require a concerted effort to balance the diverse economic interests of member countries with the collective need for environmental stewardship, potentially leading to more coherent and united global action on climate change.

3. **EU trade policy direction:** The European Union's scrutiny of the environmental repercussions of trade agreements with high pollution countries must be stringent and aligned with SDG objectives. Such scrutiny would not only mitigate the negative environmental impact but also incentivize partner countries to upgrade their environmental policies. By setting a high standard for environmental considerations, the EU can drive global trade towards a more sustainable future and ensure that economic integration does not come at the cost of the environment.

4. **Taking into account developing countries' perspective:** Developing countries, including Vietnam and Ghana, must consider the implications of increased emissions against the backdrop of trade-induced GDP growth. It is critical that these nations develop a strategic approach that fosters economic expansion while minimizing environmental costs. Emphasizing the net benefits, these strategies could involve adopting clean energy solutions and sustainable industrial practices that allow for development trajectories that are not only economically robust but also environmentally responsible.

5. **Retaliation consideration:** The prospect of retaliation against countries implementing CO2-based tariffs necessitates a strategic and multilateral approach to their introduction. By anticipating and planning for potential countermeasures, including both CO2 and non-CO2 tariffs, countries can devise diplomatic and economic strategies to reduce the likelihood of punitive responses. It is essential for these measures to be framed not as punitive but as constructive steps towards global environmental goals, encouraging collaborative rather than adversarial international relations in environmental policy implementation.

The following conclusions and recommendations are based on the stakeholder feedback:

1. **Prioritise environmental protection**: International trade policy should prioritize environmental protection and economic growth. An overwhelming majority believe that these two factors should be the main consideration in shaping trade policies.
2. **Balance trade liberalisation with environmental regulations**: As trade liberalisation progresses, it should be accompanied by stricter environmental regulations to offset any potential surge in emissions.
3. **Gradual implementation of strict policies**: Strict environmental policies, like CO2-based import tariffs, should be introduced progressively. This approach ensures that stakeholders have ample time to adjust and adhere to the new regulations.
4. **Integrate with supporting instruments**: Trade and environmental policies should be supported with other instruments such as project support, training, and guidelines. This holistic approach ensures that both environmental protection and international trade objectives are met.
5. **Consider the socio-economic impact**: While environmental benefits are crucial, it's essential to consider the socio-economic implications of policies. Costs that fall on low-income countries and threaten human rights, including the right to food and nutrition, are unacceptable.
6. **Account for hidden influences**: Policymakers should consider hidden factors that might influence the outcomes of trade policies and their impact on emissions.

Implementing these recommendations would require careful consideration, detailed planning, and broad stakeholder engagement. However, those expectations should be considered in policy planning.

7 Conclusions

The integration of Sustainable Development Goals (SDGs) into global trade agreements through cross-compliance mechanisms represents a transformative approach towards sustainable trade. Conditional market access that hinges on technological advancements in environmental protection ensures that international commerce would contribute positively to environmental stewardship. Therefore, cross-compliance not only encourages nations to invest in green technologies but also aligns global trade practices with the urgent need for environmental sustainability.

It is imperative for the European Union to rigorously evaluate the environmental impact of trade agreements, particularly with countries that have high levels of pollution. Aligning such agreements with the SDG goals would not only reinforce the EU's commitment to sustainable development but also promote environmental accountability in international trade. This consideration can lead to a more sustainable trade ecosystem that supports environmental objectives globally.

For developing nations like Vietnam and Ghana, it is crucial to balance the increase in emissions with the economic benefits derived from trade. While emissions may rise with enhanced trade and industrial activity, the overarching goal is to ensure that the net effect favours economic development without disproportionately compromising environmental integrity. Such a trade-off must be carefully managed to align with both the immediate developmental needs and the long-term sustainability goals.

Countries that choose to implement CO2-based tariffs as a measure to combat climate change should be prepared for potential retaliatory actions from trading partners. Such feedback could manifest in the form of both CO2-specific and more general non-CO2 tariffs, underscoring the complex dynamics of international trade relations in the context of environmental regulation. It highlights the need for a multilateral approach to carbon pricing and emissions tariffs to minimize conflict and promote widespread adoption of environmentally responsible trade practices.

As for the proposed reforms to the World Trade Organization (WTO), which would aim at incorporating trade policy measures to mitigate environmental impact and carbon leakage, these listed steps are essential for evolvement of the current system. These reforms would help harmonize global trade with environmental objectives, ensuring that trade growth does not come at the expense of the planet. The adoption of such measures would serve as a precedent for integrating environmental considerations into the core of trade policies worldwide.

As for stakeholders, a significant majority, 69%, believe that international trade policy can substantially influence emissions. There are varied opinions regarding the justification of a trade policy in the European Union that boosts GDP of member countries but also leads to increased greenhouse gas emissions; 64% tend to disagree while only 21% agree. On the other hand, 52% of respondents feel that a trade policy in the European Union that results in a GDP decrease but reduces emissions is justifiable. A resounding 81% emphasize the importance of striking a balance between environmental protection and economic growth in international trade policy. Furthermore, 70% are in agreement that as trade liberalization progresses in the

European Union, it should be complemented with stricter environmental regulations to counteract potential emission increases.

8 Literature

Britz, W., & Roson, R. (2019). G-RDEM: A GTAP-Based Recursive Dynamic CGE Model for Long-Term Baseline Generation and Analysis.

Britz, W., & van der Mensbrugghe, D. (2018). CGEBox: A Flexible, Modular, and Extendable Framework for CGE Analysis in GAMS. https://doi.org/10.21642/JGEA.030201A.

European Commission (2019). The European Green Deal. Brussels, 11.12.2019, COM(2019) 640 final. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN (accessed on 13 September 2023).

Hertel, T. W. (Ed.). (1997). Global Trade Analysis: Modelling and Applications.

Horridge, M., & Laborde, D. (2008). TASTE: A program to adapt detailed trade and tariff data to GTAP-related purposes.

Lanz, B., & Rutherford, T. (2016). GTAPinGAMS: Multiregional and Small Open Economy Models. https://doi.org/10.21642/JGEA.020101AF.

Matthews, A. (2023). Trade Policy Approaches to Avoid Carbon Leakage in the Agri-Food Sector. The Left in the European Parliament. https://left.eu/content/uploads/2023/02/GUE-Study-TRADE-Carbon-leakage.pdf.

United Nations Environment Programme (2018). GEMStat database of the Global Environment Monitoring System for Freshwater (GEMS/Water) Programme. Available upon request from GEMS/Water Data Centre: https://www.gemstat.org.

9 Appendices

8.1 Sectoral aggregation

All scenarios use the same sectoral aggregation (as shown below), which is fully disaggregated into 65 sectors as in the GTAP10 database.

Table 12: Sectoral aggregation

Sector	Short name
Paddy rice	pdr
Wheat	wht
Cereal grains nec	gro
Vegetables, fruit, nuts	v_f
Oil seeds	osd
Sugar cane, sugar beet	c_b
Plant-based fibers	pfb
Crops nec	ocr
Cattle,sheep,goats,horses	ctl
Animal products nec	oap
Raw milk	rmk
Wool, silk-worm cocoons	wol
Forestry	frs
Fishing	fsh
Coal	coa
Oil	oil
Gas	gas
Other Extraction (former omn)	oxt
Bovine meat products	cmt
Meat products nec	omt
Vegetable oils and fats	vol
Dairy products	mil
Processed rice	pcr
Sugar	sgr
Food products nec	ofd
Beverages and tobacco products	b_t
Textiles	tex
Wearing apparel	wap
Leather products	lea
Wood products	lum
Paper products, publishing	ppp
Petroleum, coal products	p_c
Chemical products	chm
Basic pharmaceutical products	bph
Rubber and plastic products	rpp

Mineral products nec	nmm
Ferrous metals	i_s
Metals nec	nfm
Metal products	fmp
Computer,electronic,optical prod	ele
Electrical equipment	eeq
Machinery and equipment nec	ome
Motor vehicles and parts	mvh
Transport equipment nec	otn
Manufactures nec	omf
Electricity	ely
Gas manufacture, distribution	gdt
Water	wtr
Construction	cns
Trade	trd
Accommodation,Food,service act	afs
Transport nec	otp
Water transport	wtp
Air transport	atp
Warehousing, support activities	whs
Communication	cmn
Financial services nec	ofi
Insurance (formerly isr)	ins
Real estate activities	rsa
Business services nec	obs
Recreational and other serv	ros
Public Administration, defense	osg
Education	edu
Human health, Social work act	hht
Dwellings	dwe

8.2 Regional aggregation

8.2.1 EU-Ghana EPA

Table 13: Countries Aggregation for EU-Ghana EPA

Countries	Income group (long name)	Income group (short name)
Albania	Upper middle income	Up_mid_inc
Argentina	Upper middle income	Up_mid_inc
Armenia	Upper middle income	Up_mid_inc
Azerbaijan	Upper middle income	Up_mid_inc
Belarus	Upper middle income	Up_mid_inc
Brazil	Upper middle income	Up_mid_inc
Botswana	Upper middle income	Up_mid_inc
China	Upper middle income	Up_mid_inc
Colombia	Upper middle income	Up_mid_inc
Costa Rica	Upper middle income	Up_mid_inc
Dominican Republic	Upper middle income	Up_mid_inc
Ecuador	Upper middle income	Up_mid_inc
Georgia	Upper middle income	Up_mid_inc
Guatemala	Upper middle income	Up_mid_inc
Jamaica	Upper middle income	Up_mid_inc
Jordhan	Upper middle income	Up_mid_inc
Kazakhstan	Upper middle income	Up_mid_inc
Mexico	Upper middle income	Up_mid_inc
Mauritius	Upper middle income	Up_mid_inc
Malaysia	Upper middle income	Up_mid_inc
Namibia	Upper middle income	Up_mid_inc
Peru	Upper middle income	Up_mid_inc
Paraguay	Upper middle income	Up_mid_inc
Russian Federation	Upper middle income	Up_mid_inc
Thailand	Upper middle income	Up_mid_inc
Turkey	Upper middle income	Up_mid_inc
United Arab Emirates	High income	High_income
Australia	High income	High_income
Bahrain	High income	High_income
Brunei Darassalam	High income	High_income
Canada	High income	High_income
Switzerland	High income	High_income
Chile	High income	High_income
United Kingdom	High income	High_income
Hong Kong	High income	High_income
Israel	High income	High_income
Japan	High income	High_income

Korea	High income	High_income
Kuwait	High income	High_income
Norway	High income	High_income
New Zealand	High income	High_income
Oman	High income	High_income
Panama	High income	High_income
Puerto Rico	High income	High_income
Qatar	High income	High_income
Saudi Arabia	High income	High_income
Singapore	High income	High_income
Trinidad and Tobago	High income	High_income
Taiwan	High income	High_income
Uruguay	High income	High_income
United States of America	High income	High_income
Burkina Faso	Low income	Low_income
Ethiopia	Low income	Low_income
Guinea	Low income	Low_income
Madagascar	Low income	Low_income
Mozambique	Low income	Low_income
Malawi	Low income	Low_income
Rwanda	Low income	Low_income
Togo	Low income	Low_income
Uganda	Low income	Low_income
Zambia	Low income	Low_income
Austria	European Union 27	EU27
Belgium	European Union 27	EU27
Bulgaria	European Union 27	EU27
Cyprus	European Union 27	EU27
Czech Republic	European Union 27	EU27
Germany	European Union 27	EU27
Denmark	European Union 27	EU27
Spain	European Union 27	EU27
Estonia	European Union 27	EU27
Finland	European Union 27	EU27
France	European Union 27	EU27
Greece	European Union 27	EU27
Croatia	European Union 27	EU27
Hungary	European Union 27	EU27
Ireland	European Union 27	EU27
Italy	European Union 27	EU27
Lithuania	European Union 27	EU27
Luxembourg	European Union 27	EU27
Latvia	European Union 27	EU27

Malta	European Union 27	EU27
Netherlands	European Union 27	EU27
Poland	European Union 27	EU27
Portugal	European Union 27	EU27
Romania	European Union 27	EU27
Slovakia	European Union 27	EU27
Slovenia	European Union 27	EU27
Sweden	European Union 27	EU27
Benin	Lower middle income	Low_mid_inc
Bangladesh	Lower middle income	Low_mid_inc
Bolivia	Lower middle income	Low_mid_inc
Cote d'Ivoire	Lower middle income	Low_mid_inc
Cameroon	Lower middle income	Low_mid_inc
Egypt	Lower middle income	Low_mid_inc
Ghana	Ghana	Ghana
Honduras	Lower middle income	Low_mid_inc
Indonesia	Lower middle income	Low_mid_inc
India	Lower middle income	Low_mid_inc
Iran Islamic Republic of	Lower middle income	Low_mid_inc
Kenya	Lower middle income	Low_mid_inc
Kyrgyztan	Lower middle income	Low_mid_inc
Cambodia	Lower middle income	Low_mid_inc
Lao People's Democratic Republ	Lower middle income	Low_mid_inc
Sri Lanka	Lower middle income	Low_mid_inc
Morocco	Lower middle income	Low_mid_inc
Mongolia	Lower middle income	Low_mid_inc
Nigeria	Lower middle income	Low_mid_inc
Nicaragua	Lower middle income	Low_mid_inc
Nepal	Lower middle income	Low_mid_inc
Pakistan	Lower middle income	Low_mid_inc
Philippines	Lower middle income	Low_mid_inc
Senegal	Lower middle income	Low_mid_inc
El Salvador	Lower middle income	Low_mid_inc
Tajikistan	Lower middle income	Low_mid_inc
Tunisia	Lower middle income	Low_mid_inc
Tanzania	Lower middle income	Low_mid_inc
Ukraine	Lower middle income	Low_mid_inc
Zimbabwe	Lower middle income	Low_mid_inc
Viet Nam	Lower middle income	Low_mid_inc
Venezuela	The rest of the World	ROW
South Central Africa	The rest of the World	ROW
Rest of Central America	The rest of the World	ROW

Caribbean	The rest of the World	ROW
Central Africa	The rest of the World	ROW
Rest of East Asia	The rest of the World	ROW
Rest of Eastern Africa	The rest of the World	ROW
Rest of Eastern Europe	The rest of the World	ROW
Rest of EFTA	The rest of the World	ROW
Rest of Europe	The rest of the World	ROW
Rest of North America	The rest of the World	ROW
Rest of North Africa	The rest of the World	ROW
Rest of Oceania	The rest of the World	ROW
Rest of South Asia	The rest of the World	ROW
Rest of South African Customs	The rest of the World	ROW
Rest of Southeast Asia	The rest of the World	ROW
Rest of South America	The rest of the World	ROW
Rest of Former Soviet Union	The rest of the World	ROW
Rest of the World	The rest of the World	ROW
Rest of Western Africa	The rest of the World	ROW
Rest of Western Asia	The rest of the World	ROW
South Africa	The rest of the World	ROW

8.2.2 EVFTA

Table 14: Countries Aggregation for EVFTA

Countries	Income group (long name)	Income group (short name)
Albania	Upper middle income	Up_mid_inc
Argentina	Upper middle income	Up_mid_inc
Armenia	Upper middle income	Up_mid_inc
Azerbaijan	Upper middle income	Up_mid_inc
Belarus	Upper middle income	Up_mid_inc
Brazil	Upper middle income	Up_mid_inc
Botswana	Upper middle income	Up_mid_inc
China	Upper middle income	Up_mid_inc
Colombia	Upper middle income	Up_mid_inc
Costa Rica	Upper middle income	Up_mid_inc
Dominican Republic	Upper middle income	Up_mid_inc
Ecuador	Upper middle income	Up_mid_inc
Georgia	Upper middle income	Up_mid_inc
Guatemala	Upper middle income	Up_mid_inc
Jamaica	Upper middle income	Up_mid_inc
Jordhan	Upper middle income	Up_mid_inc
Kazakhstan	Upper middle income	Up_mid_inc
Mexico	Upper middle income	Up_mid_inc
Mauritius	Upper middle income	Up_mid_inc
Malaysia	Upper middle income	Up_mid_inc
Namibia	Upper middle income	Up_mid_inc
Peru	Upper middle income	Up_mid_inc
Paraguay	Upper middle income	Up_mid_inc
Russian Federation	Upper middle income	Up_mid_inc
Thailand	Upper middle income	Up_mid_inc
Turkey	Upper middle income	Up_mid_inc
United Arab Emirates	High income	High_income
Australia	High income	High_income
Bahrain	High income	High_income
Brunei Darassalam	High income	High_income
Canada	High income	High_income
Switzerland	High income	High_income
Chile	High income	High_income
United Kingdom	High income	High_income
Hong Kong	High income	High_income
Israel	High income	High_income
Japan	High income	High_income
Korea	High income	High_income
Kuwait	High income	High_income

Norway	High income	High_income
New Zealand	High income	High_income
Oman	High income	High_income
Panama	High income	High_income
Puerto Rico	High income	High_income
Qatar	High income	High_income
Saudi Arabia	High income	High_income
Singapore	High income	High_income
Trinidad and Tobago	High income	High_income
Taiwan	High income	High_income
Uruguay	High income	High_income
United States of America	High income	High_income
Burkina Faso	Low income	Low_income
Ethiopia	Low income	Low_income
Guinea	Low income	Low_income
Madagascar	Low income	Low_income
Mozambique	Low income	Low_income
Malawi	Low income	Low_income
Rwanda	Low income	Low_income
Togo	Low income	Low_income
Uganda	Low income	Low_income
Zambia	Low income	Low_income
Austria	European Union 27	EU27
Belgium	European Union 27	EU27
Bulgaria	European Union 27	EU27
Cyprus	European Union 27	EU27
Czech Republic	European Union 27	EU27
Germany	European Union 27	EU27
Denmark	European Union 27	EU27
Spain	European Union 27	EU27
Estonia	European Union 27	EU27
Finland	European Union 27	EU27
France	European Union 27	EU27
Greece	European Union 27	EU27
Croatia	European Union 27	EU27
Hungary	European Union 27	EU27
Ireland	European Union 27	EU27
Italy	European Union 27	EU27
Lithuania	European Union 27	EU27
Luxembourg	European Union 27	EU27
Latvia	European Union 27	EU27
Malta	European Union 27	EU27
Netherlands	European Union 27	EU27

Poland	European Union 27	EU27
Portugal	European Union 27	EU27
Romania	European Union 27	EU27
Slovakia	European Union 27	EU27
Slovenia	European Union 27	EU27
Sweden	European Union 27	EU27
Benin	Lower middle income	Low_mid_inc
Bangladesh	Lower middle income	Low_mid_inc
Bolivia	Lower middle income	Low_mid_inc
Cote d'Ivoire	Lower middle income	Low_mid_inc
Cameroon	Lower middle income	Low_mid_inc
Egypt	Lower middle income	Low_mid_inc
Ghana	Lower middle income	Low_mid_inc
Honduras	Lower middle income	Low_mid_inc
Indonesia	Lower middle income	Low_mid_inc
India	Lower middle income	Low_mid_inc
Iran Islamic Republic of	Lower middle income	Low_mid_inc
Kenya	Lower middle income	Low_mid_inc
Kyrgyztan	Lower middle income	Low_mid_inc
Cambodia	Lower middle income	Low_mid_inc
Lao People's Democratic Republ	Lower middle income	Low_mid_inc
Sri Lanka	Lower middle income	Low_mid_inc
Morocco	Lower middle income	Low_mid_inc
Mongolia	Lower middle income	Low_mid_inc
Nigeria	Lower middle income	Low_mid_inc
Nicaragua	Lower middle income	Low_mid_inc
Nepal	Lower middle income	Low_mid_inc
Pakistan	Lower middle income	Low_mid_inc
Philippines	Lower middle income	Low_mid_inc
Senegal	Lower middle income	Low_mid_inc
El Salvador	Lower middle income	Low_mid_inc
Tajikistan	Lower middle income	Low_mid_inc
Tunisia	Lower middle income	Low_mid_inc
Tanzania	Lower middle income	Low_mid_inc
Ukraine	Lower middle income	Low_mid_inc
Zimbabwe	Lower middle income	Low_mid_inc
Viet Nam	Vietnam	Vietnam
Venezuela	The rest of the World	ROW
South Central Africa	The rest of the World	ROW
Rest of Central America	The rest of the World	ROW
Caribbean	The rest of the World	ROW
Central Africa	The rest of the World	ROW

Rest of East Asia	The rest of the World	ROW
Rest of Eastern Africa	The rest of the World	ROW
Rest of Eastern Europe	The rest of the World	ROW
Rest of EFTA	The rest of the World	ROW
Rest of Europe	The rest of the World	ROW
Rest of North America	The rest of the World	ROW
Rest of North Africa	The rest of the World	ROW
Rest of Oceania	The rest of the World	ROW
Rest of South Asia	The rest of the World	ROW
Rest of South African Customs	The rest of the World	ROW
Rest of Southeast Asia	The rest of the World	ROW
Rest of South America	The rest of the World	ROW
Rest of Former Soviet Union	The rest of the World	ROW
Rest of the World	The rest of the World	ROW
Rest of Western Africa	The rest of the World	ROW
Rest of Western Asia	The rest of the World	ROW
South Africa	The rest of the World	ROW

8.2.3 Full-fledged EU trade liberalisation and CO2-based import tariff/production tax

Table 15: Countries Aggregation for full-fledged EU trade liberalisation and CO2-based import tariff/production tax.

Countries	Income group (long name)	Income group (short name)
Albania	Upper middle income	Up_mid_inc
Argentina	Upper middle income	Up_mid_inc
Armenia	Upper middle income	Up_mid_inc
Azerbaijan	Upper middle income	Up_mid_inc
Belarus	Upper middle income	Up_mid_inc
Brazil	Upper middle income	Up_mid_inc
Botswana	Upper middle income	Up_mid_inc
China	Upper middle income	Up_mid_inc
Colombia	Upper middle income	Up_mid_inc
Costa Rica	Upper middle income	Up_mid_inc
Dominican Republic	Upper middle income	Up_mid_inc
Ecuador	Upper middle income	Up_mid_inc
Georgia	Upper middle income	Up_mid_inc
Guatemala	Upper middle income	Up_mid_inc
Jamaica	Upper middle income	Up_mid_inc
Jordhan	Upper middle income	Up_mid_inc
Kazakhstan	Upper middle income	Up_mid_inc
Mexico	Upper middle income	Up_mid_inc
Mauritius	Upper middle income	Up_mid_inc
Malaysia	Upper middle income	Up_mid_inc
Namibia	Upper middle income	Up_mid_inc
Peru	Upper middle income	Up_mid_inc
Paraguay	Upper middle income	Up_mid_inc
Russian Federation	Upper middle income	Up_mid_inc
Thailand	Upper middle income	Up_mid_inc
Turkey	Upper middle income	Up_mid_inc
United Arab Emirates	High income	High_income
Australia	High income	High_income
Bahrain	High income	High_income
Brunei Darassalam	High income	High_income
Canada	High income	High_income
Switzerland	High income	High_income
Chile	High income	High_income
United Kingdom	High income	High_income
Hong Kong	High income	High_income
Israel	High income	High_income
Japan	High income	High_income
Korea	High income	High_income

Kuwait	High income	High_income
Norway	High income	High_income
New Zealand	High income	High_income
Oman	High income	High_income
Panama	High income	High_income
Puerto Rico	High income	High_income
Qatar	High income	High_income
Saudi Arabia	High income	High_income
Singapore	High income	High_income
Trinidad and Tobago	High income	High_income
Taiwan	High income	High_income
Uruguay	High income	High_income
United States of America	High income	High_income
Burkina Faso	Low income	Low_income
Ethiopia	Low income	Low_income
Guinea	Low income	Low_income
Madagascar	Low income	Low_income
Mozambique	Low income	Low_income
Malawi	Low income	Low_income
Rwanda	Low income	Low_income
Togo	Low income	Low_income
Uganda	Low income	Low_income
Zambia	Low income	Low_income
Austria	European Union 27	EU27
Belgium	European Union 27	EU27
Bulgaria	European Union 27	EU27
Cyprus	European Union 27	EU27
Czech Republic	European Union 27	EU27
Germany	European Union 27	EU27
Denmark	European Union 27	EU27
Spain	European Union 27	EU27
Estonia	European Union 27	EU27
Finland	European Union 27	EU27
France	European Union 27	EU27
Greece	European Union 27	EU27
Croatia	European Union 27	EU27
Hungary	European Union 27	EU27
Ireland	European Union 27	EU27
Italy	European Union 27	EU27
Lithuania	European Union 27	EU27
Luxembourg	European Union 27	EU27
Latvia	European Union 27	EU27
Malta	European Union 27	EU27

Netherlands	European Union 27	EU27
Poland	European Union 27	EU27
Portugal	European Union 27	EU27
Romania	European Union 27	EU27
Slovakia	European Union 27	EU27
Slovenia	European Union 27	EU27
Sweden	European Union 27	EU27
Benin	Lower middle income	Low_mid_inc
Bangladesh	Lower middle income	Low_mid_inc
Bolivia	Lower middle income	Low_mid_inc
Cote d'Ivoire	Lower middle income	Low_mid_inc
Cameroon	Lower middle income	Low_mid_inc
Egypt	Lower middle income	Low_mid_inc
Ghana	Lower middle income	Low_mid_inc
Honduras	Lower middle income	Low_mid_inc
Indonesia	Lower middle income	Low_mid_inc
India	Lower middle income	Low_mid_inc
Iran Islamic Republic of	Lower middle income	Low_mid_inc
Kenya	Lower middle income	Low_mid_inc
Kyrgyztan	Lower middle income	Low_mid_inc
Cambodia	Lower middle income	Low_mid_inc
Lao People's Democratic Republ	Lower middle income	Low_mid_inc
Sri Lanka	Lower middle income	Low_mid_inc
Morocco	Lower middle income	Low_mid_inc
Mongolia	Lower middle income	Low_mid_inc
Nigeria	Lower middle income	Low_mid_inc
Nicaragua	Lower middle income	Low_mid_inc
Nepal	Lower middle income	Low_mid_inc
Pakistan	Lower middle income	Low_mid_inc
Philippines	Lower middle income	Low_mid_inc
Senegal	Lower middle income	Low_mid_inc
El Salvador	Lower middle income	Low_mid_inc
Tajikistan	Lower middle income	Low_mid_inc
Tunisia	Lower middle income	Low_mid_inc
Tanzania	Lower middle income	Low_mid_inc
Ukraine	Lower middle income	Low_mid_inc
Zimbabwe	Lower middle income	Low_mid_inc
Viet Nam	Lower middle income	Low_mid_inc
Venezuela	The rest of the World	ROW
South Central Africa	The rest of the World	ROW
Rest of Central America	The rest of the World	ROW
Caribbean	The rest of the World	ROW

Central Africa	The rest of the World	ROW
Rest of East Asia	The rest of the World	ROW
Rest of Eastern Africa	The rest of the World	ROW
Rest of Eastern Europe	The rest of the World	ROW
Rest of EFTA	The rest of the World	ROW
Rest of Europe	The rest of the World	ROW
Rest of North America	The rest of the World	ROW
Rest of North Africa	The rest of the World	ROW
Rest of Oceania	The rest of the World	ROW
Rest of South Asia	The rest of the World	ROW
Rest of South African Customs	The rest of the World	ROW
Rest of Southeast Asia	The rest of the World	ROW
Rest of South America	The rest of the World	ROW
Rest of Former Soviet Union	The rest of the World	ROW
Rest of the World	The rest of the World	ROW
Rest of Western Africa	The rest of the World	ROW
Rest of Western Asia	The rest of the World	ROW
South Africa	The rest of the World	ROW

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